CHAPTER 33
THE BEST CONTROL FOR VERTEBRATES

The July/August 1998 issue of Sierra Magazine noted: "On average, legislators who voted against protecting wildlife snared twice as much money as their pro-wildlife counterparts. And a high-profile legislator can easily beat the average: In the Senate the top recipients of anti-endangered species act contributors were Larry Craig (R-Idaho) $525,659, Kay Bailey Hutchinson (R-Texas) $462,104 and Phil Gramm (R-Texas) $444,000. In the House, the fattest cats were Don Young (R-Alaska) $471,053, Tom DeLay (R-Texas) $355,290 and Billy Tauzin (R-Louisiana) $349,350." **Way to go Republicans!**

INTRODUCTION TO RODENTS AND OTHER VERTEBRATE PESTS

Any animal with a backbone or spinal column is called a vertebrate. Humans, dogs, snakes, and birds are all examples of vertebrates, while insects, worms, jellyfish and snails are not. A few vertebrates, such as rats and mice, are common pests in urban and industrial sites. Others are not pests in their normal habitats, but may occasionally become pests when they conflict or interact with humans. A skunk in the woods is a beneficial part of nature; a skunk nesting in the attic or crawl space of your building is an entirely different matter.

Some vertebrates that are serious pests in particular situations are never considered to be pests by certain people. Pigeons, for example, can cause human health problems when roosting in large numbers. Commonly, their droppings foul sidewalks, contaminate food, and damage automobile paint. But pigeons are seen as pets and friends by many city dwellers who feed them daily. These constituents react angrily to any attempt on your part to poison or even live trap *their pet* pigeons. People feel a strong attachment towards many vertebrates that they do not feel towards other invertebrate pests. Children in particular love and cherish them. Many people today are involved emotionally in protecting the welfare of animals, particularly vertebrates. Control of vertebrates other than rats and mice is more of a public relations problem than a pest problem. So, try to repel them with strobe lights and/or hot pepper first. Killing is the control method of last resort. Please read and understand all labels and labeling and this chapter and then call Get Set 1-616-677-1261 **before using any poison!**

Rat plague, cat shortage steadily worsen for Vietnamese

By Paul Alexander
The Associated Press 3/19/98

HANOI, Vietnam -- Imagine killing 55 million rats in a year--and still losing ground.

Vietnam's vermin plague has gotten so bad that the central government has banned exports of tradiitonal rat predators and closed down restaurants that specialize in serving up cats or snakes.

Some local givernments offer bounties for each tail brought in. Television, radio and newspapers encourage farmers and children alike to go out en masse and use smoke, dogs or digging to flush out rats and kill them.

A biological solution -- a deadly rodent-specific bacteria dubbed "bio-rat" -- is being produced to avoid poisons that can kill chickens, other animals and even small children.

Losses to Vietnam's critical rice crop amounted to $6 million last year, said Dam Quoc Tru, a deputy director iin the Ministry of Agriculture and rural Development.

The problem has grown almost exponentially. Tru said 220,000 acres of rice paddies were infested in 1995. that rose to 640,000 acres in 1996 and 925,000 last year. In the first two months of 1998, more than 320,000 acres of the winter-spring crop were hit.

"If we don't inervene, the damage could be $30 million a year," Tru said. "Rat reproduction rates are very high and continuous."

At least 55 m illion rats were killed last year. "We cannot eradicate them, but if we can keep their numbers down, we can reduce the level of damage," Tru said.

Rats have become so prevalent that residents are increasingly blase about their appearances.

They scamper brazenly across the cement floors of Ben Thanh Market in the center of Ho Chi Minh City, scavenging food.

"The weather is hot, so the ants come out and the rats come out," Vu An thuy said as a foot-long rat did just that across her food stand. "We're used to it, and the customers don't complain, so it's OK, although there do seem to be more of them in the past couple of weeks."

Part of the increase has been attributed to diversificatin of crops that provide the rats with plenty of food year-round. But much of the blame is put on the shortage of cats, snakes and barn owls.

Stray cats are a rate sight in Hanoi and Ho Chi Minh City. They have been caught and served in local restaurants or sold daily by the thousands to China, where they are eaten too.

Tomas Y. Canby in a 1977 National Geographic article **"The rat, the lap dog of the Devil"** noted that in just the U. S.; rats bite thousands of people each year inflicting disease, despair and terror. They destroy a billion dollars worth of property, excluding innumerable "fires of undetermined origin" by gnawing electrical wires. In a world haunted by famine they destroy about 1/5 of all food crops planted. In India alone their depredations will deprive hungry people of enough grain to fill a freight train stretching more than 3,000 miles! Around the world - rats and their parasites spread more than 20 kinds of disease, from Typhus to trichinosis to deadly Lassa fever. More than 10 types of human infections may also be transmitted including fungi, cestodes, bacteria, nematodes, protozoa, viruses, spirochetes, trematodes, rickettsial organisms and assorted ectoparasites. **People hate and fear rats.** Public concern for the welfare of animals and the risk from vertebrate poisons to people, pets, and other non-target species have made rules governing vertebrate pest control particularly strict. Laws and regulations at the state and local level may be much more restrictive than federal regulations. Be sure you understand **all** the regulations that apply in your geographic area. Dropping lit charcoal briquettes or carbon dioxide down rat holes quickly and humanely kills all rodents including rats, but check your local regulations. Some people have actually been arrested for killing rats!

Caution: Those of us who work in or inspect crawl spaces and other areas where deer mice and other rodents can be found living could face the threat of exposure to Hantavirus. The rodents of greatest concern are deer mice (which are brown, not gray like house mice).

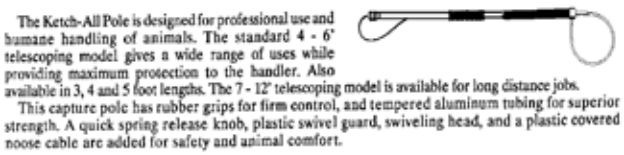
First identified by health officials in the Four Corners region of the Southwest, Hantavirus is a cause of acute pulmonary disease and, potentially, death. The virus is carried in the airborne droplets of rodent urine, droppings or saliva. A person can get the virus by coming in contact with these droplets or other things that have been contaminated by these droplets or by being bitten. This illness, if not suspected, may cause death in people who procrastinate seeking proper medical advice. Woodchucks and carnivorous wild animals, e.g., raccoons, skunks and foxes and bats are often found infected with rabies. All bites and scratch from these animals especially must be considered potentially dangerous. From 1977 through 1993 there has been a mid-Atlantic raccoon rabies epidemic in 11 states and the District of Columbia and in 1990 raccoons surpassed skunks as the U. S. species in which rabies is most often detected. **Always use animal handling gloves and a restraining pole when handling or trapping wild animals and rubber gloves when handling traps or carcasses; if scratched or bitten call a physician.** Pest control and maintenance people, plumbers, electricians or others who work in crawl spaces will want to consider the following options for their own protection:

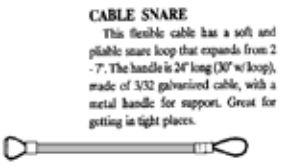
- **Ask** occupants if rodents have ever been a problem in the home/building.
- **Consider** spraying crawl space areas with a solution of water, detergent and disinfectant and/or diluted Safe Solutions Enzyme Cleaner with Peppermint and borax, wearing protective clothing as you spray.
- **Use** rubber gloves and a full-face mask with HEPA filters for clean-up if you encounter rodents, nests or droppings. Spray animal, droppings or nests with a solution of three ounces of bleach in one gallon of water. Use a disposable or cleanable item to place the material in a plastic bag. Place that bag in another, along with any disposable items, and burn, bury or dispose of the bag properly. Clean gloves or other items with a disinfectant and then soap and water and/or diluted enzyme cleaners with peppermint.
- **Open up** crawl space doors and access ways and allow air to naturally vent for 30 minutes before starting work. Leave the area until the airing out period is finished. If any doubt remains - do not enter the crawl or infested area.

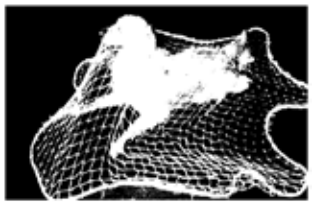
The key to avoiding the disease is to avoid the mice and their nests. If you have deer mice in a building, take steps to remove them only after clearing out the air in the area with a fan in the open vent or in an open window. The common cause of the illness in those stricken is that they all disturbed mouse nests. If you must remove a nest, spray it with disinfectant or diluted enzyme cleaners first; wear a full-face, air-purifying respirator and gloves.

INTELLIGENT PEST MANAGEMENT® OVERVIEW

The most common vertebrate pests found in or around buildings are commensal rats and mice, squirrels, bats and birds. Occasionally other intruding vertebrates such as armadillos, gophers, opossums, snakes, deer, woodchucks, lizards, skunks, squirrels, etc. are found entering or living by our buildings, although these are usually nuisances rather than destructive pests. The farther people move into outlying suburban areas, the more likely they are to encounter more and more wild animal pests. Feral or cats and dogs (that have turned back into a wild state) can be a problem in any area. There are throw nets, ketch-all poles, cable snares for catching *game*; we advise you use these items with caution unless you are experienced. See: http://www.ketch-all.com/index.php?p=main There are many different types of fencing and/or repellents to try. Regardless of the animal size and shape, there is a live trap made to capture it alive and unharmed. You can then transport the animal to some more remote area and release it (if legal). Pets can be held for the owner or

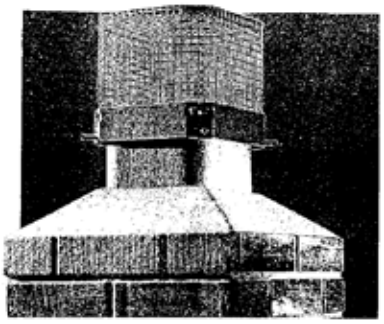

The Ketch-All Pole is designed for professional use and humane handling of animals. The standard 4 - 6' telescoping model gives a wide range of uses while providing maximum protection to the handler. Also available in 3, 4 and 5 foot lengths. The 7 - 12' telescoping model is available for long distance jobs.
This capture pole has rubber grips for firm control, and tempered aluminum tubing for superior strength. A quick spring release knob, plastic swivel guard, swiveling head, and a plastic covered noose cable are added for safety and animal comfort.

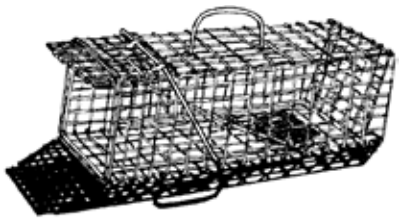




brought directly to the local humane society. Dangerous and/or non-protected wildlife (rats, skunks, etc.) can be humanely killed by immersing the trap in water for five minutes. You can also use carbon monoxide gas from your vehicle's exhaust. Set the trap outdoors, cover it with heavy plastic sheeting and/or wet tarp, and then run a short piece of hose from the exhaust pipe under the plastic/tarp. Turn on the engine and run it approximately one minute after the animal collapses - then properly of it by burial. Rats and mice are troublesome because they are well adapted to living directly inside people's habitats where they can easily destroy or contaminate food and fabrics, cause structural damage, or inflict painful bites; these rodents are primary or intermediate vectors or carriers of many types of disease organisms and may also have ectoparasites, e.g., mites, fleas, ticks, etc. Commensal rodents can be found virtually everywhere humans live. They are especially attracted to areas that provide a wealth of hiding places and easy access to food. This combination often occurs where garbage is poorly managed or where grains and other foods are stored improperly. Some of these rodent pests lodge temporarily on, within or under our buildings and become annoying primarily because their ectoparasites leave them to bite us. There are accounts of people being plagued by flea infestations they could not suppress or trace to any past or present pet occupancy. Eventually, through the identification of the flea species and a site inspection, it became apparent that the fleas were coming from a wild animal *resident* in, under or on the house, or in the attic. To solve a flea problem such as this, the suspected vertebrate must first be trapped and/or permanently excluded.

Bats and birds do not live intimately with people, but many species use buildings for suitable roosts or nests and may act as disease vectors. They produce smelly and unsightly urine and droppings, create noise, build messy nests, and also may have several insect and mite pests living on their bodies or in their nests. A high percentage of bats may be infected with rabies. Birds may be capable of harboring several different diseases; the disease most often associated with bird and bat droppings in buildings is the lung disease, histoplasmosis. **So, always take the proper precautions and use the proper safety gear.**





LIVE TRAP

Try preventing the problem with birds, bats, raccoons and other *critters* with prevention or exclusion techniques, e.g., trim all branches that touch or overhang the building, feed birds only in the winter, keep garbage covered, keep garage doors closed. Screen all openings, keep a dog outside at night inside (invisible) fencing, install spark arrestors or lifetime warranteed stainless steel chimney caps; these usually keep most pests from entering via the chimney. Managing vertebrate pests is harder than controlling insects because they are larger, stronger and more intelligent than insects. They have larger brains and quickly learn to recognize and avoid some control attempts; therefore, a fully integrated and varied control program is needed. You must understand the creature's life habits and food preferences in order to monitor and manage its population levels and destructive habits effectively and economically. Live traps are generally used to control vertebrate pests. Be careful to:

- Take some of the "shine" off them. Old traps catch more than new traps. Scuff them up with a wire brush and store them outside before using them.
- Try pre-baiting with the trap doors wired open.
- Push the wire bottom into the soft earth or sand for more *natural* footing.
- Use lard to grease and lubricate the movable portions of the trap.
- Remember the word *live* traps is an oxymoron - stress, exposure, exhaustion and relocation can kill or injure - 70% of all relocated wildlife trapped in "live" traps will die!
- Remember, trapping will only work if you reduce or remove or change the reasons why an animal is attracted to the property in the first place.

The Best Repellents - Quite often freshly ground pepper (the hotter, the better), routinely cleaning with Safe Solutions Enzyme Cleaner with Peppermint, installing strobe lights, dusting with talcum powder, lime, well used kitty litter, carnivore urine/excrement, human urine/excrement, rotten blood, blood meal, strongly saturated soaps and/or deodorants, hair, old after shave, rotten eggs, medicated body powder, loud noises and/or music, pine oils, moth crystals, motion detectors and/or Christmas and/or flashing lights, crushed or dried peppermint leaves, plants, e.g., garlic, spurge, fritillaria, etc., electric fences, old pairs of smelly sneakers or unwashed *gym* clothing, and sudden shots of water from a hose or super soaker or sprinkler will all repel vertebrate pests, but may also repel you or irritate sensitive people and pets.

THE BEST BAITS:

Cat	canned cat food, fish, meat, oil of catnip
Gopher	peanut butter and/or molasses spread on whole wheat bread
Porcupine	apples, salt, carrots, “canoe paddles”
Rabbit	vegetables in summer, bread and bird seed in winter and apple cider sprayed on the trap
Raccoon	peanut butter, sardines, fruit jellies, marshmallows, fish, sweet corn, crisp bacon, doughnuts
Skunk	chicken entrails, fish, crisp bacon, mayonnaise
Squirrels	grains, nuts, peanuts or cracked walnuts, peanut butter and/or molasses on bread or apples
Woodchucks	fresh beans, sweet corn, peas, sliced apples

Laxatives - Laxatives put in their favorite foods have killed many rodents and/or pest mammals without endangering raptors and/or the environment.

Lit Charcoal, Dry Ice or CO_2 - When put in burrows or tunnels will humanely kill the occupants.

Owls - Build some owl boxes to attract owls to your yard to help control small rodents, gophers and the like. See http://www.boston.com/news/world/middleeast/articles/2007/07/16/barn_owls_unite_israelis_jordanians/

Trap Placement - The best place to put the live trap is either close to the vertebrate pests’ nesting area or the feeding area. In the case of a skunk living under a screened porch, slide the baited and set trap under the porch or as close to it as possible.

If you have to rid a garden of raccoons, place live traps around the entire perimeter. It is important to concentrate on the side of the garden closest to the den entrance. This should be relatively easy to determine since raccoons prefer dens in hollow trees close to fresh water.

Some animals, such as rabbits, use well-defined trails to feeding areas. Place the live trap directly on the trail to intercept them. If you have only a general idea where the animal is coming from, take a 2-foot high length of wire mesh fanning out from each side of the trap mouth. This will help funnel your prey toward it.

Special Problems -The raccoon normally uses its paws to feel for tidbits in the muddy shallows of ponds, and he is just as likely to poke his paws through the side of a live trap and snatch your bait. He may also tip your trap over and simply shake out his dinner, so...

Stake down your traps. Pile logs or stones along the sides to keep raccoons (and cats) from stealing the bait, or stabilize them by driving a rebar stake through the trap and into the ground. Traps should also be checked often. A raccoon can do considerable damage to the wire mesh with his teeth in a very short time.

Rats are extremely destructive building pests. They eat and contaminate our food, pet food, animal and bird feed, fruit, vegetables, grains and meat and even packaged food or beverages in cardboard, paper, foil, plastic or cloth containers. Experts estimate that rats and mice destroy enough food each year to feed at least 200 million people. They also destroy textiles, upholstery, paper, books and insulation by using these possessions for nesting materials. Rats gnaw holes in walls and around doors or windows and chew on electrical wiring, water pipes and gas lines. Their gnawing can cause dangerous fires and other forms of severe damage. They shed and leave droppings, urine and

hairs wherever they wander. They are hated and feared by most people.

Several HUMAN DISEASES are associated with rodent infestations. Rodents can carry more than 200 human pathogens. Salmonellosis is a serious intestinal disorder that can be transmitted to people who ingest food contaminated by salmonella bacteria in rat urine or feces. Murine typhus, leptospirosis, listeriosis and trichinosis are other rat-transmitted diseases. The tropical rat mite, an external parasite of rats, causes severe itching and skin irritation in people. Rats have occasionally been known to bite sleeping people; these bites can result in an infection known as rat bite fever. Plague bacteria can be transmitted from rats to people through the bite of rat fleas. **Over $120 million is spent in the U. S. alone each year on rodent control programs.**

About the Hantavirus - Several different types of Hantaviruses exist worldwide. In the United States, the virus strain of current concern is called the Sin Nombre Hantavirus, which is also known as Hantavirus Pulmonary Syndrome (HPS). (The official name for this virus may determined at a later date). Other strains have also emerged in Louisiana and Florida, resulting in one death with the Louisiana strain.

One hantavirus called Prospect Hill Hantavirus is suspected to be distributed in the United States correlating with the distribution of some populations of the meadow vole. However, no known human disease has been associated with Prospect Hill Hantavirus.

The specific distribution of the virus and other virulent strains thus far is unknown. The hantaviruses may be (and likely are) more common and widely distributed than just those areas with afflicted individuals and deaths. For example, the attention to the virus started with the outbreak of the virus in the Southwest. Since that time, the virus has been documented in at least 22 states, 104 cases, resulting in about 60 deaths. States with reported cases thus far include: Arizona, New Mexico, Colorado, Nevada, California, Oregon, Idaho, Montana, North Dakota, South Dakota, Kansas, Texas, Louisiana, Florida, Indiana, Illinois, Wisconsin and New York. For the most current status on additional states and fatalities, contact your state Board of Health or the Center for Disease Control in Atlanta.

Pulmonary syndrome hantavirus is a serious, life-threatening disease that, fortunately, is rare. A person with the virus will normally begin to show flu-like symptoms 2 - 6 weeks after being exposed to the virus. A short time after these symptoms appear, the lungs begin to fill with fluid, causing breathing problems. Once the virus is well established within the victim, there is no treatment. In cases of early diagnosis, doctors have been treating people with ribavirin, a general medicine that is known to kill viruses.

First discovered by researchers after it struck the Navajo Indian Reservation in 1993, **Hantavirus Pulmonary Syndrome (HPS) or the Sin Nombre Hantavirus** is from a family of similar viruses that caused hemorrhagic fever, an illness that sickened 3,000 and killed 190 soldiers during the Korean War. More benign strains exist in rats and mice. In man it is a rare but deadly disease that causes victims to drown in their own lung fluids. Shortly before the Navajo outbreak, researchers in Baltimore found a strain that caused hypertension in residents exposed to rats. Researchers believe these viruses are transmitted through some form of direct contact with the mice or by inhaling airborne particles of rodent urine, droppings or saliva. The actual culprits appear to be the deer mouse *(Peromyscus maniculatus),* a/k/a the field mouse or white-footed mouse and *Peromyscus leucopus* also known as the white-footed mouse. There are 27 similar species and a laboratory test is the only sure way of confirmation. Without biological tests even the *experts* can't tell them apart. Risk of infection appears greatest when there is an increase in contact between humans and rodents, as in cabins and cottages and in winter in northern climates when mice migrate indoors. And, while the virus can readily pass from rodent to rodent or from rodent to man...if unsuspected it is possible, but highly unlikely, that it may pass from person to person, but the infected person risks death by not seeking medical help in time. HPS initially masks itself as a flu-like illness, inducing fever, sore muscles, headache, nausea and shortness of breath. Only in its later stages does it drown its victims in their own juices. The fatality rate is more than 50% and the virus has been documented in at least 22 states, but most U. S. cases have been in the Southwest. Hantavirus in Asia kills with kidney failure, not respiratory failure.

CDC Suggestions for Protecting Yourself from Hantavirus Pulmonary Syndrome Infections: Remember, the virus can be present in dust and debris even after deer mice infestations have been eliminated.

Wear masks approved by the Environmental Protection Agency when doing any pest control work or

inspections or when you are around any HPS patients.

Wear rubber or latex gloves when cleaning out rodent-infested areas and when handling and disposing of rodents.

Disinfect rodent areas and used equipment (including gloves and traps) thoroughly with an industrial disinfectant or a solution of 3 tablespoons of bleach to 1 gallon of water and/or diluted Safe Solutions Enzyme Cleaner with Peppermint and sodium borate per directions.

Those dealing directly with rodents should be informed about the symptoms of the disease and have a baseline serum sample drawn and stored at -20° C.

HANTAVIRUS PULMONARY SYNDROME (HPS) has since been called **Muerto Canyon Hantavirus** named for the Navajo site where the first outbreak was diagnosed. The Canyon del Muerto is rendered, "Canyon of the Dead."

The Grand Rapids Press, July 1994:

Deadly rodent-carried disease reported in Canada; 3 infected

One Canadian died of the virus that first showed up on a Navajo reservation.

By Miro Cernetig, Toronto Globe and Mail

VANCOUVER, British Columbia — Hantavirus pulmonary syndrome, a rare but deadly disease that causes its victims to drown in their own lung fluids, has surfaced in Canada for the first time. British Columbia officials are now warning health officials across the country that the disease, first identified 13 months ago on a Navajo Indian reservation in the U. S. Southwest, is also likely to make an appearance in other parts of Canada. Since spring, the syndrome — passed to humans by mice and other rodents — is fatal in most cases. It has infected three British Colombians, one of whom has died. There have already been 75 cases of the disease, also known as a HPS, in the United States, about two-thirds of which resulted in death. "In my messages to the outer provinces, I'm saying: 'Just wait. It's coming your way.' " said Alison Bell, director of epidemiology for the province's Center for Disease Control." The three British Colombians who contracted the disease had unusually close contact with the rodents. The victim who died was a 31-year-old rancher believed to have caught the disease in a barn. Another man lived in a house infested with mice. The most recent victim, a 31-year-old woman, is a wildlife biologist who was cleaning mice cages almost daily during field work. When the disease first broke out among the Navajo in May 1993, it caused near panic as the reported cases in the United States moved from west to east. Many people thought that they were seeing the birth of a new disease, which was terrifying because it initially masks itself as a flu-like illness, inducing fever, sore muscles, headaches, nausea and shortness of breath. Often, it is only in its later stages, when fluid builds up in the lungs and patients cannot breath, that its deadly nature becomes evident. Contrary to early impressions, health researchers say HPS has been infecting and killing people for a long time. Nor is the virus rushing through the nation's rodent population. "Probably this disease has been around for a long time, so there's no need to panic," Bell said. "The level of risk for the public is probably the same as it always was. Our level of understanding and diagnosis is what has increased."

Note: At this time, the deer mouse *(Peromyscus maniculatus)* is the primary rodent involved with the virus. Many people refer to deer mice as the "field mouse," or the "white- footed mouse." The deer mouse is one of the most common semi-commensal rodent species found throughout most of the United States. However, it is absent from most of the Gulf states, and large sections of the eastern coastal states. For specific distributions, state universities or the Department of Natural Resources in each state should be consulted.

Deer mice are 4" - 9" long, are reddish-brown in color with a white chest, white feet, and a bicolored tail: brown on top and white on bottom. Deer mice do not usually occur in urban areas. Their natural habitat is in rural and semi-rural areas, where they inhabit fields, pastures, and various types of vegetation found around homes and outbuildings. This mouse commonly invades garages, attics, sheds, wood piles, crawl spaces, as well as general living quarters of homes.

The nests of the deer mouse are generally located underground in cavities about the roots of trees or shrubs, beneath a log or board, or in a tunnel built either by another animal, or by the mouse itself. Above ground nests are established in hollow trees, building voids and spaces, closed drawers, unused equipment, cabinet voids, along the sill plate in basements and crawl spaces, log piles, unused furniture, fence posts, and old bird and squirrel nests.

The virus leaves the rodents' bodies in their droppings, urine and saliva, although infected rodents do not appear sick. Although the exact mode of transmission is not known, it is likely that people get the virus by breathing dust that is contaminated, through a rodent bite, or via direct contamination of food from rodent excreta and/or urine.

The house mouse, *Mus musculus,* our most common indoor rodent has not been implicated in the transmission of the virus. It has in some areas, however, tested positive for hantavirus antibodies. This does not mean it necessarily will, or even can, serve as a host for the virus. But according to the Center for Disease Control in Atlanta, the house mouse is not currently considered to be a hantavirus threat. Different rodents carry different forms of Hantavirus. This strain of Hantavirus is extremely deadly and about 2/3's of those people infected will die within a few days of the initial onset of symptoms although the deer mice are apparently not effected by it. The name *hantavirus* comes from the Hantaan River in Korea where in 1976 the first virus strain was isolated. **Caution: If you have a rodent infestation in the attic or drop ceiling, the (heavier-than-air) rodent effluent can "rain" the virus down on you**; **remove the source and clean or spray heavily with diluted Safe Solutions, Inc. Enzyme Cleaner with Peppermint or with whatever the doctor orders.**

RODENT ENTRY- Rodents gain entry into buildings several ways: Rats require only an opening of 1/2" diameter or larger, mice can enter 1/4" openings - or they can be carried inside. They may get in through broken windows, poorly screened attic and foundation vents, openings through any walls created by cable, oil, propane, electric, gas, water and/or sewage services, and through any other openings or cracks or crevices in foundations, walls or roofs. They can also chew holes directly through siding and/or window or door frames. Dilapidated or poorly maintained buildings usually have many places for rats to enter. Poor building design or construction also contributes to rodent entrance and infestation. Try using strobe lights to repel them.

Our buildings serve as convenient sources of rodent food, water, shelter and protection from their natural enemies. For roof rats, shrubs and trees growing near buildings, including fruit and nut species, also furnish attractive nest areas and abundant food; thick plantings of vines such as ivy and palm trees make ideal locations for nests. Trash and garbage stored near buildings supply both food and nesting sites, and encourage the growth of rat populations. Poor housekeeping within buildings also contributes to conditions that favor explosive growth in rodent infestations.

Rats that live in sewer systems can use the water and tunnels as virtual highways to enter into buildings. They enter sewers through poorly covered drains, broken lateral lines and roof vents; rats have even been known to come up through toilet bowls via sewer pipes or climbing down the inside of a vent pipe. The ample food, including American cockroaches, water and shelter provided by some sewers allows rat populations to build up to large numbers; (unbathed) individuals may then migrate into buildings to search for food or in search of new shelters.

Rats have poor vision but highly developed senses of smell, taste, hearing and touch. They use their senses to locate food and avoid danger. Rats are nocturnal and forage for food in buildings mostly during the night. This behavior usually avoids encounters with people. Rats are agile and are able to run quickly and climb and swim well. They squeeze through small openings to get to food or escape from danger. These rodents are extremely wary of new items or situations and will sometimes take several days to adjust to changes in their environment before they investigate new food or nest items. Rodents create extremely strong emotional responses in occupants ranging from fear to disgust to dread to absolute terror. **If occupants see even one rat they usually panic and usually want immediate poison control.**

INTELLIGENT PEST MANAGEMENT® CONTROL OVERVIEW - Because of the diversity of members of the vertebrate pests group, only some generalizations are given here. Refer to the individual rodent/vertebrate pest sections for additional comments on various control measures. **There are four key elements in any successful rodent and/or vertebrate control program**. 1. A thorough inspection and proper identification is completed. 2. Proper sanitation is described and instituted 3. Correct rodent/vertebrate proofing is instituted and 4. The inherent population is eliminated, repelled and/or excluded.

INSPECTION - **The key to proper control in a proper inspection.**

First, gather the proper equipment : a powerful flashlight, blacklight, inspection mirror, clipboard and pencil, tool kit and step ladder. Draw the outline of the facility — conduct a thorough verbal and visual inspection— noting all signs, problems, entryways, garbage, etc. on your outline and rodent survey form. Begin at the exterior and note all conditions conducive then go inside — be very thorough. You may wish to prebait with non-toxic materials to monitor all current activity.

Note: If you need help with a sick, poisoned or injured animal, call the International Wildlife Rehabilitation Council, P. O. Box 8187, San Jose, CA 95155, 408-271-2685, http://www.iwrc-online.org or the National Wildlife Rehabilitators Association, 2625 Clearwater Rd, Suite 110, St. Cloud, MN 56301, 612-320-230-9920, http://www.nwrawildlife.org

Exterior - **Be sure to note on your form:**

1. All loose garbage, uncovered/open dumpsters and trash cans and other sanitation problems.
2. Pet food, bird feeders, compost piles, fruit trees, other food sources.
3. Vines, ivy, shrubs, trees, brush, branches or limbs that touch or overhang the building.
4. Water sources, e.g., puddles, leaking plumbing, etc.
5. Openings around pipes, windows, doors, trims.
6. Rodent burrows, rub marks, droppings, sightings.
7. Poorly fitting doors, windows, and basement window wells.
8. Open/broken windows and/or screens.
9. Harborage sites, e.g., decks, steps, piles of wood or debris.
10. Poor ground care around buildings, pools or ponds.
11. Cracks, openings or broken concrete or windows in the foundation.
12. Openings around pipes, wires, conduits, air conditioners, etc. that enter the building.
13. Gaps around chimney caps, vents, trim, moldings, etc.
14. Missing caps at corners of siding and/or missing or warped siding and trim, open chimney flues and/or vents.
15. Note all miscellaneous pests, birds, spiders, etc.
16. If the chimney flues are open - if so, permanently install chimney caps before any vertebrate pests gain entrance to your building.

Interior

Design a wall chart showing the exact floor plan then methodically and carefully inspect for :

1. Rub marks, rodent droppings, gnaw marks, actual or verbal sightings, nests and tracks.
2. Check all bathrooms, crawls, attics, lockers, garages, window ledges, basements.
3. Carefully note all sanitation problems then correct them.
4. Carefully note all other conditions conducive to entry and/or infestation and correct them.
5. Carefully note all areas that need habitat reduction, trapping, sanitation, etc. and correct them.
6. Carefully note all moisture problems, e.g., leaking pipes, aquariums, plants, etc. and what must be done to correct them.
7. Carefully note all dirty dishes, open food sources that can provide sustenance for your enemy.

Recommendations for Homeowners - Below are some general recommendations pest management professionals can recommend to concerned homeowners based on information compiled from research, the Center for Disease Control in Atlanta, and various state board of health personnel working on the Hanatvirus Pulmonary Syndrome Virus.

- Keep rodents out of garages, sheds or barns by keeping access to water, food and nesting materials and harborage areas away from them, especially within 100 feet of your occupied buildings. Repair all holes in buildings that would allow rodents entry. Properly install strobe lights in attics and crawls.
- Open doors and windows before cleaning areas where rodents have been living. If possible, run an electric fan for at least half an hour to clear out dust. Leave the areas while the fan is on.
- Disinfect sites where you have seen rodents or their droppings. General-purpose disinfectants will kill the

virus. A mixture of three tablespoons of household bleach in a gallon of water can be used or better still use diluted Safe Solutions Enzyme Cleaner with Peppermint and borax. Spray the area and mop, rather than sweeping or vacuuming. The wetter the area, the better because dampness will keep the dust down.

- Always wear gloves when you pick up live or dead rodents, their droppings, or traps. Disinfect gloves and traps after removing captured rodents.
- **Put dead rodents and contaminated cleaning materials in a sealed plastic bag and dispose of in a sealed garbage can.**

Where deer mice may be prevalent, or in environments which might contain, or have previously housed, infestations of deer mice, safety equipment is recommended. Such areas include attics, crawl spaces, barns, sheds, etc. This is especially true in rural and semi-rural areas where deer mouse populations tend to be higher.

Typical safety precautions and equipment are listed below. However, it should be emphasized that special respirators are required when working in potentially dangerous or affected, areas. Standard face respirators used to protect against fogs, dusts, and other pesticide particles are not sufficient small protection against the hantavirus.

- Workers in potentially high-risk settings (e.g., abundant deer mouse populations), should be informed about the symptoms of the disease and be given detailed (current) guidance on prevention measures.
- Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.
- In localities of concern, professionals should wear at least a half-face (full-face is recommended) air-purifying (or negative-pressure) respirator or PAPR equipped with HEPA filters when removing deer mice from traps or handling rodents. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator use practices should be in accord with a comprehensive user program.
- Professionals should wear rubber or plastic gloves when handling rodents or handling traps containing rodents. Gloves should be washed and disinfected before removing them, as described above.
- Traps contaminated by rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or washed thoroughly in diluted Safe Solutions Enzyme Cleaner.

For more information, contact the Hantavirus Hotline at the Centers for Disease Control Atlanta: 800-532-9929, http://www.cdc.gov or your State Dept. of Health.

BAT OVERVIEW

Exclusion is the preferred method of bat control. After determining location of all entrance/exit holes by observing departures at dusk, seal all possible entrance/exit openings other than the primary exit hole(s) during the day. Then after the bats depart the following night, seal the remaining hole(s) or use the exclusion controls suggested in the bat section. If you have used the sealing off technique it may be necessary to enter the bat roost to remove any remaining bats mechanically, be sure to wear the proper respiratory equipment and protective clothing. **Regardless of the control method used, everyone should be made aware of the potential health and insect problems associated with bat roosts and droppings (guano) before any control is started.**

BIRD OVERVIEW

Depending on the physical conditions and the species involved, a variety of control measures are available. These include exclusion, traps, repellent materials and other techniques. Mechanical exclusion methods include such things as netting, bristle-like metal bars, noise makers, etc. **Regardless of the control method proposed or used, occupants should be advised of the potential health, insect or mite problem associated with bird droppings**

(guano) and nests before conducting control. This is especially important when the birds are roosting within the structure. Be sure to wear proper respiratory protection and clothing before entering such a structure for inspection or control.

RODENT OVERVIEW

Rats and mice are implicated in at least 55 human diseases - at least 16 are viral, 9 are rickettsial, 20 are bacterial, 3 are protozoan and 7 are carried by worms. Direct transmission occurs as a result of bites, direct contact and/or contamination of food or water with urine or excrement. Direct transmission occurs when parasites, e.g., kissing bugs, fleas, lice, ticks, worms etc. move from the rodents to humans.

Our primary building rodent quadruped pests are the house mouse, Norway rat, roof rat and, occasionally, "tree rats" or squirrels. Control may involve the use of glue traps, water traps, live traps, snap traps and/or baits in addition to rodent-proofing the structure and other preventative measures. 1991 marketing data estimates put the annual cost of professional and homeowner rodent control programs in the U. S. at 332 million dollars of which the (little) house mouse accounted for 220.4 million dollars. The word *commensal* means "sharing one's table" and the word *rodent* means "to gnaw". **For commensal rodents, the key to control is sanitation, harborage elimination and rodent-proofing the structure. Sanitation - eliminating all possible shelter and food - is essential for achieving adequate control of mice or rats.** Traps and poison baits are not effective without correcting this problem first! Killing a few mice or rats with traps and/or poison might actually increase your rodent infestation by inducing the survivors to have bigger litters!

Carefully dispose of all garbage and food scraps and keep all food in tightly sealed containers or in refrigerator or freezer if necessary. Clean up spills and crumbs. Routinely remove any and all refuse in storage areas and around your building. Routinely add drain openers and Safe Solutions, Inc. enzyme cleaners to open and clean the drains.

Neatly stack piles of lumber and firewood 12" to 18" above the ground to reduce harborage and reveal food and rodent droppings. Elevate garbage cans off the ground. Use a spring fastener or other method to secure garbage can lids. Rodents may also live in stone piles, dense vegetation, and rubbish. Bird feeders, pet food and certain shrubs and fruit-bearing trees may also provide food. A mouse can squeeze through an opening the size of a dime while a rat can pass through a 1/2" hole. Use steel wool , 1/4" hardware cloth, or galvanized sheet metal to plug rodent entrance holes and prevent gnawing. Patch outside holes with hydraulic cement, mortar, or masonry. Seal cracks around doors. Install metal flashing on the bottom of the door or a metal cockatiel on the outside. Cap drains in basement floors with brass-screw drain covers or a hinged metal caps. Rats can leap 4 feet sideways, jump 24" from a standstill, reach 13" from a flat surface, and walk horizontal wires. One rat can product 25,000 droppings each year and one pair can shed more than a million rat hairs each year!

Rats have caused more economic loss and more human suffering than any other vertebrate pest. From plague epidemics (the *Black Death* of Europe) to rat bites of inner-city children, from gnawing electrical wires in an attic to feeding on stored food in a warehouse, rats are a critical pest of humankind. The Centers for Disease Control, as of 1995, estimated there are more than 17,000 rat bite cases in the U. S. per year.

Rats have adapted well to living around people. So well, in fact, that rats are commonly called *domestic* rodents and they can distinguish speech patterns. They live and breed inside buildings and granaries, in city sewers and attics, in agricultural fields and warehouses, in ships and under concrete slabs. Although adapted to people, however, rats are wary. Hundreds can be living in, under, and around a complex of buildings with few people in the area aware of their existence. **Rats have even been found living in sofas and beds.**

Successful intelligent pest management® of pest rats is not easy. It requires an integrated approach based on a good understanding of the biology and habits of pest rats, that combines effective inspection and monitoring with intelligent use of all current control tactics.

Like all rodents, rats and mice have chisel-like incisor teeth which continue to grow throughout their lives. These teeth are filed and sharpened as the rodents constantly gnaw on objects and grind their teeth one upon the other.

Estimating Rodent Populations

Divide Total Consumption (24 hours)
Corn Meal Consumption Test to Estimate Rodent Populations
Rat = 15 Grams (1/2 ounce)
Mouse = 1 1/2 Grams (1/20 ounce)

The number of rats suggested by the following signs:

- **Few or no rats:** No signs (droppings, tracks, rub marks, etc.) visible, even though a rodent presumed to be a rat has been sighted in the area. There are probably fewer than five rats and they have invaded only recently.

- **A medium number of rats:** Old droppings and gnawing marks common; no rats observed in daytime, but one or more spotted at night. There are probably five or more rats in each area where one is spotted regularly at night.

- **Many Rats:** Fresh droppings (they look like olive pits), tracks and gnawing marks, with three or more rats seen at night at any one time, or seen in the daylight. There are probably more than 15 rats in all areas.

If conditions will safely permit, set up a exterior bait station every 50' along your exterior border. Place bait stations or multiple-catch traps about every 20' - 30' along the exterior perimeter of the building and be sure to locate 1 on each side of every entrance/exit door. Indoors, if conditions will safely permit, mechanical traps should be placed about every 25' along the inside perimeter wall for rats but closer (6 - 10') for mice, but always remember to locate 1 on each side of every basement window and entrance/exit door. Fumigate all burrows with carbon dioxide. Poison baits should only be placed in properly labeled tamper-resistant/proof bait stations unless they can be carefully placed in inaccessible areas such as rodent burrows, etc. Install a pair of free-range Guinea fowl.

Inside, it is best not to use bait stations with rodenticide poisons because of the risk of poisoning the occupants, pets, etc. and dead rodents can cause odor problems and may result in future fly, dermestid beetle, health, etc. problems. Mechanical traps such as snap traps, multiple-catch traps, and glue boards can usually be safely used as long as they are not accessible to children and/or pets. Remember, rat and mouse populations are best controlled by storing all food materials in rodent-proof containers, collecting and disposing of all open refuse, and the proper storage of usable nesting materials. Permanent removal of harborage and sources of food and water will eliminate existing rat and mouse populations without using poison. Routinely clean with Safe Solutions Enzyme Cleaner with Peppermint. **Remember, snap traps are not safe and they were designed to break small bones, so keep them away from people and pets!**

TRAPPING OVERVIEW

Ralph Waldo Emerson noted, "If you build a better mouse trap, the world will beat a pathway to your door." People have tried building a better mouse trap since the 1860s and almost 3500 mouse trap patents have been allowed by the U. S. Patent and Trademark Office.

Trapping is useful when poisoning fails or is too hazardous, or where the odor of unrecovered dead rodents would be a problem. If for some reason you wish not to kill these pests, live traps are available that permit their removal and/or relocation. **A very good bait for mice is made by mixing peanut butter, chocolate and birdseed. The real key to eliminating them or at least reducing them is to eliminate or reduce their life supports. But, when you trap - use enough traps.**

Multiple catch traps or set traps or glue boards. Between 15 and 40 traps or glue boards are used in a typical house to catch rats or mice, although as many as 300 taps might be used in a single building. Using traps eliminates any chance of poisoning non-target organisms. It also enables you to remove the dead rodents so that there are no decay, odor or insect problems developing from the dead bodies. The use of glue boards also allows you to check for ectoparasites that leave a rodent's body as it cools. You must make between 3 and 8 visits to a building over a 2 - 4 week period to properly monitor and maintain the traps or glue boards. **Trapping results vary greatly, depending on the skill and patience of the trapper.**

- Look for areas containing piles of droppings or rub marks or gnawing indicating regular rodent activity, and locate your traps in these areas. Be sure to use enough traps; at least a dozen or more per home.
- For large clean-outs, after the first round of captures, remove your traps and allow about seven to 10 days to expire before retrapping. Research has shown if traps remain continuously set, capture rates drop dramatically after the first few days of trapping, and are less effective that if a *rest period* is incorporated into the program. **Be sure to vary your baits.**
- Human odor does not repel rodents. However, traces of pesticides, chemicals, pet odors or nicotine may be repellent. So always handle traps with disposable gloves or clean hands.
- When trapping rats, always nail or tie the trap down with a wire to prevent the captured rodent from dragging the trap away. Do not put the trap directly in front of the hole or opening, especially if you are trappping rats.
- Dipping traps in melted paraffin not only deodorizes them, it helps the spring/snap action. Add a drop of vanilla extract under the trigger to attract both mice and rats.
- Always use disposable gloves and tongs when handling captured rodents to avoid contacting ectoparasites or pathogenic organisms. Or use a plastic bag as a glove, and then fold the rodent and trap into the bag, and tie off the bag, for disposal.
- The success of traps is often related to the availability of food at a particular account. Before implementing the trapping program, always increase sanitation and attempt to eliminate as much of the rodent's food as possible by cleaning or by temporarily moving the food. When rats and mice are hungry and stressed to find food, they often quickly go to the baited traps or glue boards.
- Finally, always consider safety. Never locate traps or glue boards or baits in areas where they might hurt children, pets or wildlife. When in doubt, place traps, baits and/or glue boards beneath cardboard or wooden boxes with holes cut into them, PVC pipe or protect the traps and/or glue boards by some other means. Rat traps should be baited but left unset for a few days before setting them. Try making several varieties of Walk-the-Plank™.
- Free-range Guinea hens will hunt down and kill mice and rats. http://www.guineafowl.com/fritsfarm/guineas/

LARGER VERTEBRATE OVERVIEW
Our primary controls will be exclusion, screening vents and chimneys, and live trapping.

INTELLIGENT PEST MANAGEMENT® OVERVIEW OF THE PRINCIPLES OF A PROPER RODENT INSPECTION

Effective rodent control begins with proper sanitation, a thorough inspection, which should reveal where the rodents are feeding, breeding, nesting, traveling, entering and the extent of the infestation(s). Your graph should carefully list/note:

1. **All conditions** that provide shelter and nesting/breeding sites, food and water for rodents or could attract rodents into your building **must be eliminated**.
2. **All visible evidence** of droppings, rub marks, gnawings, actual sightings or rodent odors which indicate the kind of rodents present.
3. **Any ½" or ¼" openings**, faults or holes in the wall, poorly sealed doors, windows, coal chutes, vents, plumbing ventilation fans or any other potential rodent entrances that need to be properly rodent-proofed.
4. **All harborages** used by rodents such as crawl spaces, attics or other hiding places that need to be sealed off with 19-gauge hardware cloth and or install strobe lights in these areas.
5. **All food or water sources** that may be used by rodents that must be cleaned up and/or stored properly, e.g.,
   - Store cereals and dry food in glass or metal containers and keep pet food and bird seed in sturdy, covered bins.
   - Stored fresh food, such as fruit that is often kept in the garden shed or back porch is very attractive to rodents. If possible, store produce in a refrigerator or a secure room that has heavy wire screen on any vents open to the outdoors.
   - Compost kitchen waste in closed bins, such as the thick, black plastic compost bins available commercially, or in other heavy, closed containers. To be rat-proof, a home made bin must be built of wooden planks and heavy ½" welded wire mesh (not chicken wire, which rats easily chew and which mice easily pass through). Do not put meat scraps or bones in the compost bin. (Note: ½" wire will not keep out mice.)
   - Store outdoor garbage in tightly closed (clean) containers, preferably made of metal.

- Make sure bird feeders are well away from the house and that the feeder prevents excessive seed from spilling onto the ground. This is very attractive to rats and mice, who will also gnaw into a bird feeder if they can reach it. Stop them from climbing bird feeder poles by placing a wide metal collar on the pole. **Feed birds only in the winter.**
- Repair any leaking plumbing, indoors or out, to remove a water supply. Norway rats, in particular, need a great deal of water and sometimes learn to chew into irrigation lines and garden hoses to obtain a drink. They have been known to eat sodium borate and drink themselves to death.

6. **Any pipes, wires and drain pipes that need to be protected with metal guards**. All flues that need chimney caps. **All branches that touch or overhang the building must be removed.**
7. **All concrete or wood being gnawed** by rodents, e.g., doors, door jambs, etc. which should be covered with 24-gauge sheet metal.
8. **All visible 1/4" or larger holes in foundations that need to be patched** with hydraulic cement.
9. **All foundation walls that need to be protected** by installing at least a 1" wide rat or curtain wall at least two feet below the ground level surface.
10. **Note wherever or however you believe the rodents could be entering**, then seal them off, including floor drains and toilets. Note if strobe lights need to be installed in these areas.
11. **List and then remove all rubbish piles, stacks of firewood and miscellaneous equipment and debris outside**.
12. **Note and be sure all garbage cans and pet or animal feeds are tightly sealed in metal containers** and elevated above ground at least 8" and at least 1" away from buildings, walls and fences.
13. **Note all grass, weeds and other vegetation near your building that should be closely cut back**.
14. **Note where any stored products need to be palatalized** at least 8" off the floor, 18" from walls, with 12" or greater aisles.
15. **Be sure to inspect all hidden areas**, e.g., attics, false ceilings and floors, boxed in areas, under stairways, crawls, cabinets, double walls, etc. Use a black light here to help inspect for urine.
16. **Continued good housekeeping and sanitation is an absolute must**.
17. **Rat droppings are** 1/4" - 3/4" long, rod-shaped, straight or slightly bent with round ends, usually dark brown or black in color; when fresh they are shiny and wet in appearance. In a few days they become dry and hard. When old they may appear gray or tan and may be dusty; because of their constant grooming you will usually find hair in their feces. When very old their droppings can "explode" and contaminate the air and surrounding food with excrement particles and rat hair. A single rat can produce 25,000 droppings per year.
18. **Runways are usually discolored** and greasy with semi-circular markings or rub marks where rats swing under or around obstruction. Look also for droppings and tracks in the dust.
19. **Peak rodent activity begins at dusk.** Use a red light to do actual counts without alarming the rodents. **(Black light will cause rodent urine to glow.)**

First, the inspection helps to control additional rodents who would try to enter your building to find harborage, food and water by eliminating their entrance and/or access to these items. You can then begin to *control* (resident) rodents by properly using poisons and traps. Baiting and trapping are usually more effective outside and near harborages and lease effective inside, especially near the areas with abundant food.

There is a natural tendency to place strobe lights, traps, glue boards, poison bait or poison bait stations only in areas convenient for you to reach. These are usually the least likely places to obtain good rodent control. Instead use areas that are not only safe but are also in the normal travel paths of the rodents you wish to control.

Poison baits should be placed in a secured bait station for protection (out of sight, out of reach = out of trouble). Placement packages of poison baits should only be used if they are out of sight and in areas where there is absolutely no chance of food contamination or exposure to wildlife, children or pets. If your label permits bait directly into the rodent holes; **remember to follow any rodenticide (poison) label very carefully.**

INITIAL RODENT PROOFING SUMMARY - Man creates the ideal environment for rats and mice in his buildings by providing them with a constant source of food, water and harborage. Rodent proofing (exclusion) to keep rodents out of buildings is the most important element of a proper control program. It can be performed by you or your staff or by an independent contractor. It is far better to seal an opening under a door, around a pipe or similar area so that rodents cannot enter than to try to kill rats and mice and remove their dead bodies, droppings, ectoparasites and odors **after** they gain entry. **Commensal rats and mice prefer fresh food if they**

can get it and are not wary of the odor of human hands - they are, however, wary of chemical odors.

Ultrasonic Devices - generally do not work in the long-run - as rodents either ignore them initially or grow accustomed to them quickly. Radio frequencies, electromagnetic devices, etc., all have not proven successful in eliminating rodents. At the time of this writing, the Author was having initial success controlling rodents in a building that previously had continuous rodent infestations using radio frequencies, and by using an ultrasonic deviced called "Not Nice to Critters". The Author's only concern was and is how these radio frequencies may affect other mammals, e.g., people.

Ex-Lax®, salt, artificial sweetners and pain killers all have been used to kill rodents. Chocolate Ex-Lax®, beer that has not lost its "fizz," aspartame, Tylenol®, will kill rodents either plain or rmixed with peanut butter, etc.

Rats are excellent climbers and can gnaw through wood and other soft materials. Every opening (even if now covered with wood) that rodents can reach by climbing must be rodent-proofed with materials they cannot chew through or remove.

RATS - When planning exclusion and other preventive measures, remember that rats can:

- **Pass through any opening larger than ½" square/diameter.**
- **Walk or run along horizontal wires (e.g., telephone or electrical wires) and climb vertical wires (roof rats).**
- **Climb the inside of vertical pipes 1½" to 4" in diameter.**
- **Climb the outside of vertical pipes up to 1½"- 3" in diameter, or anything they can reach halfway around as well as larger items that they cannot.**
- **Climb the outside of vertical pipes and conduits of any size if within 3" of a wall.**
- **Crawl horizontally on any type of pipe or conduit.**
- **Jump vertically at least 36" above a flat surface and leap 4 feet sideways.**
- **Reach about 13" above a flat surface.**
- **Dive and swim underwater for as long as 30 seconds.**
- **Swim up and through the water seal or trap of toilets.**
- **Swim as far as ½ mile in open water and tread water for 3 days.**
- **Go straight up or down the edge of a steel door or angle iron, almost as fast as they can run.**
- **If the walls are rough, rats can climb up either on the inside or outside of a 90 degree angle.**
- **Rats can slide down ropes and wires with the aid of their tail wrapped around it in a prehensile fashion.**
- **They are unstoppable chewing machines as they gnaw and leave marks on almost anything, including wood, chip board, lead pipes, cinder blocks, asbestos, aluminum, sheet metal, glass and sun-dried adobe.**
- **Fall more than 50 feet and survive.**

MICE:

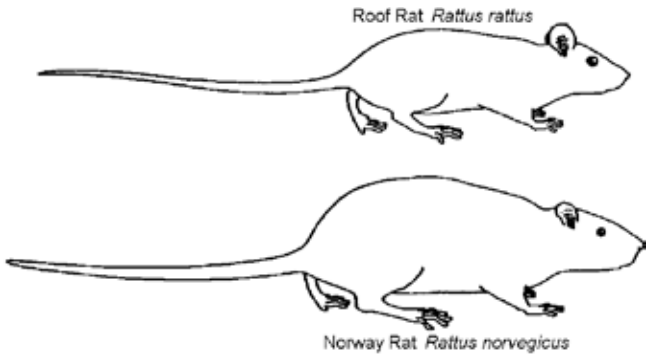
- **Repel them with Safe Solutions Enzyme Cleaner with Peppermint.**
- **Mouse-proof your house as you would weatherproof it by repairing all small holes through which mice might enter.**
- **Store grain and other foodstuffs in tight-fitting glass or metal containers.**
- **Trap mice that have already entered the house.**
- **Use a large number of traps, as many as one every 2 to 3 linear feet.**
- **Set the traps at right angles to the wall with the bait pan and trigger facing the wall.**
- **Handle traps with gloves to avoid contaminating them with human smells.**
- **Bait traps with a mixture of peanut butter and oats, or use cotton balls, which provides them with nesting material or simply use packets of aspartame split open.**

All doors should be self-closing. There should never be a gap of 1/4" or more around any door. Windows may need to be screened with hardware cloth where infestation is high.

Faults, cracks and other openings in your building's foundations must be sealed to prohibit rodent entrance.

These openings can occur anywhere will but normally be where dryer vents, water pipes, electric wires, telephone wires, sewer pipes, drain spouts and vents enter or exit the building.

RAT OVERVIEW
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Muridae



Rats have caused more human suffering and more economic damage than any other vertebrate pest. Rats contributed to more human deaths than all of the wars and revolutions in history. From spreading scores of disturbing diseases like plague epidemics (the "Black Death" of Europe) to rat bite fever, whether feeding on stored grain or gnawing electric wires, rats are enemies of humankind. Statisticians estimate that rats destroy up to from 1/5 - 1/3 of the world's food supply every year - directly by feeding and indirectly through contamination! **Stop this loss - and you will easily eliminate world hunger!** In India alone, rats eat enough grain each year to fill a train 3,000 miles long! (Bateman 1991). In the U. S. alone at least $100 million is spent yearly trying to *control* the Roof and Norway rat. One rat can produce 25,000 droppings a year. The rat is an intelligent, clever rodent that has long been man's adversary and competitor.

There are at least 1,700 mammal species in the order Rodentia and about 500 just in the Family Muridae to which rats and mice belong.

Yet, rats can be admired. They have adapted to nearly all human environments. They live in granaries, in fields, in city sewers, on ocean-going ships, on roofs, in attics, in basements, in street trees, on top of 30-story buildings, and inside subway tunnels. A rat can smell poison in baits at rates only 1 part per million and will urinate on the poisoned bait to warn others not to eat it. A rat can exert biting pressure up to 700 pounds per square inch and can bite up to six times per second! **Don't grab any rat!**

Adept athletes, rats can leap three feet straight up and four feet horizontally. They can scramble up the outside of a pipe three inches in diameter, and climb inside pipes one-and-a-half to four inches in diameter. They can walk between buildings on telephone or power lines, and scramble on board a ship on its mooring line. Rats can swim through a half mile of open water, tread water for up to three days, swim against a strong current in a sewer line, and dive through a sewer trap to pop up inside a toilet. They can fall more than 50 feet and survive.

Rats gnaw or gnash constantly; their teeth are extremely hard. They commonly chew through building materials such as cinder block, aluminum siding, sun-dried adobe brick, wall board, wooden cabinets, lead sheathing, and plastic or lead pipes. Thousands of building fires of unknown origin are caused by rats gnawing insulation from electrical wiring. (5% to 25%) of all fires of "undetermined origins" are believed to be caused by rats.) After gnawing a hole, an adult rat can compress its body and squeeze through an opening only 1/2" high!

In most instances, rats are very wary. Hundreds may be nesting in a city block — in underground burrows, in sewers, on roofs, inside buildings, even inside beds and/or furniture - with few people in the area realizing it. Populations are dynamic: rats moving in, rats moving out, rats giving birth, and rats dying. Within a population, some rats will be easy to control, some difficult. **A single pair of rats can theoretically produce 15,000 descendants in a year or 620,000 descendants in only three years!**

Successful long term rat control is not simple. The key is to control entire rat populations, not individual rats. Rat control requires an integrated approach that includes non-lethal tools such as careful inspection, upgraded sanitation, and rat-proofing structures. Lethal control often combines the use of rodenticides or rodentisafes with non-toxic control measures such as snap traps, homemade traps or glue boards.

RATS AS DISEASE CARRIERS

Rats are responsible for the spread of many diseases including at least 20 often fatal diseases. Sometimes they transmit the disease directly, by contaminating food with their urine or feces. Sometimes they transmit disease indirectly through dangerous disease carrying insects, for example, fleas biting first an infected rat, then a person other vector insects include ticks, lice, mice and mosquitoes. Following are some of the more important diseases associated with rats:

Plague - Spawned the nursery rhyme "Ring around the rosy. A pocket full of posey. Husha. Husha. We all fall down." Plague victims had rosy complexions, carried posey or a flower garland to ward off the evil spirits of the plague and made a "Husha" sneezing sound and fell down dead!

The "Great Plague" of London caused by a bacillus *(Yersina pestis)* killed half of the city's population. The "Black Death" of Europe lasted 50 years in the 14th Century and killed 25 million people. In the first quarter of this century, an estimated 11 million people died in Asia from plague.

The disease is transmitted primarily to man by a bite from the Oriental rat flea *(Xenopsylla cheopis* - Rothschild). The flea bites an infected rat, and then, feeding on a human, inoculates them with the bacteria that cause the disease.

Although no major urban outbreak of plague has occurred since 1924, this is not a disease of the past. A reservoir of plague exists in some populations of wild rodents in several Western states. Humans contacting these rodents could contract the disease. As suburbia expands into undeveloped areas, wild rodents can transmit the disease to urban rats. There is a real danger that an outbreak of urban plague can occur anytime in the United States.

When the plague is in the lungs it is referred to as "pneumonic plague". In this highly contagious form it is spread from one person to another by sputum or coughed-up droplets. When plague is transmitted to people from wild animals, rodents, rabbits directly, or their fleas, it is called "sylvantic plague." Urban (or murine) plague is transmitted from commensal rodents via the bite of the Oriental rat flea, *Xenopsylla cheopis*.

Hantavirus

An acute pulmonary disease caused by different strains of a virus. The virus is transmitted in feces, urine, saliva or other body fluids, or by direct contamination. The most common carrier in the USA is the deer mouse and then, to a smaller degree, the white-footed mouse.

Murine Typhus Fever

Murine typhus (a disease caused by a rickettsial organism or type of bacteria) still occurs in California and in southeastern and Gulf Coast states. It is a relatively mild disease in humans. As with plague, murine typhus is transmitted from rats to humans by the Oriental rat flea or directly from rats and mice feces and/or urine. In this case, however, the disease organism enters the bloodstream via bites of the fleas or when feces of infected fleas are scratched into a flea-bite wound or broken skin. It is characterized by chills, headache and fever; with a rash appearing about the fifth day and lasting up to two weeks. Respiratory symptoms are usually seen. Death occasionally occurs.

Rickettsial pox is also caused by a rickettsial organism which is transmitted by infected mice to people and is discussed in the section on mice.

Rat-Bite Fever (Haverhill fever; SODOKU disease)

Rats bite thousands of people each year; most bites occur in inner cities. [In some cases victims, particularly infants and bed-confined elderly, are bitten in the face while sleeping.] A small percentage of those bitten develop rat-bite fever. The U. S. bacterium *(Streptobacillis moniliformis)* and/or the bacterium *Spirillum minus* (in Japan and Asia) that causes the disease is carried in the saliva, teeth, gums and mucous membranes of many rats and mice and is transmitted via a bite. Although the disease exhibits mild symptoms similar to flu in most cases, it can be fatal. It is of particular risk to infants.

***Salmonella* Food Poisoning**

Rats frequent sewers, rotting garbage, livestock facilities, septic tanks, cesspools and similar sites where *Salmonella spp.* bacteria thrive. The bacteria also thrive in the intestinal tracts of rats. If infected rats travel to your table, stored food, or dishes and silverware, or food preparation surfaces, their droppings can transmit *Salmonella* food poisoning to humans.

Leptospirosis or Weil's Disease

Human cases of this disease are seldom fatal. The disease organism is a spirochete bacterium (*Leptospira icterohaemorrhagiae)* spread from rat urine or blood into water or food, and enter humans, dogs, cattle and pigs through mucous membranes or minute cuts and abrasions of the skin.

Trichinosis

Trichinosis results from a nematode, or tiny roundworm (*Trichinella spiralis*), that invades intestines and muscle tissue. Both people and rats get the disease from eating raw or undercooked pork infected with the nematode or encystic worm. Rats help spread trichinosis when hogs eat food or garbage contaminated with infested rat droppings. Other mammals and birds can be involved.

About Rabies - Never

Rats have **never** been found to be infected with rabies in nature. Rabies transmission from rats to humans has **never** been documented in the United States. The U. S. Public Health Service recommends against anti-rabies treatments in the case of rat or mouse bites.

Direct effects. Rat bites, particularly in urban areas, may be a serious health problem. An estimated **14,000-24,000 bites** to humans occur each year in the U. S.! Infants and helpless adults (unconscious, invalid and elderly) are especially subject to attack by rats. A small percentage of those bitten develop rat-bite fever, a bacterial disease carried in the teeth and gums of many rats. **All bites should receive immediate medical attention.**

KINDS OF RATS

In the United States the two most important pest rats are the Norway rat *(Rattus norvegicus*-Berkenhout*)* and the roof rat *(Rattus rattus*-Linneaus*)*. The Norway rat is also called the brown rat, river rat, house rat, barn rat, sewer rat and wharf rat. The Norway rat is generally considered the most important rat in the U. S. It is found in every state and common throughout most of the populated areas of North America. Norway rats are noticeably absent from sparsely populated areas - particularly in the western U. S.

The roof rat is also called the black rat, ship rat and Alexandrine rat. Roof rats are found primarily in coastal areas of the United States, including California, Washington and Oregon, the Southeast and Middle Atlantic States and the Gulf States.

The two species look much alike, but there are noticeable differences. In general:

- Norway rat looks sturdier than the roof rat; the roof rat is sleeker.
- A mature Norway rat is 25% longer than a roof rat, and weighs twice as much.
- Norway rat's tail is shorter than the length of its head and body combined; a roof rat's tail is longer than its head and body;
- Norway rat's ears are small, covered with short hairs, and cannot be pulled over the eyes; a roof rat's ears are large, nearly hairless, and can be pulled over the eyes.
- A Norway rat's snout is blunt; the roof rat's snout is pointed.

HABITS OF RATS

Rats must be understood to be controlled. Knowledge of their life histories, habitat and food requirements, patterns of behavior, range and other factors is essential to their management. In some urban areas, Norway rats may

travel 100-150 feet from their nests in search of food and roof rats may travel further in a more 3-dimensional range. They both usually forage between dusk and dawn, but when food is scarce and/or they are living under crowded conditions - **rats may even be seen in the daytime.**

The Norway and roof rats have similar habits. Most of the discussions below apply to either kind of rat. Where differences are important for control purposes, however, the differences will be highlighted or noted.

Life Cycle

A mature female rat can give birth to about 20 young in a year (4 to 6 at a time), if she lives that long. The average life span of a rat in the field is less than one year; females live longer than males.

The young are born in a nest. They are hairless, and their eyes and ears are closed. Within two weeks their eyes and ears open, they become furry and rat-like, and they begin exploring the nest area. In the third week they begin to eat solid food, and imitate their mother to forage, escape, and watch for danger.

If the mother rat has become wary of rodenticides or traps, many of her young will learn to avoid them. This learning experience can make control difficult in sites where long term rodent control programs have been unsuccessful in the past.

Young are totally weaned at four or five weeks old. They then weigh about 1-1/2 ounces. At three months, the young are independent of their mother. They will mate and continue the cycle in the same location or will migrate to a new, unoccupied nest area.

Seasonal Abundance

Outdoor rat populations tend to peak in summer to early fall. They tend to be at their lowest levels in late winter to early spring. Indoors, rat populations may remain at the same levels throughout the year, limited only by periodic shortages of food, water or nesting sites.

Responses to Environmental Factors

Rat abundance is directly dependent on the availability of food, water and shelter. They need about an ounce of food and 1/2 fluid ounce of water daily, although the roof rat can get by on less. Both prefer to nest where water is easily available. **Rats and mice prefer fresh food if they are offered a choice.**

While the Norway rat prefers to feed on protein foods like meat, fish, insects and pet feed, the roof rat prefers a more vegetarian diet. It feeds on fruits, nuts, seeds, berries, vegetables, and tree bark. But the roof rat will also feed on garbage, pet food and meat if it is readily available. Like squirrels, rats often cache or hoard food (including rat poison) in hidden areas for use when food supplies run short.

Social Behavior

Rats are social animals and live in colonies with well-defined territories that they mark with urine and glandular secretions. The colony has a complex social hierarchy with a dominant male leader and a “pecking order” of subordinate males and ranking females. The strongest and most dominant animals occupy the best nest and resting sites, and feed at their leisure. Weaker, subordinate rats are pushed out to less favorable sites, or forced out of the territory completely. **Stronger, more dominant animals are the first to die in walk-the-plank traps.**

Rats are aggressive, and social conflicts are most common at feeding sites, prime resting areas, and territorial boundaries. Females fiercely defend their nest and young from other rats or invaders.

SENSES OF RATS

Rats have poor vision. They are nearly color blind, and react to shapes and movement rather than identifying objects by sight. Thirty to forty-five feet is the limit of their vision. Their eyes are adapted to dim light.

Other senses, however, compensate for poor vision. They use their sensitive nose to locate food, follow pathways, tell whether another rat is friend or foe, and identify new objects in their territory. They use long whiskers and guard hairs to "touch" their way through dark burrows, pipe chases, wall voids, and other runways. Their ears detect faint sounds that signal danger. **Rats can taste certain chemicals at a parts-per-million concentration.** This explains why rats often reject poisoned bait or avoid traps that have been contaminated with insecticide poisons. Rats are interesting creatures that like to be tickled at the nape of their necks. Finally, rats have an excellent sense of balance which allows them to walk on wires and always land on their feet in a fall.

Fear of New Objects (Neophobia)

Rats are wary of anything new that appears in their territory. A bait station, a trap, a block of wood will be avoided for a few days until the rats become familiar with the new object; even then, they approach cautiously. This fear of new objects can make baiting and trapping difficult. Rats will avoid poison bait when it is first placed. Later, they may nibble warily. If the poison bait makes them ill, but doesn't kill them, they will avoid similar baits or stations in the future. Commensal rodents are not wary of the odor of human hands - **they are wary of chemical smells.** They literally fight to jump into our 55-gallon water trap or garbage can with floating oats, and they can not tread water for 3 days in this version of Walk-the-Plank™. Irritate them with strobe lights. Kill them with chocolate Ex-Lax® or beer that has not lost its fizz or salted/corn oil-covered seeds. Alka-Seltzer tablets covered in peanut butter or borax-covered seeds or baked in peanut butter cookies will work better, but borax and sodium borate are also toxic to other animals.

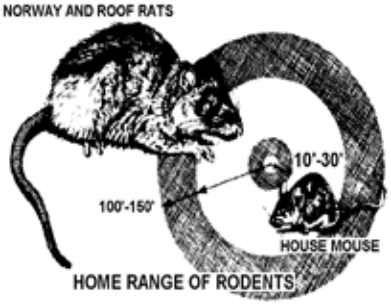
FOOD & WATER

Rats need about one ounce of food daily. Norway and roof rats prefer different types of food. Norway rats prefer protein-based foods such as meat, fish, insects, pet food, nuts, and grain. Household garbage is ideal food for Norway rats. Roof rats are more vegetarian and prefer plant materials such as fruits, nuts, seeds, berries, vegetables and tree bark. They occasionally feed on garbage and meats. Each rat species, however, will feed on non-preferred food if nothing else is available. They produce 20 - 50 droppings per day.

Rats often cache or hoard food in hidden areas. This food may or may not be eaten when other food supplies run short. Hoarding is important for two reasons. First, rats may be moving a toxic poison bait into a location where the label does not permit it to be. Second, rats may be hoarding poison bait while feeding on their regular food; thus, any baiting program can become ineffective and/or dangerous.

Rats need water every day. The amount varies, depending on the moisture content of their food, but is usually around 1/2 to one fluid ounce, which they excrete as urine every day. Rats prefer to nest where water is easily available. Feed them beer (or pop) that still has *fizz* to kill them; they can't burp, vomit or fart.

RANGE



Rats usually begin foraging just after dark. Most of their food gathering occurs between dusk and midnight, but short bursts of restlessness and activity can occur anytime, day or night. Rats commonly travel 100 to 150 feet from their nest looking for food and water and patrolling their territory. It is not unusual for a colony of rats that nests outdoors to forage inside a building 100 feet away.

NESTS

Norway rats may nest inside or outside. Outdoors, Norway rats usually nest in burrows dug into the ground. The burrows are shallow (usually less than 18 inches) and usually short (less than three feet long), with a central nest. The main opening is called the *mail hole*. Extra "bolt holes" at least one of which is well hidden are used for emergency escapes. They are hidden under grass or boards or lightly plugged with dirt. Burrow openings are two to four inches in diameter. Norway rats may also nest in sewers or storm drains. Indoors, Norway rats

nest inside walls, in lower floors, behind seldom used stored materials, in the space between floors and ceilings, underneath equipment, between and under pallets, and in crawl spaces, storage rooms, and any cluttered area that is normally unoccupied. Norways prefer to nest in the lower floors of a building.

Roof rats commonly nest above ground in trees - particularly untrimmed palm trees, and in piles of wood or debris, vine-covered fences, and stacked lumber. Overgrown landscaping is also a prime nesting area. Roof rats will sometimes nest in burrows if above-ground sites are limited and Norway rats are not nesting in the area. Indoors, roof rats prefer to nest in the upper levels of a building in the attic and in ceiling and attic voids near the roof line. But at times they also nest in the lower levels of a building as do Norway rats.

Both species also nest in sewers and storm drains, and both on occasion can be found in highly unusual nest sites. Both Norway and roof rats can have several "hotel" nest sites in an area. A rat may spend a week in its home base and then move for a day or two into a secondary "hotel" nest site. Norway rats have been shown on occasion to have a home range of up to 20 acres when these secondary nest sites were included in the calculations.

INSPECTION - The first step in rat management is to find all areas of infestation.

A thorough inspection begins on the exterior - look for areas that provide food, water and harborage. These areas include, planters, sheds, storage units, garbage, wood piles, vegetation, etc. Rats give many signs that they are infesting an area. Inspection will determine if a site is infested, and will identify where rats are feeding and nesting, their patterns of movement, the size of the population, and the extent of the infestation. Remember rodents are most active in the night - so do not forget to look after dark with a red light and/or black light. This will help you decide what control measures to use, where and how to use them, and how much effort is needed to put the program in place.

Flashlight

An inspection using a powerful red flashlight just after dark is the best way to see rats. Dead rats are signs of a current or past infestation. If all that are found are old dried carcasses and skeletons, it may mean an old infestation. Many fresh carcasses are an indication that someone may be baiting the area currently. If rats are actively observed during the day, the rat population is probably high. **Black lights will fluoresce rat urine. Red lights will let you see them at night, but they won't see you!**

Sounds

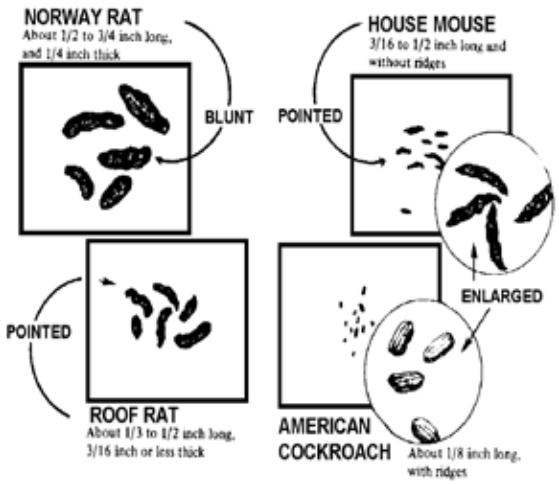
When a building is quiet, typical sounds of rat infestation, e.g., squeaks and fighting noises, clawing and scrambling in walls, or gnawing sounds may be heard.

- Use a stethoscope or electronic listening device to help pinpoint activity.

Droppings

A single rat may produce up to 50 droppings daily or up to 25,000 per year. Roof rat droppings are generally smaller (half-inch) than Norway rat's (three-quarter inch). The highest number of droppings will be found in locations where rats normally rest or feed. **Trap these areas very heavily.**

- Determine if a rat population is active by sweeping up old droppings, then reinspect a week later for new droppings.
- Look at the appearance of the droppings to determine if rats are currently active. Fresh rat droppings are black or nearly black, they may glisten and look wet, and they have the consistency of putty. After a few days or a week, droppings become dry, hard and appear dull. After a few weeks, droppings become gray, dusty and crumble easily. (Note that sometimes old droppings moistened by rain may look like new droppings; however, if crushed, they will crumble and do not feel like soft putty.)



Urine - Ultraviolet light inspection. Conduct an ultraviolet or black light inspection at night.

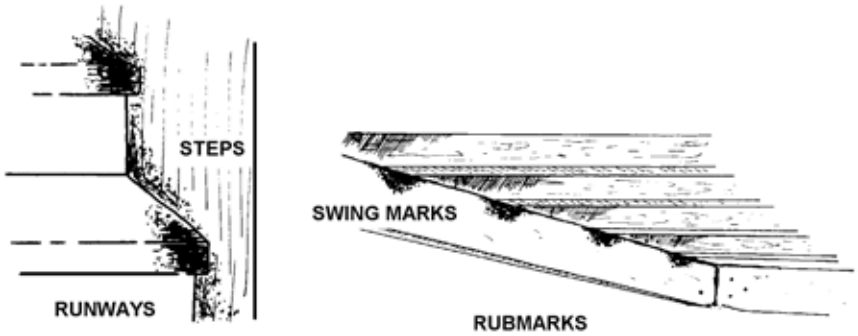
Both wet and dry rodent urine stains will glow blue-white to yellow-white when dry, bluer when fresh under an ultraviolet light (blacklight). **Rodent hair also fluoresces blue-white.** Rodents usually urinate while in motion. Pet urine will be spots on carpet 3" - 4" in diameter; underneath the carpet the spot will be 2 - 3 times larger. Optical bleaches found in soap and detergents will fluoresce a brilliant blue-white. Lubrication oils and greases fluoresce green-white to blue-white or brown. Clean up with diluted Safe Solutions Enzyme Cleaner with Peppermint and reinspect with black light again on another night.

- Portable black light or ultraviolet lights are used in the food industry to identify rat urine on food items. Other substances besides rat urine also glow, which can be confusing, so proper use of this inspection method takes practice.

Grease marks or smudge marks

Grease or smudge marks and dirt rub off of a rat's oily coat as it scrambles along. The grease marks build up in frequented runways and become noticeable. **Be sure to also trap all of these areas**.

- Look along wall/floor junctions, on pipes and ceiling joists, and on sill plates where rats swing around obstacles. Grease marks are also found at regularly used openings in walls, floors and ceilings.



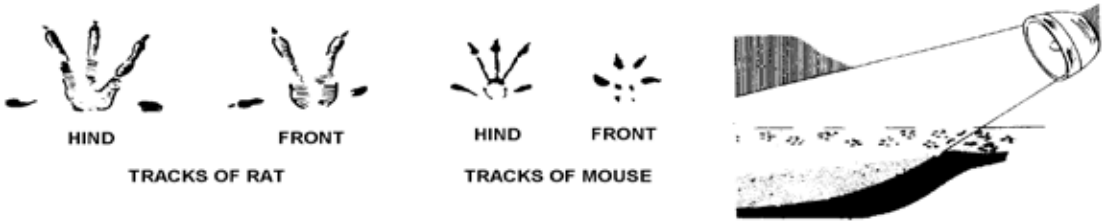
Runways

Outdoors, **rats constantly travel the same route**; their runways appear as beaten paths on the ground.

- Look next to walls, along fences, under bushes and buildings. Indoor runways (harder to identify) may appear as well polished trails, free of dust.

Tracks

A rat's foot print is about three-quarter inches long, and may show four or five toes. Rats may also leave a "tail drag" line in the middle of their tracks.



- Look in dust or soft, moist soil.
- Place a tracking patch in suspected rat areas to show footprints. (A tracking patch is a light dusting of an inert material such as clay, talc [unscented baby powder], or powdered limestone. Don't use flour, which may attract insect pests. A good patch size is 12 x 4 inches.) Apply patches in suspected runways and near grease marks. When inspecting tracking patches, shine a flashlight at an angle that causes the tracks to cast a distinct shadow. (Note that a tracking patch is not the same as tracking powder. Tracking powders are rodenticide poisons in dust form, tracking patches use non-toxic dust. Do not use a tracking powder to make a tracking patch - we do not advise using poisonous tracking powders at all.)

Gnawing Damage

A rat's incisor teeth grow at a rate of about five inches per year. Rats keep their teeth worn down by gnashing or continuously working them against each other and by gnawing on hard surfaces.

- Look for gnawing damage as evidence of a rat infestation. Gnawed holes may be two inches or more in diameter.
- Inspect floor joists, ceiling joists, door corners, kitchen cabinets, and around pipes in floors and walls. Rats can gnaw through most building materials including wood, plaster, sheetrock, soft cement, foundations, doors, windows, asphalt, lead, copper, plastic pipes, aluminum or vinyl siding, electrical wiring, etc. They also gnaw on and damage sewer lines, automobiles, furniture, garbage cans, pools, etc.

Nest Sites

Roof rats, in particular, often nest or store food (or rat poison) in the attics of buildings. Roof rat nests may also be found when dense vegetation is being trimmed or removed.

Burrows

Outdoors, rat burrows may be found singly or in groups along foundation walls, under slabs and dumpster pads, in overgrown weedy areas, beneath debris, and in embankments.

- Look for a burrow opening that is free of dirt, leaves, and debris, often with smooth, hard-packed soil.
- Look for rubmarks at the opening, and soil pushed out in a fan-shaped pattern.
- Fill the opening with a small amount of wadded-up newspaper or a few leaves and cover it with loose soil. If the rats are still using the burrow, they will reopen and clear the hole overnight.
- Estimates of relative abundance of a limited area can be made by counting, mapping and loosely plugging burrow entrances on a weekly basis.
- Putting propane, carbon monoxide or carbon dioxide in burrows during the day usually "fumigates" or kills all of the occupants. Carbon dioxide is the safest way to "fumigate" burrows. Propane is, obviously, very dangerous and probably illegal. The Author usually uses only carbon dioxide (heavier than air) gas.

Pet Excitement

Cats and dogs may excitedly probe an area of floor or wall where rats are present, especially if the rats have only recently invaded.

Food Caches. Rats may store surprisingly large quantities of food (or rat poison) in protected areas.

Fire. Probably half of all fires of unknown origin are caused by rodents gnawing on wires or matches.

Odor. Heavy infestations have a distinctive odor which can be identified with "practice". The odor of rats can be distinguished from the odor of mice.

Estimating Rat Numbers

It's not easy to tell exactly how many rats are infesting a site. As a rough guide, you can use rat signs to characterize the population as low, medium, or high.

- In rat-free or low infestation conditions, no signs are seen. The area either has no rats or was invaded recently by a few.
- With medium infestation, old droppings and gnawing can be observed. One or more rats are seen at night; no rats are seen during the day.
- When there is a high infestation, fresh droppings, tracks, and gnawings are common. Three or more rats are seen at night; rats may be seen in the daytime.

Note: Remember with rats (as well as all other pests) 90% of the pests will be found in 10% of the area.

INTELLIGENT PEST MANAGEMENT® CONTROL AND MANAGEMENT

Most successful rat control programs use a combination of tools and procedures to knock down the rat population, and to keep it down. Non-toxic methods used combine sanitation, rodent proofing, habitat alteration and trapping. Some of the tools, such as baiting and trapping, are lethal to the rat. Some tools are not; rat-proofing and strobe lights, for example. Usually you will have to recommend changes that the occupants need to make, such as proper storage and/or increasing the frequency of garbage pickup or making building repairs. **In most areas improperly managed organic garbage is the main source of food for rats.**

The following sections describe some of the major techniques and tools used in controlling rats:

Sanitation - Your long term rat control will be in direct proportion to your ability to reduce their food supply and access into your building.


SANITATION

Rats are attracted by food spills, open garbage, and food stored or left lying in accessible sites. Bating and trapping programs often fail because the bait can't compete with the rats' regular food. Reducing the rats' food will reduce the rat-carrying capacity of the site, as well as making lethal control programs more effective. **All conditions that foster/ create your rodent problem must be eliminated or greatly reduced.**

In urban settings, rats feed largely on garbage, but they prefer fresh food. Regular trash pickups at the end of each day, rather then storing trash overnight, and the use of rat-proof trash containers are relatively simple methods of reducing rat food sources. Damaged dumpsters and containers should be repaired and replaced and should always be kept closed at night. Clean up all garbage and food materials. Pet food dishes and water dishes should not be kept full overnight. Bird seed is a favorite rat food. Bird feeders should be equipped with seed catchers, or the dropped seed should be cleaned up every evening.

Like all animals, rats need food to survive. Baiting programs often fail because the poison bait can't compete with the rats' regular food. The rats simply ignore the poison baits or cache them. Reducing the rats' normal food encourages them to feed on any rodenticide baits or trap baits placed in their territory.

- Food scraps must be removed daily from the kitchen - all inside garbage containers should be cleaned with Safe Solutions, Inc. Enzyme Cleaners at least weekly to be sure no food scraps are left.
- Close or repair or replace dumpsters and garbage containers that are left open or damaged or can not be properly sealed with securely fastened lids. Schedule more frequent pick-ups and cleaning. Spray the container with diluted enzyme cleaner and borax.
- Clean food spills. Keep food spillage at a minimum. Fruits, nuts and vegetables should also be removed.

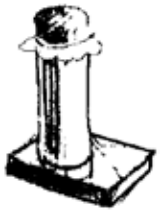
- Store human and pet food stuffs in metal or glass screened containers or in refrigerators or freezers (even bars of soap may have to be refrigerated or enclosed).
- Do not allow food to be left out overnight. Do not let pet droppings or fruits or nuts lay outside.
- Outdoors, remove seeds spilled under bird feeders or food around doghouses.
- In warehouses and food plants, look for spills around railroad tracks and loading docks.
- Ensure food in storage is rotated properly (first in, first out) and is stored on pallets, not on the ground or against walls. The pallets should be 18 - 24 inches from side walls and placed so that aisles permit visual inspection and cleaning around the stored food.
- Routinely clean with diluted Safe Solutions Enzyme Cleaner with Peppermint.

Eliminate hiding places. Rats are experts at hiding and secretiveness. Landscaping should not include thick hedges or bushes which obscure the ground. Ground covers such as ivy, which provide cover or runs for rats, should not be planted adjacent to buildings. High grass, weeds, wood piles, and construction debris should not be permitted near foundation walls. Dumpsters and outside garbage containers should always be closed and sit on a paved or concrete pad. Indoors, reduce clutter in rarely-used rooms and organize storage areas. **Fill in all voids they have been using with aerosol foam and/or hydraulic cement.**

Outdoors

- Always remove all cardboard, newspaper, plastic, fabric, trash, clutter and other debris.
- Check for and repair all plumbing leaks and/or drain all standing water sources.
- Remove plant ground covers such as ivy near buildings. Thickly cover drainage ditches with smallish gravel. Burn/wilt all emerging weeds “peeking” through the gravel.
- Remove high grass, weeds, wood piles, and construction debris that permit rats to live and hide adjacent to a building. Install an 36" vegetation-free barrier next to the building. Prune woody shrubs to expose the lower 18" of the trunk. Remove all large-leaf Algerian Ivy.
- Rat proof the building - trim all branches that touch or overhang the building. Caulk and seal all openings.
- Fumigate burrows with carbon dioxide or carbon monoxide.
- Free-range Guinea fowl will hunt down and kill rodents.

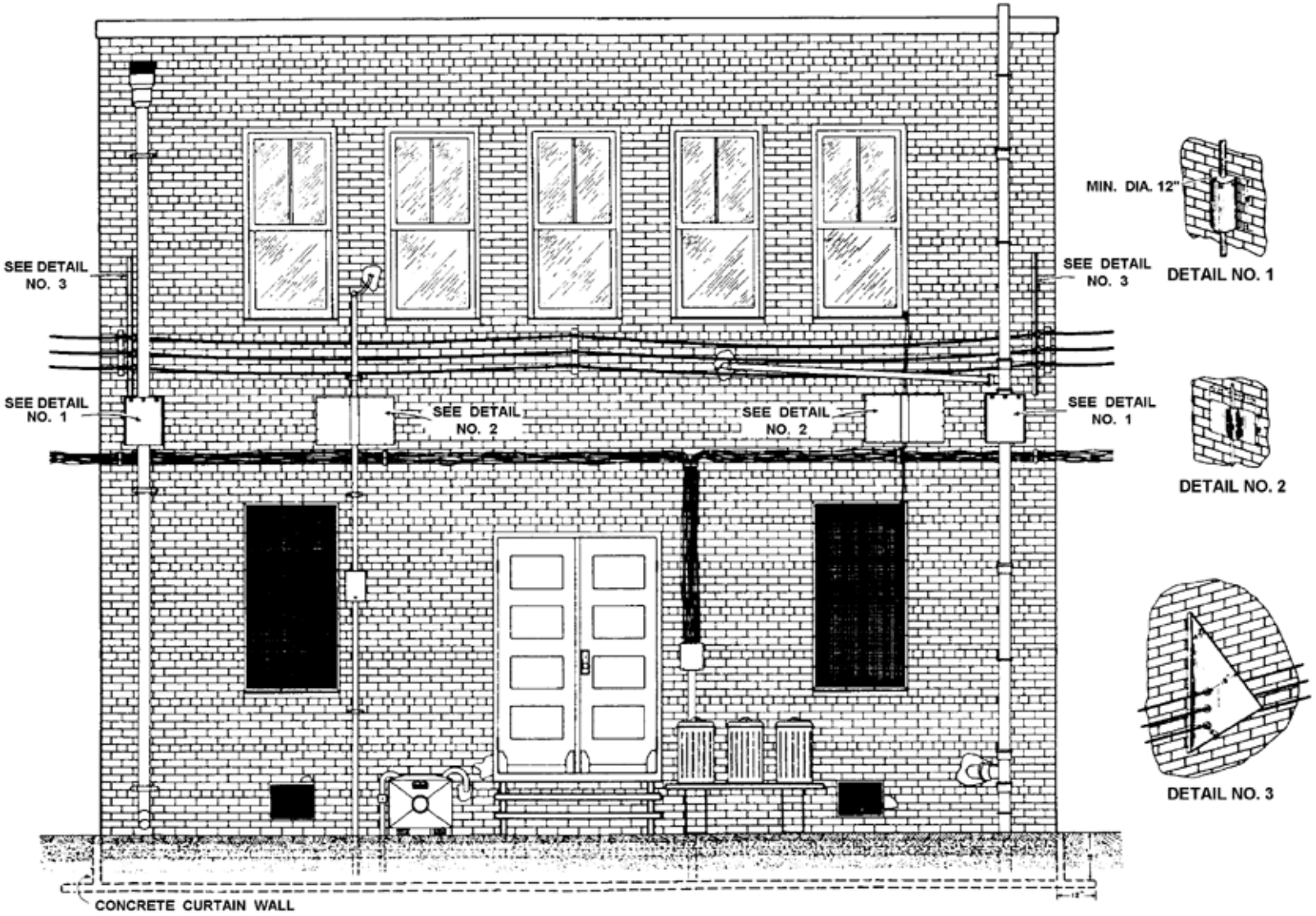
Indoors



- Eliminate clutter in rarely-used rooms - basements, storage rooms, equipment rooms. Organize storage areas. Put stored items on pallets 18" from the walls.
- Repair broken sewer pipes - rat-proof toilet drains by feeding the pipe form the toilet bowl into a pipe section of larger diameter.

Rat-Proofing (Exclusion)

Long term, the most successful form of rat control is to build them out. Also called rat-proofing, this technique makes it impossible for rats to get into a building or an area of a building. Rat-proofing prevents new rats from reinfesting a building once it has been cleared. **If you have rats currently - begin your baiting and trapping program before you rat-proof the building to reduce the chance you will trap rats inside.**



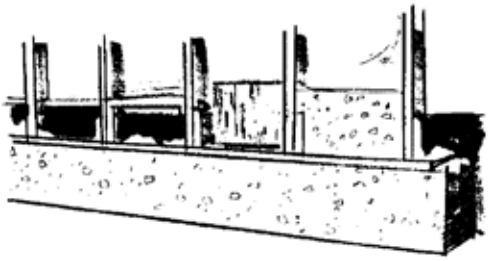
MODEL BUILDING
AFTER RATPROOFING

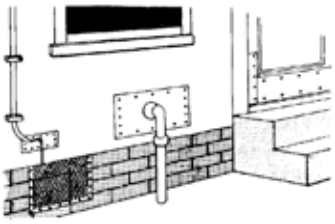
SHEW-PYE-COE ATLANTA, GA.

REV. DEC. 1944
SEPT 32, 1947

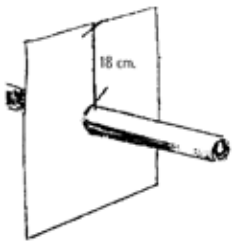
Building Exterior. Seal all cracks and holes in building foundations and exterior walls. We lost a school account once because the kitchen staff refused to close the door - a "competitor" came in and continued to poison the rodents! Phew! Rotting rodents stink!

- Block or seal all openings around water and sewer pipes, electric lines, air vents, and telephone wires.
- Screen all air vents.
- Caulk and seal all doors to ensure a tight fit, especially between door and floor threshold. Install metal plates where needed.
- Fit all windows and screens tightly.
- Caulk and close all openings on upper floors and the roof, inspect under siding and repair damaged soffits.
- Repair all breaks in the foundation, especially below ground level.

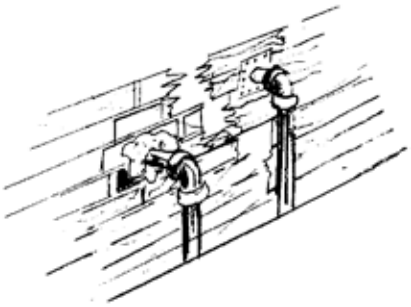




EXCLUSION



Typical Repairs.



- Seal spaces inside hollow block voids or behind wall board. Repair broken blocks and holes around pipes. Stuff with coarse steel or copper wool.
- Repair gnaw holes or temporarily stuff them with coarse steel or copper wool.

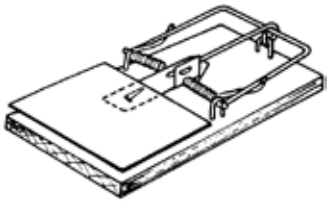
Exclusion. Building rats out of a structure, and keeping them out, is called rat-proofing or exclusion.

- Block or seal all openings around water and sewer pipes, utility lines, and air vents.
- Install metal kick plates or sweeps on doors and metal jambs on windows and doors.
- Screen all air vents.
- Seal any cracks or holes in foundations (above-and below-grade) and exterior walls.
- Repair damaged roof soffits and seal any openings to the roof.
- Repair any gnaw holes after temporarily stuffing them with steel or copper wool.
- Equip all floor drains with sturdy metal grates.
- In roof rat areas, cables, trees, and pipes leading to or touching a structure should all be rat- proofed with galvanized metal barriers.
- If rats are running along pipes (or utility lines), you can install a 2-foot diameter disc to stop them or, better yet, place a plastic pipe of a larger diameter over the pipe. When the rat tries to walk on the plastic pipe, it will roll and throw the rat to the ground.

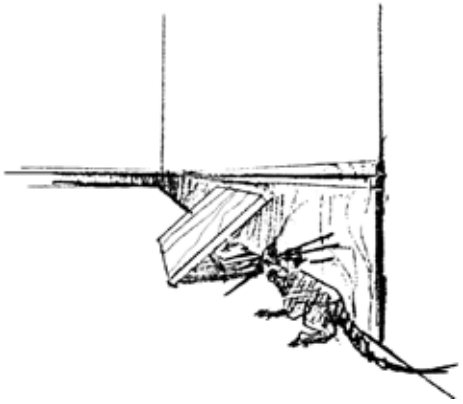
Trapping - The snap trap is an effective method of killing rats when used correctly with fresh bait. Traps are especially useful when you wish to avoid the use of poisons, to eliminate bait shy or bait resistant rats, to avoid odors from dead rats in inaccessible places, or to collect live rats for ectoparasite or resistance screening. The best traps are those with expanded triggers (treadles) set for a light touch. Set the traps along runways with the trigger towards the wall, or tie the traps to pipes or rafters or wherever droppings, gnawing, grease marks,

and other evidence of activity is found. **The number one mistake in using traps is not using enough traps! Be sure kids and pets can not reach your traps!**

Traps. The Rat Zapper® is portable "electric chair" for rats that can even be monitored on the computer. The power pack is run by batteries and the electric "trap" is either a see through or metal sleeve. Prebait the trap with dry baits, e.g., peanut butter dog biscuits and after feeding has commenced. Attach the power pack and bait the plate. The first rodent (rat, chipmunk, mouse, vole, etc. that makes contact will instantly die and "spot" the trap with urine. No violence is visible; the urine smell and new bait ensures that rodents will continue to enter and die. If a child touches the trap they will say the sleeve bit or stung them, but should not sustain lasting injury. Try to keep it out of the reach of children and pets. The snap trap is an effective method of killing rats when used correctly. Snap traps are not safe, however, because they are specifically designed to break small bones. To make the new traps more effective, tape a small piece of dowel or pencil on the bottom of the trap under the spring; the bait or trigger should be up in the air. When the rodent pushes the trap down to get the bait, the additional movement insures greater effectiveness. Trapping is advised for use in places where rodenticides are considered too risky or aren't working well, if the odor of dead rats in wall or ceiling voids would be unacceptable, or when there are only a few rats infesting a limited area. **Trapping has several advantages**. There is less non-target risk than from a toxicant. You know instantly whether or not the trap has been successful. Traps also allow for disposal of the carcass so that there are no odor problems. Careful attention to detail is necessary to ensure proper placement in adequate numbers or rats will simply pass them by. **The best snap traps are those with expanded triggers (treadles) set for a light touch. Caution: Accidental release can severely damage a hand or foot, especially of a child or a pet, so keep them out of their reach!**

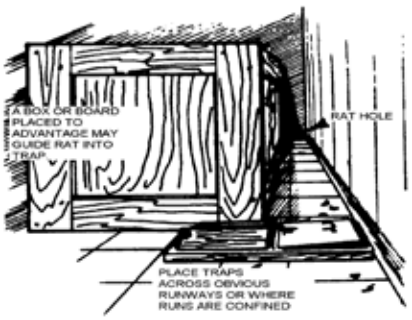


- If possible all traps should be placed in crawl spaces, attics, basements or locked storage rooms where kids, pets and other non-target animals can't reach them.
- Leaving the baited traps unset for a few days may increase the catch by reducing the chance that wary rats will trip the traps without capture.
- Set several unbaited traps along runways, along walls, or other objects that edge walls, behind objects, in dark corners where the rat is forced through a narrow opening. Place the trigger side of the trap next to the wall. (Rats will step on the trap during their regular travels.)
- Set traps with bait, if food for rats is in short supply, or without bait if food is plentiful. Good baits for Norway rats include peanut butter, hot dog slices, bacon, or nut meats. Roof rats respond to dried fruits and nuts, or fresh fruits such as banana or apple.
- Tie moveable bait to the trigger using string or dental floss, or else the rat may simply remove the bait without triggering the trap.
- Lightly sprinkle cereal, such as oatmeal, around traps to make them more attractive.
- When runways are located on rafters and pipes, set expanded trigger traps directly across them, fastening them to pipes with wire, heavy rubber bands, or hose clamps, and to rafters with nails.
- Set traps where droppings, gnawing damage, grease marks and other evidence of activity is found.
- **Use enough traps.** (A dozen may be needed for a house, a hundred for a small warehouse.) Set five or ten traps in an active corner of a room. Set three traps in a row so a rat, leap ing over the first, will be caught in the second or third. If unsure about sites of activity, set traps along possible runways spaced 10' to 20' apart.
- Camouflage traps when left with only a few rats that become



very difficult to capture. Set traps in a shallow pan of meal, sawdust, or grain. (Place a small piece of cloth or plastic over the trigger to prevent the meal from jamming the mechanism.)

- In stubborn cases, expose food in shallow pans or inside can drink cartons until the rats readily feed on it. Then add a buried trap. Try a bait station on its side (with holes closest to floor) with a rat snap trap inside.
- Move boxes and objects around to create narrow runways to the traps.
- Avoid spraying insecticide on the trap, or even storing traps with application equipment. The odor of other rats improves a trap's effectiveness. Likewise, the odor of insecticide can make a rat steer clear of your traps. Rats are smatter than people; they avoid insecti cide poisons!
- Fill a large garbage can or 55-gallon drum 2/3's full with water with some corn oil sprayed on the exterior - throw in 2 boxes of cocoa puffs or 2 pails of oats or bird seed (whole) or sunflower seed - that float, put a plank up to the top and wait. Rats usually fight to get in this water trap that looks like a major food source and harmless to them. For a single rat you can use a 5-gallon pail "Walk-the-Plank® with some cooking oil on the edges.
- Inspect traps frequently to remove dead rodents and change old bait - handle with gloves. Use a shovel to put the trap and dead rodent in a plastic bag which is then sealed and dropped into the garbage.



Glue Boards

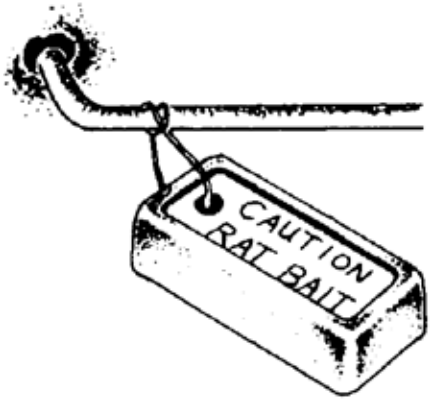
Another way to trap rats is with glue boards. Glue boards use a sticky material that captures rodents. Although most often used against mice, they are sometimes effective against rats. Be sure to use larger glue boards that have been designed to trap an animal the size of a rat. Be aware that some people consider the use of glue boards inhumane, since they often kill the rodents slowly and the rats and mice may struggle for sometime. The advantage of using glueboards is that as the rodent loses body heat any ectoparasites will leave and become trapped on the glueboard, so monitor them very carefully.

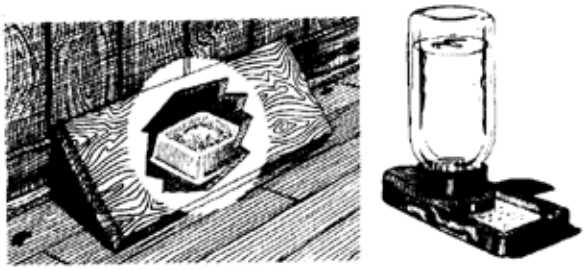
- Place glue boards in the same location as you would place snap traps. Place them lengthwise flush along the wall, box or other object that edges a runway. Overhead runways along pipes, beams, rafters and ledges are good sites too.
- Do not place glue boards directly over food products or food preparation areas.
- Secure the glue boards with a nail or wire so a rat can't drag it away.
- Install glue boards in bait stations if people might be upset to observe a struggling rat, where children or pets could come in contact with the glue, or in areas with excessive dust or moisture. Bend a glue board to fit inside the contours of a 12" long PVC pipe.
- Check glue boards frequently and dispose of rodents humanly.
- Adding a dab of bait or a drop of vanilla extract to the center of the glue board (even if prebaited) may improve its effectiveness.
- Any live rodents caught should be scooped up (trap and all) and dropped in water to drown.

Repellents - A combination of naphthalene and sulfur can often repel rodents, but is not used by the Author. The Author uses peppermint.

Rodenticide Poisons

A rodenticide is a poison used to kill rodents. There are three major formulations of rodenticide poisons used to control rats: food baits, water baits, and tracking powders. **Poisons are easier to use than traps but leave dead bodies to decompose and stink in the building.** As a **last** resort, caring certified applicators can apply these toxins or rodentisafes, e.g., chocolate Ex-Lax®, , aspartame (NutraSweet®, Equal®, Spoonful®).





BAIT AND WATER POISONING

Natural Enemies

Rats may be preyed upon by many other animals including dogs, cats, weasels, snakes, and owls. Rats are susceptible to a variety of diseases and parasites. Some natural enemies ranging from ferrets to bacterial toxins have been used in the past with varying degrees of success in rat control programs.
In abnormally crowded conditions or when exposed to pesticides or other stress situations, rats may display aggressive behavior toward each other, including cannibalism and abandonment of young.

Food Baits - Rat baits and trays "marked" with rat feces and urine containing pheromone result in increased feeding activity than unmarked areas and/or foods!

Rat baits combine a poison effective against rats with a food bait attractive to rats. At one time, applicators mixed their own baits. Now baits are mostly purchased ready-made and packaged as extruded pellets, in a dry meal, or molded into paraffin blocks for wet sites. Baits may be obtained in 45-pound bulk tubs, in placement packs containing less than one ounce of bait, or anything in between. **Remember they prefer fresh baits and do not mind the smell of human hands, but they will usually avoid chemical (poison) odors.**

Some baits kill rats after a single feeding, some require multiple feedings. Some are anticoagulants causing rats to slowly bleed to death, some affect respiration, and others have totally different modes of action. Some are only slightly toxic to people or pets, some moderately toxic, and some very toxic.

Many of the old, ancient poisons that were used to kill to humans were also used to poison rodents. Experimentation with poisons for killing rodents, produced rodenticides made of arsenic, cyanide, strychnine, etc.: stomach poisons, that were mixed with food and had such extreme toxicity that they killed any other animal that ingested them in sufficient amounts. Rats that did not eat a lethal dose, however, recovered, became "bait shy" and communicated their preference - or revulsion - to others in the colony. Because of this, these poisons are and were very undependable.

A new type of rodenticide poison was developed in the 1940s that reduced the clotting ability of the blood. This material became Warfarin, the first anticoagulant rodenticide. Others followed warfarin: oumafuryl, chlorophacinone, diphacinone, pindone, valone. The anticoagulants were effective and did not cause bait shyness. Several factors overcame the risks of acutely toxic poisons. While the anticoagulants could be lethal to warm-blooded animals, many species including poultry, farm animals, pets, and humans would have to consume large quantities over several days to cause fatalities. In addition, an antidote, vitamin K, was developed to stop the internal bleeding.

Evidence of resistance to anticoagulant poisons and a desire for quicker results drove the successful search for single dose anticoagulants - brodifacoum and bromadiolone. In recent years non-anticoagulant rodenticide poisons with different modes of action, such as bromethalin or cholecalciferol, have been proven effective. Zinc phosphide, used as a single dose non-anticoagulant poison, is somewhat poisonous to all vertebrates. It is often used as a tracking powder poison and licked from the fur when rodents groom themselves. It is also incorporated in dry baits. Zinc phosphide should never be mixed with bare hands nor applied without wearing gloves.

Laxatives - Phenolphthalein placed in their favorite food or chocolate Ex-Lax® will kill rats as will beer and/or Pepsi® that has not lost its *fizz*. Equal®, (aspartame) will quickly kill mice; try it on rats.

Remember, rodenticide poisons must be used very carefully: they are made to kill animal species of the same class as humans. Place poison baits only in inaccessible areas to children and pets. In other words - any poison should only be placed in areas not capable of being reached!

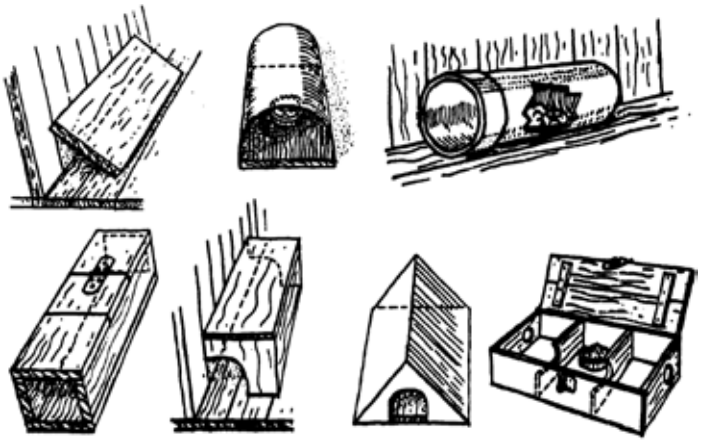
Several general guidelines should be followed when using a poison bait. First and foremost, protect children, pets, wildlife and domestic animals from eating the bait. All rodenticides have warnings on the label telling you to place the bait "in locations not accessible to children, pets, wildlife, and domestic animals, or place in tamper-proof bait boxes." What are safe, inaccessible areas is determined by evaluating each case. Ask questions like these:

- Is it possible for a child to reach under a refrigerator to grab the poison that you hid underneath?
- Could a guard dog at a warehouse find and eat the poison you placed under a loading dock?

If so, change your placement or put the bait inside a real tamperproof bait box and clearly note: **Poison - Do Not Touch**! Hopefully, there will still be some "safe" areas to which only the rodent has access.

Delmar food inhibitor - (561-969-0741) 2164D White Pine Circle in West Palm Beach, Florida, 33415 combines 0.0001%, (0.032 oz.) of corn oil with 90% (28.8 oz.) of cellulose (you could use sawdust or ground up newspaper, but remember cellulose insulation has a lot of borax which is toxic to people/pets if ingested) with 9.999% (3.2oz.) molasses to make 32 oz. of food energy inhibitor product. After feeding on the cellulose the rodents (who need high amounts of food and eat constantly to maintain their metabolism) believe and feel they are *full* and return to their nesting areas to rest and digest the *feast*. Energy levels quickly deteriorate, rats become weak and die within a short period of time!

Carbon dioxide or carbon monoxide can be used to fumigate burrows and safely kill all the occupants. Both are heavier than air and silently and quickly cause death without warning or odor. Be careful if you are using carbon monoxide, especially in large amounts.



Bait boxes. A tamper-proof bait box must be secured and designed so that a child or pet cannot get to the bait inside, but the rat can. Bait trays and flimsy plastic or cardboard stations are not tamper-proof bait boxes. Tamper-proof boxes differ in the type and quality of construction, but they are usually metal or heavy plastic. Rat bait stations are normally larger than those used for mice. Most designs are not considered to be truly tamper-proof unless they can be secured to the floor, wall or ground.

- Ensure that poison bait boxes are clearly labeled with a precautionary statement and securely tied, staked, glued or nailed down.
- Check stations or boxes periodically to ensure rats are taking the bait and that the poison bait is fresh. (Rats will rarely feed on bait that has spoiled.)
- Poison bait boxes should be placed wherever the rats are most active as determined by droppings and other signs (near burrows, along walls, and at other travel sites, etc.).
- Put placement packs in burrows, in wall voids, and similar protected sites. If a site is damp, use paraffin bait blocks or other water-resistant formulations. Roof rats often need to be baited in areas above ground such as attics, trees and roofs. When putting poison bait packages in ground burrows - push in with a crumpled 1/2 page of newspaper. Then cover the hole with dirt. If the burrow is active the paper will be on the ground in the A.M., but normally not the poison.
- Put out enough bait and check it often. (Incomplete baiting can lead to bait shyness and make control difficult.) Rats will also eat original formula Ex-Lax® chocolate and literally will defecate themselves to death. They also will eat sodium borate and drink themselves to death.
- Be sure to limit the rats' normal food supply or your baits may be rejected.
- Remember that rats fear new objects at first so your baits may not be taken for a few days or a week.
- Once bait is taken, leave the box in place for some time; the rats now consider it to be part of their normal surroundings.
- Good bait placements can be effective even when placed 15 - 20 feet apart. Bait placed outdoors around a commercial building can kill rats that are moving in from nearby areas.
- Delmar food inhibitor baits are a good alternative that pose no secondary poison hazards.

Bait station caution: If bait can be shaken from stations when they are lifted, all accessible units must be nailed, glued, secured or otherwise immobilized.

Water baits. Rats drink water daily if they can. When rat water supplies are short, water baits - specially formulated rodenticide poisons that are mixed with water - can be extremely effective. Several types of liquid dispensers are available. The best are custom designed for toxic water baits, but plastic chick-founts can also be used in protected sites.

- Use poison water baits only where no other animals or children can get to them.
- Beer or Pepsi that has not lost its *fizz* can be used to kill rats because they are unable to burp, fart and/or vomit, but should also be kept away from children and/or pets.
- Antifreeze will kill rats but it is not labeled for this and will kill anything or anyone else who drinks it.

Tracking powder poisons. Rats groom themselves by licking their fur. Tracking powder poison makes use of this behavior. This formulation is a rodenticide poison carried on a talc or powdery clay, applied into areas where rats live and travel. The powder sticks to the rats' feet and fur, and is swallowed when the rats groom themselves. The major advantage to tracking powders is that it can kill rats even when food and water is plentiful, or if rats have become bait or trap shy, **but they are very toxic and we do not advocate their use!**

- Apply tracking powder poisons more heavily than an insecticide poison dust (but never deeper than 1/8".) Best application sites are inside wall voids, around rub marks, along pipe and conduit runs, and in dry burrows (when permitted by label). Apply with a hand bulb, bellows duster, or with a (properly labeled) flour sifter or salt and pepper shaker. There are electric or pressurized dusters, but we do not suggest their use. **We also do not advise any use of tracking powder poison in schools or homes.**
- Never use dangerous tracking powder poisons in suspended ceilings, around air ventilators, around people, or near food or food preparation areas. The poison can easily become airborne and drift into and contaminate non-target areas. **The rodenticide in tracking powders is generally 5 to 40 times more concentrated poison than that in baits.** Tracking powder poisons can be made with acute poisons or slower-acting poisons.

Baking powder/peanut butter: A mixture of 1 tsp. baking soda and 1 tsp. peanut butter will kill rats and mice.

Lit charcoal. When safely possible, lit charcoal briquettes can be dropped in rat burrows to kill the occupants with (the heaver-than-air) carbon monoxide. The Author prefers to use carbon dioxide.

INTELLIGENT PEST MANAGEMENT® SUMMARY

Rats have learned to avoid nearly all human trapping and poisons. Ferrets and owls and other natural predators still eliminate a percentage of rats - but, you will have to use imagination to get the rest. Rat trap - try filling a 55-gallon drum 3/4 full with water - skillfully cover the water's surface with floating oats or bird seed (whole) - put a ramp or plank up to the drum's edge - rats will jump into the "oats" and quickly drown. Locate nests and use lit charcoal; try also using Exlax® original chocolate laxative, or the active ingredient, in a bait placed in their burrows. Along the way, rats have caused more human suffering and economic damage than any other vertebrate pest, but they are marvelous athletes and successful survivors as well. Successful long-term rat control is not simple. **The key is to control the cause, not individual rats.**

The two most common pest rats are the Norway rat and the roof rat. To be controlled they must be understood. Three of the most important biological factors to help control rats are (1) Their fear of new objects, and (2) their large foraging range of 100 - 150 feet or more from their nest. (3) Both are carnivores and will eat practically anything, both rats require water daily and prefer to nest where water is available - remember this when you prepare baits or traps.

Successful rat control programs usually use a combination of tools and procedures to knock down a rat population and keep it down. Long-term, the most successful form of rat control is to build them out, also called rat-proofing, and to practice proper sanitation, especially concerning the storage of food and garbage. Other control tactics include habitat reduction, trapping and the use of beer. **Whatever you do, care must be taken to avoid all risks to people, children, pets and non-target animals.**

NORWAY RAT
***Rattus norvegicus* (Berkenhout)**
(Also known as the wanderatte, migratory rat, brown rat, gray rat, house rat, wharf rat, barn rat, water rat and sewer rat)

Probably originated in eastern Asia, or possibly northern China - not in Norway (where it was classified). It arrived in California in 1851. It is the most important urban rat for most parts of the world. It has long been thought that Carl Von Linne, better known as Carolas Linneaus, was a Swede who, obviously, disliked Norwegians as he made Norway famous when he called this terrible pest the Norway Rat, but it probably was the son of a Dutch Merchant named John Berkenhout, who was an English physician and naturalist, who named the brown rat the Norway Rat.

DESCRIPTION

Adult - Body rarely longer than 16" long, not counting the tail, with a weight seldom more than 1-1/2 pounds, coarse, dark grayish brown to reddish-brown fur with scattered black hairs; the underside is usually dirty gray or yellowish-white. Thick heavy-set body with a blunt muzzle. The tail is shorter than the head and body combined. The ears are small with short hairs and close set and appear half-buried in the fur. Usual weight is about 3/4 - 1-1/2 pounds. Average length between 7" - 10" (up to 16") plus tail or an overall average length of about 13" - 18". Females are in heat every 4 - 5 days. The Norway rat is more aggressive than the roof rat, they can become predators and often associate in packs of 60 or more. These packs are all closely related and usually descend from a single pair. If a nursing mother is killed another nursing mother of the pack will raise the orphans to insure survival of the species. Albino forms of the Norway rat are used for scientific research. The Norway rat is considered the most important pest rat ("kleptoparasitic") in the U. S.

Young - Born pink, naked and blind, they quickly begin to resemble the adult, but smaller in size. Each has a large head and feet. Their eyes open in 9 - 14 days and they are weaned 10 - 15 days later. They average 8 to 12 per litter with 4 - 7 litters a year. Sexual maturity is attained in 2 - 5 months. Females may be re-impregnated

within one hour after the birth of their litter. Breeding peaks are normally in the spring and fall of the year; the gestation period is only 22 days.

Norway rats are a more advanced species than the roof rat and when competing for the same habitat and food supply they will quickly take over completely. They have rather poor vision and are color blind, but their senses of hearing, smell, touch and taste are keenly developed. Touch is via their vibrissae or long whiskers. They are good runners, climbers, jumpers and swimmers. They can leap 2 feet straight up or 4 feet sideways or 8 feet from a height and drop down 5 stories. They are marathon swimmers - able to use sewers as highways and can tread water for days, unless they are in water covered with garbage or with grain!

A Norway rat eats 3/4 - 1 ounce of food and drinks 1/2 - 1 ounce of free water each day and creates about 30 - 180 capsule-shaped droppings and 1/2 ounce/3 teaspoons of urine each day.

Rats are nocturnal and very cautious; like mice, they are social creatures and live in colonies. Although they constantly explore their surroundings, they shy away from new objects and changes. This is called *neophobia* or "fear of the new." **Outdoors**, Norway rats prefer to nest in burrows in the ground, especially along railroad embankments, stream/river banks, dumps, piles of rubbish, under concrete slabs, etc. Their burrow will have at least 1 entrance hole and at least 1 emergency exit which is often hidden under grass, debris, etc. A new burrow is usually short - only 15" - 20" long - as the colony grows the burrows become very large and expanded. These are social animals and often many underground burrows will be located within a given area. Burrows can be "fumigated" with carbon dioxide or carbon monoxide. Only an opening 1/2" or larger is required for entry into buildings, e.g., warehouses, homes, zoos, hotels, schools, stores, hospitals and restaurants. **Indoors**, Norway rats usually nest in basements and the lower portions of buildings in piles of debris or merchandise as long as they are not disturbed. Although Norway rats prefer the ground or lower levels of buildings and sewers, on occasion they may be found in attics, roofs and in other high places. On farms they will invade and nest in granaries, barns, silos, livestock buildings and corn cribs. **They have even been found nesting inside furniture inside the same rooms as the occupants!**

Norway Rats will eat practically anything, including garbage and dead and dying members of their own species, but they prefer meat, fish and cereal. Norway rats in the wild will eat grains and will hunt, catch and consume fish, crayfish, frogs, birds, snakes, insects and many other small animals. In sewers Norway rats catch American cockroaches and pull off their wings and legs and then consume the body of the cockroach. If the food material eaten proves to be disagreeable, they are quick to develop food/bait shyness. Once they find an acceptable moisture and/or food source, rats tend to eat and drink their fill at these locations and will come back time after time. Norway rats will travel about 100' - 150' from their harborage for food and/or water. They will gnaw through almost anything including bone, cinder block and plastic or lead pipes, especially to gain access to food and/or water. They have been blamed for power failures, their bite marks can be found along the insulation of electrical cable, and the Author once found one inside a wall electrocuted with its teeth still embedded in the wire.

Once established, Norway rats tend to follow the same route or pathway between their harborage and food and/or water sources. As often as possible, they follow vertical surfaces which their vibrissae or long whiskers can contact. Runways along vertical surfaces will usually include dark rub marks on the vertical surfaces where their oily fur makes contact. Their runway will be free of debris and, outdoors, the grass will be worn away to the bare soil. Their loosely matted nests are made up of chewed bits of paper, cloth, leaves, grass or any soft materials.

LENGTH OF LIFE CYCLE - In captivity they live 3 or more years, but average about 5 - 12 months in the wild.

HABITAT

Outdoors - Lives near water, e.g., river banks, sewers, drains and generally live in the ground in burrows, under concrete slabs in lumber piles, garbage dumps and rubbish heaps. The burrows are usually only 6" - 8" below the surface with escape entrances or bolt holes. They will enter buildings at night to forage for food.

Inside - They will nest in rooms where food is stored, prepared or handled, in wall voids, behind appliances, under floors and slabs, in crawls, closets and drawers, basements, and outbuildings. They prefer to travel

over flat surfaces, but will travel on pipes, wires, rough walls, climb stairways and over roofs if necessary to find harborage, food and/or water. They can slide down ropes and poles with the aid of their tails, they love to swim and cats are afraid of a full grown Norway rat. **They will normally be found on the first floor or in the basement of buildings.**

Note: The best way to control their numbers is with conscientious garbage storage and pick-up.

NATURE OF INJURY - Incredible destruction and pollution of food products, e.g., grains, fruit, poultry, vegetables, etc., holes gnawed in packages, concrete blocks, floors, walls and other structural objects; transmission of disease organisms and ectoparasites and biting. Norway rats generally feed on any type of food, but prefer greasy meat and animal products as well as fruits, grains and vegetables. When starved, they will eat virtually anything, e.g., soiled or stained clothing, snails, cockroaches and other insects and animal feces. Water can often be obtained in buildings from leaking pipes or faucets, condensation, pet dishes and sinks and toilet bowls. Norway rats have also gnawed holes in plastic and metal (including lead) pipes to obtain water.

HARBORAGE POINTS - Ground level of structures, holes in the ground, under building foundations, in rubbish dumps, storage areas and closed places such as closets, boxes and drawers. They may travel many miles in search of housing, water and/or food. Some rats may live outside and may enter your building only at night to search for food or water, and then leave at dawn, others may spend their entire lives outside or inside. Some may forage in the fields during the summer and return to your building only when cold weather arrives - **so rat proof your building**.

DISCUSSION - The Norway probably originated in Central Asia and spread to Europe in the 1700's and to the United States by trading ships at the time of our colonization. Infestation is still spread from one area to another either in products being shipped or by walking. They will simply walk away from your building when you deny them food and shelter. They routinely carry food and nesting materials back to their nest(s) so you may find your rodenticide or rat poison in kitchen drawers, walls or wherever they choose to "store" it. The Norway rat is stronger, bigger, more aggressive and better adapted for producing offspring and surviving colder temperatures than any other rat species.

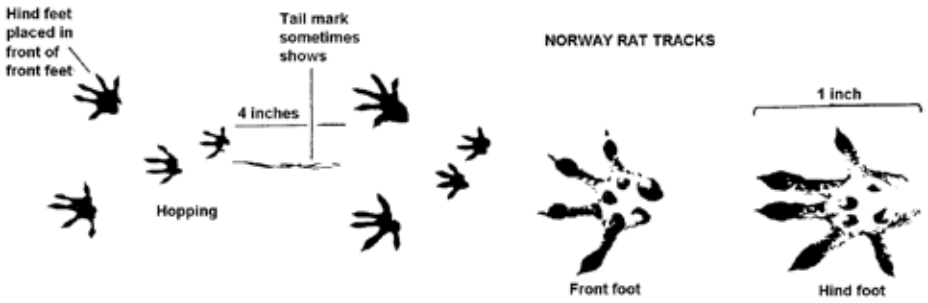
The Norway rat is usually closely associated with man and his buildings. It may forage in fields in the summertime, but will return to buildings as cold weather occurs. Only where abundant food and water is continually available, will this rat be found living completely apart from man. Their front teeth never stop growing, and without the rats' constant gnawing that grinds their teeth down, their incisors would eventually lock their jaws shut and kill them.

SIGNS OF INFESTATION

1. **Contaminated foods and damaged goods**. Norway rats prefer meat, fish and cereal (dry dog food or kibble is a favorite), whereas roof rats prefer fruits, vegetables and cereals.
2. **Gnaw marks**. New gnawing or holes tend to be rough, whereas old gnawing are smooth from wear and are often greasy.
3. **Droppings**. Fresh droppings are soft and moist, whereas old droppings are dried and hard; adult droppings are about 3/4" with blunt ends compared to adult roof rat droppings which are about 1/2" with pointed ends.
4. **Burrows**. Found in earthen banks, under concrete slabs and under walls. If active, they will be free of dust and cobwebs. Main opening usually with hard packed soil; rub marks may also be visible. The Author knows of a farmer who covered all of the tunnels he had around his barn but 2 - then he flooded the tunnels with anhydrous ammonia - until the rats ran out and then he and his helper clubbed them to death - for several days after this *treatment* rats could be seen all over the farm still *squealing* in agony. This *treatment* was very effective, but very cruel, somewhat dangerous and probably illegal. Dropping down dry ice or injecting carbon dioxide from a cylinder or lit charcoal briquettes into the burrows or frying a cellulose sponge in butter and leaving 1/2" cubes in the tunnels or using chocolate Exlax® are also probably illegal and could be very dangerous to non-target species and should be not tried.
5. **Runways**. Norway rats usually will follow the same paths, usually along walls, stacked merchandise, etc. Active runways have a "fresh" greasy appearance, free of dust and cobwebs., with fresh "rub" marks, tracks and/or droppings.

6. **Typical rub marks** are dark, greasy markings on vertical surfaces. Fresh marks are soft, greasy and easily smeared, whereas old marks have dry, flaky grease.
7. **Tracks**. Front foot has 4 toes and is in front of the usually longer hind foot track with 5 toes. Fresh tracks are clear and sharp, whereas old tracks are at least partially obscured by dust.

CONTROL - The key is proper pest identification, sanitation, harborage elimination and rat-proofing the



building:

1. **Rats usually have a separate water supply, especially if their food if their food has a low moisture content**. Liquid baits are particularly effective when the normal water source can be reduced or eliminated. Try to feed them beer as late as possible in the day. Carefully pour a cold quart of beer in a cold greased pan or several cups or bowls (so the beer does not foam or lose its *fizz*); continue baiting until the beer is left. They cannot vomit or burp or fart and the gas usually blows their stomachs apart. Do not let children or pets drink the beer.
2. **Norway rats prefer meat, fish and cereals**. Use high-protein baits to bait the center of glue boards and snap traps, e.g., hot dogs, bacon, red carnations, pecans, sardines, cake, cheese, pork kidney, etc. They will eat laxatives, e.g., Phenolphthalein, chocolate Exlax®, and defecate themselves to death.
3. **Rats are elusive, cautious and naturally trap-shy**. Minimal disturbance is desirable. Pretrapping with unset snap traps and/or prebait. When baiting for hard to catch Norway rats try using a de-legged American cockroach to reduce their normal neophobic response to your trap.
4. **Norway rats defecate somewhat indiscriminately within their territories but mostly where they feed**. Rat droppings serve as an indication of their presence and where your control efforts should be concentrated. Non-toxic tracking powders can also be used to determine where they are most numerous. Tracking powders must be applied in paper-thin patches and we do not recommend their use.
5. **Rats are gluttons, although they can survive on as little as 1 ounce of food per day**. Place sufficient bait in each bait station. Once a preferred bait is found, they will utilize this bait until feeding stops and death occurs. Try peanut butter spread on Alka-Seltzer®.
6. **Rats will travel 100' - 150' for food and/or water along established runways** and usually with their vibrissae in contact with vertical surfaces. Look for rub marks and clean runways. Place traps or bait stations along runways and against vertical surfaces.
7. Try Delmar food inhibition baits which safely kill rats and create no secondary poison hazard; neither would Ex-Lax®, beer, Alka Seltzer®, carbon dioxide or lit charcoal create a secondary poison hazard.

ROOF RAT
***RATTUS rattus* (Linnaeus)**
(Also known as the Black Rat, Ship Rat, Gray- or White-Bellied Rat, House Rat or Alexandrine Rat)
Probably originated in southern or southeastern Asia and reached the America's in the 1500's.

DESCRIPTION

Adult - **Smaller than Norway rats**, about 6" - 8" long with soft smooth fur with several color varieties; black to brown-backed to mottled grayish-white, tawny above and grayish-white or cream colored or lemon below. The muzzle is slender and pointed. **The tail is longer than the slender head and body combined, all dark and scaly and is jerked like a whip**. The eyes and naked ears are large and more pronounced. Average weight is 6 - 12 ounces.

Young - Born pink, blind and naked; they are smaller than the adult. Have large head and feet. The tail is much longer than the body. They average 6 to 8 young per litter and 4 - 6 litters a year. Sexual maturity is attained in 2 - 5 months.

They have rather poor vision and are color blind, but their senses of hearing, smell, touch and taste are keenly developed. Touch is via their vibrissae or long whiskers. They are good runners, excellent climbers and jumpers and, if forced, rather good swimmers.

A roof rat eats ½ - 1 ounce of food and requires 1 ounce of water each day, with the water often coming from its food. They create about 30 - 180 spindle-shaped droppings and ½ ounce/3 teaspoons of urine per day.

HABITS - Roof rats are nocturnal and they are very cautious. They are the *vegetarians* of the commensal rats and prefer to eat seeds, fruit, nuts, berries and vegetables. Although they constantly explore their surroundings, they also shy away from new objects and changes. Roof rats prefer to nest in the upper parts of structures, but may be found under buildings as well as occasionally in basements and sewers. Outdoors, they prefer to nest in higher places such as in trees but may occasionally be found in burrows in or under vegetation around the structure. These are social animals but less so than Norway rats, but several nests may be located with a given area. Only an opening of ½" or greater is required for entry into buildings.

Roof rats will eat practically anything including pet food, bread. slugs, spiders, worms, insects and snails, but they prefer fresh citrus and other fruits, nuts, vegetables and cereals. If the eaten food material proves disagreeable, they are also quick to develop food/bait shyness. Once they find an acceptable food source, rats tend to eat their fill at this location and will come back time after time. They will eat sodium borate or borax until they die.

Once established indoors, roof tats tend to follow the same routes or pathways between their harborage and food and/or water sources. Runways along vertical surfaces will usually include dark rub or swing marks on the vertical surface where their fur makes contact. Their runways will be free of debris and, outdoors, the grass will be worn away to the bare soil.

LENGTH OF LIFE CYCLE - An average of 1 year.

HABITAT - Ships, common in sea ports and/or in any room or area of a building, crawl space, attic, particularly where food is stored, prepared or handled. They are excellent climbers, often living in vines, trees, e.g., palms, but they can also be found living under rubbish or in underground burrows. They enter buildings much like squirrels via branches or various utility lines, etc. **They are often found living on the second floor or in attics of buildings.**

NATURE OF INJURY - Destruction and pollution of food, holes gnawed in packages, doors and other structural objects, transmission of disease and ectoparasites and biting. They prefer to eat vegetable matter, e.g., seeds, vegetables, fruits, nuts and grains, but they are omnivorous and will eat virtually anything when hungry.

HARBORAGE POINTS - Normally found inside ships and/or above ground level, in attics, between walls, in enclosed spaces of cabinets and shelves, and in trees, dense vine growth and other foliage, on the sides of buildings and fences. Occasionally they are found in sewers. In buildings, they nest in wall voids, attics, rafters and other secluded and elevated locations. They will leave when you install strobe lights where they nest. They are good climbers and can swim and squeeze through openings as small as ½" in diameter; therefore, they are very difficult to exclude from buildings. As populations increase in number they will nest in underground burrows, ground floor areas and under piles or rubbish and other debris.

BOTANICAL RODENTICIDE - The 1947 edition of *Bailey's Standard Encyclopedia of Horticulture*, Gliricidia ("killers of gnawers"), a member of the legume family grows in Cuba, Mexico and South America. A rodent poison is made from the seeds of this tree that resembles the ornamental honeylocust in the genus Robinia. *Gliricida platycarpa* and *Gliricida maculata* are described as being grown in southern Florida. The leaves, seeds and bark are all poisonous if eaten.

DISCUSSION - The roof rat is capable of surviving in uninhabited areas. They live well on fruits and other foods found in forests and other outdoor areas. They are more likely to be found in rural areas but do also occur in large numbers in cities, especially in sea port cities. They are not very good runners and can be easily caught by men or dogs, but they can climb, run on telephone wires or straight up rough walls. They are excellent climbers and will often walk along telephone wires to enter a building. They may also use overhanging tree limbs. Since roof rats often enter from above ground, they are not controlled by bait and traps placed at ground level. It is, therefore, often necessary to trap roof rats in attics. Be sure to remove them as soon as possible. They carry food and other articles back to their nests, including poison baits.

SIGNS OF INFESTATION

1. **Contaminated foods and damaged goods**. Roof rats prefer fresh fruits, vegetables and cereals, whereas Norway rats prefer fresh meat, fish and cereal (dry dog food or kibble is a favorite).
2. **Gnaw marks**. New gnawing or holes tend to be rough, whereas old gnawing are smooth from wear.
3. **Droppings**. Fresh droppings are soft and moist, whereas old droppings are dried and hard; adult droppings are about 1/2" with pointed ends compared to adult Norway rat droppings which are about 3/4" with blunt ends.
4. **Burrows**. Not common, but if present they are shallow. They usually nest in or under vegetation. Fumigate with carbon dioxide.
5. **Runways**. Roof rat travel paths may not be visible outside because they may travel along fences or on overhead power to telephone lines. Indoors they usually move along walls, stacked merchandise, etc. Active runways have a *fresh, greasy* appearance, free of dust and cobwebs, with fresh tracks and/or droppings.
6. **Typical rub marks** are dark, greasy markings on vertical surfaces. Fresh marks are soft, greasy and easily smeared, whereas old marks have dry, flaky grease. Note: Swing marks are often seen around rafters. Rub marks can be removed with diluted enzyme cleaner or peppermint soap.
7. **Tracks**. Front foot has 4 toes and is in front of the usually longer hind foot track with 5 toes. Fresh tracks are clear and sharp.

INTELLIGENT PEST MANAGEMENT® CONTROL - The key is proper pest identification, sanitation, harborage elimination and rat-proofing the building:

1. **Rats usually have a separate water supply, especially if their food if their food has a low moisture content**. Liquid poison baits are particularly effective when the normal water source can be reduced or eliminated. Try to feed them beer as late as possible in the day. Carefully pour a cold quart of beer in a cold greased pan or in cups or bowls (so the beer does not foam or lose its *fizz*); continue baiting until the beer is left untouched. They cannot vomit or burp and the gas usually blows their stomachs apart. Do not let children or pets drink the beer.
2. **Roof rats prefer seeds, fruit and vegetables;** so use these materials to bait the center of glue boards and snap traps, e.g., fruits, avocados, candy, sardines, raisins, pecans, nuts and/or chicken.
3. **Roof rats are elusive, cautious and naturally trap-shy**. Minimal disturbance is desirable. Pretrap with unset snap traps and/or prebait. Try a natural roof rat food, like snails to reduce their normal neophobic response to your trap.
4. **Roof rats defecate where they spend most of their time**. Use rat droppings as an indication of where to concentrate efforts. Non-toxic tracking powder can also be used to determine where they are most numerous. Apply non-toxic tracking powder in paper-thin patches.
5. **Roof rats are gluttons, although they can survive on as little as 1 ounce of food per day**. Place sufficient bait in each bait station. Once a preferred bait is found, they will utilize this bait until feeding stops and death occurs.
6. **Rats will travel 100' - 150' for food and/or water along established runways**. Look for rub/swing marks and clean runways. Place traps or bait stations along runways and against vertical surfaces. Snap traps and/or glue boards wired to traveled pipes, rafters, etc. are effective.
7. **If you trap** try our 55-gallon barrel *trick* with 3/4 water in it covered with a pail or two of floating, edible garbage, oats or bird seed or coco puffs with a plank leading the top.
8. **If you bait** try the Delmar food inhibitor or 90% pelletized cellulose (sawdust) 9.999% molasses and .001% corn oil bait and/or make your own. Replenish product as needed and then maintain feeding (you can use bait stations or place directly in their burrows and/or use 2 oz. per 20 feet of runway/walls) for

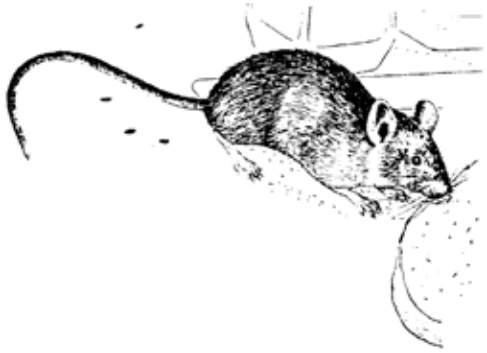
several weeks or until all signs of rodent activity ceases. They also will die if they eat pieces of sponge (that expand in water) if they are covered with peanut butter or fried in butter, or chocolate Exlax®, but these are not registered rodenticides.

9. Fumigatge the burrows with carbon dioxide and/or properly install strobe lights.
10. Free-range Guinea fowl will hunt down and kill rodents outside.

Note: Occasionally a wood rat *(Neotome spp.)* will invade a building when the weather gets cold.

HOUSE MOUSE
CLASS - MAMMALIA
ORDER - RODENTIA
FAMILY - MURIDAE

HOUSE MICE OVERVIEW



The house mouse was originally named *Mus musculus* (Linnaeus), it easily adapts to life with people. It thrives in a wide range of climatic conditions in a great variety of habitats, feeding on most human food, and reproducing at a remarkable rate. Later, taxonomists considered that two subspecies had been introduced from Europe into the New World; *Mus musculus domesticus* and *Mus musculus brevirostris* (Schwartz and Schwartz). There have been so many (hundreds) of varieties of interbreeding that opinions have been revised again and we now call U. S. mice, *Mus domesticus* (Rutty); and Eastern European mice, *Mus musculus* (L). The word “mouse” comes from the ancient Sanskrit word meaning “thief”.

House mice exist throughout the United States. They are found in most areas of human habitation. House mice are also found living in the wild, competing with native fauna. They are common inhabitants of grassy fields and cultivated grain crops, as well. House mice have been captured in open tundra in Alaska, miles away from human settlements.

You will soon find that the house mouse is the most troublesome and economically important rodent. House mice are a common problem in schools, homes and in all types of businesses. Nearly everyone can remember times when they were irritated by mice. They are a nuisance to rich and poor alike. The continual drain that house mice impose on stored food and fiber, and the damage they cause to personal possessions, are the most serious economic threats. House mice also have the potential to transmit diseases and parasites to people and domestic animals. Control of house mice requires understanding mouse biology and habits, and particularly the major differences between mice and rats. During the past few decades, control of Norway and roof rats has improved while problems with house mice have increased. Baiting programs often are more successful in controlling rats than they are in controlling mice, so rather than using poison baits on mice, use traps and glue boards.

Of Mice and Menace - Musophobia, the fear of mice, is the third most common fear of Americans, right behind fear of public speaking and fear of going to the dentist. A man weighing 150 pounds would have to run 20,000 to 30,000 miles a day to equal the relative distance a 20-gram mouse normally moves in the same period of time. Mice eat 20 - 40 times a day, consuming 3 - 4 grams of food daily. Mice are the rabbits of the rodent world. A single pair could product 15,000 descendants in a year. Don’t bother standing on a chair to escape a mouse. They are good climbers, can leap 12” vertically and can jump down from a height of 12’ without injury. Mice can squeeze through a space as small as a dime. **Eliminate food sources** like pet food and open trash cans. Store pet food in plastic or metal containers with lids. **Block points of entry** with sheet metal, steel wool or cement, paying special attention to spaces around pipes, vents and ducts. **Eliminate nesting points** such as wood piles, stacks of newspapers, cardboard boxes. Store firewood, lumber and building supplies away from buildings and at least a foot off the ground. You can buy all the rodenticide poisons you want, but if you don’t take care of these three things you are wasting your time and money. **Often mice are called the “Mammalian weed”.**

LOSSES DUE TO MICE - The word mouse can be traced to the Sanskrit word “musha”, which is derived from a word meaning “to steal”. When mice infest stored food, the greatest loss is not what mice eat, but what is thrown out because of real or suspected contamination. In six months, one pair of mice can eat about four pounds of food and deposit about 18,000 droppings. The amount of food contaminated by the mice is estimated to be about ten times greater than what is eaten. So common are mice infestations, that the government permits a certain number rodent hairs, and sometimes droppings, to remain in food commodities destined for human consumption. Yet food inspectors often have to condemn food products and fine manufacturers because of house mouse contamination in excess of that permitted. Losses are not only connected with food. Family bibles or heirlooms stored in a trunk in the attic or garage that are damaged by mice are irreplaceable, as are original paintings and manuscripts stored in museums. Mouse-riddled documents in the bottom file drawer of an office cannot generally be valued in dollars and cents, but these losses can also be costly.

Electrical wiring gnawed by rodents start many fires. Many listed as “cause unknown” are probably rodent-related. House mice frequently take up residence in electrical appliances and end up chewing into the power supply. This is particularly costly when computer systems are disrupted.

MICE AS DISEASE CARRIERS - Excluding the spread of food poisoning, house mice are not as important as rats as carriers of disease and parasites. Yet their potential cannot be neglected. House mice and their parasites are implicated in the transmission of a number of diseases. **Clean routinely with Safe Solutions, Inc. Enzyme Cleaners.**

Asthma and Allergies - More and more is being written about mouse allergens (especially from mouse hair) as a cause or trigger of asthma. In addition, the pathogens in their droppings and/or urine can persist long after the mouse infestation has been eliminated.

Salmonellosis - Bacterial food poisoning, *Salmonella spp.* bacteria, can be spread when some foods. people or surfaces are contaminated with infected rodent feces. Mice are probably more responsible than rats for the spread of this disease

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Rickettsial pox - *Rickettsia akari* is the bacterial causal agent of rickettsial pox, a disease causing a rash of the chicken pox type. Rickettsial pox is transmitted from mouse to mouse, then to man by the bite of the house-mouse mite (*Allodermanyssus sanguineus*).

Hantavirus or “Four Corners Disease” - An acute pulmonary disease, the virus is spread by mice via feces, urine, body fluids or via direct contamination to people; it is often lethal. See the rodent introduction.

Meningitis - Lymphocytic choriomeningitis is a virus infection of house mice that may be transmitted to man (mainly to children) through contaminated food or dust.

Lymphocytic choriomeningitis virus (LCMV) may be spread by mice to people causing birth defects in newborn infants and flu-like symptoms in adults.

Leptospirosis (Weil’s Disease) - The house mouse’s blood and/or urine can be a major carrier of leptospirosis (Weil’s disease), although human cases are more commonly caused by rats.

Rat-bite Fever, Ray Fungus & Ringworm - Rat-bite fever can be transmitted via a bite from house mice. So can ray fungus, *Actinornyces muris*. Certain tapeworms are spread in house-mouse droppings, and ringworm, a skin fungus disease, can be carried to man by mice or contracted indirectly from mice through cats. Tularemia has also been linked to house mice.

Dermatitis - Dermatitis caused by the bites of mites has been associated with house-mouse infestations. The uncomfortable skin irritation and itching can affect children and adults. Mites may spread through all mouse-infested house or apartment during particular times of the year, and the dermatitis is frequently blamed on other causes (heat rash, allergies, fleas, and the like). **In addition they have been vectors of bubonic plague, favus (ringworm), several tapeworms and two roundworms: *Toxocara cati* and *Toxocara canis* that parasitize cats and dogs and cause a disease in humans called larva migrans.**

Lyme Disease - *(Borrelia burgdorfei)*, a microorganism carried by ixodid ticks is the cause of this disease. House mice are considered to be vectors of this disease in Europe, Denmark and Russia.

Find out more online:

- Centers for Disease Control & Prevention: LCMV (Lymphocytic Choriomeningitis) - http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/arena.htm
- Centers for Disease Control & Prevention: Rickettsialpox - http://www2.ncid.cdc.gov/travel/yb/utils/ybGet.asp?section=dis&obj=rickettsial.htm
- Centers for Disease Control & Prevention: Salmonellosis - http://www.cdc.gov/ncidod/dbmd/diseaseinfo/salmonellosis_g.htm
- Centers for Disease Control & Prevention: Toxocariasis and larva migrans - http://www.cdc.gov/ncidod/dpd/parasites/toxocara/default.htm
- Hantavirus Information Network - http://www.hantavirus.net
- Centers for Disease Control & Prevention: Hanta viruses - http://www.cdc.gov/ncidod/diseases/hanta/hps/index.htm
- Johns Hopkins Medical Institutions: Mouse allergen study, December 2000 - http://www.hopkinsmedicine.org/press/2000/DECEMBER/001211.HTM
- Lyme Disease Network - http://www.lymenet.org
- The Leptospirosis Information Center (Weil's Disease) - http://www.leptospirosis.org

APPEARANCE - The house mouse is a delicate, agile, little rodent. Adult weights vary from region to region and may be linked to the suitability of habitat, but usually range from ½ to 1 ounce. Adult house mice vary in color from white to light brown to dark gray to black to black and white but most often are a dusky gray or medium brown over most of their bodies, except the belly, which may be a slightly lighter shade of their general color but never white. The mouse has moderately large ears for its body size. The tail is nearly hairless and about as long as the body and head combined (2½ to 4 inches). The feet are small in proportion to its body. The eyes are also relatively small.

Our native deer (white-footed) mice *(Peromyscus spp.)*, which often invade buildings adjacent to fields and woodlands, are about the same size as or slightly larger than house mice. Deer mice have a distinct, bicolored tail; the upper portion is brown or gray and the underside is distinctly white, with well-defined line where the two colors meet. Even less frequently harvest mice *(Rethrodentomus spp.)* and pocket mice *(Rerognathus spp.)* will invade buildings that adjoin woods or fields.

Meadow mice or voles *(Microtus Sp.)* also sometimes invade homes; they are less agile, have larger, chunky bodies, and weigh at least twice as much as house mice. They also have much shorter tails and small ears and eyes.

HABITS OF HOUSE MICE
Life Cycle

Under optimum conditions, house mice breed year round. Out-of doors, house mice may tend toward seasonal breeding, peaking in the spring and fall. Environmental conditions, such as the availability and quality of food, can influence frequency of pregnancies, litter sizes, and survival. Under ideal conditions, females may produce as many as ten litters (about 50 young) in a year. At very high densities, however, reproduction may nearly cease despite the presence of excess food and cover. Mice can live in freezers even at sub-zero temperatures - they simply grow thicker hair on their tails and bodies.

New-born mice are quite undeveloped, weighing between 0.02 and 0.03 ounce and are nearly hairless. Eyes and ears are closed, but by the end of two weeks, the body is covered with hair and the eyes and ears are open. At about three weeks, the young begin short trips away from the nest and begin taking solid food.

Social Behavior

While mice primarily are active at night, some day activity occurs. Movements of house mice are largely determined by temperature, food, and hiding places. Home ranges of mice tend to be smallest (only a few feet from the nest) where living conditions are good.

Mice are very curious and tend to travel over and explore and re-explore their entire territory daily, investigating each change or new object that may be placed there. They are very aggressive. Unlike rats, they show no fear of new objects. They dart from place to place, covering the same route over and over again. This behavior can be used to advantage in control programs. Disturbing the environment at the beginning of a control program by moving boxes, shelves, pallets, and other objects can improve the effectiveness of traps, glue boards, and bait. Mice will investigate the changed territory thoroughly. This is why (live catch) traps work so well. **Seeing one mouse in the daytime may only indicate curiosity.**

SENSES OF MICE

Like rats, mice have relatively poor vision, and are also color blind. They rely heavily on smell, taste, touch and hearing. Mice use their keen sense of smell to locate food items and to recognize other individuals, especially those of the opposite sex. Taste perception in mice is good also. Mice use their acute hearing to detect and escape danger. They do not like the smell of peppermint, so clean with Safe Solutions Enzyme Cleaner with Peppermint.

An important sensory factor with mice is touch. Like rats, mice use long, sensitive whiskers near the nose and the guard hairs on the body as tactile sensors to enable them to travel in the dark, pressing against walls and boxes, scurrying through burrows.

Mice also have an excellent sense of balance. A mouse's ability to quickly carry out actions or movements is governed by constant practice of sequences of muscular movements [sometimes referred to as the kinesthetic sense]: a subconscious recording of a series of movements necessary to go from point A to point B. This activity occurs from stimulation of sensory nerve endings in muscles, tendons, and joints. The result allows mice to quickly escape danger.

CURIOSITY

Mice do not fear new objects as do rats. As mentioned earlier, they quickly detect new objects in their territory and investigate them. They will immediately enter bait stations and sample a new food (although they may only nibble on a small amount). They will also investigate traps and glue boards. Control programs against mice often have success early in the control program; just the opposite of rat programs. House mice do not mind the smell of human hands.

PHYSICAL ATTRIBUTES

It is very difficult to mouse-proof building or control mice without understanding their physical capabilities:

- For their size house mice are excellent jumpers, with some of the more agile individuals jumping 12 inches high from the floor onto an elevated flat surface or long jump 2 feet!
- They can jump against a wall or flat vertical surface using it as a spring board to gain additional height.
- They can run up almost any vertical surface, from wood and brick walls to metal girders, pipes, weathered sheet metal, wire mesh and cables without much difficulty if the surface is rough.
- They can run horizontally along insulated electrical type wires, small ropes, pipes and the like, with ease at about 12 feet per second!
- They can squeeze through openings slightly more that 1/4" high.
- They can easily travel for some distance hanging upside down from 1/4" hardware mesh.
- They are capable swimmers, although they generally do not take to water as well as do rats and tend not to dive below the surface, but when flushed down a toilet they may *resurface* a minute later.
- They can walk or run along ledges too narrow for rats.
- They can easily jump down or fall from a height of 8 feet to the floor, without harming themselves.
- They can develop thick long coats and survive in their nests at a constant 24° F. temperature for ten generations, and for at least one generation at 14° F.
- They have been reported 1,800 feet below the ground in a coal mine.
- They are quick to explore any physical change in their environment.

FOOD AND WATER

House mice prefer cereals over other items, although they will feed on a wide variety of foods. Mice sometimes search for foods high in fat and protein, such as lard, butter, nuts, bacon, and meat. Sweets, including chocolate, are taken at times. Mice get much of their water from moisture in their food, but they will drink if water is readily available. Mice in buildings catch and eat flies, spiders, centipedes, cockroaches, beetles, millipedes and other insects. They will eat the roaches off sticky traps. Outdoors house mice consume a wide variety of weed seeds, grass seeds, various grains and vegetation. In addition they consume many insects and other invertebrates, e.g., slugs, spiders and centipedes. When caught in a live trap, mice trapped later may eat the first, weaker captive(s). **A very good bait for mice is a mix of bird seed or oatmeal, chocolate, peanut butter and a drop of vanilla extract to which you can add a toxin and/or aspartame. Aspartame packets will kill mice within 4 days.**

Mice are erratic nibblers, feeding 20 or more times during evening rounds. Mice have two main feeding periods, at dusk and just before dawn. In any territory, there will be one or two feeding sites, dark and protected, where mice will eat more than at other places. Mice tend to hold on to grain kernels, such as oats or wheat, nibbling on it like corn on the cob. They often drop portions of the kernels as they get smaller. In six months, one pair of mice can eat 4 pounds of food and contaminate much more. If they eat crayons their droppings will be the same color.

RANGE

Mice are territorial and seldom travel more than 10-30 feet from their nest. Their range is much smaller than the rats' range of 100 to 150 feet. When food is nearby, mice may restrict their activity to a few feet. Males average slightly larger ranges than do the females.

NESTS

House mice may nest in any dark, sheltered location. Nests are constructed of fibrous, shredded materials such as paper, cloth, burlap, insulation, or cotton and generally look like a loosely woven ball. They are approximately four inches in diameter. Mice tend to gather in groups near food, warmth, water and shelter.

Outdoors, house mice sometimes dig and nest in small burrows.

The small range of mice, the way they feed, and their food preferences are the characteristics that set house mice apart from rats. Keep these in mind when controlling mice. **Many failures in mouse control can be blamed on an applicator using rat-control techniques.**

INSPECTION

Sounds

Sounds are common at night where large numbers of mice are present.

- Listen for squeaks, scrambling and sounds of gnawing.

Droppings

A house mouse produces about 70 droppings per day. Fresh droppings are not usually as soft in texture as rat droppings and in a few days become quite hard. Mouse droppings are frequently the first evidence that mice are infesting. Large cockroaches, bats, and other species of mice such as deer mice *(Peromyscus sp.)* and meadow mice *(Microtus sp.)*, may produce droppings similar to house mice. In six months one pair can product about 18,000 fecal droppings. So if you find a dropping or two, do not think you are "infested".

- Look along runways, by food near shelters, and in other places mice may frequent.

Urine

House mice occasionally make small mounds known as "urinating pillars." These consist of a combination of grease, urine, and dirt and may become quite conspicuous.

- Look for many small drops of urine and/or *pillars*.
- Use a blacklight. Urine stains will fluoresce under ultraviolet light at night.
- Clean with diluted Safe Solutions Enzyme Cleaner with Peppermint and then reinspect at night.

Grease marks

Like rats, mice produce greasy smears where dirt and oil from their fur mark pipes and beams. House mouse spots are obviously smaller and not as easy to detect.

- Expect markings to cover a smaller area than those made by rats.

Runways

Most house mouse runways are indistinct trails free of dust but not readily detectable.

Tracks

- Look for footprints or tail marks on dusty surfaces or on mud.
- Use a non-toxic tracking dust to help to determine the presence of house mice within buildings.

Gnawing damage

Recent gnawings on wood are light in color, turning darker with age.

- Look for enlarged cracks beneath doors.
- Look for small tooth marks. [Such evidence frequently helps to distinguish between mice and rats.]
- Look for wood chips with a consistency like coarse sawdust around baseboards, doors, basement windows and frames, and kitchen cabinets.
- They also chew on electrical wires and are capable of causing electrical fires.

Visual sightings

Mice are often active in daylight and this may not indicate a high population as it does with rats. They are curious and can not see clearly beyond 6 inches and may not even be aware of your presence.

- Use a powerful (red) flashlight or spotlight or black light at night in warehouses and food plants to confirm house mouse presence.

Nest Sites

- Look in fiberglass insulation, garages, attics, basements, closets, and other storage places.
- Be alert to fine shredded paper or other fibrous materials; these are common nest-building materials.

Pet Excitement

- Follow up when cats and dogs paw excitedly at a kitchen cabinet door, the floor at the base of a refrigerator, or at the base of a wall, especially if mice have invaded the premises only recently.

Mouse Odors

- Smell for the characteristic musky urine odor produced by mice. It usually can be easily differentiated from that of rats, unless there are two or more simultaneous infestations.

Estimating Numbers of Mice

Estimates are more difficult to get than for rats. The number of mice observed or food consumed is not highly reliable as a census technique with house mice. Unlike rats (which may travel widely within a building leaving tracks on many patches of dust) house mice do not range widely and are curious.

- Read natural signs such as droppings, urine stains, tracks and damage.
- Carefully make non-toxic tracking patches of talc at 20- to 30-foot intervals throughout a building. The more tracks seen in each patch, and the more patches showing tracks, the larger the population. The percentage of patches showing tracks, will reflect the extent of the local infestation.
- Tracking patches are also an excellent means to evaluate a control operation. Compare the number of tracks or patches with mouse tracks or patches with mouse tracks before and after a control program.

INTELLIGENT PEST MANAGEMENT® CONTROL

Control and prevention of house mice is a three-part process:

- sanitation,
- mouse-proofing and
- population reduction with traps, aspartame baits or clean with Safe Solutions Enzyme Cleaner.

The first two are useful preventive measures. When a mouse population already exists, some kind of lethal control is necessary. Otherwise, the reproductive capability of the mice, and their remarkable ability to find food in almost any habitat, will keep their populations up or increase them.

House mouse control is different from rat control. Technicians that do not take these differences into account will have continual control failures.

- Sealing mice out of a building is difficult because mice are smaller.
- Range is small. Identify each infested site in order to target control procedures.
- Mice often can produce offspring faster than control methods can work.
- Stop feeding them - properly store food and garbage.

Nevertheless, many of the techniques to control and manage rats also apply to mice. In the sections below the differences in procedures between rats and mice are emphasized.

Sanitation

Proper sanitation is the most important contgrol activity you will ever do, so routinely clean with Safe Solutions Enzyme Cleaner with Peppermint. Good sanitation makes it easier to detect signs of mouse infestation. It also increases the effectiveness of baits and traps by reducing competing food. However, the best sanitation will not eliminate all house mice; they require very little space and small amounts of food to flourish.

- Keep mice hungry; properly seal and protect all food and garbage.
- Store bulk foods in mouse-proof containers or rooms. In warehouses, restaurants and food plants stack packaged foods in orderly rows on pallets so that they can be inspected easily. A family of mice can happily live in a pallet of food without ever having to leave the immediate area.
- Keep stored materials away from walls and off the floor. A 12" - 18" yellow or white painted band next to the wall in commercial storage areas permits easier detection of mouse droppings. This band and the areas around pallets should be swept often so that new droppings can be detected quickly.
- **Routinely clean with diluted Safe Solutions Enzyme Cleaner with Peppermint.**

Mouse-proofing

I**t isn't easy to completely mouse-proof a building** since mice are reported to be able to squeeze through an opening as little as 1/4" high.

- Remove ivy, blackberries, shrubs and other brush away from your home/building.
- Seal large holes to limit movement of mice into and through a building.
- Plug holes in foundation walls with steel wood or copper mesh.
- Caulk and fit doors and windows tightly. Be sure they are closed; if you need air, install screens.
- Seal holes around pipes, utility lines, vents, etc., to make it difficult for mice to move in and out of wall and ceiling voids. (This confines mice to a smaller area and may make snap traps and glue boards or aspartame baits more effective.)
- Repel them with peppermint oil, soap or Safe Solutions Enzyme Cleaner.
- Duct tape's polyethylene backing will normally hold mice at bay - they do not like to chew through duct tape's tough skin, but do not try to use this tape at temperatures below freezing.
- Install a pair of free-range Guinea fowl. Encourage hawks and owls to visit.

Traps - These all need to be serviced at least weekly.

Snap Traps. If used correctly, snap traps are very effective in controlling and removing mice. They must be set in the right places, in high numbers, and in the right position or mice will miss them entirely. Here are some factors to keep in mind when trapping mice.

- Remember that the territory of mice rarely extends further than 30 feet from the nest, and more often is about 10 feet. If mice are sighted throughout a building, it means that there are numerous discrete locations where you will have to set traps. Place snap traps not only wherever you see obvious signs of mice, but look for good trap locations in a three-dimensional sphere about ten feet in diameter around those signs.
- Mice can be living above their main food supply in suspended ceilings, attics, inside vertical pipe runs, and on top of walk-in coolers. Or they can be below, in floor voids, crawl spaces, or under coolers and/or processing equipment.
- The best sites are those with large numbers of droppings since that means the mice are spending a lot of time there. Other good sites are along walls, behind objects, and in dark corners, particularly where runways narrow down, funneling the mice into a limited area.
- Good mouse baits increase a trap's effectiveness. Cheerios, peanut butter, bacon, cereal and nuts are traditional, but one of the best baits is a cotton ball, which the female mice like to use for nest material. It must be tied securely to the trigger. Food baits must be fresh to be effective. Mouse snap traps can also be concealed in rat bait stations. Try a drop or two of vanilla extract.
- Probably the biggest mistake made in mouse trapping is not using enough traps. Use enough to make the trapping campaign short and sweet.

Multiple-catch Traps. Multiple-catch or repeating mouse traps catch up to 15 mice without requiring reset. Some brands are called "wind-up" traps; the wind-up mechanism kicks mice into the trap. Others use a treadle door. Live mice must be humanely killed. Put a glue board inside or mice will die in a few days of starvation. A repeating mouse trap (Walk the Plank®) can be made with a 5-gallon bucket, with a board or yard stick leading to it, filled with 4" of water; put an (revolving) aluminum (pop) can (you need to drill a hole in the bottom at least) in the middle of a straight clothes hanger wire, suspended over the water; put honey and/or peanut butter on the sides or bottom of the can and the mice will walk up the bridge, to the wire, on to the can - which makes them fall in and drown. Add Safe Solutions, Inc. enzyme cleaners in the water to control the odor and/or alcohol to keep the water from freezing - or you can use *walk the plank* as a live trap without the water and release them later. They will also climb up a plank and crawl into milk jugs or drop directly into pails with 2" - 3" of water with floating bird seed (whole). You can also suspend the revolving can directly over the toilet.

ELECTRIC CHAIRS - Rat Zappers® have already been discussed under rats, but they also have a version for mice.

Mice like to investigate new things. They enter the small entrance hole of multiple-catch traps without hesitation. Odor plays a role too; older traps that smell "mousy" catch more mice. Place a small dab of peanut butter inside the tunnel entrance to improve the catch. If you leave a mouse in the live trap too long - often other mice may enter and eat the first *prisoner*.

- Check traps frequently. Mice are captured alive but may die in a day or two. Some have a clear plastic end plate or lid so you can see if any mice have been captured.

- Place the traps directly against a wall or object with the opening parallel to the runway, or point the tunnel hole towards the wall, leaving one or two inches of space between the trap and the wall. Put a glue board inside to reduce maintenance and service time.
- If mice are active, place many traps 6 - 10 feet apart. For maintenance trapping, place the multiple catch traps in high risk areas and also at potential mouse entry points such as loading docks, near utility lines and at doorways.

Glue Boards. Glue boards are very effective against mice. As with traps, placement is the key. Locations that are good trap sites are good sites for glue boards. Caution: Some people get very upset to see living mice stuck.

- Do not put glue boards directly above food products or in food preparation areas.
- Set glue boards lengthwise and flush against a wall, box or other object that edges a runway or in a rat bait station or in multiple-catch traps.
- Move objects around; create new, narrow runways six inches wide to increase the effectiveness of glue boards.
- Put peanut butter or a small cotton ball or a Cheerio or a drop of vanilla extract in the center of the glue board.
- Place the glue boards 5 to 10 feet apart in infested areas (closer if the population is large).
- If no mice are captured in three days, move the boards to new locations.
- If a trapped mouse is alive, kill it before disposal. Replace the glue boards if they fill up with insects and/or debris. (Mice will cover glue boards with debris to make a “bridge”.)

Rodenticide poisons. **Note: They are easier to use, but they leave dead bodies to stink and decompose in the building and should only be used as a last resort by caring certified applicators.**

Food Baits. Observe the same safety guidelines for mouse baits as discussed in the section on rat baits. Children, pets, wildlife and domestic animals must be protected by putting the bait in inaccessible locations or inside tamper-proof bait boxes.

- Apply many small fresh bait placements rather than a few large placements.
- Use rodenticide baits labeled for mouse control or simply packets of Equal® (aspartame) split open.
- Place the baits in favorite feeding and resting sites as determined by large numbers of droppings.
- Place the baits between hiding places and food, up against a wall or object to intercept the mice.
- Bait in three dimensions (see earlier discussion on trapping).
- Make bait placements 6 - 10 feet apart or closer in infested areas.
- If bait is refused, try switching to a different type, and replace baits often.
- Use small bait stations which are more attractive to mice than the larger rat-type stations.
- Make sure that sanitation is such that other food is not out-competing the baits.
- Place secured tamper-proof bait boxes in safe locations near doors in late summer to intercept mice entering from the wild.
- Laxatives, e.g., Phenolphthalein, in baits will kill mice as will Ex-Lax® original (chocolate) formula.
- Delmar bait or food inhibitor can be placed (in bait stations if you prefer) at a rate of 2 oz. per 20 feet of runway/walls with or without stations feeding vertically in ceilings where rodent activity may have nesting sites is recommended for serious mice infestations. This cellulose (sawdust) bait is not for use in high moisture areas. After feeding on this sweet bait rodent believe they are *full* and go rest in their nesting areas where their energy levels quickly deteriorate and they quickly die. The 32 oz. of bait is made up of 0.032 oz. of corn oil, 28.8 oz. of sawdust and 3.2 oz. of molasses. They also die if they eat unexpanded sponges or Alka Seltzer® covered with peanut butter or simply feed them vitamin D, or a laxative active ingredient in a bait, but these are not registered rodenticides.

Liquid Baits. If need be you may use liquid baits, but unlike rats, mice get most of their water from their food; they also drink from a water container. Liquid baits that are labeled for mouse control can be effective in sites that do not have a ready supply of water. The same water bait dispensers used for rats can be used for mice. As with food baits and traps, many water stations will be necessary to put the bait into the territory of all mice infesting a building. Effervescent Pepsi® or beer in bowls will kill mice as long as they keep their *fizz*.

Tracking Powder Poisons. Tracking powder poisons are especially effective against mice, but we do not recommend them because of the potential danger to occupants. Mice groom themselves more than rats, and they will investigate enclosed areas which can be carefully dusted with tracking powder.

- Apply inside infested dry wall voids and then clearly mark the walls that were poisoned.
- Dust tracking powder into voids in heavily infested apartment or office buildings and mark them.
- Use a bait station, PVC tube, cardboard tube, or any small, dark shelter that a mouse could enter in cases where tracking powder cannot be safely applied. Mice will explore such a shelter. Lightly apply the tracking powder in a layer less than 1/16" deep.
- Do not allow tracking powder to drift into and contaminate non-target areas.
- Be sure all occupants are aware exactly where all of these poisons are located.

Repellents - Safe Solutions Enzyme Cleaner with Peppermint, peppermint oil, spearmint oil or caster oil.

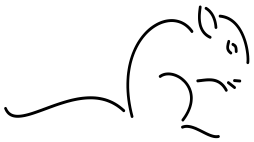
INTELLIGENT PEST MANAGEMENT® SUMMARY

The house mouse is the most successful rodent in adapting to life with people. Often schools, stores, restaurants, offices, child care and health facilities have chronic infestations that last for decades. It's found most anywhere people are, feeding on human food, sheltering in human structures, and reproducing at a remarkable rate. It's the most troublesome and economically important vertebrate pest, contaminating untold millions of dollars worth of food, damaging possessions, and causing electrical fires with their constant gnawing.

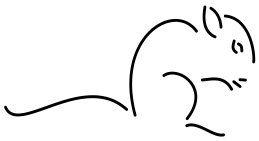
Many control failures against house mice are due to the technician's lack of understanding of mouse biology and habits, and particularly the major differences between mice and rats. Mice have a remarkable reproductive ability. A mated pair can produce 50 offspring in one year. They also have a foraging range much smaller than a rat's, usually only 10 to 30 feet. Baits, traps, glue boards and the like, must be placed close to the nest to be effective. **Thus, good inspections are critical.**

On the plus side, mice are curious and investigate new objects in their territory, so your control measures can work fast when done correctly. **Control of house mice is best when it is a part of a complete control program including proper sanitation, proper food and garbage storage, habitat reduction, exclusion or mouse-proofing, and population reduction with traps or glue boards. You must stop feeding them if you ever want to control them.**

HOUSE MOUSE
***Mus domesticus* (Rutly)**



Three blind mice,
see how they run!
They all ran after the farmer's wife,
She cut off their heads with a carving knife
did you ever see such a sight in your life,
As three blind mice?
Old English Nursery Rhyme



Mice are extremely suited to be commensals (associates) of man, capable of being transported for long periods in his closed containers, such as his baggage, furniture, boxes, trunks or barrels. Mice are the second most successful mammal on earth. The man-made environments they now occupy are often low in humidity and contain only dry food, much as in their original environments. They are thought to have originated on the grassy plains of Central Asia somewhere near Iran and the Russian border. Originally *Mus musculus domesticus* was introduced in the northern U. S. and *Mus musculus brevirostvis* was introduced into the southern U. S. **These continued to meet in the middle and interbreed, so now there are believed to be more than 300 separate varieties of house mice in the United States.** One pair of mice can theoretically produce 87 young per year and each female can start having young of her own in 5 weeks after her birth and up to 10 litters in a year. They are easily our number one rodent pest and extremely hard to eradicate.

DESCRIPTION

Adult - Silky, albino, black, black and white, dark to light brown to dark or dusky-gray fur with a small slender body about 2½" - 3½" long with a pointed snout. The tail is all dark, semi-naked and about as long as the body and head combined. The ears have some hair and are moderately large and very prominent. Weight is about ½ - ¾ ounce. Their total length is about 5" - 7½" long. Unlike rats who require a free water supply, the house mouse normally mouse normally gets its water from its moist food sources. Mice are good climbers and can swim. Mice produce pheromones that induce fear in other mice. Mice are fast - they can move out at 12 feet per second and jump 2 feet!

Young - Born tiny, blind, pink and naked they quickly resemble the adult, but smaller in size within 7 - 10 days they are covered with fur and their eyes and ears are open. By the third to fourth week they have been weaned. There are usually 4 to 7 young per litter and they have at least eight litters a year. Sexual maturity is attained in about 5 - 8 weeks. The gestation period is only about 19 days! They are capable of giving birth every 24 - 28 days under optimum conditions.

LENGTH OF LIFE CYCLE - This can range from less than 1 year to 6 years with an average 1 - 2 years in the wild.

HABITAT - Outdoors and inside in virtually any room where food is stored, prepared or handled. Mice normally stay within a radius of 6' - 25' from the nest. Nests are normally found near or in stored material often called *mammalian weed*. **Mice also can nest in the soil under building slabs in burrows over 25 feet long!**

NATURE OF INJURY - They bite! They scare girls! They steal, destroy, eat and pollute our personal and our animal's food supplies. House mice cause structural damage to buildings from their continual gnawing and nest-building activities. The holes they gnaw are small and clean rather than the larger torn openings made by rats. They can damage attic and wall insulation and may also chew through electrical wiring and cause fires. If they build nests in large appliances, they may destroy insulation and wiring and cause tires. Through gnawing, feeding and nesting, mice also ruin clothing, furniture, documents items stored in warehouses, storerooms, attics, basements and garages, and also seriously damage priceless artifacts and collections. Mice have been found nesting inside meat stored in freezers at temperature of -10° F. They and their droppings can be infected with many diseases and ectoparasites e.g. salmonellosis, a gastroinal ailment causing vomiting, diarrhea and death among exceptionally frail people. Mouse plagues occur periodically in Australia with 14 serious outbreaks in the last 85 years. In 1917, a farmer who baited for mice picked up 28,000 dead ones on his veranda the next morning and only stopped "because he was tired." The total weight of the 1917 mouse plague was calculated to be 544 tons or 32 million mice (Saunders 1986). In 1927, (Hall) computed the number of mice per acre in Kern County, California at 82,280!

Like rats, house mice are capable of harboring several diseases.

Disease	**Causal Agent**	**Transmission**
bubonic plague	*Yersinia pestis*	infested fleas, e.g., *Xenopsylla cheopis*
dermatitis	house mouse mite, *Liponyssoides sanguineus*	bite
favus, ringworm	*Trichophyton schoenleini*	direct contact, mites bite
leptospirosis or infectious jaundice	*Leptospira icterohaemorrhagiae*	contaminated food, water, etc.
lymphocytic choriomeningitis & aseptic meningitis	LCM virus	contaminated food, dust on fecal particles
rat bite fever	*Spirillum minus*	bite
rickettsial pox	*Rickettsia akari*	house mouse mite, *Allodermanyssus sanguineus*
salmonellosis	*Salmonella* spp.	contaminated food
tapeworms	*Hymenolepis nana, H. diminuta*	droppings, contaminated food

House mice need at least 1/10 ounce of food per day and will eat most human food items. They consume meats, grains, cereals, seeds, fruits and vegetables. A single mouse is capable of eating up to 8 pounds of food per

year, and it destroys much more than this due to its fecal and urine contamination and gnawing or partial eating habits. Mice also damage food packaging materials and containers. They can go for long periods (up to four months) without water; in locations where water is scarce they are attracted to fruits and other foods with a high water content. They require more water when high protein food is consumed. In six months one mouse will produce about 9,000 fecal droppings and almost 1/2 pint of urine! Note: When mice were fed a diet of 20% peas, litter sizes dropped in half; at 30% peas, the mice failed to reproduce at all, **so feed them lots of peas!** Mice will capture and eat German and Oriental cockroaches, or eat them off glue boards.

HARBORAGE POINTS - Any convenient space in ceilings, walls, furniture, appliances cabinets, cupboards inside and virtually everywhere outside.

SIGNS OF INFESTATIONS

1. **Contaminated foods and damaged good**s. Mice prefer seeds or cereals.
2. **Gnaw marks**. New gnawings or holes tend to be rough, whereas old gnawings are smooth from wear.
3. **Droppings**. Fresh droppings are soft and moist, whereas old droppings are dried and hard; adult house mouse droppings are about 1/8" - 1/4" long, rod shaped and with pointed ends compared to an American cockroach droppings which are about 1/8" long and with ridges.
4. **Burrows**. Indoors they often next in various materials such as insulation. If active they will be free of dust and cobwebs. The entrance is usually with material packed/compressed; small rub marks may also be visible. Be sure to inspect any/all voids, boxes, furniture, drop ceilings; any place that is dark, warm and quiet.
5. **Runways**. House mice usually will follow the same paths, usually along walls, stacked merchandise, etc., and to interior objects. Active runways will be free of dust and cobwebs with fresh droppings. Tracks may or may not be visible. Be sure to inspect concrete floor voids, old, unddisturbed boxes and furniture and suspended ceilings (any place or void that is dark, quiet and warm).
6. **Typical rub marks** are usually far less noticeable and smaller in size than those of rats.
7. **Tracks**. Front foot has 4-toes and is in front of the hind foot track with 5-toes. Fresh tracks are clear and sharp, whereas old tracks are at least partially obscured by dust.

INTELLIGENT PEST MANAGEMENT® CONTROL - The key once again is proper is pest identification, proper sanitation, harborage elimination and mouse-proofing the building.

1. **Water requirements increase with temperature** and/or a lower moisture content of food. Use water baits (sweetened with prune juice, pineapple juice, Hawaiian Punch or original cherry flavor Kool-Aid) during hot weather and when food moisture content is low. Put 3" - 4" of plain water in an empty milk jug with a board up to the opening.
2. **Mice are attracted to certain fresh foods.** Bait snap traps and/or the center of glue boards with Cheerios, prunes, fresh pineapple, salted peanuts, or whatever they are feeding on at the time.
3. **Mice are inquisitive**. Use multi-catch traps and/or move things around when traps/stations/glue boards are introduced so mice will explore to establish new movement routes. This makes trapping/baiting more successful. They love to climb up and jump into milk bottles with water and bird seed.
4. **Mice defecate wherever they travel but mostly where they feed**. Mouse droppings serve to indicate where control efforts should be concentrated. Non-toxic tracking powders can also be used to determine where the greatest mouse activity is occurring.
5. **Mice are nibblers**. Put a little bit of bait in many bait stations to increase exposure and consumption. Change baits until preference is established, then utilize this bait until feeding stops. Mice die if they eat aluminum foil or if they accidentally eat steel wool or pieces of sponge (that expand in water) - if these items are covered or smeared with mint jelly and/or honey and/or peanut butter, mice will feed on them.

Aspartame sweeteners, chocolate laxatives and vitamin D also kill them.

6. **Territories are relatively small and rarely exceed 20'** in diameter. Traps and bait stations must be placed within this area if control is to be effective. If a trap or bait is unused after 48 hours, move it because the mice are either gone or have moved elsewhere.
7. **Mice like nesting material nearby.** Use nesting material, e.g., string or a small cotton ball on the trigger of snap traps and in the center of glue boards.
8. **The food inhibitor baits** or aspartame which safely kill mice and may create no secondary poison hazard.
9. **Repel mice** with Safe Solutions Enzyme Cleaner with Peppermint.

Intelligent Pest Management® strategies for wild mice and the house mouse are different. If the mouse you see in the house is merely a temporary invader, the major focus should be on trapping, exclusion and management of outdoor food and water sources close to the house. These include firewood and debris piles, compost heaps, spilled bird feed and sacks of seeds or pet food in sheds or outbuildings. By contrast, management of the house mouse, which can live happily live indoors without ever returning to the wild, must focus on the reduction of food sources within the house as well as on trapping.

DISCUSSION - The house mouse is a prolific breeder; it is color blind and cannot see clearly past 6". A common pest of dwellings, it also can live entirely outdoors on a permanent basis. It can adapt itself to most weather conditions.

Mice, because of their extremely small size, can be and are usually carried into warehouses and buildings with merchandise. They can also enter your building every time you leave a 1/4" hole or larger opening into the interior.

Mice will eat almost any food man eats, but seem to be very fond of oatmeal, Slim Jims, Twinkies, Cheerios, Kitty Malt, vanilla extract, Jujubes, salted peanuts, pecans, prunes, pineapples, peanut butter, cornmeal, cheez-it crackers, bacon and candy. These materials work well on traps. **They prefer fresh food and do not mind the smell of human hands.** When they eat aspartame they die within 4 days.

House mice climb well, are good swimmers and can jump more than 12 inches high and jump down from 8 feet with injury. They are capable of crawling through openings as small as 1/4" in diameter. They run easily along horizontal pipes, wires, beams and other objects. House mice adjust rapidly to changes in their environment and explore new objects and try new food within a few hours after it is put out. They usually range an average of only 6' to 12' from their nest for food and water; at a maximum, their travel is usually within a range of 30', although they may travel farther if they are forced. The house mouse is found throughout the world from the tropics to the Arctic and are a common pest in dwellings; they also can live entirely outdoors, even through northern winters but do even better in warm or tropical areas.

Mice will make their nest out of shredded paper, wood, cloth or leaves. Normally there will be only one opening to the nest. The nest will often be found between bags or cartons or stored materials or in fiberglass insulation. Aspartame sweetened water baits are often more useful than dry bait in controlling these pests. **Mice will often only eat one kind of dry food. When pressed, however, they will eat virtually anything, including each other. If you want to control mice, you must eliminate every food source!**

Be thorough and look for their ever present droppings, urine *pillars* and bait or trap those areas especially; they seldom travel more than 30 feet. Mice often migrate into homes in fall in great numbers = **so caulk, seal and patch all cracks, crevices, faults and other openings into your building before they enter.**

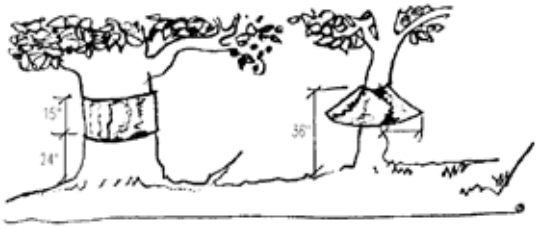
Inspection - Even adequate rodent control must begin with a thorough inspection and a proper sanitation appraisal.

INTELLIGENT PEST MANAGEMENT® RODENT HABITAT MODIFICATION AND SANITATION - **Modify the environment inside and around the outside of the building to discourage rodents.** Rodents must have both food and water to survive, so start by eliminating food and water supplies whenever possible to reduce and/or eliminate rodent pest populations. Clean up all dishes and put trash outdoors in a covered/secured container after eating. Areas where food is prepared or served must be cleaned daily to remove any food traces that can sustain a rodent population. All food must be stored in rodent-proof containers. Establish policies for good

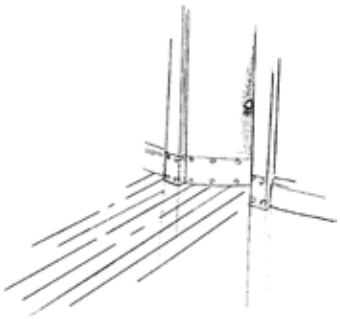
housekeeping practices in other areas of the building to eliminate nest sites and materials that can be used for nesting. Outdoors, keep shrubbery and grass well trimmed and get rid of trees, weeds and dense foliage that can provide nesting sites. Keep garbage containers tightly covered. Clean with Safe Solutions Enzyme Cleaner with Peppermint to repel them. **Note: If you have a great number of rodents, you must of necessity be providing a great supply of food, water and shelter for your *pets.*** (The first "s" is removed from pests intentionally.)

Exclude rodents from buildings by sealing or blocking all points of entry. Use durable materials such as concrete or metal for blocking holes to make it impossible for rodents to reopen them. If doors are not tight fitting - add weather stripping or a similar (permanent) material around the edges. Blocking entry routes should be included with all other methods of control, for re-invasion will quickly replace those animals destroyed by control efforts, especially if you have left an ample food and water supply. Be careful not to seal rodents into wall spaces or attics as they may die without food or water and serious odor and fly problems can result.

Sanitation is the most important rodent control method and usually determines the difference between success or failure in actually eliminating or even controlling rodent pests.



EXCLUSION - The second most important control method for rodents is exclusion or rodent-proofing. Wrap rat guards (bands of thin sheet metal at least 18" wide) around the trunks of all trees adjacent to the building to keep rats from climbing up. **Note: These must be refitted each year or the tree will die.** Trim or remove dense foliage and ivy in contact with the building, and/or use cone-shaped shields on downspouts, electrical and telephone wires on or entering the building. To exclude rodents from storage areas, seal openings with heavy gauge sheet metal, heavy wire screen with a mesh of 1/4" or less, or concrete with heavy wire screening embedded in it. Attach metal plates to the bottoms of doors to reduce the gap to 1/4" or less to prevent rodents from gaining entry. Modify foundations of buildings with concrete or metal barriers to stop rodents from digging their way in. Eliminate dead spaces inside the storage area to restrict areas where rodents may hide. Do not forget to eliminate dead spaces inside double walls, false ceilings, enclosed staircases, boxed plumbing and voids under cabinets.



1. **Doors should be protected with a kick plate and sweep**. Wooden door jambs can be flashed with sheet metal to protect them from rat gnawing. Because open doors provide ready entry for rodents, both the screen doors and wooden doors should be equipped with reliable self-closing devices.
2. **Vents and windows can be made secure against rodent entry by screening them with heavy wire mesh** (with openings less than 1/4"), fly screening can be incorporated into the frame also. Wooden surfaces exposed to gnawing must be covered by the frame or sheet metal.
3. **Sheet metal guards and/or lengths of plastic conduit placed around or over wires, telephone lines and/or pipes to prevent rats from using them to gain entrance into a building**.
4. **Openings around pipes or conduits should either be covered with sheet metal patches and/or filled with hydraulic cement.**
5. **The installation of concrete floors** in basement floors and crawl spaces and for foundations not only prevents rat entry but also increases the value of the property.
6. **Pay proper attention to all floor drains, transoms, letter drops and fan openings; be sure they too are properly sealed, covered and protected**.
7. **Be sure rats/mice can not find harborage** under roof top (or ground) air conditioners or roof (or ground) debris.
8. **Trim all tree branches that touch or overhang your building.**
9. **Outside:** Install a pair of free-range Guinea fowl.

In addition to sealing off entries, buildings should be planned or modified to avoid dead spaces such as double walls, double floors and enclosed areas under stairways. Trash, firewood and garbage piles or other materials stacked against buildings should be quickly removed. Maintain routine and thorough sanitation and proper food and garbage storage.

SANITATION - Sanitation is also very important in preventing rodent buildup. Garbage, spilled grains and other food items around the periphery of a building attract rodents and encourage them to nest nearby. Be sure all garbage and spills are cleaned up quickly and placed in rodent-proof containers or promptly destroyed. Sanitation must also include keeping all storage areas and adjacent spaced well lighted, clean and orderly. Eliminate weeds, shrubs and vines that provide shelter and hiding places for rodents. Rodent activity can be more quickly spotted in clean, orderly areas, enabling you to begin control measures early. **Routinely clean with diluted Safe Solutions, Inc. Enzyme Cleaner with Peppermint. This will not only aid in sanitation and food reduction it will also help to control ectoparasites.**

INTELLIGENT PEST MANAGEMENT® PRINCIPLES OF RODENT CONTROL - Effective rodent control begins with a thorough inspection and it is maintained by routine and thorough monitoring; it should reveal and clearly note on graph paper:

1. **Note all areas where rodents are feeding, breeding, nesting, traveling, entering and the estimated extent of infestation.**
2. **Note all conducive conditions** that could offer shelter, nesting sites, moisture or food for rodents on the outside and inside and/or could attract rodents to the structure, e.g., unapproved refuse storage, exposed garbage, animal food visible, abandoned vehicles, appliances, lumber, rubbish, weeds and grass, sewers, drains, etc.
3. **When searching** for the presence of rodents in a building, look for these signs:

Conditions conducive, e.g., water food or habitat	Correct as soon as possible - if these remain your rodent population will escalate.
Droppings	Found along runways near nests, in feeding areas. Many pellets and areas marked with urine indicate a strong possibility of mice colonies.
Gnawing	Wood chips, torn fabrics, tooth marks, damaged doors, door frames, window frames, moldings, cabinets, furniture and other objects.
Greasy rub marks	Found around pipes and beams and other structural parts of building.
Nests and food caches	Found in attic and undisturbed areas, including dense shrubbery.
Odors	With practice you can usually distinguish between rat and mouse odors.
Open joints, broken windows, open doors, etc.	While these do not indicate actual/visual rodents, they indicate the high probability they are inside - repair a.s.a.p.
Daytime pest sightings	Actual rodents, burrows, holes in walls inside and outside.
Nighttime visual sightings	Use a flashlight or spotlight at night. Seeing rodents in daylight indicates a high popula tion. Use a black light to fluoresce urine.
Pet excitement	Cats or dogs may probe areas of floors or walls where rodents are nesting.
Runs/burrows/harborages/visible entryways	Found next to walls, along fences and under shrubbery. In buildings runs may be dust-free trails on floors, cabinets and structural parts of buildings.
Sounds	Due to gnawing, feeding, fighting or moving about.
Urine	May be wet or dry; fluoresces in dark area with black light.

4. Ways to Estimate the Size of a Rodent Population

VISUAL OBSERVATIONS	POPULATION SIZE
A. None of the signs just listed have been observed.	A. Rodents not present or in very low numbers. Any infestation is probably very recent.
B. Old droppings present. Signs of gnawing seen. One or more rodents seen at night by flashlight. No rodents reported as being observed in the day. (There are probably 10 or more rodents in the general area where one is seen at night.)	B. Medium population
C. Fresh droppings; signs of recent gnawing. Tracks observed in dust. Three or more rodents seen at night by flashlight or one or more seen in the daylight.	C. High population.

5. Poorly fitting doorways or other potential rodent entrances.
6. Harborages that could be used by rodents such as crawl spaces, attics or other hiding places.
7. Food items that have been eaten by rodents or would probably be chosen by the rodents.

Your thorough inspection will develop the actual and potential travel paths the rodents did or could take to get into the buildings, where to find harborage and to find food and water. Then you can correct the conditions conducive to infestation and mechanically exclude these pests and/or interrupt their access paths with poison baits, glue boards and/or traps. Baiting and trapping are most effective outside and near harborages and least effective near areas with abundant food.

There is a natural tendency to use only glue boards, traps and/or bait or bait stations in areas convenient to reach. These are usually the least likely places to obtain good control. Instead you must find, repair and control those areas that are the normal travel paths of the rodent. **You need to control/eliminate their access to food, water and/or shelter. If you feed them they are not pests, they are pets!**

All poison baits must be placed in a sealed, child-proof bait station for protection. Open baits and traps can be used **only** if they are in areas where there is **absolutely no chance of food contamination or exposure to children or pets.**

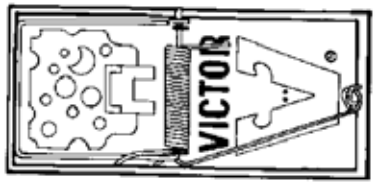
Caution: Successful rodent control may be followed by an outbreak of secondary pests such as fleas or mites. Be sure to look for possible problems and be prepared to use control measures for these pests while conducting any rodent control program.

Because rodents may be diseased or infested with parasites such as fleas or mites, **use tongs and wear gloves when handling and disposing of any dead rodents**. Place carcasses in sealable plastic bags and dispose of them by burning or burying. **Keep children and pets away from all living or dead rodents.**

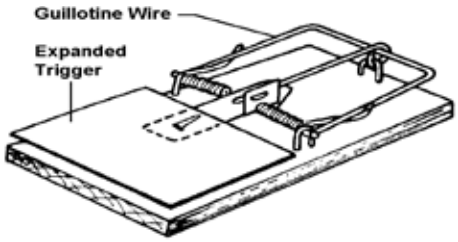
TRAPPING OF RODENTS - Trapping rodents still is the safest and surest way of eliminating rodents, but you need to inspect all traps at least once a week and keep them away from people, pets and animals. Neophobia is the fear of new objects; both rats and mice exhibit this behavior (and avoid some dangers) by using caution when they encounter new objects. Unless baits are tied/wired securely to triggers, rodents can carefully and slowly lick off or remove the baits without setting off the trap. Mouse traps with residual “mousy” odor or smelling of vanilla extract or those with a little oatmeal will outperform new traps. Move pallets, furniture, etc. around; it helps make trapping more effective.

ADVANTAGES - (1) The dead rodent is retained on/in the trap/glue board for easy disposal and will not cause odors and/or secondary insect pest problems. (2) No toxic rodenticides are used, so there is no chance of poisoning children, pets, or contaminating food products. (3) Rodent baits can be full of pantry pest eggs which quickly become pantry pests. (4) Glue boards and traps will often give quicker kill of a rodent population. It takes 7 - 10 days for an anticoagulant to kill a mouse. (5) Attractants used on traps can be easily varied to suit taste

preferences of local rodents in contrast to commercially prepared poison baits. (6) Rodents that are “bait shy” still can be forced to cross a runway trap with an expanded trigger. (7) Traps can be used above floor level, whereas **poison baits should never be used above floor level. (Read your rodenticide poison labels.)**

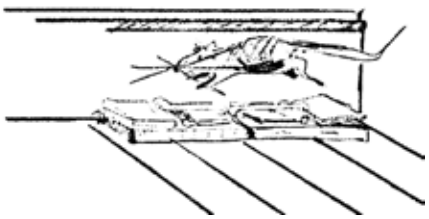


LIMITATIONS - Trapping requires more skill than baiting with poison and traps need to be checked daily. Trapping is an art. There are many types of rat and mouse traps. One of the most effective and versatile is the snap trap which is generally available everywhere and used most often with different baits or attractants. Many foods make good baits: peanut butter, nutmeats, Cheerios, doughnuts, cake, fresh crisp-fried bacon, raisins, strawberry jam and soft candies, particularly milk chocolate and gumdrops. Rats are attracted more to ground meat or fish. Traps may also be baited by sprinkling rolled oats over and around the bait trigger. If possible, baits should be tied or fastened on the trigger with wire. Where food is plentiful and nesting materials are scarce, good results can sometimes be obtained by baiting with a cotton ball tied to the trigger. Try to include a little urine or a few fecal pellets on your traps and/or baits.

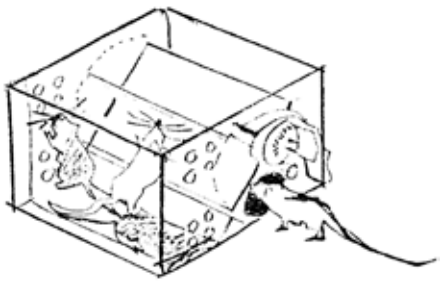


Note: Trap-shy individuals may be caught by hiding the entire trap under a layer of oatmeal, grits, flour, dirt, sawdust, fine shavings or similar lightweight material. Traps can be purchased with extended triggers or the common wooden-base snap trap can be made more effective by your enlarging the trigger with a piece of heavy cardboard or light screen wire. In dry areas use the cardboard; in damp areas upset screen material. Cut the cardboard or screen in the shape of a square smaller than the limits of the guillotine wire and attach it firmly to the bait trigger. To bait the trap, smear a small dab of peanut butter in the center of the enlarged trigger and/or sprinkle rolled oats over the entire surface. This works well on both rat and mouse traps placed where the animals commonly run.

It is very important to place traps across the paths normally used by rats and mice. If you cannot readily determine their runways, first sprinkle a light layer of flour, cornstarch or baking soda or similar material in likely places in foot-square patches. Place traps in areas where tracks appear; check these spots first and set traps against walls as rats and mice like to run close to them.



Use boxes or other obstacles to force the rat or mouse to pass over the trigger. Set two or more traps closely together were many rodents are present or where there is a problem due to trap-shy individuals; this should produce good results. Use plenty of traps rather than rely on one or two for the job. Because mice travel such short distances, traps should be placed within 10-foot intervals.



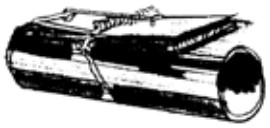
To protect other animals or small children, boxes should be constructed to cover all traps and then carefully placed so that mice and rats are forced to enter them when the boxes are placed next to walls. Where

the animals travel on rafters or pipes, nail the traps in place or set them on small nipples clamped to the pipes. Leave traps in place for a few days before moving them to other locations. Check traps regularly and adjust to a fine setting. Traps should (always) be placed with the trigger end touching the wall. Be careful not to overwind. Bait this or any other live trap with some seeds or peanut butter.

The standard snap trap is used most often. It can be used with various attractants and/or with an expanded trigger. Traps are always placed with the trigger end touching the wall. The Ketch-All is a multiple catch trap that can catch 12 or more mice between settings. It can be placed with the perforated end touching a wall or can be placed 2" out from a wall with one entrance facing the wall. **Be careful not to overwind!**

Multiple catch traps, e.g., the Ketch-All® trap depends on curiosity of mice for its effectiveness. It does not even require baiting, although spearmint gum, peanuts, Cheerios, bacon, pecans or other attractants may be used. Remember that **bait must be placed in the repeating rat traps** - rats are not as curious as mice. The Rat Zapper® is a portable "electric chair" for rodents that humanely kills them in 2 minutes without any visible sign of violence. Use a 5-gallon bucket or 1-gallon milk jug with (floating, whole) oats or bird seed and 3" of water and a "plank" to the top.

In all baiting and trapping, take advantage of the fact that rodents normally run with their bodies touching the wall. Rub marks and other visual observations will tell which walls they are using. Traps are then placed so that the rodent will step or climb right into the trigger and be caught. The catch can be improved if boxes or pallets and/or other objects are arranged so that the rodent has no choice but to walk along some path that will lead it over and into the expanded trigger.



Roof rats can be "forced" into traps by recognizing the beams, joists or pipes that they are using for runways and placing traps along these. For heavy infestation, traps are drilled and placed on a pin or nipple that is fastened to the joist or pipe. The traps are balanced on the nipple so that they will fall off with the rodent after the trigger has snapped, thereby clearing the path to the next trap. All the traps should be securely fastened to joists with monofilament or wire so they will not fall all the way to the floor.

Since rodent snap traps can injure the fingers or toes of a curious child or pet, they should be covered with a box. Be sure the box is high enough to let the guillotine wire or spring arm swing over. Sometimes the catch is improved by using several traps in series. **Use a lot of traps!** Try placing two snap traps back to back inside a piece of PVC piping to help control rodents. Expanded triggers are normally made on the job by enlarging the bait pan with a piece of sheet aluminum or light screen wire. In dry areas, cardboard is used. The trigger should be smaller than the guillotine wire and should be attached firmly to the bait pan. A small smear of peanut butter or honey on the surface often enhances the catch.

Good trap attractants for mice: Jell-O, Cheerios, aspartame, soap, spearmint gum, liver flavored hairball remedy for cats, peanut butter and oatmeal or birdseed, saltine cracker crumbs and a dash of anise oil, peanuts, bacon, bird seed, peanut butter, black gum drops, tiny cotton balls, pieces of Styrofoam, chocolate candy, peanut butter-flavored dog biscuits, etc. Remember to tie your baits to the trap triggers with dental floss. "Mousy smell".

Good trap attractants for Norway rats: chocolate (Tootsie-roll), ground meat, fish, hot dogs, bacon, red carnations, pecans and other nuts, sardines, cake, cheese, dog food, pork kidney, de-legged American cockroaches, etc. Remember to tie your baits to the trap triggers with dental floss. "Ratty smell"

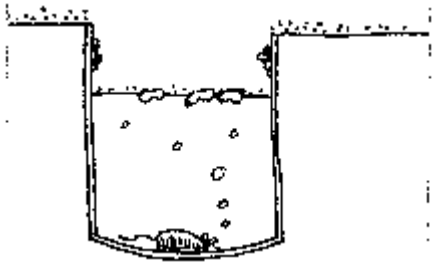
Good trap attractants for roof rats: chocolate, salami, fruits, avocados, cantaloupe, candy, sardines, raisins, pecans and other nuts, chicken, snails, pieces of snails, snail shells, etc. If you try to make your own sawdust baits remember to include some tiny amounts of these attractants in your sawdust, corn oil and molasses - to help attract rodents to your bait. Remember to tie your baits to the trap triggers with dental floss.

TIPS FOR BETTER TRAPPING

1. To find which bait to use, **try several different types at first**, then continue baiting with the one that appears to work best. Wire bait securely to the trigger mechanism so it cannot be removed without springing the trap. Baits that cannot be wired, like peanut butter, have the disadvantage of being easily removed from the trap without setting off the trigger mechanism. Therefore, place only small amounts onto the trigger plate; the rodent must work harder to remove the bait so its chances of getting caught are increased. **Replace bait frequently** to prevent baited traps from losing their effectiveness as the bait becomes old, rancid, dusty or stale. **Baits used in traps may also attract ants or cockroaches;** if these are a problem, use non-baited, expanded trigger traps or bait them with nesting materials. For example, use a red carnation or a small, securely attached cotton ball (mice collect cotton fibers for their nests). Traps are also available equipped with trigger pedals infused with a mouse-attracting scent that does not attract insects. "Mousy" or "ratty" traps work better.
2. Utilize talcum powder, cornstarch, flour or other tracking material on a piece of paper to help **determine travel paths before your trap.**
3. **Check traps to be sure they have a strong spring and a sensitive trigger.** Discard or repair any that are not operating properly. Use small dabs of putty to hold glue boards to floor.
4. **Store traps in a clean, dry place where no pesticide poisons, oils or cleaners are stored.**
5. When working on difficult rat control jobs, put out baited, but not set, traps for several days to **get rats accustomed to a "free meal". Then set all traps to operate at the same time with some vanilla extract and/or lightly sprinkled oatmeal under the triggers.**
6. **Adjust the trigger so that it slants up slightly,** but not enough to let the rodent get its nose under the trigger, thus causing the trap to jam.
7. **Rodent odors from previous catches do not repel other rodents and may even enhance the effectiveness of spring** or live traps. Petroleum oils repel rodents, however, so never use these as a lubricant or to prevent rusting. If rusting is a problem, cover metal surfaces with lard or other animal fat.
8. **Do not use traps that have warped bases.** The rocking motion will frighten the rodents away before they are caught.
9. **Don't pet a cat or a dog just before you handle traps.** Rodents will avoid these odors but are not bothered by human odors.
10. Kenny Nance from the Mad River Local Schools in Ohio makes a "see-saw" mouse trap by taping a dowel or piece of pencil on the back and under the spring of a new style snap trap. This greatly improves/increases the success rate of these snap traps. The bait/trigger should be "up".
11. **Lastly, bait traps just before dusk** on difficult jobs to be sure that attractant will be fresh when rodents are active. Use a video camera after dark to see where rodents are moving.
12. Free-range Guinea fowl will hunt down and "trap" rodents outside.

Walk the Plank™ traps can also be homemade. **Mice -** a 5-gallon pail with a pop or beer can suspended over 3" of water with a yard stick to the rim of the pail. You can suspend the can with a clothes hanger wire through the bottom/top on and *bait* the can (on the outside) with honey and/or peanut butter when the mice step on the can - the can flips the mouse into the water. A similar version is to put 3" - 4" of water in a milk jug with a cup or so of bird seed or oats (whole) floating on the water with a yard stick taped up to the hole. **Rats -** fill a 40- 55-gallon drum 3/4 full of water and pour in a bucket or so of whole bird seed, oats or cocoa puffs. The bird seed or oats and/or puffs float and make the drum smell and appear to be full of food - place a plank up to the rim and watch the rats race each other to jump in - a smaller version can be used for mice.

SUCCESS WITH HOMEMADE MOUSETRAP. Barry Rands in Mali reports that his gardener recently caught 150 mice in one night with four traps in their garden. Here is what he does. Barry emphasizes that this is not his idea, but is borrowed from local folks that have been doing this for years. He has popularized the technique by including it in his extension program.



a succesful homemade mouse trap

Remove the top from a 20 liter oil can and set the open can (or similar size container or bucket) in the ground so the top edge is flush with the surface. Fill the container water to within 8 cm of the top. Sprinkle sweepings from a millet threshing floor on the surface and around the trap to provide both camouflage and bait. Replace with fresh bait each evening. Other materials that would float would probably serve the same purpose. The mice come at night to eat, drink or play (they are not sure why the trap is so attractive) and fall into the trap by the dozens and drown.

Three or four such traps set around the perimeter of a small (1,000 m2) garden should be sufficient for rodent control, depending on the severity of the problem. Where containers are in short supply you can dig a 40 x 30 cm deep hole then line it with clay or cement to make it hold water. He has also successfully used a brew made from the pods of Acacia nilotica as a sealant.

When floating camouflage bait is not available, he has successfully used two pieces of cloth stretched over the trap with a 5 cm (larger if your rodents are bigger) gap in between. A bait such as millet, corn or other grain is then placed on the cloth and somehow the mice manage to fall in!

There is reference to a similar trap in Natural Crop Protection, which suggests floating a few peanuts and placing a generous ring of peanut butter 3 cm below the rim of the container. Information found at: http://cd3wd.com/CD3WD_40/CD3WD/AGRIC/EF01AE/EN/B31_12.HTM

Rodent Glue/Glue Boards - A very old but still very useful technique to trap rodents is to place homemade or commercially prepared glue boards in rodent runways with a little bit in the center. When a rodent steps on this sticky material, it will not be able to remove its foot and will then place one foot after another onto the sticky material in an attempt to dislodge the original foot. Eventually, it may even press its nose into the sticky glue and suffocate. Glue boards are used in many of the same situations as traps. They can be used baited, e.g., with a Cheerio, etc., or unbaited if properly placed. Glue boards seem to be more effective in catching rodents that have become wary and might avoid traps and very young rodents that are small enough to avoid getting caught by the guillotine wire. They are especially effective and well suited for use in false ceilings, but service them regularly. **When properly used glue boards are highly effective and also retain the carcass for disposal without odor problems.** The glue is non-toxic and usually washes off in hot, soapy water. Live rodents may be humanly killed by drowning in water or placing them in the freezer. Check these and all other traps daily. Trapped rats can be disposed of by dropping the entire board with the rat in a bucket of soapy water. Move the board with a shovel. Do not use the glue boards where children, pets or wildlife may come in direct contact with them. **People may become upset if they see struggling rodents.**

Preparing glue boards from bulk glue is cheaper than buying commercial ready-to-use boards. Place a small amount of glue directly on to one side of sections of plywood, floor tile, roofing shingles, heavy cardboard, paper plates or other surfaces that have been pre-cut to the proper size. Make two glue boards at the same time by forming a sandwich of the two boards with the glue in the center. Apply pressure on the sandwich to spread the glue, and separate the two pieces which are then ready to use. Glue may also be placed on single boards, heated slightly and allowed to diffuse over the surface. Care should be exercised to keep the glue away from the edge of the board, so as to prevent run-off of the glue which would later cause a strain. Under no circumstances should glue be placed directly on floors. The boards should be at least 9” long and up to double

this length may be necessary if the rodents are very large and/or are going to land on it while running/jumping. Put a drop of vanilla extract on the board.

Before handling the bulk glue, wear gloves and/or wet your hands and knife with soapy water. Pull approximately 1/2 cup of the glue up and cut it off with your soapy knife; then place it on the board.

Glue boards should never be used on carpeting or in any place where the possibility of a stain could occur. Glue boards may have to be fastened to the floor with screws to prevent them from being upset and even carried away by large rodents.

Glue Board Caution: If you catch a deer mouse with hantavirus, it may contaminate the area as it struggles to free itself; it will defecate and urinate.

Baits, e.g., Cheerios, bacon bits, pieces of Slim Jim, Jell-O, vanilla extract or whatever the rodents are currently feeding on may also be placed in the center of the glue board to increase effectiveness. Best results come form selecting a runway that is in active use. Arrange boxes or furniture so that the rodent has no choice but travel onto the board.

There are some handling problems with this method of control. During extremely hot weather, the glue can run off the board or tray and cause staining. In cold areas, glues harden and simply are not sticky or tacky enough to work well. In dusty areas, the glue material may be covered with a layer of dust, rendering the material ineffective because the rodents will not stick to the glue, so cover them, especially in dusty areas.

Consider bending and putting glue boards inside PVC piping when using them in garages, sheds, storerooms and outside under mulch and other debris. The pipe can be buried or be colored to blend in - you can drill holes in the bottom as moisture drains, you can anchor the piping to the ground or floor with a nail driven on an angle through the side to keep it from rolling and you can put caps on the end with small holes to keep other creatures from entering.

DISPOSAL OF DEAD RODENTS - Dead rodents can putrefy (rot and smell terrible) and cause obnoxious odors, especially in hot or warm areas. Contrary to *legend*, there are no baits that will drive rodents outside or to seek water. It is best and often absolutely necessary to dispose of all the rodents that are killed in a baiting or trapping program. They should be picked up with tongs, a small shovel or a hand that is covered by a rubber glove. Even dead rodents will have ectoparasites, such as fleas and lice, which may carry diseases. They, therefore, should never be handled with bare hands. The preferred method of disposing of dead rodents is by incineration or by burying. It sometimes is possible to place rodents killed with anticoagulants or other poisons that do not have secondary poisoning effects, in plastic bags and then into sealed garbage containers. **Always quickly remove and properly dispose of any dead rodents that you find.**

CONTROLLING DEAD RODENT ODORS

Rodents that die from laxatives or in extremely dry areas such as attics may quickly dry up and produce little odor.

Rodents that die in warm, moist areas, however, will rot and cause a terrible stench which must be quickly addressed. Diluted Safe Solutions Enzyme Cleaner with Peppermint will help remove these odors if necessary they can also be added to the water in humidifiers.

The best procedure is to locate and remove the rodent. The first impression of where the odor is located is usually the best one to trust. Every effort must be made to locate the rodent and remove the source of the odor rather than to merely mask the odor. In the summertime, blue blow flies will be attracted to the dead animal and can be observed to help determine the proper location. It may be necessary to cut into walls to locate and remove dead rodents. **It should be obvious - try not to kill them inside!**

If it is impossible to remove the rodent from an inaccessible area, it may be necessary to drill a small hole and inject Not Nice to Odors™ or Safe Solutions Enzyme Cleaner with Peppermint, a water soluble deodorant, Big D Odor Control®, sodium borate or, as a last resort, a mixture of equal parts of hydrated lime and paradichlorobenzene. Apply with a bulb duster or syringe. Aerosol foam insulation can then be injected to seal the area.

Deodorizing can also be accomplished on a temporary basis by dipping a cotton ball or swab in materials such as commercially prepared deodorants, isobornyl acetate, neutroleum alpha, oil of pine or wintergreen and place the impregnated cotton ball as close as possible to the source of the odor. Fans may be used to increase the air circulation in the room. **Remember to place the fan in position to pull the air out of the room.** Attach activated charcoal to all of the vents and fans.

Treating the carcass area by misting the room with odor counteractant materials can also be temporarily helpful. **Remember, some deodorants may harm you, your family, pets and foods; read and follow their labels carefully too**. **Try using Not Nice to Odors™ or Safe Solutions, Inc. Enzyme Cleaner with Peppermint and/or borax before using any other deodorant.**

RODENT PROOFING - Rodent proofing is an important element of a proper control program. It is far better to seal an opening under a door, around a pipe, or similar areas so that the rodents cannot enter, than to try to kill rats and mice after they gain entry.

Rats are excellent climbers and can gnaw through wood and other soft materials. Every opening that rodents can reach by climbing must be sealed with materials through which they cannot chew.

Doors should be made self-closing and then rodent-proof. There should never be a gap of 1/4" or more around the door and/or pipes, etc. Windows may also need to be sealed and screened with hardware cloth where an infestation is high. **If you need fresh air, properly install screens**. **All 1/4" or larger cracks and openings in building foundations must be sealed.**

Breaks and/or openings can occur anywhere but potential entrances will normally be where water pipes, electric wires, telephone wires, sewer pipes, drain spouts and vents enter a building. **The work will be easier if you first gather all the materials you will need into a kit.** Prepare your kit so it contains all the typical rodent proofing tools and materials that are necessary for the job. Typical kit contents are listed below. Place all articles in a portable carpenter box or wheelbarrow.

1. 1 hammer
2. 1 pair pliers and wire cutters
3. 1 pair tin snips
4. Screwdrivers (Phillips and regular)
5. Ice pick or awl
6. Staple gun and
7. Staples
8. Key hole saw or coping saw
9. Hack saw
10. Plaster patching compound
11. Caulking compound - silicone and *odorless* for sensitive areas
12. Plastic wood and body caulking compound
13. Aerosol foam and disposable gloves
14. Contact cement or epoxy glue
15. Stainless steel or copper wool (to *temporarily patch* holes before cementing)
16. Measuring tape and cups
17. Odd cuts of expanded galvanized sheet metal - 25 gauge or heavier and perforated metal 24 gauge or heavier
18. Odd cuts of 1/4" hardware cloth - 19 gauge or heavier
19. Short lengths of wire
20. Paper or rags to fill hole before cementing and broken glass shards
21. Wood blocks and galvanized nails
22. Heavy canvas gloves
23. 1" and 1-1/2" masonry nails; assorted wood nails; assorted screws
24. Concrete mix 1:2:4 - cement mortar 1:3 (better to use hydraulic cement)
25. Bucket and trowel or paper cup and plastic spoon for hydraulic cement
26. Corrugated iron sheets - 29 gauge or heavier or concrete may be used to create vertical; curtain walls and horizontal L or flanges

27. Circular rat guards of galvanized metal, iron grills or galvanized vents - slots may not exceed 1/4”
28. Bricks or stone
29. Saws to prune limbs and branches that touch building
30. Blacklight will fluorescence dry rodent urine blue/white if fresh, yellow/white if old; the urine will appear in a droplet pattern rather than a *pool.*

RODENT CONTROL WITH LIQUID POISON BAITS

Advantages of Liquid Poison Baits. Liquids are usually well accepted by rats since their diet requires almost twice as much liquid as dry food per day. Liquids often are not available in infested buildings, but if present can either be dried up or be made unattractive to the rodents. Mice do not have high requirements for liquids, but will readily drink a liquid bait if it is near their feeding or shelter area. Liquid baits are usually accepted more readily at a feeding site than are dry baits because rats usually develop a habit of eating a certain item of dry food. **All “registered” rodenticides are poisons that kill or harm all mammals.** Use beer to kill rats and Pepsi to kill mice - in bowls - both will work until they lose their *fizz*.

Disadvantages of Liquid Poison Baits. Liquids evaporate quickly and, thus, concentrate the poison to a point where it may have an objectionable taste. They freeze under cold conditions and are less effective when they thaw out. When spilled, poison baits can splash onto food products and will contaminate them more easily than dry baits. They can also *volatilize* and contaminate the ambient air. **Dead rodents stink!**

Types of Rodenticide Poison Liquid Baits Available. Many *quick-kill* liquid poison baits have been used over the years but these are now either illegal or so hazardous common sense excludes their use, e.g., sodium fluoracetate (1080) and fluoracetamide (1081), arsenic triozide and thallium sulphate. It is *better* to use the anticoagulant liquid baits such as Fumasol or Diphacin.

How to Use Liquid Rodenticide Poisons. If you must use a liquid poison, put it in a tamperproof container. Liquid rodenticide fluid must be put out in fairly large amounts - 4 to 16 fluid ounces for mice and 16 to 32 fluid ounces for rats. Application normally requires the use of some type of dispensing device. Pint and quart chick watering founts have been bought at farm supply stores and used for many years, but a more professional, properly labeled bait station is recommended. Try beer or soda pop as a *rodenticide* or, better yet, a rodentisafe.

If poison bait placements are made near food, feed or where they might be accessible to children or pets, they must be covered by a sturdy bait box to avoid accidental spillage or contact. They must, of course, like properly placed traps, be placed in rodent travel paths and touch a wall.

ATTRACTANTS AND FLAVORINGS - Although plain water is usually used as the poison bait carrier and attractant, acceptance is sometimes improved with the addition of various other attractants. Oil of anise has been used for many years at the rate of two drops per gallon of water to attract rodents. Orange juice or orange extract has been very effective in the South, particularly against the roof rat. (The cap on a 2-ounce bottle of orange extract will hold enough flavoring for one gallon of water.) Cranberry-prune juice, pineapple juice and Hawaiian Punch have attracted mice and rats in some tests. They are used at full strength. Remember, “mousy” or “ratty” smells contain pheromones to attract rodents. Sugar (up to 1/2 cup per gallon) has often been used to both increase consumption and lower the freezing point.

First try to control rodents without adding attractants, since they may be repellent to some of the rodents in a particular location. If acceptance is poor, one or more flavors can be tried in separate locations. It is totally illegal and extremely dangerous even if it’s extremely effective against rodents to put antifreeze in Hawaiian Punch - **so do not try this; it is very dangerous!** Try aspartame.

TRACKING POWDER - Tracking powder poisons have been useful tools for the control of rodents for many years. Tracking powders work because the rodent picks the material up on its feet and fur as it tracks through the powders. The toxic material in the powder can be absorbed through the skin or can be swallowed as the rodent grooms and cleans its feet and fur. **The Author does not recommend their use.** Anticoagulant tracking powder poisons, particularly Rozol, are effective when used properly and have the advantage of killing rats and bats as well as mice. They will kill any rodent (or mammal) that tracks through the fresh powder and then stops to groom itself. **Be very careful around children and pets.**

Tracking powder poisons have some disadvantages. They are more expensive than baits and are slow acting, requiring a week or more to kill. The anticoagulant content in a tracking powder is 40 times stronger than in anticoagulant baits and, thus, 40 times more dangerous to handle or place. They also can and do contaminate the ambient air. **Dead rodents stink! We do not recommend the use of (rat) poison!**

Suggested Use:

1. **Carefully** place poison dust only in areas that are runways or nests for rodents.
2. **Do not use** within a minimum 15 feet of exposed food or utensils.
3. **Carefully** place the poison dust where it is protected from children and pets. This can be done by placing it only in a wall void, behind cabinets, or by placing it in tracking powder stations. Never use it loose, especially in exposed areas where there is any breeze or air movement.
4. **Carefully** place the poison dust where it won't be blown onto food, food utensils or onto a surface that may be contacted by children or pets. This can be done by first thinking what could cause the poison to be blown...a nearby outside door or window, a fan (ceiling or otherwise), a refrigeration motor and fan, or an air conditioner outlet. Protect your poison dust by placing it away from drafts and/or by using it only in a secured child-proof tracking powder station.
5. **Carefully** place the powdered poison where it will not fall onto food or food utensils. It should be placed only at floor level or below. **It should never be placed on a ledge or in a ceiling area.**
6. **Carefully** apply with a spoon or very carefully with a duster. Avoid dusting into the air with a blast. The dust can become airborne and inhaled by a person which could be extremely dangerous.

Tracking Powder Poison Stations. These stations are devices to protect the pesticide poison from contact by children, pets and air currents, while providing shelter for the rodent, so that it may stop and groom itself right in the station. Ordinary bait boxes can be used, but a longer box will assure more contact with the powder. **Whatever you use must be properly labeled and positioned. Remove all poison as soon as possible!**

Historically, metal downspouts and plastic sewer pipe were cut in 18" lengths, labeled and used, as was 1" x 4" lumber, nailed together to form a *tube*. The stations were improved by adding ½ " quarter round at each end to help prevent blowing of the dust, but you personally must label this type of station and assume all risk.

Reasons for failure to obtain control with tracking powder poisons:

1. If tracking powder poison is placed in the open, rodents may run through the powder and travel a considerable distance before they stoop to groom themselves. The powdered poison may have fallen off by that time and contaminated a living area! Rodents are killed more as a result of grooming and cleaning their fur than they are from skin absorption of the material. Placing the material in a tracking powder station or in a natural shelter area will aid in better control.
2. If powdered poisons are put out in an unusually dusty area, the dust may cover the tracking powder poison and render it ineffective.
3. If the poison powder is placed in an unusually moist area such as a damp burrow, it may harden to the point that it won't be picked up by the rodent.

Caution: This is a very dangerous form of control. Be sure to protect yourself, your family, pets and food. Read and carefully obey the label(s). We do not recommend nor use this type of poison control.

POISONED BAITS

Warning: If you leave dry baits in a building more than a few months they usually will become infested with pantry pests, e.g., confused flour beetles!

If you use any poison, it should be placed in a tamper-proof bait station out of reach of children, pets and/or wildlife. These plastic containers hold the bait and lock with a metal screw. A small hole allows rodents to enter but denies easy access to children, pets and wildlife.

Mice can be controlled with anticoagulant baits if baits stations are no more than 10' - 15' apart. Small amounts of bait are needed, but mice must eat anticoagulant poison daily for up to 5 days before succumbing.

Water-soluble bait is not as important in mouse control as in rat control since mice require very little water other than that derived from food. **Don't run out of bait. Check bait daily during the treatment period and replace it as it is consumed. After the second or third night, move untouched bait to major feeding areas. Remember, dead rodents stink!**

Disturb rodents as little as possible during poison treatment. Keep the entire building closed and dogs, cats and people out. Remember that besides the inherent danger, another main drawback to poisons is that rodents crawl off and die in out-of-the-way places - resulting in terrible odors and insect infestations and may poison other animals that eat their dead bodies! Nontoxic (to human/pet) rodentisafe baits that will kill rodents include: foodstuffs mixed with Vitamin D or laxatives, Phenolphthalein, Alka-seltzer® or compressed sponges with bacon grease or peanut butter smeared on them or Pepsi or beer that still have "fizz" but, remember, they are not registered rodenticide poisons.

In 2003 the EPA began to re-register the nine (9) most commonly used rodenticides in order to prevent secondary poisoning. More restrictions are probably on the way. We do not recommend the use of any toxic rodenticide poisons.

Rodenticide	**Characteristics**
Multiple-dose Anticoagulants	
chlorophacinone (Rozol®)	Widely used by pest control companies; lower toxicity to humans and other mammals; risk of poisoning to non-target mouse predators.
diphacinone (Ramik®, Contrax-D®)	Widely used by pest control companies; lower toxicity to humans and other mammals; risk of poisoning to non-target mouse predators.
coumafuryl (Fumarin®, Fumasol®)	Relatively new material; a few resistant rodent populations reported.
warfarin and sodium salt of warfarin (d-Con®, others)	Most widely available rodenticides; widespread resistance reported, thus it may be totally ineffective in many areas; comparatively non-toxic to humans.
Single-dose Anticoagulants	
brodifacoum (Talon®, Havoc®)	May kill with a single dose; unknown risk of poisoning non-target species.
bromadiolone (Maki®, Contrac®)	May kill with a single dose; unknown risk of poisoning non-target species.
warfarin + sulfaquinoxaline (Prolin®)	Warfarin plus antibacterial agent to kill intestinal bacteria that produce vitamin K_1; it has been difficult to prove superior effectiveness.
Single-dose Non-anticoagulants	
The Author does not advise their use.	
zinc phosphide	Very widely used material; has garlic-like odor; available as a dark gray powder, insoluble in water.
strychnine	Extremely hazardous to non-target organisms.
cholecalciferol (Quintox®, Rampage®)	Mobilizes calcium from bone matrix to plasma; death is from hypercalcemia 3 - 4 days after eating a fatal dose.
Fumigants	
carbon dioxide	Useful in small, enclosed spaces; the safest of all rodenticides - kills by excluding oxygen.

Biological Control of Rodents has been used in Russia since about 1980. Two commercial microbial rodenticides, both containing cells of *Salmonella enteritidis* var. *Issatschenko* are available there for use against rats, mice and voles.

Laxative Control of Rodents - Feeding chocolate Ex-Lax® or a favorite food laced with a strong laxative will quickly kill rodents who will literally defecate themselves to death. There is usually less odor.

ANTICOAGULANT RODENTICIDE POISONS - Anticoagulant poison baits, beginning with Warfarin, have proven to be very useful tools in rodent control. They are eaten over a period of days, and interfere with the coagulation of the blood of the animal which then bleeds to death, either through an injury or by internal hemorrhage. Since rodents apparently cannot detect anticoagulants in a bait, they continue to feed until death occurs in from 3 - 14 days, depending on the type of rodenticide and the amount eaten.

The main advantage of anticoagulant poisons is that there is usually little chance of secondary poisoning. This means that pets that eat poisoned rodents probably will not be killed. There is, however, danger to pets from eating anticoagulant baits directly, particularly those containing Diphacin. There has been a problem with forgotten poison baits becoming infested with stored product pests and they have been reported contaminating the ambient air if conditions are right.

Single dose rodenticide poisons are used where a quick kill (within 24 hours) is needed. Unlike anticoagulant poisons, they kill with a single feeding. Although *necessary* on some occasions, use should be discontinued after initial control is achieved. Unused baits should be removed a.s.a.p. and replaced with safer baits. **Follow the label directions very carefully. Keep everyone out of the building.**

SINGLE-DOSE RODENTICIDE POISONS - **Single dose rodenticides have several disadvantages. Most of them can also kill pets or children with a single feeding. Secondary poisoning of pets and raptors can occur if the guts of the poisoned rodent is consumed.** Rodents that recover from a sub-lethal poison dose will usually avoid that bait for months afterwards. **The Author does not recommend their use!**

Single dose rodenticide poisons include DLP 787 (Vacor), chlolecalciferol, zinc phosphide, red squill, strychnine baits and 1080/1081. DLP 787 is the *safest* single-dose rodenticide and gives consistent control of both rats and mice.

Zinc phosphide will give good control of both rats and mice but is more dangerous to pets and children and cannot be used effectively more than 2 - 3 times a year.

Strychnine is very poisonous and should be used only under very carefully controlled and supervised conditions. No people or pets should be inside the building during the entire baiting process.

1080 (or 1081) should never have been used. It is much too dangerous, has no antidote and has been responsible for many human deaths.

The *safest* poison choice against Norway rats is red squill but, unfortunately, control is variable and it is not effective against roof rats and mice. Try aspartame and/or a laxative bait.

Antu (alphanapthyl biourea) is a highly toxic to Norway rats but will not control roof rats or mice. It is relatively safe to man and many domestic animals, but dogs, pigs and chickens are highly susceptible. **Antu has several drawbacks**: It absorbs odors making baits unattractive rapidly. Young Norway rats have a natural Antu tolerance. Adult Norways develop bait shyness and a tolerance for sub-lethal doses. Antu should only be used once every 6 - 12 months due to the rapid build-up of tolerance to this poison. Baiting in fall or winter is desirable because breeding is at a low state and few young are present. Antu is available as a 20% tracking powder. It is insoluble in water and can not be used as a water poison. It kills by filling the lungs with fluids and/or acute lung dropsy.

DLP-787 (Vacor) is another rodenticide poison that can kill with a single feeding. Death usually occurs within 24 hours on Norway rats, roof rats or house mice. This poison is available only as a ready-to-use bait and is labeled for indoor use only.

Although it appears to be safer to man and dogs than other single-dose poisons, **it apparently kills cats at a lower LD_{50} than mice.** Extreme care should be used around homes for this reason. DLP 787 apparently interferes with the ability of the body to absorb Vitamin B-1. Secondary poisoning does not seem to be a problem in laboratory testing. Dead rodents should be picked up, if possible, and removed from the premises for proper disposal. Early reports indicate very few bodies are found, indicating that rodents probably die in harborage areas. **Dead rodents stink!**

Red squill (a/k/a scilla or sea onion) is obtained from the bulb of a lily-like plant that grows in the Mediterranean region. It is a quick-acting rodenticide with a natural emetic action that causes most animals to vomit (rats can not vomit). Its strong taste and disagreeable odor generally makes it unacceptable to roof rats and mice. Use only a fortified squill. Minimum acceptable strength is 500 mg/kg for concentrate. Finished bait will contain about 10% of this concentrate. Carefully mix according to the label. Fresh meat or fish are good bait materials for increasing acceptance of red squill. Even then, results are often less than satisfactory. However, where safety and quick kill are needed, squill may fill the bill. Rats surviving red squill develop bait shyness so at least three months should elapse before rebaiting with red squill. Red squill absorbs water from the air and quickly becomes caked and hard. Store it in tightly sealed containers. It is extremely irritating to the skin, so wear rubber gloves when mixing baits. When handled without gloves the needle-like crystals of calcium oxalate, irritate human skin and produce a stinging sensation. Red squill was first used in North Africa in 1500 B.C.E. **Dead rodents stink!**

Strychnine is a quick-acting, extremely deadly poison that has been used for many years for mouse and bird control. It is a natural poison known as *Nux vomica* and is extracted from the seed of an Asiatic tree. It is extremely poisonous to man and has figured in suicides, murders and some fatal accidents. It is one of the few products used in the pest control industry which carries the skull and crossbones, signifying an extremely dangerous poison.

Advantages. Strychnine can give overnight control of mice. If used properly, only small amounts need to be consumed by mice for fatal results. The small size of the grains used with strychnine (slightly larger than BB shot) permits their placement inside wall voids and in crevices where no other animal can get to it.

Disadvantages. Strychnine is extremely toxic to any animal that eats it. A bait dish could contain enough poison to kill any child. It is only effective on mice. Because of its bitter taste, rats will avoid eating a fatal dose, so a separate poison must be used if both rats and mice are present. Strychnine has no effect on grain insects, hence the grain bait base can quickly become infested with these pests, which reduces the attractiveness of the bait to mice. **Dead rodents stink!**

Prolonged exposure to sub-lethal doses of strychnine poison causes tolerance to develop, so it is not a good repeat poison.

Proper control. It must be placed where children and pets cannot get to it. Bait stations would not be sufficient protection if children could life the bait box and shake the poison out. Strychnine should be used only as a last resort and then only in wall voids or other areas that preclude any chance of an accident.

Zinc Phosphide. This rodenticide poison has been used for many years and is a toxic and effective rat poison. Death usually occurs within 24 hours. It is a black powder, slightly soluble in water and with a distinctively disagreeable odor which does not repel, but may attract rats. It is safer than other highly toxic rodenticide poisons because both its odor and color are usually objectionable to man and pets.

Zinc phosphide has a toxicity of about 40 mg/kg for rats. It is used 1% by weight in baits (1/6 oz. per lb. of bait) which must be thoroughly mixed because of the small amount required. It is exceptionally well suited for coating cubes of fresh fruit or vegetables, (an even gray coating will be observed over all surfaces when mixing has been adequate.)

Poison baits may be prepared outside by placing 1/2" cubed materials and zinc phosphide, after each is carefully weighed, in a paper bag or an ordinary bucket. Another easily prepared bait can be obtained by mixing 1/6 oz. (3/4 tsp.) of zinc phosphide with a 15½ oz. can of cat food an placing it where rats can eat the material but, of course, protected from cats. **Never use without a mask and only when all people can stay out of the building until all baits are consumed or completely removed**.

This poison should only be used when very secure bait boxes and other safety regulations are obeyed. **Zinc phosphide baits should be used only where a toxic poison will never be touched.**

Zinc phosphide kept dry in a sealed container is quite stable. It should last at least 3 years. In the presence of moisture, it decomposes slowly. Some phosphine gas will be given off, particularly in the presence of dilute

acids. Since phosphine gas is very toxic, mixing should always be done outside. Mixing with citrus or other high acid foods will cause a faster reaction. This reaction, however, will cause only a minor decrease in the poison effectiveness of the baits. Zinc phosphide is toxic if eaten or inhaled and can be absorbed through cuts or breaks in the skin. It is important to wear rubber gloves and a respirator when mixing the bait.

Fresh baits, with a great deal of moisture, may lose their potency but dry grain baits are considered to be lethal indefinitely. Some tests show zinc phosphide on apples and potatoes to still be 98% effective after 48 days. **All baits should be recovered and destroyed before letting the occupants reenter.**

Zinc phosphide should only be used when quick kill is an absolute necessity. Secondary poisoning of pets can occur if the pets consume enough of the guts of poisoned rodents. Remember, all rodenticides are poisons used to kill mammals; dead mammals stink, other mammals can die and we do not recommend their use.

Reasons for unsuccessful rodent control: Poison and traps should be placed in every area rodents frequently use as evidenced by their droppings, often this is not possible or practical without removing all of the occupants and pets. More rodents were attracted or *recruited* into your building, especially if you forgot to rodent-proof the building; left garbage and other potential rodent foods improperly stored and sealed; trash, debris, construction material, firewood and other potential shelter areas left as harborage for rodents. You did not use enough stations or traps or place them properly. The main reason rodenticide baits and traps are ineffective is because of the literally tons of food waste that is readily available to rats every day in unsecured disposal (garbage) containers. **Install and then daily use a sealed, sell-contained compactor**. It is all in one piece and has no openings to allow rat access. A key feature is a protective enclosure called a “dog house” - doors that close tightly over the loading unit. **This is true IPM rat control.** There are dozens of manufacturers of self -contained compactors. They range in size from 40 down to 6 cubic yards. They are the state-of-the art technology for compacting large volumes of wet wastes with food material. **They can substantially decrease the rat populations around large buildings**. If you have a small building, a small amount of waste, or a very limited space for a compactor, there are vertical, pest-proof, watertight compactors down to 1 cubic yard that are emptied by a front-loader truck. **No spillage, rodent-proof, fewer flies, fewer yellow jackets, less odor**. If you have an extremely sensitive building or a very high initial rat populations, there is an ozone generating unit that is hooked up to the compactor and fills its interior with ozone. The ozone greatly inhibits bacterial growth inside the container and decreases, if not eliminates, the odors associated with organic decomposition thereby making the unit even less attractive to foraging rodents, flies and wasps. **Killing rodents without correcting the cause is dangerous and useless!**

Until all rodent populations are eliminated or at least brought under control you should also store all attractive food, even closed, packaged crackers or candy, in the refrigerator. Bags of grass seed, dry pet food, garbage and other food materials should be put in metal or screened bins tough enough to foil rats and mice. Fallen fruit, nuts and similar foods may be feeding rats in your neighborhood. Rake, sweep or scoop them up with a flat shove and properly dispose of them daily. Stop feeding them.

In most areas, improperly managed garbage is the main source of food for rats. Clean it up and store it away properly. Electric garbage disposal units may reduce cockroach and ant problems in the kitchen, but they can exacerbate rat problems by feeding rodents within the sewer system.

In commercial settings where garbage is stored in large metal dumpsters, lids should be sealed tightly when closed and kept closed when dumpsters are not in use. Some dumpsters have drain holes to allow them to be hosed out periodically to remove organic material that sticks to the inside. These holes should be fitted with removable plugs or wire mesh screens or else these holes will turn the dumpsters into huge feeding stations for rodents by providing easy access close to the ground. **Use a compactor. It is important that no refuse falls next to the dumpster,** particularly on school grounds where people often throw waste in the general direction of the container. In such situations the area around dumpsters should be monitored daily before dark. All misplaced material should be thrown into the dumpsters and the lids kept tightly closed for the night. You can protect your garbage cans against rodent invasion by setting them on at least a 12” high platform and equipping them with spring fasteners or elastic cords available from hardware stores. Use two cords per can. For permanence you can bend the metal hook ends of the cords completely around the can and lid handles. This system has the extra advantage of keeping cans and lids together after the trash collector empties them. **Remember to practice good sanitation and exclusion!**

INTELLIGENT PEST MANAGEMENT® EXCLUSION OR RODENT-PROOFING A BUILDING:

- Safe Solutions Enzyme Cleaner with Peppermint, castor oil, peppermint oil, spearmint oil are all common rodent repellents.
- Norway rats can enter buildings through breaks in sewer lines and cracks in concrete foundations. Caulk all cracks, crevices and other openings. Look for rat holes and rub marks. Install strobe lights.
- Any hole a rat can fit its skull through (1/2" in diameter or larger) can provide entry. Plug such openings temporarily with tightly-packed (coarse) copper, or steel wools then permanently seal them with 19-gauge or thicker galvanized metal sheeting, 1/4" hardware cloth (strong wire mesh) or 22-gauge or thicker aluminum sheeting. Do not use plastic, wood or other chewable materials.
- Seal holes in foundations of buildings or entrances to rat burrows with a minimum of 2" of reinforced mortar mixed with iron filings (from machine shops) or broken glass pieces 1/8" to 1/2" long. (Old time pest control people used to say a rat can chew through any glass - but a broken, green Coke bottle.)Shake the filings or broken glass pieces into the mortar as you are mixing it. The glass or the filings deters rats from digging the filled holes out again before the mortar hardens, or chewing through it later. Use 3¾" thick mortar, hydraulic cement if you don't use the filings.
- Cap drains in the floors of basements so rats cannot enter through them. Install a brass drain cover or a perforated metal cap held in place by a hinge so it can open for cleaning. Make sure the unhinged type of cover is threaded so it screws in place, otherwise the rat can push it open. Place 1/4" galvanized screen under existing drain covers to prevent rat entry if holes are larger than 1/2". Properly install exterior bait stations and/or covered traps.
- Place barriers between and within walls to prevent rodent travel. Any open space between floor joists gives rats free access to wall voids. Wooden 2 x 4 stops are sometimes used on upper floors, but a noncombustible material should be employed on lower floors. In old buildings. Galvanized sheet metal can be cut to fit and nailed between studs, joists, floor and sill. In new construction noncombustible stops of a good grade of cement are recommended.
- Install flashing or metal channels on the lower edges of doors to prevent rat entry. The channels can be made by bending galvanized sheet metal in a U-shape to fit the lower edges of the door. They can be fastened with screws. The clearance between the door and its threshold should not exceed 1/4". The door easing should also be protected with sheet metal to prevent rats from widening cracks by gnaing. Frequently used doors should be equipped with mechanical self-closing devices. Use duct tape to temporarily prevent mice from entering.
- Install a pair of free-range Guinea fowl outside.

INTELLIGENT PEST MANAGEMENT® HABITAT MODIFICATION AND SANITATION

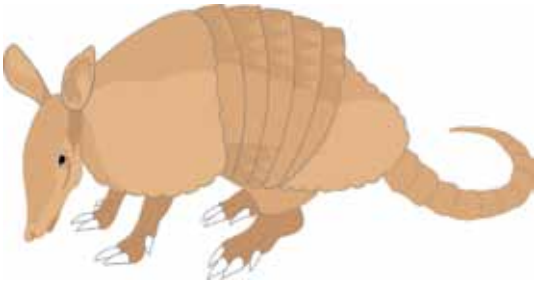
- Practice proper sanitation and exclusion. When you clean with Safe Solutions Enzyme Cleaner with Peppermint, you literally repel mice. Install strobe lights in all dark areas.
- Identify and record all high activity areas and work to change the conditions conducive to infestation, especially in these areas.
- Store lumber and equipment at least 18" above the ground on a rack. Prop the legs on concrete blocks to prevent decay and rusting from damp soil. Trim all branches that touch or overhang the building. Tall grass and other vegetation should be kept low. Keep outdoor areas free of trash and other rodent harborages. Frequently empty and clean dumpsters.
- Prevent rodents from finding water and food inside and around the building by proper storage of garbage and other potential food sources and correct all moisture problems. **Feed birds only in the winter.**
- Rodent proof your building by keeping it sealed so that rodents can not find an entrance 1/4" or larger.
- Check incoming packages, furniture and/or appliances to ensure rodents are not coming in with them.
- Use compactors or enough cans with securely fitting lids to hold all your garbage - store on racks at least 18" above the ground. Do not store surplus garbage in cardboard, plastic or paper bags that can be penetrated easily by mice and/or dogs and/or rats. Schedule daily garbage pick-up immediately after lunch.
- Wash out cans and dumpsters periodically with diluted Safe Solutions Enzyme Cleaner with Peppermint and/or borax so that no organic matter remains after they are emptied.
- Never leave garbage cans open during the night, and don't leave garbage outside in plastic bags or cardboard boxes. Routinely spray all cans and dumpsters with diluted enzyme cleaners or soaps.
- Pick up or properly bury (24"+ deep) all garbage, fallen fruit and pet feces daily. Store pet/livestock feed in

metal/glass canisters. Put away any food that pets or livestock do not eat between feedings.

- Install several radios and play rock and roll music 24 hours a day at a level loud enough to be just heard outside the building or areas you wish you exclude rats.
- To reduce rat harborage in landscaped areas, avoid large expanses of single-species ground cover that allows rats to run undetected for long distances. Break up dense plantings with exposed pathways, stretches of lawn or highly prostrate ground covers. Remove shrubs and closely mow grass at least weekly. These openings act as deterrents because rats dislike moving across exposed areas. Avoid plants such as Algerian ivy *(Hedera canaariensis)* and date palms that rats are known to live in or feed on.
- You can make a rat-proof barrier to separate landscaping from the foundations of adjacent buildings by digging a small trench 8" - 12" wide, 8" deep and as long as the building and filling it with pea gravel. Rats dislike burrowing in the loose gravel and will be discouraged from trying to penetrate the foundations. Don't forget to also cover drainage ditches with pea (or smallish) gravel and keep them weed free.

INTELLIGENT PEST MANAGEMENT® RODENT SUMMARY - Rodent proof your buildings; clean with Safe Solutions Enzyme Cleaner with Peppermint, bait with aspartame and correct all other conditions conducive to infestation. Install free-range Guinea fowl outside.**Stop feeding the rodents or give them names, they have become pets not pests. Review control and management sections.**

Nuisance Wildlife - As we continue to build homes in underdeveloped areas urban wildlife control will continue to be one of the fastest growing areas of the pest control industry. Before you begin to follow these suggestions, make sure you have all of the proper permits and know about and follow all of the appropriate regulations!



ARMADILLOS
CLASS - Mammalia
ORDER - Edentata
FAMILY - Dasypodidae

Armadillos are members of a primitive order of mammals, which includes ant eaters and sloths, known as Edentata. The scientific name of the nine-banded U. S. species is *Dasypus novemcinctus* (Bailey). The nine-banded armadillo gets it name from its protective *armor* of horny hard skin. This armor covers the entire body, tail, head and legs, except for the ears and underside which is sparsely covered with hair. Its legs are short with well developed claws and its snout is long and has an ant eater-type tongue. Armadillos are beneficial because they are voracious feeders of pests such as worms, insect larvae and pupae, fire ants, termites, roaches, spiders and scorpions, but they are not liked because of the damage they do to compost piles, cemeteries, golf courses, parks, lawns and gardens in their search for food. They also undermine orchard trees, house foundations and break out water levees as well as leave holes in fields that are a hazard to animals and farm equipment. Armadillos can be infected with Chagas' disease, leptospirosis and a leprosy-like disease. Armadillos are nocturnal but may be seen during the day. They live singly in burrows with a home range of about 50 acres. Their burrows are 7" - 8" in diameter and may be as long as 25' with a single entrance. They can run surprisingly fast, swim very well and even dig a burrow in a relative short time. They have poor eyesight, but excellent hearing and smell. The head and body are 15" - 17" long with the tail; they are 24" - 31" long; they are heavy, weighing 8 - 17 pounds. The armadillo cannot tolerate cold because it does not hibernate. They generally like dense shady cover, e.g., thickets, tall grass, brush, woodlands, pine forests or stream bottoms... any place where there is a good insect population. While feeding they follow a rambling hunting path, rooting with the snout and digging under leaves and other debris for insects, toads, frogs, snakes, lizards, scorpions, crayfish, earthworms and a variety of insects. As they excavate, they do considerable damage. Gestation is about 5 months. The armadillo mates in mid-summer and young are born in February through April. There are always four genetically identical quadruplets born from the same egg. The young have a soft coat of armor that does not harden until they are fully grown. They are nursed for about 2 months and also feed on insects before they are weaned. They are thought to spread leprosy in the USA.

Intelligent Pest Management Control Overview: Fence them out. Search for them at night - the animals are best caught in the early evening hours using a very bright light (appropriate clearance should be obtained from any appropriate wildlife authorities). Use a fish landing net with a 10' - 15' handle. The long handle enables

you to get closer to the animals without scaring them. Move slowly and quietly until within reach. Armadillos have the tendency to jump straight up into the air when first startled, a trait that serves to get them even further entangled in your net. If netting fails, set live traps such as Havahart, National, etc. They should have a least 11" x 11" openings. A wooden trap can be built according to specifications from the Texas Extension Service. The live traps can be baited with overripe or spoiled fruit such as pears, apples, etc. Traps should be set under cover rather than in open areas. As a last resort, use a No. 330 Connibear trap. Connibear traps are very powerful and great care must be exercised in properly placing them where pets, children and irresponsible persons will not be injured. Check local regulations since several states currently have legislation pending on the use of leg hold traps and other types, including live catch traps. Look for trails used by armadillos, holes under fences or dens. Tunnels or walls of brush or sticks should be used to lead the animals to your traps. If legal, you can "shine them" at night; **they will "freeze" in a bright light for a moment** and can be netted, shot or clubbed. They are edible.

Additional Controls for Armadillos

Using insecticide poisons or Pestisafes®, e.g., Safe Solutions, Inc. enzyme cleaner sprays that act to restrict the food sources (i.e., reduce the insect population) may help to reduce but will not stop armadillos from digging. It is important to realize that no poison chemical treatment will eliminate all of the armadillo's potential food sources and all chemical/poison "treatments" will have to be reapplied periodically virtually forever to have any impact.

Where highly valued plantings are in need of protection, small fences may be used to keep these animals out. These fences should be approximately 24" high with half of the fence buried below the surface of the ground.

Armadillos can be trapped in live traps such as those available from Havahart (model 1079 or 1081), 69 N. Locust St., Lititz, PA 17543, http://www.havahart.com or in Tomahawk (Nos. 108, 109, 207, 208), P. O. Box 323, Tomahawk, WI 54487, http://www.tomahawklivetrap.com or in homemade box-type 1'x1'x3' traps. Traps should be located near the entrance of armadillo dens or burrows and baited with live earthworms and surrounding soil placed in bags made of old nylon stockings so the odor of the earthworms can still be sensed by the armadillo. Trapping is most effective when leaf litter or soil is placed over the entrance to the trap to create familiar surroundings. If other species of animals get into these live traps, they can also be released unharmed. **Use marshmallows.**

Other methods of trapping include:

- firmly inserting a 4-inch diameter PVC pipe into the entrance of an active burrow (regular-sized) armadillos will often get stuck in the pipe as they try to exit the burrow); they are not very smart.
- a nylon throw net used for fishing can also be loosely staked down so it covers the burrow entrance (some armadillos will get tangled in the nets after they emerge).

Because armadillos are nocturnal, PVC pipe and net techniques should be applied late in the afternoon and checked several hours after darkness. Leg hold traps (Nos. 1 or 2) or Conibear traps (size 220) can be used as a last resort - **but the Author never recommends their use in urban or suburban situations**.

Relocating problem animals to another area is not recommended. This approach only transfers your problem somewhere else, can enhance the spread of diseases and upsets the balance of nature in the receiving area. **Call your local wildlife people for suggestions.**

Armadillos can be discouraged from returning to burrows if you fill the hole with a mixture of dirt and mothballs or predator urine or freshly ground pepper (the hotter the better) and/or talcum powder after you are sure that they have left for the night, or you can fumigate with carbon dioxide to kill them during the day.

Shooting is another method frequently used to control nuisance armadillos. Should you choose to control armadillos by shooting, be sure it is legal in your specific vicinity. Remember that it is usually illegal to use artificial lights to aid in the shooting of armadillos at night, but they will freeze for a moment when a bright light hits their eyes. Also, remember that armadillo meat is edible if properly prepared (fried or barbecued) and there is no bag limit or season on them in most states. **Fumigate** burrows with carbon dioxide (dry ice or gas) or carbon

monoxide (lit charcoal briquettes) during the day. Poison baits are both illegal and ineffective.

A combination of control methods will likely be most effective.

BEAVERS - The Author wrote an interesting "beaver" letter that can be found at:
http://www.getipm.com/personal/dam.htm

CHIPMUNKS
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Sciuridae

Chipmunks, such as the Eastern chipmunk *(Tamias striatus),* the Least chipmunk (*Tamias* (formerly *Eutamias) minimas)* and the Western chipmunks (*Tamias* (formerly *Eutamias*) *spp.*) are usually small solitary rodents closely related to ground squirrels; they sometimes cause trouble when they burrow under buildings and into flower beds, lawns and golf courses. Most chipmunks have alternating light and 3 - 5 dark longitudinal strips on their backs that run nearly to the tip of their noses. They are active by day. Chipmunks are very territorial and have small ranges less than 100 yards - normally you will only find 2 - 4 chipmunks per acre. If you feed the birds, you may end up with 7 in your front yard, like the Author did in 2003.

Chipmunks usually live for up to 5 years in underground burrows but are also found climbing trees, porch railings, rain gutters, roofs, fences and inside building walls and wood piles. Their underground burrows are sometimes lengthy, covering 30' or more, but are rarely conspicuous. They are most active from spring to fall, spending most of the winter in their burrows. All species breed during spring or summer and have about a one month gestation period. Two litters of four young are produced - one in spring and the second in late summer/early fall. The daily diet of chipmunks consists of seeds, nuts, grains, fruits and insects. Some go into hibernation in fall. They can live 3-4 years in the wild. Protect garden beds with dried blood meal and/or freshly ground pepper and/or talcum powder and/or well used kitty litter.

Intelligent Pest Management® Chipmunk Control can be accomplished using exclusion or shooting or traps or, if you insist, by using registered poisons baits in the same manner as described for ground squirrels. Due to their size, rat-size snap traps or glueboards or live traps or Sherman traps are highly effective; chipmunk traps should be baited with apple slices, nutmeats, sunflower seeds, bird seed, high quality grains, e.g., wheat, barley, oats or peanuts, peanut butter, corn (especially sweet corn) or rolled oats or oatmeal or mixture of baits and then covered. Covered traps should be placed around rock piles, logs or near burrow entrances and covered with a box. Kill traps are seldom more effective than properly placed live traps, so why use them? They are potentially dangerous to people, birds, pets and other wildlife. If you must kill them - shoot them. Hardware cloth (1/4" mesh) is the best exclusion and/or trap material available. Try using a version of Walk-the-Plank™ rodent trap - take a 5-gallon pail, suspend a pop/beer can (with a hole on either end) over the pail with the bottom half of a clothes hanger through the holes in the middle of both ends - smear honey and/or peanut butter on the bottom of the can (or simply float whole sunflower or bird seeds on 5"-8" of water). Place a yardstick or similar *bridge* to the ridge of the 5-gallon container - put in 3" - 4" of water and wait. The chipmunks will walk up the *bridge or plank* to the rim, onto the wire to the can and then roll off (or simply jump into) your trap and drown.

Whenever handling chipmunks or any other wild rodent (dead or alive) gloves or tongs should be used since the animals or their ectoparasites may carry dangerous diseases. Be sure to check in with the local wildlife people before beginning your controls. **Also see ground squirrels.**

INTELLIGENT PEST MANAGEMENT® CHIPMUNK CONTROL

Only rarely do chipmunks become a serious pest problem but at times they cause concern because they can serve as a source of plague and other diseases. They forage up to half an acre. In most cases, lethal control is unnecessary. Altering the habitat may cause the chipmunks to move.

- Sprinkle dried blood or blood meal or talcum powder or freshly ground pepper where you want to repel them. If you decide to shoot them, use a .22 or small gauge shotgun and be very careful.

- "Chipmunk-proof" the building to prevent entrance. Use 1/4" mesh hardware cloth.
- Remove objects such as stones, logs and debris close to a structure that may provide an attractive denning environment.

Trapping. Live trapping with live traps or a *dry* version of the *walk the plank* and relocating chipmunks (where permitted) is considered a humane method of control. Effective baits include peanut butter, nuts, sunflower seeds, oats, corn, bacon and apple slices. Relocation should be done into remote forest areas five miles from the trap site. Filling a 5-gallon pail half-full of water and floating bird or sunflower seeds on the top with a board to the rim will quickly control chipmunks, but be sure you can legally do so in your area.

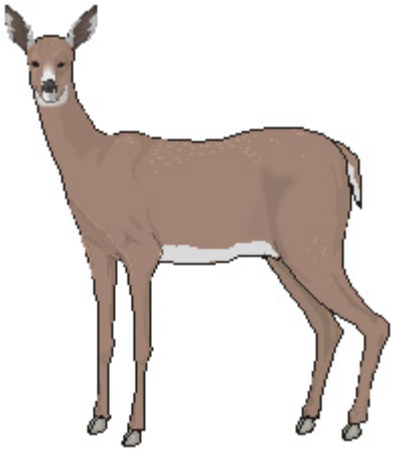
Rat snap traps, glueboards or Sherman traps can also be used effectively. Traps should be placed at den entrances and baited with an apple slice, perhaps with some peanut butter. Seeds and nuts should not be used because they will attract ground-feedling birds.

Poison baits that are labeled for chipmunk control can be used as described for ground squirrels, but we do not advocate their use. Burrow fumigation is not usually a recommended control tactic because chipmunk burrows are too long, too difficult to find, and often too near buildings if you must fumigate try dry ice or lit charcoal briquettes at night - be sure to seal all openings. **Be very careful with any poison and/or lethal (kill) traps.**

Fumigation of their burrows can be accomplished with any vapor that is heavier than air, e.g., dry ice or carbon dioxide in a cylinder (CO_2), propane or several lit charcoal briquettes **(but never both at the same time).**

DEER
CLASS - Mammalia
FAMILY - Cerridae

Habitat and Food Habits



Deer generally favor a mixture of forest habitat and open country, which provides both food and protective cover. They are usually not abundant in dense forest, and often thrive in agricultural areas and on the edges of towns. The white-tailed deer, *Odocoileus virginianus,* often lives year-round in orchards, streamside thickets, and other low-elevation habitats. In 1909, New Jersey estimated it had less than 100 herds; now they estimate over 160,000 herds. The mule deer, *Odocoileus hemionus,* often winters in the same Southern interior valleys as the white-tailed deer, but it is more migratory and tends to summer at higher elevations. Food habits of the two species of deer are similar. A wide variety of woody plants are eaten, with favored species including aspen, willows, red-osier dogwood, snowbrush, and juniper. In summer, many herbaceous species are eaten, including several species of grasses. It does not take deer too long to realize a man in the woods is dangerous, but groups of people present no danger. It is against the law to hunt in the city and in the suburbs, so deer and other "nuisance" wildlife begin to see your lawn as their protected park.

Damage and Damage Identification

Insurance companies expect to pay about $1 billion in claims for an anticipated 1.5 million automobile/deer accidents in 1998. In 1997 68,000 motorists in Michigan hit a deer, including the Author and his son, Victor. Michigan had 63,136 reported vehicle-deer crashes reported in 2002 according to AAA Michigan. Michigan has approximately 2 million deer and leads the Nation in car/deer crashes. Cornell Cooperative Extension Service estimated that total deer damage Nationwide is in the 2-billion-dollar range.

Most deer damage to plants takes place from late fall through early spring, when wild foods may be in short supply. Buds and twigs of a wide variety of cultivated plants are eaten, but damage is most frequently reported to fruit trees, grapevines, rose bushes, and ornamental conifers, especially cedars. However, many kinds of garden plants tend to be avoided by deer, and if you live in an area where deer are abundant, it may be possible

to minimize deer damage problems by carefully choosing deer resistant plant species for your garden and/or yard. As we evelop and destroy their native habitat, deer will become more and more of a suburban pest problem.

Deer will also eat leaves, limbs and buds of many garden bushes and plants during the growing season, although such damage tends to be less severe. Deer damage is usually easy to identify. Twigs eaten by deer usually show a ragged or torn edge, unlike those eaten by rabbits or rodents, which appear to be cleanly bitten off. In many cases, the damaged stems are at such a height that other garden pests can be ruled out. Even if deer are not seen, there are usually signs of their activity such as tracks or pellets of manure. Deer browsing will cause over $250 million in damages this year to flowers, shrubs, trees, bushes and vegetables to just homeowners. One State of Michigan Student watched helplessly as deer ate up the trees he planted for his doctorate thesis.

Do not forget Lyme Disease and that the deer tick *(Ixodes scapularis)* uses the whitetail deer and white-footed mouse as reservoirs of that disease.

Legal Status

Deer are valued game animals, and are generally protected except when being hunted during a legal hunting season. On very rare occasions, where deer are causing serious losses to commercial orchards or nurseries, groves or airports and all other damage control measures have been ineffective, kill permits may be issued or special limited-entry or swat team hunts may be held. However, kill permits would not normally be issued for deer damage to a home garden or your front yard.

Intelligent Pest Management® Damage Prevention and Control Overview

Three major methods of damage prevention or control are available for the home garden: fencing, resistant species and chemical repellents. Fencing (especially woven wire or invisible or solid panel fencing) tends to be more effective, but is more costly; it should be considered if deer damage on your property is severe and/or persistent. Repellents, which are less costly but tend to be less effective, may be adequate if deer damage is infrequent and only of light to moderate severity. Choose resistant plant species and the deer will go over and much your neighbor's salad bar for deer. Ring your garden with garlic.

Deer can cause extensive damage to gardens, orchards, ornamental shrubs, and other valuable crops by browsing on twigs, buds and leaves. Invisible fencing can be used to keep barking dogs inside an area, e.g., an orchard, field or garden to chase deer out. The underground fencing works by sending a radio signal to a receiver on the dog's collar, which gives the dog a slight shock if it leaves the property and its *guard duty* - the deer leave and the dogs stay. Herding breeds of dogs, e.g., border collies, are better at removing deer than most deer-chasing mongrels. Two male dogs are more effective than females or a single dog. The wire that activates the shock collars on the dogs does not need to be buried. Two dogs can protect up to 150 acres of orchard. House and feed the dogs within the wire area. You can also permanently fence deer out from sensitive areas. This is the most permanent solution to deer problems; unfortunately it is also the most expensive. Plastic netting may also be used to protect individual trees and shrubs. Check your local ordinances before installing devices such as electric or barbed wire fences. Random popping of a propane popper will drive out any deer but "may also annoy" your neighbors. Hang a sweaty work shirt and/or a smelly pair of shoes or a dog blanket wherever you want the deer to avoid. Simple *home* repellents such as bars of scented soap (with a hole drilled in the middle) hung in the general area are effective for a limited time. Because of its low cost and moderate effectiveness, soap has been extensively used by orchardists. The major weakness of repellent use is deer hunger. A starving deer will simply ignore all repellents. Soap, human hair, hot sauce, garlic, rotten eggs and/or castor oil sprays, freshly ground peppers, predator scent, blood meal and other esoteric repellents have been used successfully to repel deer temporarily, so routinely vary them to increase deer repellency.

The best way to prevent deer damage is to exclude them with a strong fence. Whitetail deer can jump 15 feet vertically. We prepare a virtual gourmet feast for native deer in our yards that provide them with lawns to graze on and lots of low shrubs and tree limbs to nibble. Fences can pay for themselves when used around orchards

or areas of intensive agriculture. A tight chicken wire fence at ground level will deter rabbits, but deer are great jumpers. If you place, at intervals, two disposable aluminum pie tins tied next to each other, they will clang and shine in the slightest breeze and have a wonderful startle effect. Lightweight posts can be placed around the garden and a light wire strung at the top. Deer fear entanglements and won't try to jump through the opening. An effective 8' tall deer fence can be constructed by stacking two 4' widths of cattle or hog wire fencing, one on top of the other. Posts used should be 12' long and the bottom of the fence must fit tightly against the ground or deer will slink under it. A slanted deer fence can be constructed with only one width of hog wire if it is slanted at a 45° angle away from the crop. Deer will walk under the overhang and be unable to jump the fence. A snow fence is appropriate for small areas that are less than 40' x 60'. Since deer prefer to squeeze through a fence, electric fences do not have to be 8' tall. The shock provided on contact is enough to modify most behavior. After a few shocks, deer approach no closer than 3' to 4' feet. As they like to be within inches when they jump a fence, the electric shocks also prevent jumping. A single electrified strand 2½ feet off the ground that uses peanut butter bait to encourage deer to touch it with their tongue - after such a traumatic encounter deer learn quickly to avoid the fenced area. Adhesive tape is wrapped around the wire at 3' intervals and treated or coated with peanut butter. Aluminum foil is used to cover the peanut butter on the adhesive tape or a 1 to 1 mixture of peanut butter and vegetable oil can be wiped directly on the wire each month. An electric fence charger is then attached to the wire, and the charger is grounded and connected to an electrical source. U. S. deer populations have increased to approximately 25 million, up from 1 million a century ago; as deer populations increase, conflicts with cars, landscaping, gardens and people also increase. White-tailed deer *(Odocoileus virginianus)* and mule deer *(O. hemionus)* make up most of the population.

Strings of alternating or blinking Christmas tree lights or strobe lights will often repel deer from an area. Try repelling deer by hanging perforated cans of rotting fish/animal guts/slaughterhouse tankage 3' - 5' high around the garden. Predator urine or feces (from coyotes, mountain lions, African lions, snow leopards, Bengal tigers, etc.), baby powder, feather meal, meat meal, garlic, *Denatonum bengoata,* kerosene/creosote/bone tar oil soaked rags or mothballs can also be used to repel deer. Try spraying hot pepper sauce (2 tablespoons per gallon of water) and or castor oil to repel them. Repellents work best during the warm months (April - October). Castor oil plants will be actively avoided, but they are also poisonous to humans. Deer prefer to eat corn, soybeans, vegetables, alfalfa, grain, fruit trees and roses. Deer dislike strongly scented, prickly or poisonous plants, e.g., artemisias, common foxglove, lamb's ears, lemon thyme, Madagascar perwinkles, rosemary, rotunda Chinese holly, spearmint, sweet autumn clematis, arbor, thorny blackberries and/or wormwood. Materials registered as commercial deer repellents include two fungicides, Thiram and Ziram, and Capsaicin derived from chili peppers. Putrefied (rotten) eggs are also used as commercial sprays. You can make your own deer deterrent by mixing 3 T. of kelp, 1 c. fish emulsion, 3 T. liquid Dial® hand soap in 3 gals. water; spray until the point of runoff on any plants that are being eaten. Reapply weekly and/or after a rain. You can add a "kicker" of 1 T. hot sauce.As a last resort, spray trunks of trees and lower limbs generously at 2 - 3-week intervals with a commercial repellent or castor/garlic oil sprays.

Discourage feeding of deer. Twenty years ago there were about 5 million deer in North America; today there are at least 20 million. Many states have laws against feeding deer, and municipalities with deer problems should consider enacting regulations to keep citizens from attracting deer. Deer no longer have any natural predators to trim the herds. Plant species of plants that deer do not normally feed upon. Consult your local horticulturist or deer biologist for information on any/all deer resistant species. When you plant and fertilize and water plants that deer love to eat in your yard, you basically are providing them with parks that do not allow hunting - a perfect habitat! Harassment of deer such as chasing them out of the yard is also often a deterrent. **Check with your local conservation officer before beginning any harassment techniques to see which are lawful methods. Plant deer-resistant plants so they will leave your yard alone.**

To protect fruit trees, shrubs and flowers, spray the plants with Hinder® (ammonia) or with a spray solution of 2 - 6 eggs to 1 gallon of water. Spraying the base of trees, grass and shrubs along the deer trail usually stops them in their tracks. To protect roses, break a whole egg beneath the bush. Renew the *spray* after a rain. To protect small areas like berry patches, small gardens or cottage landscapes when you are gone, lay a 4-foot wide section of chicken wire and/or hardware cloth on the ground all the way around the perimeter of the patch. The deer will not walk on the wire and they can't reach the garden without crossing the barrier. Human or dog hair in a ladies nylon, hung 2 per tree and/or no more than 3 feet apart, can be very effective. Hair must be changed every week. Rabbits and deer avoid the smell of blood meal that has been sprinkled around. They also are repelled by containers of garlic oil hung every 4 - 6 feet to create an odor barrier. Reapply after a heavy

rain. Corn cobs that have been soaked in vinegar for 5 - 10 minutes and scattered throughout the garden work well too. After 2 weeks soak them again. Note: Hungry and urban deer are not easily repelled by these odors. Zoo-Doo: 1-800-ILUV-DOO will sell you composted rhino and elephant droppings and/or Siberian tiger manure to place in your garden and repel deer and rabbits. Make up your own spray using extracts from catnip, daffodils and hot peppers; usually this combination of odors literally drives deer away. **Remember deer are edible.**

DEER MICE
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Muridae, formerly Cricetidae

Caution: There is a severe danger of Hantavirus pulmonry syndrom (HPS) and asthma with these pests!

There are over 55 species of deer mice *(Peromyscus spp.)* that live in wooded or shrubby areas and often inhabit hedgerows. Deer mice are sometimes collectively called “white-footed” mice. They are about the same size as house mice but with a distinct bi-colored tail and body and larger eyes and ears. The upper side of the tail and body of the deer mouse is dark colored, generally some shade of brown (although the juveniles are gray) and the underside is white. Deer mice normally nest where there is little or, better yet, no activity. Deer mice have 3 - 6 young per litter and 3 - 4 litters per year, depending on climate and other factors.

Nuts, seeds, berries and insects are their usual food. Outdoors these mice construct nests in stumps, under logs, in hollow tree cavities or in abandoned bird nests. The litters vary in size between two and seven young, and several litters may be born throughout the year.

Deer mice frequently enter unoccupied cabins, cottages, houses, garages, storage sheds, animal barns and/or stored campers during the colder months where they may damage clothing, foodstuffs and furnishings.

Note: White-footed mice *(Peromyscus leucopus)* are very similar to deer mice and are hosts of the black-legged tick which can transmit Lyme disease.

INTELLIGENT PEST MANAGEMENT® CONTROL - Use the same techniques described for house mice. Rodent proof your building. In occupied buildings use several glue boards or snap traps baited with moistened oatmeal, sunflower seeds or peanut butter and placed in corners, along walls and behind objects. In unoccupied buildings control with poison baits placed in corners, along walls and behind objects and throughout the building in areas where the mice will readily find them. When the building is reopened for use, all baits and dead rodents should be collected. A rough sketch of the floor plan can be made and the location of the bait boxes marked thereon so that none will be left for children or pets to find later. **Exclusion is the best control. Do not touch the nests or mice!** Use the proper safety equipment, including a respiratory device with a N95 (or HEPA) filter. (See: http://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/n95list1.html) Try the Walk-the-Plank method (chipmunk version). Wash all infested areas with diluted Safe Solutions Enzyme Cleaner with Peppermint.

FERAL DOGS AND CATS
CLASS - Mammalia
***Canine fecalotus* (SLT) and *Feline agravatas* (SLT)**

Dogs always want to lay in a shady spot, usually right on top of your flower bed. Try a little black pepper sprinkled over the plants; this will help steer your dog or cat pest(s) to a new spot. To get cats to stay away from your house plants, plant or crush rue leaves and sprinkle them on your plants; they are very repulsive to cats, but may also cause human allergic reactions; or try 2 parts cayenne powder, 3 parts dry mustard powder, 5 parts flour - mix in adequate water and spray in areas you wish to repel cats. Several applications should be enough to break your cat of this bad habit.

Probably nothing is more annoying than having someone’s dog defecate in your front lawn or vegetable patch, urinate on the tires of your vehicles or prized plant specimen or seeing a strange cat patrolling your backyard for unwary birds that you are feeding or using your

child's sand box as a cat box (toilet). Electric fencing controls feral dogs and cats, but you may very well have some angry parents or neighbors.

Chicken wire laid on top of the sandbox may help to keep cats from leaving *presents* for your kids. Try using the herb rue dried or planted by areas you wish to repel cats. You can create a homemade version of commercial pet repellent by distilling their active (poison) ingredient nicotine sulfate - fill a jar of cigarette butts with water and let stand a few days - strain, add 1 teaspoon of liquid soap and spray or splash a few drops around, but remember nicotine is a very dangerous poison; so be very careful!

Dogs and cats both respond to being sprayed with water, scolding, clapping of hands, broom-waving, hurled clods and stones and repellents. There are many materials registered as dog and cat repellents.

Spray diluted Safe Solutions, Inc. lavender or eucalyptus soaps in those areas you wish them to avoid or make your own spray with a finely chopped garlic bulb a finely chopped medium onion a teaspoon of Tobasco sauce, a tablespoon of red, black or cayenne pepper to a quart of warm water - steep for 2 hours, strain, add a teaspoon of liquid soap and spray away - or simply sprinkle freshly ground pepper in the areas you want pest-free - Be careful! Turn the sprinklers or hose on them to make them vacate Plant common rue (*Ruta quaveolensi*) any where dogs are a problem, but remember, rue can also cause human allergic reactions.

Both forms of moth crystals (naphthalene and paradichlorobenzene) are very effective (but dangerous) inside the building and out. For instance, a few crystals placed in the favorite winged-back chair will compel Fido or Kitty to seek another parking place The same is true outside. Trees, fireplugs and other urinating points for dogs, with the exception of the tires on vehicles, can be equally unattractive with a few crystals sprinkled around the base. Cats will avoid walking or resting on walls with moth crystals sprinkled at regular intervals, but remember these moth materials are also irritating and toxic to humans so use only as a last resort, especially inside. Try the commercial dog repellent aerosols containing either citral, citronella, creosote, allyl isothiocyanate, amyl cetate, anethole, bittrex, bone oil, capsaicin, citrus oil, cresylic acid, eucalyptus, geranium oil, lavender oil, lemon grass oil, menthol, methyl nonylketone, methyl salicylate, nicotine, pentanethiol, pyridine, sassafras oil and thymold, some of which are highly annoying and toxic to people, so only use them outside as a last resort. **Simply turn the sprinklers or hose on to make them vacate.**

Barking dogs. If the dog barks for no visible reasons and will not obey your voice command to be silent, it can be conditioned or trained not to bark except when excited by an intruder. Use a "silent" dog whistle, a small, purse-size compressed gas emergency alarm to scare off attackers or a compressed gas air horn used at outdoor (athletic) events. The silent whistle only captures the dog's attention, while the others actually frighten the dog into silence. Used frequently at first the dog soon expects to be silenced and is thus conditioned to remain silent.

Dogs in the yard. Contrary to popular belief, you actually can have a nice yard even though you have a dog. The two aren't mutually exclusive. But a yard that's nice doesn't mean a yard that's perfect, as there are trade-offs to be made between Fido and fine fescue. It is dog urine, not feces, and the continual patter of big or little paws that lead to the grass' demise. But the damaging effects can be minimized.

DOGS GONE

Detroit steps up effort to round up feral canines

By Jim Suhr
The Associated Press 5/15/98

DETROIT - Johnnette Rule knows all too well how her job can become a real dogfight - like the day the 10-year veteran mail carrier had to use her satchel to fend off a stray German shepherd.

Whether born on the streets or turned away from homes, wild dogs or their predeccors once were pets.

But when they run and breed in groups, they cause a lot of grief.

"We've had carriers who have had plugs torn out of their arms and legs, many who hafe had their clothes torn by dogs," Rule said. "It's really ugly."

and it's not just in Detroit. In March, an Illinois farmer received $1,300 from the state, compensation for 26 pigs killed in 1993 by a pack of wild dogs. Dogs killed two ostriches in Oregon, fatally attacked a $15,000 horse in Tennessee and joined coyotes in killing livestock and pets in Colorado. In the past year, a small pack of stray dogs attacked and injured a Massachusetts boy on his way to a school bus stop.

Postal Service spokesman Mark Saunders says dogs attack 2,700 letter carriers across the country each year, costing taxpayers about $25 million for medical expenses and substitute carriers He didn't know how many of those attacks were by wild dogs.

In Detroit, the dog menance is considered so bad that the city's postmaster threatened to stop delivering mail in some areas.

"A lot of people are saying that because of the dogs, they're sometimes trapped in their homes," said Donyale Stephen, an assistant city ombudssman.

The city's Animal Control Division recently got four new vehicles to boost its dog-catching ability.

"We've been trying to get as many dogs off the street as we can," Donald Hamel, the animal control office's supervisor, said Thursday.

He said his division has made arrangements for two more animal control officers, though they weren't included in the budget, to birng the total to 15. They are responsible for 144 square miles in the city of 1 million people.

Officers can snare individual dogs, but have to work as a group to round up packs that generally are drawn together by a female dog in heat.

"We can have packs of dogs up to 20. We can't always get them all," Hamel said.

Though Detroit's exact populaitons of feral dogs isn't known, evidence of the crackdown is. Animal control workers caught 919 dogs from July through September of last year.

Through this year's first three months, crews caught 1,532.

Feral dogs on the loose:

- **Vigilance -** Urine is a concentrated source of nitrogen that can burn, or kill, the turfgrass it contacts. Minimize its effects by keeping the lawn well-watered so the frequent jolts of ammonia are diluted. Run a sprinkler for a few minutes after the dog has had its daily romp of the area.
- **Traffic Changes -** If the dog is restrained with rope and collar to one area, change the area every few days to give grass in the immediate area a chance to recover. Install several anchoring posts for the rope to make it easier for you to change traffic patterns.
- **Thick/Tough turf -** The lawn can better resist the stress of a resident dog if the turf is kept well-fed and weed-free. Thick grass naturally keeps weeds down by denying them the room and sunlight needed to grow. For example, crabgrass seeds - tough as they are - need light to germinate. By keeping the turf thick, they are denied that requisite. Turf experts recommend a lawn be fed organic fertilizers at least twice a year and if an extra-nice turf is desired, then up to five times. Five times is appropriate with a dog in the equation. Begin in mid-May and finish with a special fall fertilizer applied between Halloween and Thanksgiving. Similarly keep weeds in check with timely applications of organic fertilizers and a hoe.
- **Overseed -** Dead spots are easily fixed. Use a shovel full of fresh soil if the loss was caused by urine or use a garden fork or power aerator to loosen compacted soil caused by continual traffic. Use a high-traffic tolerant blend of grass seed for overseeding. These are often called playground mixes because they contain typed of rye and fescue grasses that put up with less-than-ideal conditions. Choose a mix that matches your sun conditions and climate, too. Early autumn is the best time to overseed or repair

dead or damaged areas; late spring is the second best time. Timing is mostly a matter of having plentiful moisture, warm soil and moderate weather - which is more typical fall, than spring.

- **Surrender Part -** Sometimes it is best surrender a portion of the yard, especially if one or more rambunctious or big dogs are pets. If there's an area that can be fenced in or somehow reserved for your dogs, surrendering that area is a reasonable strategy. In this case, keep the surrendered area as healthy as you can, and keep the rest of the yard off-limits to the dog(s). You can make the area more attractive by filling a small plastic pool with sand and then burying a few dog toys and munchies for old Rover to dig up and enjoy.
- **Garden areas -** A raised bed offers some protection. While most dogs can easily scale the 10 to 20 inch height typically used in beds of this sort, the height may be enough to discourage the dog from bothering the area.

Garbage cans/trash bags. Dogs will usually not overturn or disturb garbage cans or trash bags that have been sprayed lightly with a 1:1 dilution of Pine-Sol or similar pine-scented cleaning detergent. Use the same material to spray your tires - or you can dust the area with freshly ground pepper and/or talcum powder or spray them with a hose. As a last resort you can always call the dog pound.

Dander. Dogs and cats; all pets can cause allergic reactions, no matter what breed, what size, or whether or not they shed. People who are sensitive to furred animals usually are allergic to their dander or skin scales which they continually shed. Too small to see and very sticky, dander sticks around for years, even after a pet has left. Vacuum the air with a HEPA filter and rinse-and-vac or mop and routinely clean with Safe Solutions, Inc. Enzyme Cleaners and wash your pet in Safe Solutions Pest Wash.

FERAL HOUSE CATS
ORDER - Carnivora
FAMILY - Felidae

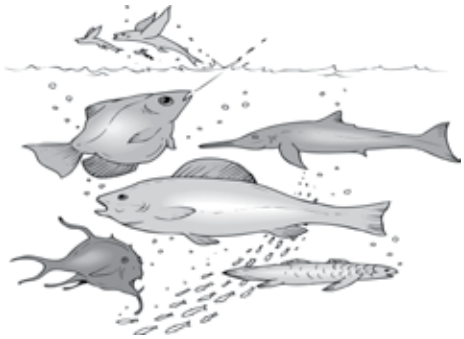
Feral cats are house cats which have escaped their owners or have been abandoned and have adapted to living wild. Wild house cats may serve as potential reservoirs for human and wildlife diseases such as cat scratch fever, salmonellosis, mumps, ringworm, toxoplasmosis, leptospsirosis, feline immunodeficiency virus, leukemia virus and distemper and, more rarely, rabies. They also may have ectoparasites, usually ticks and/or fleas. They may also be an important factor in introducing these diseases into susceptible wildlife populations. Feral cats automatically become the property of the landowner upon whose land they choose to exist on, to do with as the owner wishes, but state, county and municipal laws related to cats vary. Before any lethal control is undertaken, consult local laws. Even if live capture is desired, consult the local laws and consult the local animal control agency for instruction on disposal of captured cats.

Feral cats produce litters ranging between 2 and 10 kittens. Litters may be born any month of the year. When food and harborage are abundant, an adult female may produce as many as 3 litters a year. Feral cats are most active at night. During the day feral cats use established dens or lairs to rest and hide. Dens are often located in old buildings, in crawl spaces, beneath porches, around granaries, drainage pipes, junked cars and similar places that afford some degree of protection. They are opportunistic predators and scavengers that feed on rodents, rabbits, birds, carrion, garbage and leftover pet food. One Michigan study found a single cat killed 1,660 mammals and birds in 18 months, even though it was fed at home! Cats **hate** to be sprayed with any amount of water - got the idea! **Anyone know where the hose or the kid's super soaker is?**

INTELLIGENT PEST MANAGEMENT® CONTROL - Problems with feral cats can be reduced by eliminating cat habitat or access to food. Exclusion by fencing, repairing broken windows, doors and plugging holes in and around buildings will deny cats harborage. Old buildings should be sealed and holes under foundations plugged. Brush and junk piles, bale piles, old machinery and junk cars should be removed. Areas of vegetation in the vicinity of affected buildings should be kept closely mowed. Elimination of all obvious food sources which may

be attracting or sustaining a local feral cat population, e.g., outdoor pet food dishes, garbage, must be eliminated or properly managed and contained in tight-fitting cans. Try contraception. Repellents (other than holly or water) can be and are irritating and repulsive to people as well as cats. Plant some catnip *(Nepeta cataria)* in an area far away from your bird feeders, sand box and/or gardens; keep this area attractive to cats by adding some areas of sand. Spray white vinegar where you want cats to vacate. Feral cats should be live-trapped if legally permitted. **Be sure you inspect your traps every 4 hours or less.** Captured feral cats can be turned into to animal control agencies without harm, back to the owner with proper warnings, or humanely destroyed. The larger models of live traps such as Havahart® No. 7 can be used to trap feral cats. Traps should be set in areas of cat activity, feeding locations, e.g., dumps and garbage cans, and at or nearby entry areas to suspected dens. Successful baits include fresh catnip, oil of catnip, meat, fresh or canned fish, commercial cat foods, fresh liver or chicken. Keep in mind that cats for several generations of feral parents will completely revert to the wild in all habits and temperament. To avoid being scratched, live catches should be handled with extreme caution. No toxicants are registered for the control of feral cats. Try using sheets of Bounce to repel cats. At present it is estimated there are 70 million house cats in the U. S. Ancient Egyptians shaved off their eyebrows to mourn the death of their cats. Cats are very sensitive to citrus oils and strobe lights.

FISH
CLASS - Pieces
ORDER - Perciformes
FAMILIES - Various



Fish are aquatic, cold-blooded animals with backbones that have fins and gills throughout their lives. Stunted or trash fish can be removed from water that has been “fumigated” with carbon dioxide - this is a far safer alternative than rotenone - electric shock also works better.

GROUND SQUIRRELS
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Sciuridae

There are 17 species and numerous subspecies of ground squirrels, e.g., the thirteen-lined ground squirrel *(Spermophilus tridecemlineatus)*, also called “thirteen-liner or striped gopher” the California ground squirrel *(Spermophilus beecheyi),* and others, are a common problem in and around building foundations, lawns, golf courses and gardens. They can be distinguished from tree squirrels by their shorter and less bushy tails and by the fact they live underground. Ground squirrels are sometimes incorrectly called *gophers*, especially in the Mid-West, but this is truly a misnomer because true (pocket) gophers (e.g., *Geomys bursavius* and *Thomomys talpoides*) belong to an entirely different family of rodents. After emerging from hibernation, ground squirrels mate. The gestation period is about one month. Depending on the species, females produce single litters ranging between 4 and 8 young in May. Gestation periods range between 28 to 35 days. The young leave their home burrow system in summer to establish their own burrows and territories. Most species are found west of the Mississippi River. They hibernate in winter and/or in hot, dry areas of the west they go into summer torpidity (estiration).

Ground squirrels are nervous, excitable animals seldom found far from their burrows that are 15 - 20 feet long with several entrances. Escape burrows are shorter and only have one entrance. The entrances are 2” in diameter holes. Mounds are seldom present at the burrow entrances, but occasionally the grass around the entrance may look *worn*. Burrow entrances are often closed at night. If you are going to fumigate with dry ice - locate the nests during the day - remove the plug at night and drop in 2 - 3 pounds of dry ice - first try dropping well used cat litter and/or freshly ground pepper, blood meal or talcum powder into their burrows. They are excellent burrowers but only a few are good climbers. Their preferred habitat is open fields, plains or valleys, occasionally in a forest opening, but they are not usually found in forests, brushy or damp areas.

Damages - One ground squirrel is capable of destroying over 50 pounds of wheat per season! Ground squirrels and their ectoparasites can transmit several serious diseases to humans, including: plague, tularemia, relapsing fever, spotted fever, and Colorado tick fever. They are also very powerful "gnawers."

The natural food of ground squirrels consists of almonds, walnuts, melons, barley, seeds, roots, fruits, insects (e.g., caterpillars, grasshoppers), occasionally mice and shrews and green vegetation. Ground squirrels often are troublesome thieves in gardens where they dig up newly-planted seeds and bulbs. Other damages include lawns in golf courses, homes, parks and cemeteries and earthen dikes. They can form an underground tunnel system covering several acres, with numerous holes to the surface. They seem to love to dig up newly planted seeds, consume sprouting seeds and damage garden vegetables. They also routinely damage corn and hay fields.

Intelligent Pest Management® Control - One of the best ways to discourage ground squirrel activity is to allow grasses, shrubs, flowers and other vegetation to grow tall and dense where you do not want them; or fence them out with a 1/2" wire mesh or sheet metal fence 18" or higher and buried 6" or deeper or cultivate soil routinely. If you must kill them, shoot them, or fumigate them with carbon dioxide, but first check with your local wildlife and/or conservation agency regarding each species. Local laws may also prohibit the use of firearms in your area - so call the local (police) authorities before you begin any control with guns. Rodent-proof your buildings. If legal, you can fill the active tunnels with carbon dioxide or carbon monoxide; this control works best in the early spring. Rat snap traps for the smaller species such as the 13-lined ground squirrel, connibear traps, leg-hold traps (No. 0, 1 or 1-1/2) or live traps (Havahart® No. 2, 2A, 1078 or 1025 or Tomahawk® 102) are all very effective. Traps should be placed near the active burrow entrances and connibear traps and leg traps 103 or 104 and rat snap traps should all be covered with a box to prevent harming any children, pets and/or non-target wildlife. They carry ectoparasites and can be infected with plague, relapsing fever, Colorado tick fever, spotted fever and/or tularemia; therefore, they must be handled with great care. Properly release or dispose of all trapped individuals. **There are poison baits available for ground squirrels and chipmunks, but we do not advise their use anywhere. Never handle live or dead animals without proper protection!**

GROUND SQUIRREL AND CHIPMUNK PEST SUMMARY

A number of species of ground squirrels and chipmunks occasionally become pests in and around buildings. The major concern is their burrowing around foundations, in lawns, on golf courses and in gardens. Chipmunks carry the excavated dirt in their cheek pouches and scatter the dirt far from the burrow - often a homeowner is unaware of the extensive tunneling damage until something caves in! Ground squirrels in particular can have extensive burrows with large mounds, especially along roads and ditch banks. On occasion, burrows beneath buildings have caused structural damage. Some lawns look like Swiss cheese.

Ground squirrels can carry diseases (such as tularemia and plague), particularly when populations are dense. **Bury them at least two feet deep to prevent pets and wildlife carnivores from digging them up.**

Both ground squirrels and chipmunks are active during the day and are easily seen when foraging, but they spend much of the time in their burrows. During winter months, most ground squirrels and chipmunks go underground and stay inactive. In some areas, ground squirrels will go into a summer hibernation when temperatures are at their highest.

Ground squirrels are primarily vegetarians, feeding on grasses. When vegetation dries up, they switch to seeds, grains and nuts. Chipmunks eat both plant and animal material from seeds to nuts, from insects to worms, to songbirds and frogs.

Management and Control. Depending on your state's or municipality's local laws, ground squirrels and chipmunks may be protected. Try a version of our "Walk-the-Plank® with floating oats in a 5-gallon pail or fumigate the burrows with CO or CO_2 or simply try putting freshly ground hot pepper or carnivore urine in their holes.

Ground Squirrels - Intelligent Pest Management®

Control is usually only begun after there are severe infestations. Several important steps must be taken if a control or management program is to succeed:

- Correctly identify the species causing the problem.
- Alter the habitat, if possible, to make the area less attractive to the squirrels.
- Use the most appropriate control method.
- Establish an inspection or monitoring program to detect reinfestation.

Ground squirrels are generally found in open areas. However, they usually need some kind of cover to survive. Removing brush piles and debris and tall vegetation will make the area less attractive to the squirrels and will facilitate detection of burrows and improve access during the control program. Ground squirrels can be controlled with traps, rodenticides and fumigants, e.g., "registered" poisons or carbon dioxide or carbon monoxide and/or repellents with predator urine, talcum powder, freshly ground pepper and sometimes aftershave.

Trapping. Trapping is a practical means of controlling ground squirrels in limited areas where numbers are small. Live traps are effective but present the problem of disposal of a live squirrel. **Because squirrels can carry diseases, many states will not permit the animals to be released at some new locations, so they must be humanly killed.**

For the smaller species, rat snap traps or glueboards can be effective, but (put them under a propped up bucket to) keep them out of the reach of people, pets and/or wildlife.

- Place traps near burrow entrances and bait with nuts, oats, barley or melon rind.
- Place traps under a box if any non-targets might be killed in the trap.
- You may wish to try a 10-gallon version of Walk the Plank™ with 7" of water and floating seeds.

Rodenticides. Rodenticides are the most cost effective way of temporarily controlling large populations of ground squirrels. A number of products are registered for this use. Grain baits are most effective when squirrels are feeding on grains and seeds. **Remember, they are poisons that not only kill squirrels and chipmunks but mammals and birds. We do not recommend their use.**

- If absolutely necessary, carefully place rodenticide poisons in burrows or in protected bait stations, accord ing to the label directions.
- Try putting well used kitty litter, talcum powder, predator urine, blood meal, aftershave, freshly ground pepper in the burrows first.

Fumigation. Ground squirrels can also be killed by gassing their burrows. Aluminum phosphide tablets or smoke cartridges are most commonly used. Fumigation is most effective when soil moisture is high; moisture helps seal the tiny cracks in the burrow walls. Fumigation is not effective during period of hibernation because the squirrels plug their burrows. Spring is normally considered to be the best time for burrow fumigation. Fumigation is not a good choice adjacent to buildings because of the risk that the fumigant gas could find its way into the structure. **We do not recommend the use of dangerous fumigants and/or rodenticides.** If you must fumigate try using several pounds of dry ice in the burrows in spring (or several lit charcoal briquettes) or a tank of carbon dioxide, e.g., a fire extinguisher - be sure to seal off all the *smoking* holes. Fumigatge after hibernation and before spring reproduction.

MEADOW MICE
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Muridae, formerly Cricetidae

Meadow mice or voles (Microtus spp.) are small, chunky rodents; adults are about 7" long with a short tail, about 1-1/2". They are sometimes called voles or field mice. Their ears are furred and do not project much above the hair on their heads. Mature meadow mice or voles are chestnut brown mixed with black on the back. Young meadow mice or voles are uniformly gray. Meadow mice have rounded, somewhat blunt snouts, and their front teeth are chisel shaped. Their usual foods are grasses and herbs, but during the late fall, winter and early spring they may gnaw (girdle) the bark of young fruit trees and ornamental plantings, especially where snow cover is present, causing damage and even death to the plant.

Mice or voles can produce from 5 to 10 litters per year with an average of 5 young per litter. Gestation is about 21 days and females may mate again the same day the young are born. Young voles grow quickly, are weaned at 2 or 3 weeks, and are sexually mature in a month or two. They sometimes enter slab-type buildings; they are poor climbers and have to enter low.

INTELLIGENT PEST MANAGEMENT® CONTROL - Occasionally meadow mice may enter a building, but, they seldom become established or reproduce inside. **Ordinary snap traps are very effective.** A dozen or more snap traps with expanded triggers baited with peanut butter and oatmeal, should be carefully used. Vole runways should be located in grassy borders of gardens and traps set at right angles to the runways with the trigger in the runway. Traps can be set at 10-foot intervals along the plant rows. A pinch of oatmeal sprinkled over the trigger of the trap is an effective bait. Traps should be reset daily and freshly baited until no more voles are caught. Keep grassy and weedy areas well-mowed to reduce the protective cover for voles. Voles occasionally enter buildings; control them inside by setting snap traps, glue boards or live-catch traps. Meadow mice rarely climb over even low wire-mesh fences. **See also Voles**.

MOLES
CLASS - Mammalia
ORDER - Insectivora
FAMILY - Talpidae

OVERVIEW

Moles are not rodents like mice and gophers, but members of the insectivores (insect eaters) like shrews and hedgehogs. Moles search for food in deep as well as shallow surface burrows, in lawns, meadows, stream banks, and open wood lots. They feed on live earthworms, grubs, millipedes, beetles, ants, other insect larvae and vegetable matter. The star-nosed mole is an adept swimmer and will sometimes eat small fish. Their appetite is voracious and they often eat more than their own weight (about 5 oz.) in food every day! The origin of the word “mole” comes from “earth thrower”. Only rarely are these secretive little mammals seen above ground, moles are 4” - 9” long, including the tail, with long dark gray or brown fur. Eyes are tiny, like a pinhead, and the tail and feet are usually pink. They have no visible ears. There are seven species in the United States. When you see raised ridges in soft, moist soil areas - this is probably the Eastern mole *(Scalopus aquaticus)* - **Eastern moles burrow near the surface** in well drained, sandy loam-type soils and make visible ridges (they avoid extremely dry soil). When you only see piles of soil scattered over the lawn it probably is the deep tunneling, star-nosed mole *(Condylura cristata)* - **Star-nosed moles burrow 4” - 6” deep** in damp soils near water and make “volcanoes” or circular mounds of dirt. Tunnels are usually not visible. The Towsend’s mole *(Scapanus towsendii)* is the most troublesome pest on the coast of Oregon and Washington. As they burrow, they sometimes damage plants, but the major problem with moles are those surface tunnels, mounds, and ridges that disfigure lawns. As they tunnel just below the surface, moles raise the sod up with their front digging feet, looking for gardens, nurseries, parks, golf courses and cemeteries for food or new tunneling sites. They can push up surface tunnels at the rate of a foot per minute if the soil is loose; up to 100 yards in a single night. Mature moles can maintain 350 yards of tunnel systems, often containing 2 or more levels! In summer and winter when the burrows are deeper they can still tunnel 12 - 15 feet per hour and then they leave mounds of soil pushed up to the surface. A simple litter of 3 - 5 moles are born in the spring after a 4- to 6-week gestation period. They prefer loose, moist soil shaded by vegetation. Mice may use the surface burrows pushed up by moles and feed on plant tubers and bulbs. Moles are sensitive to vibrations, so any vibrating device that imparts the vibration to the ground will deter their tunneling in that area.

Intelligent Pest Management® Control

Although time consuming, the most effective method of control is by the use of traps and the removal of mulch. The best time to trap is in the early spring when the first burrows are seen or after the first fall rains. Trapping in spring can eliminate the pregnant females. (Killing moles with fumigants, poison baits, or chemically reducing food/prey is not only ineffective, but it is very dangerous.) First try venting your anger by trying to repel them with whistling pop bottles, whirligigs or other soil vibration devices or well used (cat urine) kitty litter. Moles can effectively be controlled by the use of Herbruck’s Nature’s Supreme 2-5-3, Nutri-Plus 10-3-4 and/or Pelleted Poultry Manure 4-3-2, bgeerlings@herbrucks.com, or human urine diluted 50% with water.

Since there is no easy way to know which parts of the surface tunnels are active and which parts abandoned, mole tunnels should be tamped down in several places over the yard. Mark tamped down sections with a peg or wire flag. If the tunnel has been pushed back up the next day or so, a trap should be set in that place. If your traps are not sprung in two days, remove them and reset them in different locations. There are four types of traps in general use: harpoon traps, scissors-jaw, chokers and live traps. If you do not want to use a trap, watch for them around 8 a.m. or 5 p.m. - when you see them pushing up the soil, very quietly sneak up on them and push a shovel into the tunnel 2' behind them - the kind of punishment you wish to inflict is up to you as the mole is now trapped in a very small stretch of tunnel. Sometimes simply rolling the lawn in the early a.m. or late evening will solve the mole problem, as will carbon dioxide or carbon monoxide burrow "fumigation". Soil fumigant "registered" poisons do not work as well as carbon dioxide or carbon monoxide. Carbon dioxide will not harm plants.

Moles are basically beneficial creatures that improve the soil and eat many pest insects (up to 50 pounds per year). There are seven species of moles and shrew moles *(Neurotrichus spp.)* in the U. S. The Common or Eastern Mole *(Scalopus aquaticus)* and the Hairy-tailed mole (*Parascalops breweri*) are the most numerous and widespread in the eastern United States and are responsible for most of the complaints concerning mole damage to lawns and gardens. The most troublesome species on the coast of Oregon and Washington is the Townsend's Mole *(Scapanus towsendii)*, and in California the broad-footed mole *(Scapanus latimanus)*. The mole's velvety fur was once used to create fur coats.

Moles feed primarily on earthworms, white grubs, ants, spiders, centipedes and other arthropods and animals found in the soil. A smaller part of their diet consists of various seed and softened vegetable matter (e.g., fallen bird seed), but they usually do not eat bulbs or the roots of garden plants and damaged grass recovers rather quickly. If they eat an unchewed stick of Juicy Fruit® gum pushed into their tunnel, they will supposedly die in agony, but how can you get these insectivores to eat it? Sometimes they are repelled by weasel urine (synthetic or natural) and/or well used kitty litter or try 50% human urine and 50% water and spray the tunnels.

Moles are active day and night throughout the entire year, but they are most visibly active in the morning, during the spring and fall on damp days or following rain showers when they excavate more tunnels and push up highly visible mounds. When the ground surface becomes frozen in the winter, or very dry during the summer, moles use only the deeper burrows. Mating occurs during February and March with only a single litter of 3 to 5 young born later in the spring following a 6-week gestation period. Young moles grow rapidly, look like and behave like adults, fend for themselves in 4 weeks. Young moles may stay inside their family's subterranean burrow system for up to six months before dispersing to establish their own burrow systems and territories nearby. **Moles love mulch and will actively "work" mulch beds and borders.**

Moles are insectivores, not rodents. Moles are insect eaters that *swim* through moist, soft soil searching for prey e.g. grubs, earthworms, and millipedes. They are well adapted to life in narrow underground tunnels. Their large, rounded, outward-turned front paws have stout claws and their feet are all specifically designed for digging, and their dark brown fur can lay forward or backward to facilitate either movement. They have streamlined skeletons, delicate skulls, pointed snouts and many sharp, pointed teeth. Moles are about 5" - 8" long with short, velvety fur that is usually gray to silvery-gray. Their eyes and ears are not easily seen. If you throw a rodent e.g. a mouse into the water it will swim back to shore - if you throw an Eastern mole into the water it will continue to swim in 6 - 10 foot circles until it drowns.

During the moles' burrowing activities, they sometimes dislodge plants, injure plant roots and leave those annoying mounds and ridges that disfigure lawns and make it harder to mow the grass. However, moles do not intentionally eat plants or plant seeds. Several species of mice use mole runways, and often these are the real pests responsible for the occasional damage to seeds, roots and bulbs encountered in the soil. Put used kitty litter in the tunnels. Compact the soil with a heavy roller. Spray castor oil (in the rain) to moist soil and keep the soil moist. Some dogs dig out moles. Put some (carbon monoxide) lit charcoal briquettes or carbon dioxide gas in the tunnels as a last resort.

If you discover an elaborate series of tunnels in your lawn, it does not necessarily mean that you have more than one mole. Moles may tunnel extensively at any time of day or night just to obtain enough food to satisfy their enormous appetite. Most species are not gregarious; in fact, they are highly territorial and will fight to the death any moles attempting to enter their private burrow system. So, the number of mounds or surface

ridges seen in a yard is simply no real indication of how many moles may actually be present. Generally, however, one acre of land will not support more than three moles, although occasionally there are cases of as many as six moles being trapped over a summer's period within lawns of less than an acre. Spring floods are nature's control for moles. The adults may manage to climb out of their tunnels and wait for the water to subside on elevated ridges or drifting material, but the young are extremely vulnerable in their nests. **Even a heavy rain can drown them.** Lit charcoal briquettes (carbon monoxide) or carbon dioxide gas in their tunnels will kill them and carbon dioxide will help the plants.

NESTS, TUNNELS AND RUNWAYS - The permanent tunnels are usually 3" - 15" below ground leading to nests that can be 2' deep and located either in protected areas underneath objects such as boulders, trees, stumps and fence rows or randomly within the tunnel system in open field areas. Nests are slight enlargements of the tunnels and softly lined with bits of leaves or grass. Moles also produce surface runways commonly seen as the raised *ridges* running through lawn areas. These runways wind around with no apparent *direction plan* and can be extended at a rate of 100 feet per day! Surface runs may be used daily, may be revisited at irregular intervals, or may be used only once and then abandoned. They connect with the deep tunnels which are located between 3" and 12" below the surface. To find an active tunnel collapse a tunnel with your foot, then come back in an hour or two to see whether the tunnel has been reopened. **If the tunnel has been pushed back up, it is an active tunnel, so fumigate it with carbon dioxide.**

Deep tunnels are normally used daily as the mole travels to and from its surface tunnels and/or nest. The soil excavated from the deep tunnels is deposited on the surface through lateral tunnels in volcano-like mounds. A molehill is built like a volcano by the thrusting up of earth plugs through the center that then roll down all sides, whereas a gopher is horseshoe-shaped, built like a mine dump with loose dirt pushed out and away fro the exit hole on one side. Very little, if any, soil is excavated in mounds as a result of the production of surface runways.

When fence rows, concrete paths or other man-made borders are within mole-active areas, the moles tend to construct their main tunnels following along these artificial borders. It is also common for the main tunnel runs to be excavated in a direction that follows the woody edge perimeter of a field or yard.

Barriers - To prevent moles from invading an area, dig a trench about 6 inches wide and 2 feet deep. Fill it with concrete, gravel, stones or dried compact material such as crushed shells. Cover the material with a thin layer of soil.

Repellent plants - Plant the mole plant (*Euphorbia lathyris*) near tunnels to deter moles. The castor bean plant (*Riciaus communis*) also works to repel moles, but they both are also very toxic to humans.

Flooding can be used by you and will have the greatest impact in the spring when the young are still in the nest. To drown them or force them to the surface open the mole hill, poke a garden hose into the tunnel and turn on the water. Expect it to take about 10 or 15 minutes before there is enough water in the tunnels to flush out the adult mole. Watch for its emergence from one of the other exits; you can kill it with a small shovel. This method is likely to be effective only if the tunnel system is confined to a fairly small area. **Flooding rarely works in deep, sandy soils, but carbon dioxide will work here.**

Fencing a small area either with small-mesh, tightly woven hardware cloth or with low concrete barrier walls has been shown to protect the area against mice and the common eastern mole. The *fence* or wall should begin slightly above the soil surface and extend into the soil at least 18" to 24". If you make it bend outward underground in an L-shape it is even more effective. The base of the L should point away from the area being protected. Joints or connections in the *fence* or wire wall should be overlapped and tightly closed with stapes or wire.

Live traps. You can capture moles live in a pit trap, then release or drown them. First dig through a mole tunnel that is likely to be in active use. Excavate deep enough so that the mouth or top edge of a wide mouth quart jar or large-mouthed gallon jar or a 3-lb. coffee can will be level with the floor or bottom edge of the mole tunnel, then the container is sunk into the hole you have just made. Then **lightly** cover the top of the tunnel with a board or piece of cardboard or plywood so light and air currents cannot enter and alert the mole of danger; the mole will not be able to climb out of the container. If your covering collapses the tunnel and/or they find the can they may fill up your "trap" with dirt. Check the status of the trap at least daily by removing the cover board. If you do not check this trap often, trapped moles may die of starvation, thirst or stress. If several days pass with no

sign of the mole, the runway has probably been abandoned and you should repeat the procedure in a different tunnel. **A lethal trap can be constructed simply by putting a glueboard on the floor of the tunnel and then lightly covering the top of the tunnel.**

Other kill traps. The most effective method for removing moles is to use one of the commercially available mole traps. Generally, trapping is easiest and most effective during the spring and fall, when mole activity is at a peak. Once mole activity is noticed, control efforts should begin as quickly as possible to keep mole damage to a minimum. Also, trapping in the early spring can eliminate pregnant females, thereby reducing the likelihood of having to contend with a family of moles later. **The keys to success are patience, practice and persistence**. Moles are shrewd animals: they will evade, spring, "heave out" or go around any improperly set traps. So place all of your traps carefully, and keep trying until experience leads to success.

To begin a successful trapping program, it is essential to first locate the main tunnels. Usually if a runway or tunnel takes more or less a straight course for some distance or seems to connect two runway systems, it is likely to be a main system. Moles will repair their main runways and tunnels virtually immediately. You can determine which surface main runways are active by pressing down the earth with your foot and watching to see which ridges are rebuilt, or you can poke a number of small holes in the ridges you think may be active with your finger or a stick and check to see which are repaired. Repairs should be made within a few hours or at most within a day. Any tunnel that is not repaired is not active enough for use for trapping. Since nests are commonly located at some protected spot along the edge of an area, such as hedge rows or fence rows, border trapping at the places where runways/tunnels center the yard, field or garden often provides the best results. The runways/tunnels should be checked as previously described. Unless the mole activity is extremely light, more than one trap should be used. Do not depend upon a single trap to do the work of a dozen, especially if activity is heavy or if there is much area to be covered.

How to Trap. Be careful not to touch your trap with bare hands, as moles have a very sensitive sense of smell and will avoid your traps by tunneling around them. Cover your hands with a new plastic bag. There are three commonly used lethal traps, the Victor® harpoon trap, the Victor® Out o' Sight® scissors-jaw trap, http://www.victorpest.com/mole_gopher_products.htm **and the Nash® choker loop trap (Nash Mole Trap Company, 5750 E. S Ave., Vicksburg, MI 49097, 269-323-2980)** Harpoon traps are available from most hardware and garden shops; choker loop and scissors-jaw traps are less common and may have to be ordered.

The harpoon trap is probably the easiest trap for the novice to use. To properly set a harpoon trap on a main surface runway, first lightly press down with your foot a small section of an active runway so that the runway is collapsed 1/2 of its original dimension. (Do not push down the ridge completely.) Raise the spring of the trap and set the safety catch. Then push the supporting spikes into the ground, one on either side of the runway until the trigger pan just barely touches the depressed tunnel. (Be sure the trap is centered over the runway and the supporting spikes do not cut into the tunnel below.) Next, release the safety catch and spring the trap (several times) to ensure that the prongs will penetrate smoothly into the tunnel. Finally, reset the trap and leave it, taking care not to tread on or otherwise disturb any other portion of the runway system. Inspect traps after a rain - if the soil has washed away, leaving a space between the trap trigger, insert a chip or flat stone in this open space to ensure quick trigger release or reset the trap. When the mole triggers the trap, the prongs are released, driven through the earth/sod, impaling and killing the mole.

To set the scissor-jaw trap on an active main surface runway or tunnel, again slightly depress a small section of the run and force the points of the jaws directly into the depression it until the trigger pan rests upon the depressed portion. Then push apart the levers at the top until the trap is locked. Again, it is important that the trap is centered and in line with the runway system so that the mole must pass directly between the jaws. The bottom tips of the jaws should cut into the floor of the tunnel about ¼". In some cases it may be necessary to scrape off some dirt or grass on the top of the mole ridge in order to bring the trap down nearer to the actual burrow.

To set a Nach choker loop trap, find an active surface runway or tunnel and follow the labeled directions very carefully. Basically the trap consists of a cast metal frame with two spring retractable loops. Two slits are cut in the mole tunnel and the loops placed inside. When the mole triggers the trap (from either direction), it is immediately crushed. **This is the only mole trap with a money-back guarantee**.

Trapping results can sometimes be improved by setting traps in the deep tunnels used by the moles on a daily basis. These tunnels, 3" - 12" below the soil surface, can be found by probing with a sharp stick or steel rod near or between two soil mounds until the runway is located.

Using a fence post digger or sharp, straight-edge shovel or trowel, cut out a section of the active tunnel about the width of the trap. Next, replace some soil into the tunnel, building a "plug" upon which the trigger of the trap will rest. Proceed to set the trap in the manner described above, then fill in around it with loose soil to exclude any light. Mark the trap location and check results about every 8 - 12 hours. Note: If properly handled, all 3 traps will give good results. All depend on the same type of mechanism for releasing the spring: the trap is triggered as the mole excavates and upheaves the depressed portion of the surface burrow over which the trap is set. If a trap fails to catch the mole after two days, it can mean any of three things: the mole has changed its habits, the runway was disturbed too much during trap placement or the trap was improperly set and was detected by the mole. In any event you must move the trap to a new location.

OTHER METHODS OF CONTROL - Killing moles with commercial ("registered") poisonous gases or poisoned baits is undependable and/or ineffective. Either the commercial poisonous gases will not penetrate sufficiently through the extensive runway system, or the killing effect will escape through the top of the surface tunnel. Poisoned baits are generally not effective, since moles feed on earthworms and grubs and rarely take in nuts, seeds, pellets, etc.. In addition, poisoned baits pose a hazard to other animals such as children, birds, dogs, cats and squirrels, which may consume them. Often moles will simply throw the poison bait out of their excavations. There is a new anticoagulant bait that has a special attractant that mimic the odor and flavor of earthworms and grubs called RCO Mole Petrol. Michigan State University has documented 100% control especially with star-nosed moles. Treatment consists of 1 tablespoon of bait per hole. Try Mole-Med, a castor oil based repellent. (Call 1-800-255-2527; commercial accounts call 1-800-221-7645 for a supply; web site: http://www.mole-med-inc.com/) Mole Med is the first liquid mole repellent approved by the Environmental Protection Agency, and it is registered for use in all 50 states. It is a concentrate that is mixed with water, sprayed on the lawn or garden bed and then watered in to distribute the active ingredient, oil from the castor bean through the top few inches of soil. Grubs and worms absorb the oil, which is passed on to the mole as it dines. Some gets on the mole as it burrows. These exposures cause so much distress, but not injury, to the moles that they leave the area and don't return, at least not for a while. Research by a wildlife expert at Michigan State University found Mole-Med drove off, and then kept away, moles during a 10-week evaluation period. The Company recommends re-application every 60 days.

Propane is a gas that is heavier than air, unlike natural gas that is lighter than air. This means that it seeks out the lowest areas. Propane does not seem to kill vegetation as natural gas does. So it would seem that your little propane torch kit might be the answer to your mole dilemma (if it is legal). Here's the plan: Screw the torch onto a small canister of propane and gently push the torch tip into a main run tunnel. Turn it on so the gas comes out slowly; leave it on until you start smelling propane permeating out of nearby runs. This will mean that you have flooded this group of tunnels with gas. Go to the next set of tunnels that do not smell of propane and do the same. **Now, don't smoke or light any matches around this area for at least a week, to be safe.** As an alternative, try lit charcoal briquettes (carbon monoxide) or dry ice (carbon dioxide), obviously

without the propane, dropped in the tunnels in copious quantities in spring - seal all entrances. The Author uses a 20# tank of carbon dioxide.

If moles are continually deprived of their food supply, they will be forced to seek another area. Organic fertilizers, e.g., Herbruck's Pelleted Poultry Manure, http://www.herbrucks.com/, or diluted Safe Solutions, Inc. enzyme sprays/soaks, or nematodes or bacteria that parasitize insects/grubs will reduce earthworm, mole crickets and grub populations in turf areas, thus indirectly controlling the moles. The applications must be thorough, and the results may not be evident for several weeks. Moles also leave when copious amounts of perfume or cologne, or ammonia (rags) or used kitty litter are put in the tunnels. Caster oil sprays will repel moles for about 2 months.

In considering use of any synthetic insecticide poisons, keep in mind, they are toxic to people, birds and pets, pollute ground and potable water supplies and will also kill the earthworms that are beneficial to the soil, and are also a source of food for certain birds, which may leave if their food supply diminishes, or die if they eat the poisoned worms or grass. If you succeed in poisoning the earthworms - your soil will begin to compact - causing your grass roots to suffocate. Tunneling worms bring air to your plant's roots and leave behind a rich and free fertilizers. Also, moles will shortly re-invade the *treated* area in their search for food or the opposite sex. If you actually succeed in killing everything in the soil profile - your *treatment* would actually be worse than the mole problem.

The use of organic fertilizers, e.g., Herbruck's, the increase in microorganisms often results in the safe elimination of grubs, fungus, moles and nematodes and eventually weeds. Organic fertilizers dramatically increase the number of micro-organisms and the health of your soil/lawn/field/garden.

If you are trying to reduce the number of white grubs, try any organic fertilizers (not human sewage) or a labeled use of neem, milky spore disease or *Bacillus popillae* sold for Japanese beetle control. The Author has found that some moles will leave an area by applying 4 oz. USP castor oil, 3 oz. Ivory dish soap, and 7 oz. water in a garden hose jar (treats about 5000 square feet) or you can use *straight* castor oil (you can buy the *stinky* stuff at hobby shops) apply it during a rain storm. You can repeat the application every 10 days or until the moles leave. If you make a 6' to 8' band around your entire yard or treat only the active areas they will leave better than if your treat the whole area. You can also place 2 - 3 T. diatomaceous earth per mole tunnel - then push the soil down so the tunnels are blocked. The moles will also leave if you systematically block and **routinely** stamp down all their new tunnels and runways and/or drop dry ice down their tunnels. Copious amounts of diluted Safe Solutions, Inc. enzyme cleaner sprays will also kill grubs and other soil inhabiting insects.

Small, sensitive areas can be fenced to keep out moles, gophers and pine voles. The barrier should be made with small-mesh galvanized hardware cloth, brick or concrete. The barrier should extend at least 6" above the ground and 2 feet below the ground, with an outward projection extending 3" - 6". If you tend toward the mischievous or the barbaric, you may want to wait them out. With shovel in hand, watch for them around 8 a.m. or 5 p.m. You will see them pushing up the soil as they tunnel. Very quietly, sneak up on them and push the shovel into the tunnel 2 feet behind them. They are now trapped in this small stretch of tunnel. The kind of punishment you wish to inflict is up to you.

Grand Rapids Press 4/1/07: Darwin Andringa said, "We visited one home where the guy used a hose and filled a mole tunnel with propane," Andringa said. "He said his whole front lawn blew up. He didn't see any dead moles, but he had fun doing it. "Oh, the things people have tried."

Remember that moles are primarily beneficial - they eat pest insects and improve the soil through aeration. Do not kill them unless their damage is becoming intolerable.

SKUNKS, RACCOONS AND OPOSSUMS OVERVIEW

These three vertebrates are often considered together because they are similar pests with similar management and control recommendations. **Proper management of these animals almost always involves exclusion and/or live trapping.** Note: Live traps must be inspected at least once a day, seven days a week. Sometimes they and other nocturnal predators can also be repelled with the use of (freshly ground) sprinkled red, black or chili peppers, paprika or even talcum powder which gets on their paws and up their noses and gives them sneezing fits. The anti-fur movement has virtually stopped the winter trapping of raccoons and other fur-bearing

animals, causing a population explosion.

OPOSSUMS
CLASS - Mammalia
ORDER - Marsupialia
FAMILY - Didelphidae

Related to kangaroos, the Virginia opossum *(Didelphis virginiana)* is the only marsupial native to North America. The opossum (commonly called a *possum*) is a whitish or grayish animal the size of a house cat. Its face is long and pointed with a black snout and rounded, hairless ears.

Normally about 12" high and usually about 33" long including its 15" - 22" body and 10" - 16" rat-like tail, it does grow up to 40" long. They can weigh up to 14 pounds; the average is 6 to 12 pounds for males and 4 - 6 pounds for females. They have 50 adult teeth including 10 upper incisor teeth, more than any other North American land animal. They have 5 toes on each foot, so their tracks look like they were made by little human or monkey hands. They have a naked prehensile tail and females have a well developed marsupium (pouch). They have litters of 5 - 25 or more (average 7 - 9); young are born blind and naked about the size of a kidney bean or honey bee and quite undeveloped at birth; they must crawl the 2 inches from the birth canal to enter into the mother's pouch where they attach themselves to 1 of the 12 nipples in order to survive and grow; the surplus babies will perish. This will be their home and food supply for more than 2 months. In 12 weeks the young 'possums are about the size of a mouse and they exit the pouch to be carried about on their mother's back. There is one generation per year. Rarely more than 7 - 8 make it. **Sometimes they are mistaken for large rats.** Originally considered to be a southern animal, they are now found in the U. S. as far north as Sault Ste. Marie, MI.

Opossums prefer to live near streams, lakes or swamps, but in some areas they have become the most common non-rodent mammal, but they will live virtually anywhere. They den in the burrows of other large animals and in tree cavities, brush piles and under sheds and in buildings. Occasionally they move into attics and garages. Repel them with hot pepper and/or strobe lights. They are omnivores that eat nearly everything they can find from insects to carrion, fruits and vegetables, nuts to grains, garbage to pet food to snakes, mushrooms, frogs, eggs, birds, green plants, fish, crustaceans and small animals. Opossums are nocturnal or active at night. Their mating season is January to July, and they may raise two to three litters per year. Most young die in their first year; those that survive may live up to seven years. They are nocturnal and usually they go about their business completely unnoticed.

Opossums move slowly. Their top speed is about seven miles per hour. When threatened, opossums climb trees or go down into burrows. If cornered they may growl, hiss, bite, screech and exude a smelly green fluid from their rear end. If these defenses aren't successful, they may play dead. They can curl up into a ball and enter a trance-like state that can last for hours. They have the undeserved reputation of being stupid, but, if legal, you can easily hunt them with dogs, shine them with lights and grab them by the tail, net or shoot them at night with a red light (if legal).

Dangers. As a pest, the main complaint against opossums is that they get into garbage, bird feeders or pet food left outside and make dogs bark. Opossums have spread tularemia to people, so wear protective gloves when handling them or the traps. They also have ectoparasites and can be infected with Rocky Mountain spotted fever, relapsing fever, leptospirosis and murine typhus. They will raid compost piles, tomato plants, gardens, chicken coops and garbage cans during the evening.

For the most part, an opossum living in or around the yard is not a problem at all. They're generally not very aggressive. They'll eat assorted garden and house pests (mice, rats and roaches). They don't dig or gnaw like burrowing animals or rodents (yes... in case you missed it, opossums are marsupials and thus biologically more like kangaroos than rats or mice). Opossums are **highly resistant** to rabies and account for far fewer cases of rabies than **any** other common wild animal in the United States.

They will bare their teeth and growl at someone who happens to get to close and like all wild animals, will probably bite if you try to do something stupid like pick them up or try to pet them. Occasionally opossums have chased after people and animals in order to drive them away. Apparently, opossums have been found to be a

primary carrier of deadly disease in horses known as *Equine protozoal myeloencephalitis.* In general, steps should be taken to keep opossums away from horses, horse feed and stables.

Opossums are among the most primitive mammals. They lived during the time of the dinosaurs and have survived by adapting to human habitats and with their ability to eat just about anything. They dig roots, beetles, ants, grasshoppers, earthworms, scavenge for carrion, eggs, vegetables, fruit, corn, berries, and grain. Garbage, mice, frogs and venomous snakes are also in their diet. **Opossums love snails.**

Opossums have strong prehensile tails and opposable *thumbs* on their hind feet, which make them clever tree climbers. The tail is also used as a fifth limb to carry food and other items such as grass to line a nest site. Contrary to myth, opossums do not sleep hanging upside down by their tails. They can hang from the tail only for short periods, and use it primarily for grasping or as a balancing pole when climbing.
Unless cornered, opossums are not dangerous. It's first defense when threatened is to try to escape by climbing a tree. If cornered on the ground, it will growl, hiss and bare its 50 sharp teeth. It may also drool or defecate, and emit a smelly substance from its anal glands. However, when *playing opossum* the animal's brain and nervous system react to fear by automatically throwing the opossum into a catatonic state, which lowers heartbeat and respiration.

If this ancient visitor is not welcomed in your backyard, here are some suggestions on how to humanely remove them and/or keep them away.

1. Fence in your backyard or garage area. Secure can lids and take in pet food at night.
2. If you should catch an opossum raiding pet food or garbage cans, make no attempt to corner it. Use bright (strobe) lights, make loud noises, rustle paper, open and close doors, or squirt water to frighten it away.
3. Carefully place ammonia-soaked rags, mothballs in socks, talcum powder and/or freshly ground cayenne pepper in strategic places surrounding the area most frequented by opossums.
4. As a last resort, live-trap opossums with 9" x 9" x 32" traps baited with fish, apples, or canned pet food. Once trapped, cover the trap with burlap for safe transport, and transport them at least 5 miles for release in suitable habitat **if this is legal in your area.**

They are classified as game animals and/or furbearers, so check with state and local regulatory officials before beginning any control program.

INTELLIGENT PEST MANAGEMENT® CONTROL - The most effective method of controlling opossums is to deny their access to structures via exclusion techniques previously discussed for other nuisance wildlife. Live-catch traps can be used to capture and remove problems animals using live traps (Havahart® 3 or 3A or Tomahawk® Nos. 103, 105, 106, 205, 206 or 1094). The traps should be set in locations the animal frequents or where it is causing damage. Fish, raw red meat or poultry, moist canned cat food or dog food are excellent opossum baits. A small trail of bait leading to the trap will help direct the animal into the trap. Both doors of the trap should be left open. Take a large garbage can or 55-gal. drum and cover the top with about 5 sheets of newspaper taped to the sides - put some smelly bait or cat food (on an aluminum dish or plate) on top of the newspaper - put the can/drum next to a porch or some object or have a plank lead to the top and the bait. When the *marauder* goes for the bait she/he falls into the can/drum and awaits your pleasure. Leg-hold traps No. 1-1/2 or 2 can also be used as a last resort. All traps should be placed away from children and pets and checked in the morning and early evening so that captured animals may be humanely destroyed or released in an authorized area several miles from the trap site unharmed. To prevent a recurrence of the problem, all attractions for the opossum, such as food, burrows or holes under buildings, should be removed, filled in or closed off. **Build them out, fence them out or drive them out with strobe lights**. **Be clean.**

http://www.tomahawklivetrap.com/

POCKET GOPHERS
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Geomyidae

Pocket gophers *(Thomomys spp. and Geomys spp.)* are burrowing rodent pests that are named for the fur-lined pouches or "pockets" outside of their mouths, on each side of their faces. There are 35 species of pocket gophers in the Americas and they spend 99% of their lives underground. These pouches, which are capable of being turned inside out, are used for carrying food. Adult pocket gophers are about 5" to nearly 18" long (head and body). Their fur is very fine and soft. Colors range from nearly black to light brown to almost white. They are powerfully built in the forequarters and have short necks; their heads are small and flattened. Gophers have small external ears, small eyes and lips that close behind their large incisors and their forepaws have large digging claws. **Gophers are extremely fond of alfalfa and carrot tops.**

Pocket gophers dig burrows in lawns and gardens, pushing the soil from the burrows into distinct mounds on the surface. These mounds are characteristic in that they are built in the shape of a horseshoe or a fan around the burrow opening (Note: moles construct volcano-shaped mounds). Their underground burrows may be several hundred feet in length, ranging in depth from a few inches to several feet. Gophers are solitary animals except when breeding or rearing young. They are active year round, but are the most visibly active in the spring and fall when your lawn's soil is of the ideal moisture content for digging. Cut roots from your plants are usually stored in small chambers within their burrows. Their average litter size is 3 to 4 young. In late summer and early fall young gophers disperse from the family unit to establish their own burrows and territories. There are 33 species of gophers in the U.S. As many as 62 gophers - each with its own burrow system have been found in a one acre plot! Note: Pocket gophers never stray more than a few inches from one of their own tunnel openings.

INTELLIGENT PEST MANAGEMENT® CONTROL - Unlike moles, gophers are poor swimmers so flood the tunnels with water or you can use several one-gallon plastic milk jugs filled with water...turn them upside down with its opening in each hole. The water will drive the little miner out of its hole and right into your milk jug. Put the cap on and dispose. If that does not work, or you feel a little squeamish about the milk jug trick, put some carbon dioxide gas or dry ice in their tunnels. The carbon dioxide will keep the tunnels free of oxygen for at least a several hours. Lit charcoal briquettes will also kill them in their tunnels. Be sure to keep all the openings open so the charcoal can burn. The gopher plant or spurge *(Euphorbia lathyrus)* will sometimes detour or repel gophers - plant at least one plant every 2 - 3 feet to get control.

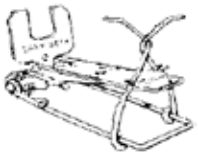
Try repelling them with well used cat litter and/or pine needle oil or drop rags soaked in ammonia in the holes and then seal the entrances. Pocket gophers also hate and avoid daffodils and the castor oil plant. Spray your yard with castor oil and/or drop castor oil beans directly into their hands. Hunt for them with ferrets. Put ferret urine or scent of human/dog hair into their tunnels. Sprinkle talcum powder or freshly ground hot pepper into their tunnels. Soak the ground and/or the tunnels with a mix of dish soap and castor oil in a hose-end spray rig that mixes water into your concentrated solution.

Gophers are incredibly sensitive to ground vibrations and can sometimes be repelled by whirligigs, pinwheels, half-buried pop bottles with the top up and/or battery-operated ultrasonic devices, e.g., Gopher It®. For small numbers of pocket gophers control is best accomplished with the use of traps. Two of the most commonly used commercial traps include the two-pronged pincher trap and the squeeze-type box trap. Both of these types of traps work by the gopher pushing dirt against a flat vertical pan or seizing bait attached to a trigger.

The key to effective gopher trapping is to properly locate main tunnels and then to correctly place the traps within the main tunnels. Traps are most effective when they are placed in pairs in opposite directions in main tunnels as they will intercept gophers coming from either direction. In addition to the main tunnel traps, traps can also be placed in the lateral tunnels leading to the mounds. Switch the cover crop from alfalfa (which is a favorite gopher food) to barley or sudan grass or a less attractive plant.

Main runways can be located by probing with a sharp stick or rod one or two feet away from a mound opposite the burrow plug. Once the tunnel is located it should be opened with a trowel or shovel to allow for the placement of traps. The traps should be worked back and forth in the tunnel to loosen the earth. After setting the traps, it is important to exclude light and air currents by covering the opening with plywood, cardboard, or some similar

material. All traps should be wired to stakes to allow for safe and easy trap/carcass recovery as well as to prevent predators from removing the traps. Traps should be checked once or twice daily. If a trap fails to catch a gopher within 3 - 4 days, it should be moved to a new location.



Lethal Traps. Trapping can be done any time of the year (as long as the ground is soft enough to permit digging), but spring is overall the best time to trap because this is when gopher activity is high and the ground is easy to work. Moreover, trapping in the early part of the year will help to maintain population levels by eliminating breeding females.

"The only good varmint is dead varmint." (*"Carl"* from Caddyshack)

Live Traps. A good bait for a small live trap or lethal trap is peanut butter and/or molasses on whole wheat bread. After removal of any trapped gophers, it is wise (if it does not pose any hazard to children or pets) to leave a few traps set in the burrows for a week or two because new invading gophers often explore vacated burrows before constructing completely new burrow systems.

Dry Ice. In early spring insert carbon dioxide gas from a 20# cylinder or dry ice into the burrows at several spots; seal off all areas where you see "smoke" from the dry ice. Be prepared to "stomp" any escapees from the suffocating gas - normally they simply go to sleep and die. Note: Often well used kitty litter or human or predator urine or simply ammonia soaked rags will repel them in spring.

PORCUPINES
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Erethizontidae
A.K.A. - "Porkies" or "Quill pigs"

DESCRIPTION

The tree porcupine *(Erethizon dorsatum)* is brown to black in color with a thick-set (chunky) body with a high arching back, small head, short legs and a thick, little tail. Their feet have unique soles with small, pebbly textured fleshy knobs and long, curved claws. Four toes on the forefeet and 5 toes on the hind feet. Their tracks are distinctive and toe in. They have over 20,000 (1-1/2" - 4") sharp, barbed quills on their body and tail. The porcupine can raise/lower these quills at will and can *slap* you or ram you, imbedding their *darts* into your flesh. If not removed, they will become embedded deeper and deeper. Porcupines are nocturnal, weigh 10 - 20 pounds and usually are 2 - 3 feet long. They are more common in coniferous or mixed forests, but occasionally even where no evergreens exist. They usually produce only one baby in spring, but occasionally there can be twins. Their nests can have as many as 6 - 10 individuals in winter and usually are located in hollow logs, stumps, under buildings or rocks. A large, blackish, (hystricomorph) rodent with an overlay of yellow-tipped hairs, the size of a small dog; most of its body - especially the rump and the tail are thickly set with long, sharp and hollow barbed spines. Porcupines basically sleep all day long in dens, hollow logs or trees and do most of their feeding and traveling at night.

Damages. They girdle and kill trees as they gnaw on and eat bark; they also feed on plants, flowers, leaves and buds, lily pads, rose bushes, corn, fruit trees and berry bushes. They love salt and readily chew on canoe paddles, saddles, toilet seats, oars, furniture, handles of all types and even building siding, frames and trim. They are often seen along highways (especially where salt has been used) in the evening and early morning. Trees with their tops barked indicate the nearby presence of porcupines. They are strict vegetarians in spring they feed on leaves, twigs and green plants. In winter it girdles trees to feed on the innerbark at various trees including pines, fir and hemlock. Note: They can return from releases less than 25 miles away. Their quills can cause intense irritation or even death if they are not removed from their attacker's head.

INTELLIGENT PEST MANAGEMENT® CONTROL - Porcupine-proof your buildings (especially crawls and porches) erect electrical fences to protect your gardens, tools and paddles, siding, timbers or trees. Many are

killed by cars. Use homemade box traps, Havahart® (Nos. 3 or 3A), http://www.havahart.com, or Tomahawk® (Nos. 108 and 109), http://www.tomahawklivetrap.com/, live traps; bait with salt, carrots, fresh apples and/or the stinking, offensive and putrid smell called long distance call lure, road kill stew, skunk essence, fish oil or other colorful names to describe the materials they have allowed to decompose in the sun inside a sealed container trappers use. Shoot them (within the first two hours after sunset) or catch them in a large fish net or run them down and/or club them if your local regulations permit. As with all large vertebrate control programs, **call your local game authorities before you even start any control program, to see if they are protected.**

RABBITS
CLASS - Mammalia
ORDER - Lagomorphaa
FAMILY - Leporidae

They do occasional damage to ornamental plants, young trees and vegetable gardens. A (tied or fenced) dog, sprinkled talcum powder and/or blood meal and/or small containers of garlic oil hung every 4-6 feet and/or human/dog hair, freshly ground cayenne, red or black pepper mixed in lard and put on or near the plants will repel them temporarily. Rabbits are also repelled by marigolds, globe thistle, cat mint, Black-eyed Susans, wormwood, castor bean plants, onions, shallots, leeks and/or garlic - so plant them in borders and between rows of susceptible plants.

INTELLIGENT PEST MANAGEMENT® CONTROL - Rabbits are active throughout the year, feeding mostly in early morning and late afternoon on various types of vegetation and the stems, buds and bark of woody plants. They usually live in areas of heavy vegetation, brush, piles of debris and briar patches. Controlling nuisance rabbits can be accomplished via habitat reduction, fencing, the use of chemical and physical repellents to protect plants, and by live trapping and removal of problem rabbits. Filling clear glass bottles with water and putting them where the rabbits are; they seem to frighten them. Habitat reduction is best accomplished by mowing, trimming or removing brush, branches, trees and grass and by cleaning up all debris, wood piles, abandoned machinery, etc. This will have a dramatic impact on rabbit activity as rabbits usually do not travel great distances from their cover to feed.

Tree guards can also be effective in reducing rabbit damage to tree trunks. It should be strong enough to resist rabbits chewing through it; 1/2" hardware cloth should be placed so that it extends 4" below the surface. The guards should be loose fitting to allow for several years' growth and should at least extend 2' above the average snow depth. Covering tree trunks with animal lard (with or without hot pepper) will often prevent rabbit damage. (Be sure any fence or guard is at least 18"-24" above the snow line.) Other protective measures include wire fencing for yards, gardens and individual plants. For homes surrounded by woods and/or dense vegetation, a 2' high fence along the yard perimeter adjacent to the obvious rabbit habitat will help to reduce rabbit activity. **Repellents** include predator feces, predator urine and gland secretions, dried blood, cow manure, onions and garlic oil and powdered rock phosphate. **Use live catch traps.** Bait with apples, lettuce or carrots. For best results, use several traps; locate rabbit traps so that the entrance to the trap is near tall grass, weedy areas, adjacent brush or any other areas where regular rabbit activity has been noted. It is usually easier to live trap rabbits during the winter than the summer. Be sure to release them at least 5 miles away. **Beagles and hunters** make quick work of most rabbits.

Rabbits can cause damage any time of the year. They prefer to eat young succulent, green vegetation and relish some flowers, vegetables, and crops during the growing season. In winter, when little green vegetation is available, rabbits may turn to trees and shrubs for food. **Girdling damage to woody plants that occurs during the winter often is not noticed until spring.**

The presence of rabbits does not always result in damage to personal property. Like most animals, however, rabbits are opportunists and will readily use our plants for *their* food.

Intelligent Pest Management® Control

Before implementing a control or management program, several important steps must be taken if the program is to succeed:

- Correctly identify the species causing the problem.
- Weigh the time and costs of control versus the expected level of damage and economic returns.
- Exclude the rabbits with woven-wire fences.
- Alter the habitat, if possible, to make the area less attractive to the rabbits.
- Use frightening devices or repellents to deter the rabbits from living in gardens and other areas.

Rabbits can be controlled with exclusion, habitat modification, frightening devices, repellents, traps, and shooting.

Exclusion. Excluding rabbits from valuable plants is a long-term solution to costly damage. Bury the bottom edge of the fence about 4 inches below the ground. A 3-foot fence will keep out both cottontails and jackrabbits. Wire cylinders can be loosely wrapped around individual trees or shrubs to protect them from being clipped and girdled.

Habitat modification. Cottontails can't live in areas that do not provide them cover from severe weather and hiding places from predators (including cats and dogs). Remove brush piles, weed patches, rock piles and other debris that cottontails hide in to make the habitat less suitable. Remove tall weeds and other cover from the vicinity of new woody plantings, such windbreaks and hedgerows. Mow or weed whip vegetation within 3 to 4 feet of recently planted trees and shrubs.

Jackrabbits prefer open areas where their vision is unobstructed. In general, improved range condition, with its greater amount of vegetation, may make rangeland less suitable for jackrabbits.

Frightening devices. Frightening devices, such as scarecrows, owl and snake effigies, strobe lights, pinwheels, pie pans spinning in the wind, and others cannot be relied upon to totally protect plants from damage. Animals acclimate very quickly to objects that are no longer perceived as a threat, so move them frequently and use frightening devices in conjunction with other damage control techniques.

Repellents. Repellents may provide temporary protection from rabbit damage, but their overall effectiveness is highly variable. They work best in spring and summer. When rabbits have alternative foods they can eat instead of the protected plants. And as with frightening devices, rabbits often acclimate to them. Always read and follow all label directions when using any "registered" pesticide, including repellents. Check out P.U. (predator urine) by Leg up, or try using some of your own urine.

Trapping or shooting. Trapping or shooting can be used to remove individual rabbits, where it is legal and safe to do so. Trapping or shooting will not likely provide long-term control where habitat is suitable for rabbits, because rabbits can repopulate areas quickly.

RACCOONS
CLASS - Mammalia
ORDER - Carnivora
FAMILY - Procyonidae

Raccoon Damage and Prevention Overview

Raccoons are omnivorous and can cause considerable damage to vegetable gardens, particularly sweet corn. This masked bandit is one of the strongest pound-for-pound animals on the earth. They will raid pet food dishes, back packs, coolers, garbage cans, and food supplies to get a "free" meal. Freshly laid sod lawns are often rolled up in search of earthworms and grubs. They also kill poultry. In these cases, the best method of prevention is to deny them entry. Keep raccoons away from poultry with tightly covered doors and windows in buildings or mesh-wire fences with an overhang surrounding poultry yards. Raccoons are excellent climbers and can climb conventional fences or bypass them by using overhanging limbs. A "hot" wire from an electric fence charger at the top of the fence will greatly increase effectiveness. A one-wire or two-wire electric fence

is best for large garden areas and lawns, which is easier said than done. They will climb down chimneys, tear apart root vents, or literally tear open the roof to find a place to have their young. They will also climb up on a roof, or open a trailer from underneath to find a protected area where they can do do routinely defacate. Keep smelly garbage in plastic bags indoors, or build a garbage shed. The lids on all garbage cans should fit tightly. They can be secured with rubber straps and hooks, but these items should be removed before trash collectors collect the refuse. Putting a half cup of household ammonia or a handful of talcum powder or predator urine or ground hot pepper in garbage bags also helps discourage them from scattering the contents about the area.

Raccoons cause damage or nuisance problems around houses and outbuildings when they try to enter attics, crawl spaces or chimneys. In extreme cases, they may tear off shingles or fascia boards. To keep them out, cover possible access points with heavy wire screening. Also, tree access to rooftops should be eliminated by pruning overhanging limbs and by placing a piece of tin loosely around the trunk, flaring it out like an upside-down funnel (also useful for keeping them off drain pipe downspouts and out of fruit trees, if there is no other way into the tree). Raccoons will eat fish in ornamental ponds. Wire screening over the pond is the best protection. Electric fencing will keep them out of any area. **Do not put out food for raccoons or other wildlife and never leave pet food where wildlife can get it. Keep pets indoors at night. Dogs are not an effective method of keeping raccoons away.** Try strobe lights.

Raccoons, *Procyon lotor*, sometimes called “coons” for short, live near streams, ponds, lakes or marshes. They prefer trees or brush as a natural cover. They do not dig dens of their own. They normally use hollow trees or logs, rock crevices and burrows for dens. Sometimes, however, they create a nuisance of themselves when they raid garbage cans, tear up lawns, or use our buildings for dens, including our chimneys, attics and the hollow areas beneath porches and outbuildings.

Raccoons mate in January or February, and after a 63-day gestation period, two to eight (average of four) young are born each year. At about two months of age they accompany their mother on her outings in search of food. The family group is very sociable, remaining together for about one year. They are large animals. Adults vary in size from 24” to 46” in total length and from 12 to 25 pounds. Raccoons are common throughout North America. They are easy to recognize with their black face mask and black, brown, and white ringed bushy tail. They have long thick fur with a thin muzzle and pointed ears. Their feet are well adapted to climbing and getting into things. **They are creatures of habit and usually use the same “path”.**

Their senses of hearing, sight, and touch are well developed, while those of taste and smell are not. They are commonly found near streams, lakes and swamps, and often do quite well in suburban areas and even in city parks. Raccoons den up during the day inside hollow trees or logs, rock crevices, deserted buildings, culverts, storm sewers, chimneys, attics, and crawl spaces. **More than one den may be used.**

Mostly active at night or nocturnal, raccoons may be seen at dawn or dusk and sometimes even in the middle of the day. Winter months are spent in the den, but they do not hibernate. They may become active during warm spells. Raccoons feed on animals and plants. In the spring and summer, they feed on crayfish, mussels, frogs, and fish. In the fall, they switch to fruits, seeds, nuts, and grains. They also eat mice, squirrels, and birds, and are quite happy knocking over a garbage can. Raccoons, too, can transmit rabies. Recently (raccoon) rabies has become a serious problem. There were 983 confirmed rabies cases in New Jersey in 1991. Several hundred raccoons have been trapped and euthanized in the counties surrounding Washington, D.C. If there is an outbreak of rabies (even suspected) in your area do not release trapped animals, ask your local wildlife and health department personnel how to properly dispose of them.

The raccoon is a wily animal and difficult to trap. Wait 1 - 2 hours after dark and they have left; then close all openings unless here are young still inside. Being a clean animal try sprinkling a 2’ wide border of powdered lime around your corn patch (reapply after a heavy rain) they hate to walk in lime. A few drops of Fox Lure on pieces of cloth around the area you want to protect on stakes every 6’ - 8’ works well too. Reapply after a heavy rain or 24 hours of extreme heat. Mix a little Wilt-pruf or Vaporgard with it to make the Fox Lure last longer. **Never set baited cages on unfinished floors or bare roof shingles!**

Their scientific name is *Procyon lotor*, of Greek origin and means “before the dog”. The last part, ***lotor***, is from the Latin word lutor meaning “a washer”. It refers to the raccoon’s habit of often *washing* items of food before eating. The common name, “raccoon”, was probably derived from the Algonquin Indian name for the

animal, *arakun*, meaning “he who scratches with his hands.”

DESCRIPTION

Raccoons have fur that is usually grayish or brown, strongly tinted with yellow or orange. Two areas of black markings can be found on their fur coat. One is the black “mask” over the eyes and, the other is the tail with 4 - 7 black bands. Occasionally, an albino is found. When full grown, raccoons can be 20 - 40 inches in length and weigh 12 to 42 pounds. Their average life span is 7 - 10 years. When undisturbed, raccoons may make a chuckling sound; when annoyed or fighting, they snarl, growl and hiss. A soft, low snort is given in recognition of unsociable individuals. The female uses a low, grumbling purr to call her young. The young, when separated from their mother, give a call very similar to that of a tree frog. In the fall especially, raccoons may call to each other with a shrill, screech owl-like whistle.

Raccoon tracks are frequently seen in dust or mud. Droppings (or scats) are also often seen in one or two locations close to where the raccoons are found, e.g., on the roof near the chimney.

HABITAT

Raccoons can be found throughout most of the United States, with a normal home range of about 1 - 2 miles in diameter. Problems with raccoons often arise when we try to *befriend* them and try to help them by feeding them - in doing this we condition them to lose their *respect* for people - a trait that makes them dangerous pests (not pets) that lose their ability to survive naturally and causes local populations to become denser than the habitat can adequately support and they are more likely to become ill and transmit diseases, e.g., rabies. **Do not breathe their dry excrement; always use a respirator!**

Raccoons prefer to live along streams, marshes, swamps, lakes or ponds in hollow logs or trees, and occasionally in rock dens and burrows. Raccoons may live in road culverts and in buildings that are occupied or unoccupied. They will frequently invade and live in attics and garages or chimneys, and they may invade your home if the chimney damper is not closed properly. They can enter your attics one of two ways; via the attic vents located on the sides of homes especially if they are unscreened or screened only with regular window screen material, not hardware cloth. Many attic vents have metal louvers that raccoons can easily spread apart or they simply tear off a few shingles on your cedar shingled roof and then enter directly into the attic. **Some raccoons climb on a roof and routinely defecate there - where they will not be disturbed.**

Habits. **Raccoons are usually nocturnal and are excellent agile climbers.** During the fall, raccoons use certain areas more than others but usually select a different resting site each day. These spots may be as much as one mile apart. During periods of snow and ice storms, raccoons usually den up for a few days, either singly or in groups, including both sexes and all ages. They do not hibernate, but do go into a state of torpor. Raccoons are normally easy to frighten, but they can be extremely vicious if cornered and can inflict fatal wounds on or drown larger animals. Female raccoons are extremely protective of their young. They routinely damage buildings to gain entrance. They routinely enter uncapped fireplace flues and nest on the smoke shelf behind the chimney damper. They love bacon, cat food, corn, melon and honey on bread.

Other Foods. Raccoons are officially classified as carnivores but they are actually omnivores, eating all types of plant and animal foods. **Because they eat just about everything imaginable raccoons almost never starve.** They readily open garages and raid trash cans at night. They love to eat the sunflower seeds found in bird feeders. Their plant food consists of fruits and berries, grasses and sedges, nuts, sweet corn and corn and other various grains, and honey. Their animal food consists of earthworms, various insects, spiders, clams and oysters, crabs and crayfish, fish, turtles, eggs or young of ground nesting birds, dead animals and birds, mice, squirrels, rabbits, and muskrats. They also will kill and eat ducks and geese crippled during the hunting season. They are also known to raid chicken coops, poultry barns and cornfields. Raccoons will frequently “roll back” sod in fine lawns in search for grubs, insect/larvae and earthworms. In some cases, the damage they can cause to a lawn can be extensive. Raccoons can also rip shingles off roofs; chew holes in buildings; knock down garbage cans and spread garbage about; have noisy conversations in attics; help themselves to the vegetables in a garden; and leave not only damage, but droppings as well.

Reproduction. Raccoons mate early in spring. The gestation period is 63 days. Females are sexually mature at 10 - 12 months of age. An average of four young are generally born in April or May. They are born blind and helpless, weighing about 2-1/2 ounces at birth; their eyes open in 18 or 19 days. Young raccoons start taking solid food by 40 days, and are weaned by the time they are 3 months old. They are cared for by the female until early winter. **The young raccoons will raid other *nests* during the day, steal babies from sleeping mothers and terrorize their "pets".**

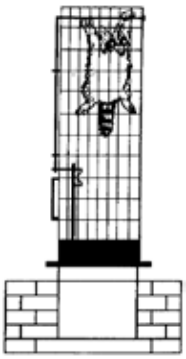
Raccoons are edible, and their fur is valuable. Therefore, raccoons are usually protected or regulated in most states. A license is usually required for hunting or trapping. Check local and state laws and regulations before attempting any control operations. Also, check with these agencies for the best release sites if you are live-trapping. **Raccoons have returned as far as 75 miles from a release site. "They're back!"**

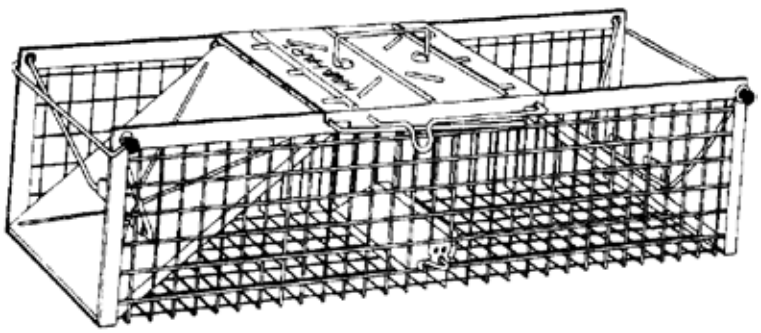
Ticks, lice, fleas, botfly larvae, roundworms, flukes, and tapeworms parasitize raccoons. They are known to have rabies, leptospirosis, Chagas' disease, tularemia, distemper, tuberculosis, and a skin disease caused by a fungus, so only handle raccoons with great care and thoroughly clean the area with copious amounts of diluted Safe Solutions, Inc. Enzyme Cleaner with Peppermint and/or borax. **Raccoons are the main reservoir host of cat fleas!**

Intelligent Pest Management® Control. **They are considered game or furbearing animals, so talk to your local and state authorities before doing any control work!** Often raccoons can be repelled by baby (talcum) powder, freshly ground red, black and/or chili peppers or paprika sprinkled around the areas where they have been seen; or try dog droppings or red fox urine lure! Let dogs roam free at night within a fenced area (invisible fence works well, too), but do not leave pet food outside over night. **Build them out - exclude them!** Keep your garage doors closed. Cut back all branches that touch or overhang the building. Raccoon (as well as all other urban wildlife) access to chimneys can be prevented by properly fastening a rain cap or commercial spark arrestor cap of sheet metal and hardware cloth over the top of the chimney, or by fastening heavy hardware cloth or a screen securely over the opening. Be sure this does not adversely affect the draft. Raccoon access to rooftops can sometimes be limited by trimming all overhanging tree branches and/or installing 2 strands of electric fencing 6" apart. **Raccoon are very sensitive to electric shock - they quickly learn to avoid charged fences!**

The Best Control method to remove raccoons from around buildings is to use live traps. Professional live traps for raccoons include Havahart® (Professional Raccoon Trap No. 1079; Nos. 3, and 3A); and Tomahawk® (Nos. 108, 109, 207, 608 or 609.5) and the chimney trap. **You may not be able to legally release them; call your local authority to check first!**

Setting a <u>live trap</u> to remove a problem raccoon is relatively easy, but to achieve the desired results you've got to set it correctly. Traps always should be set where they can be visually monitored easily. Never place the trap in the attic or under a mobile home unless it's absolutely necessary and you can check it at least daily. It is far preferable to put the trap in the raccoon's normal path of travel or in an open place where it is known to be feeding. Try to secure and place the trap so the raccoon must enter inside to eat the bait. If they hesitate, they may be "trap-wise" so tie your live trap open, fill it with food and let them eat for a few days before you untie the trap door.





Bait the trap with something that it is currently feeding on or with something that will surely tempt it. This is not too difficult because raccoons will eat virtually everything. In most cases, a dry cat food that includes fish meal in an inexpensive, non-messy, excellent choice. Raccoons can be very easy to lure into a trap, but at other times they are exceptionally frustrating. Try switching baits if the raccoon will not enter your trap after the first 3 or 4 nights. Chicken necks, sweet corn, peanuts or a chocolate candy bar are some of the varied foods that might tempt your problem animal. If switching baits does not produce results, you will have to reduce the raccoon's fear of the trap. Wire the door of the trap open so it cannot fall shut. Then place bait both inside the trap and around the outside. After a few days, the raccoon probably will begin to enter the trap to feed. Once it is doing this regularly, you can unwire the door.

One final consideration is your choice of trap. Although there are many brands of live traps, they all work much the same. One difference, even among the same brand, is the number of doors available. When trapping raccoons, traps that open at only one end are preferable than those that open at both ends. If you are using a two-door trap, consider closing one of the doors and locking it down, thus making a one-door trap. This forces the raccoon to go all the way to the back of the trap to reach the bait and ensure that it will be trapped when the door is triggered.

Some raccoons readily enter live traps upon first encounter while others remain wary of the traps for several days. Therefore, pre-bait the traps by placing baits in and around the traps and twist-tie the trap door open for 2 - 3 days. Raccoons are scavengers, and we have had great success baiting with chocolate candy bars.

Effective baits for raccoons include, chocolate candy bars, peanut butter, fruit jellies, marshmallows, sweet corn, sardines and other fish, fish-flavored cat food, melon, crisp bacon, and cooked fatty meat. Raccoons have great noses to catch the aroma. Tiny amounts of baits should be placed in a trail leading into the trap, with the major portion of the bait placed at the back end or the closed end of the trap. Raccoons tend to be naturally attracted to shiny objects. Adding a mirror or wadded up piece of aluminum foil at the back of the trap on the trigger or dangling above the trigger may help to stimulate their curiosity. Try fried chicken, fish, sweet corn or crisp bacon. A few drops of a raccoon lure will also aid in attracting the raccoon to the trap. Raccoons are very clever so the baited end of the live-trap should be blocked/covered so the raccoon can't reach the bait from the outside. Also, place weights on top of the trap and/or tie it down, so the raccoon can't tip it over to get to the bait. **Remember that relocated raccoons may spread dangerous diseases and it may very well be illegal to release live trapped raccoons in your local area.**

In urban areas marauding raccoons may be a serious problem. Sanitation will help defer their activity. Store all trash in sturdy, steel trash cans with sealed, tight fitting lids; remember, plastic trash cans are no match for these large pests and or dogs. They are temporarily repelled by baby powder, blood meal, red fox and/or human urine and excrement, flashing or motion detector lights and/or radios.

Make a moat: Encircle your corn or melon patch with a 3-foot-wide "moat" made by laying black plastic or mesh fencing on the ground. A raccoon's feet are hairless, sensitive, and plantigrade, which means that the entire bottom of the foot touches the ground when it walks. **The animal doesn't like to tread on unusual surfaces, especially if they make a noise or deliver a shock!**

Make a raccoon "night-light": Put a blinking or rotating light or blinking Christmas lights in the garden at night. Like other nocturnal animals, raccoons have an extra set of light-gathering cells in their eyes. **Flashing, bright lights are very unsettling to them, so use strobe lights!**

Irritate them: Turn on a blaring radio and/or plant a scratchy vine crop such as winter squash or pumpkins around and among your corn to irritate and discourage the masked raiders. Sprinkle some predator urine around. Install several Not Nice to Critters.

Surround your crops: Sprinkle hydrated lime or freshly ground hot pepper in a 4-to-5-inch-wide band around your corn crop when it ripens.

Cover your "ears": Wrap individual corn ears in pantyhose *socks*, paper bags, foil or plastic, and secure the covering with a rubber band.

Let your fence top flop: If you use a chicken-wire fence, don't attach the top 1 foot of wire to the posts. When a coon tries to climb up, the loose portion will bend backward and keep the animal from making it over the top or put electric fencing on top.

Raccoons dislike strong smells and these can often be used to discourage them:

- pure soap flakes, spread on the lawn and then watered in thoroughly;
- bone meal and blood mixed in the garden soil;
- naphtha flakes (the active ingredient in mothballs) or mothballs themselves sprinkled around the edges of lawns and gardens;
- diluted Tabasco sauce, freshly ground pepper or talcum powder sprinkled over vegetables, but wash them before eating;
- light up the area where raccoons gather to help keep them away. Use one 100-watt bulb for every 15 square meters (50 ft. by 50 ft.) of garden.

Shoot them - Wherever safe and legal, spotlight and shoot them and dispose of them properly. **Never touch a dead animal without proper protection!**

Garbage

Raccoons will eat virtually anything. Raccoons are unafraid of people and live in close association with people. Garbage cans provide a real feast for them, and once a meal is found they will return again and again to the same place. To close down your raccoon cafe:

- Fit garbage cans with tight lids and secure them upright and close all dumpsters;
- Put Tabasco sauce, mothballs, or an inch of ammonia in the bottom of a garbage can or dumpster to help stop the night time feasting;
- If the lid on the can or dumpster does not fit tightly, weigh it down with a rock or cement block; tie a bungie cord from side handle to side handle and pass it over the lid of the can or dumpster lid to discourage raccoons;
- Put a bright light in the garbage area to help keep raccoons and other nocturnal animals away.

Homes, Attics, chimneys, and other raccoon residences. Attics and chimneys are favorite sleeping places for raccoons. Uncapped chimneys are an open invitation, and so are loose shingles and openings in roofs and eaves. Although keeping these animals from getting into your home should be your first plan of attack, the following approach will help you to remove them if they do get in, and to discourage them from re-entering.

Step 1:

Encourage raccoons to leave on their own by making the home unlivable for them. To make the space unpleasant to the raccoon, place in the area:

- Strobe lights;
- A heavy sprinkling of naphtha flakes, talcum power or freshly ground hot pepper;
- Ammonia soaked cotton rags;
- A radio playing loud music or talk shows;
- Or a bright light or lots of flashing little lights;
- Predator urine, e.g., dog, fox, coyote, male raccoon or human, on a cotton ball and thrown in the space.

Step 2:

Before any opening is closed off or any chimney is capped, check to see that all of the raccoons have moved out. Shove a crumpled newspaper in the entrance hole.

- Check especially well between May and July when there may be baby raccoons as well as adults;
- Be sure no animal is trapped inside a sealed area as it will starve to death. Not only will the animal suffer, you will be left with a smelly decomposing carcass and flies.

If you think you know where the animals are getting in, check if the entrance is currently in use by:

- Sprinkling flour in front of it and look for footprints in morning;
- Lightly stuffing a rag or bunched up ball of paper in the opening to see if it is removed.

Step 3:

When you are sure that all raccoons have left: Shove a crumpled newspaper in the entrance/hole.

- Secure the opening to prevent re-entry;
- Block all holes with galvanized sheet metal;
- Repair siding and holes in buildings;
- Use heavy, rust proof screening to cover open air vents;
- Screen all vents and cap chimneys securely;
- Trim overhanging tree branches;
- Remove unused T.V. towers;
- Leave behind a good dusting of naphtha flakes, talcum powder, freshly ground pepper, ammonia or bleach to discourage the raccoons in their search for another opening back into their old den;
- Install electric fencing and flashing Christmas lights or, better yet, strobe lights.

As a last resort use a #2 leg-hold trap or a #220 Connibear trap. Before using any Connibear traps or leg-hold traps check with fish and wildlife officials on the legal use of these traps. **Even if legal - you must be very careful not to hurt people or pets**.
If there is a female raccoon with young nesting in a chimney or attic, wait for the young to mature before you try to "flush" or drive all of them out at once. Welder's gloves should be worn to protect your hands and arms and a respirator to protect your lungs. Try releasing an aerosol pyrethrin spray or a tear gas aerosol up into or ammonia below the damper. Lower ammonia-soaked rags down the chimney; then **after** the raccoons have left; a chimney cap or ¼" or ½" mesh hardware cloth should be securely attached to the chimney...or drop cotton balls saturated with chloroform or dry ice **(be very careful not to breathe either gas yourself)** down the chimney and wait until the raccoons have lost consciousness; then open the flue and grab them firmly with a leather glove and ventilate the entire structure.

To prevent raccoons from entering attic vents, ¼ or ½" mesh hardware cloth should be used to screen them out. Half-inch staples and construction adhesive should be used to firmly attach the screen to the building. Raccoons can squeeze through a hole with a diameter of only 3½ to 4 inches. Therefore, check for all possible entry points anywhere in or on the entire house or building. To keep raccoons out of a small garden, an electric fence can be used where feasible and legal. A fabric or chicken wire-type fence should be at least 3 feet high, and should be turned under and outward at the bottom about 2 feet. The electric wire should be located 4 inches above the top of the fence wire and a second electric wire can be located on an arm 4 inches away from the fence. Check local city ordinances before installing any electric fencing. Raccoons are easily caught with leg-hold traps, but we do not recommend their use.

Rabies Caution - **Raccoons are the most susceptible to rabies of all wildlife!** They can become rabid if bitten or if they eat the carrion (dead body) of a rabid animal. **Raccoons that are sick and/or show no fear of humans, should never be approached or touched. If scratched or bitten, even by a healthy raccoon, seek medical care immediately!** The Latin word for "to rage" is "rabeve" from which rabies was derived. Rabies is always fatal if not treated in time; it attacks the central nervous system. The incubation period in humans is usually 2 - 8 weeks but can range from 5 days to an entire year. Prompt treatment via vaccine is virtually 100% effective in stopping rabies. Symptoms include itching and/or burning at the bite location, fever, headache, hydrophobia, convulsions, hallucinations, disorientation, paralysis and death. Two forms of rabies occur in animals: the "berserk" kind wherein they foam or drool at the mouth and are nervous and/or attack, and the passive or paralytic kind wherein the animal is often choking, weak and very lethargic. **See skunk and bat sections for more rabies information.**

SHREWS
CLASS - Mammalia
ORDER - Insectivora
FAMILY - Soricidae

Shrews are small, mouse-sized mammals with an elongated snout, a dense fur of uniform color, small eyes, and five clawed toes on each foot. The teeth are small and sharp and may have dark tips. Shrew feces are often corkscrew-shaped. Both shrews and moles are insectivores, whereas mice are rodents.

Insects make up a large portion of the typical shrew diet. Shrews eat beetles, grasshoppers, butterfly and moth larvae, wasps, crickets, spiders, snails, earthworms, slugs, centipedes, and millipedes. Shrews also eat small birds, mice, small snakes, and even other shrews when given the chance. Seeds, roots, and other vegetable matter round out their diet.

Shrews live for about 1 to 2 years. They produce 1 to 3 litters per year with 2 to 10 young per litter. The gestation period is approximately 21 days.

They occasionally fall into window wells, attack pets, attack birds and chipmunks at feeders and feed and contaminate stored foods with their feces and urine.

Shrews can usually be controlled using snap traps or glue traps. Hamburger or other meats are effective baits for shrews. **No toxicants are registered to poison shrews**.

Intelligent Pest Management® Control Summary of Skunks, Raccoons, and Opossums

Exclusion. These animals can be prevented from entering buildings by repairing breaks in foundations and screening crawl space vents with hardware cloth. Nocturnal invaders can also be discouraged with smelly old sneakers (strategically placed), blaring radios and/or blinking Christmas lights. Cover a fence with black plastic (that flaps) and/or tinkling bells; use a photo-electric (intruder or motion detector) bright light system and your own ingenuity before your resort to the use of poison, a shot gun or a lethal leg trap.

- If the animal is currently living under the building, seal all openings but one, then sprinkle a tracking patch of talc at the opening.
- Examine the area after dark. If tracks show that the animal has left, close this last opening immediately.
- Seal attic openings.
- Cap chimneys with a wire cage or other animal-proof cover.
- Put chicken wire flat on the ground in areas they are digging.

When excluding animals in spring or early summer, be aware that young may also be present. Be sure that all animals have been removed before sealing the building. Otherwise, a serious odor problem from a dead animal could result. **Wait until they all leave any chimney vents—before you cap these chimneys properly.**

Live Trapping. The best way to remove animals from around buildings is to trap them. Talk softly when approaching.

A word of warning: In many areas of the country, releasing a trapped animal may be illegal. This is particularly true with skunks and raccoons because they can carry rabies. Another word of warning: the spotted skunk is protected in some states. A final word of warning: Some of these animals may be regulated as fur bearers under fish and game laws your state. Know your state and local regulations before proceeding.

- If the animal must be killed, lower the trap into a tub of water or gas it with (dry ice) CO_2 or cover the trap with a heavy tarp and inject CO from an exhaust pipe.
- If the animal is to be released, do it far away from human dwellings. Use what you have learned about the biology of the animal to find a suitable habitat. The release site for these large animals should be over ten miles away from the capture site. **Be sure it is legal in your area to kill and/or release trapped animals.**
- Remember to check all applicable federal, state and local regulations.
- Set traps as close to the den as possible where damage is occurring, e.g., at corners of gardens, breaks

in stone walls, or along obvious animal trails.
- Set multiple traps in a number of different locations.
- Since these animals are active at night, check caps at least every morning; preferably twice a day.
- Check traps often to spot and release non-target animals.
- Remember, 70% of all relocated wildlife will die; trapping also separates mothers from their young, leaving them to die terrible deaths.
- Fumigate burrows with carbon monoxide or carbon dioxide during the day.

There is, obviously, a special problem when trapping skunks, but skunks don't like to "shoot," if they can't see their target.

- Cover all but the entrance of the trap with burlap or canvas before placing the trap, or
- Use commercially-sold solid skunk traps.
- Approach the trap slowly, cover the trap and transport it gently.

To release a trapped skunk, stand more than 20 feet away and release the trap door using a string or fishing line.

The suggested baits for each animal are listed below:

Skunk: Chicken parts and entrails, fresh fish, cat food, sardines, eggs, mayonnaise, crisp bacon
Raccoon: Chicken parts and entrails, corn, fresh fish, sardines, candy bar, jelly, crisp bacon
Opossum: Apple slices, chicken parts and entrails, fresh fish, sardines.

Maintaining a good level of sanitation in a neighborhood is the best preventive measure for skunks, raccoons, and opossums. Remind occupants that released vertebrates must fight their way into new territory to establish themselves and overcrowded habitat results in increased risk of disease and marginal nesting sites. Prevention is the most humane way of managing vertebrate pests.

If live traps don't work, you can use a leg-hold trap strong enough that it will hold the animal, but no so strong that the bones or even the skin are broken. Set your leg-hold trap with a piece of screen under the trigger; then use a garden trowel and dig a 2" - 3" hole a little off center in front of the trap at about a 65° angle; throw some bait/food in the hole; then carefully sift a little dirt over the food and just cover the trap. You can funnel the pests to the trap or put the bait between two logs and then put a trap at either end; you may catch two animals with the log set. If you use leg-hold traps, prepare a snare using an ax handle with a flexible (brake) cable at one end and a *pull* at the other. Catch the animal by the neck - release the leg - the place the trapped animal in a cage, transport and release at an approved location.

Skunk Overview

Of the five species of skunks in the U.S., there are only three kinds of skunks that may become pests, the striped skunk and the two spotted skunks. The striped skunk is about the size of a large house cat and has two broad stripes running from the back of the head to the large bushy tail. Spotted skunks are about half that size, with four irregular stripes beginning behind the eyes and below the ears and are much better climbers than striped skunks and may occasionally have dens in tree holes and attics.

Skunks are nocturnal. They do not hibernate, but may sleep through cold weather periods. They usually live in underground burrows, hollow logs, or rock piles. They may decide to live under houses, porches, decks, wood piles, sheds, cabins, or storage buildings or even in attics.

Of course, the main problem with skunks is their stink. But they become "pests" when they change their dietary selections from rodents, insects, and wild fruit, to garden crops, garbage, and lawn insects and locate their habitat closer to humans. Another major problem in some areas of the country is the transmission of rabies.

SKUNKS
CLASS - Mammalia
ORDER - Carnivora
FAMILY - Now Mephitidae (means "foul-odored ones" in Latin). Formerly skunks were considered to be in the subfamily Mustgelidae.

Skunks belong to the weasel family (Mustelidae) and are well-known fur-bearers (with scent glands) about the size of a large house cat. They are not disturbed by human odors and/or activities, so they often decide to take up residence under "our" buildings, porches, and decks! Even though they are solitary creatures, there may be 5 - 15 skunks in one square mile! Skunks will frequently move in to our yards and forage. They are normally nocturnal and prowl around at night., but are occasionally seen in broad daylight, especially in the mating season. They are omnivores, found outside early in the evening hunting for grubs, aphids, beetles, yellow jackets, moles, grasshoppers, insects, crickets, frogs, snakes, mice, rats, pet food, garbage and table scraps. They breed in February and 4 to 10 kittens are born in April, May or June. The kittens usually remain in the den for about 6 weeks. Five species of skunks are found in this country, but only three are of any economic or public health importance: the common or Striped skunk *(Mephitis mephitis nigra)* and the Western *(Spilogale gracilis)* and Eastern *(Spilogale putorius)* spotted skunks. In addition, the Hooded *(Mephitis macroura)* and Hog-nosed *(Conepatus mesoleucus)* skunks may also be found in localized areas. Skunks to not truly hibernate, but become inactive during the winter for various periods of time. Sometimes they are called "pole cats".

Skunks are disliked primarily because of their ability to spray people, pets and building with a very obnoxious odor when provoked. Two internal glands located at the base of their tails produce a thick, volatile, oily liquid that contains odorous sulfur compounds, such as butyl mercaptan. The spray is released primarily in self-defense. Skunks usually stamp their front feet rapidly and loudly, growl, hiss, or walk a short distance on their front feet with their tail erect as a warning prior to spraying. When the tail is raised, a skunk can discharge either one or both glands to form a stream of noxious liquid that disperses into a fine spray. This fluid can be directed accurately for up to 10 feet, and somewhat less accurately for up to 20 feet. Skunks can discharge their scent glands several times within a short period. The stinking, acrid secretion is extremely painful if it gets in a person's or pet's eyes and may cause nausea and temporary blindness for 15 minutes or more and can cause internal bleeding or asthma if inhaled directly. They are attractive nuisances to dogs and are infected with rabies, histeriosis, mastitus, distemper, Q fever, microfilaria and histoplasmosis. They love to dig and burrow and destroy lawns. **Skunks are another one of our main sources of rabies, so all bites and scratches should be cared for by a physician and the health department should be notified immediately!** Rabies is an infectious disease caused by a virus found in the saliva of infected mammals about the time they become ill. Rabies is transmitted by bites and/or eating a rabid animal and is usually fatal (if not attended to by a physician) to all mammals, including man but excluding bats. If you pick them up, use "cat grabbers". http://www.ketch-all.com/index.php?p=show&id=8

The Salem (Mass.) Evening News reported in March on an incident in which Carmen LaBrecque, 51, had to outrun a rabid skunk, which was literally snapping at her heels, for 15 minutes before an animal control officer arrived to shoot it. Unable to slow down enough even to open her front door and get inside, LaBrecque circled her yard 12 times, a foot or two in front of the skunk. On one pass by her front door LaBrecque's elderly mother handed her a cell phone, which LaBrecque used to call 911 as she ran!

Skunks sometimes eat mice, poultry and eggs, garden vegetables, and fruit. They can also damage bee hives as they feed on adult and larval bees. Skunks commonly damage lawns when they dig in search of insect larvae. Usually the damage by skunks has the sod "rolled back" in a similar fashion as done by raccoons. As skunks "root" for insects they can literally upend huge areas of your lawn. They also can throw garbage about, spray people and pets and make an area very smelly and/or uninhabitable for a time. They are opportunistic feeders and will eat grubs, adult insects, garbage, pet (especially cat) food, frogs, snakes, dead animals, rodents, fruit, berries, eggs, mushrooms, birds, etc.

DESCRIPTIONS - There are 11 species divided into 4 genera: *Mephitis, Spilogate, Mydaus* and *Conepatus*

The common or striped skunk is about the size of an adult house cat, about 30" long including its tail, and its fur is mostly black with white on extends posteriorly, usually separating into two white stripes. All-black or all-white (albino) individuals are sometimes seen. They have litters of 4 - 10, born in late spring or early summer. They can squirt 9' - 10' **into** the wind. Cloths soaked in ammonia may repel them.

Spotted skunks, as their name implies, are black with white spots or short streaks of white. They are much smaller than the striped skunk and only about half the size of a house cat. They are also more active and nervous then striped skunks. They are found in a variety of areas, including brushy or soil bank type areas, stream beds, rocky outcrops, road culverts, industrial yards and around buildings, homes and other suburban areas which are within about ½ mile of their natural habitat.

Spotted skunks are much better climbers than striped skunks and may occasionally have dens in tree holes. Because of their climbing ability, they are capable of entering open unscreened windows of an attic, cabin or house or other suitable openings above ground level. They have litters of 2 - 6, born in early summer.

Skunk dens are usually enlargements of the burrows of other *evicted* animals. Rock piles or outcroppings also are used in some areas, as are hollow logs. They may establish their dens beneath your home, school, shed or other building if they can gain access. More than one family may occupy the den. Occupied dens will often show signs of fresh digging, at least in the spring. Droppings will be evident and, like bats, usually contain numerous insect fragments. Loose hair and rub marks also can be found.

Skunks are nocturnal in behavior, so their occasional presence may go unnoticed around your yard or buildings for awhile - until you note a strange smell as they take up occupancy beneath your building or have a confrontation with your pet or some other animal, leaving the tattletale *clue* of their presence hanging patently in the air! A faint lingering skunk odor occasionally is detected where skunks have fed or traveled, even though the animals have not actually sprayed the area.

Since skunks are fur bearers, they are trapped and harvested seasonally in some states. Hence, before beginning any control, be sure to check with officials of the local fish and game conservation agency. Legal provisions normally permit action to remove skunks to prevent (further) damage.

As with all the other vertebrate pests, the best solution to skunk problems beneath buildings is to prevent them from entering, so carefully screen, block or build them out, NOT IN! After they leave or before they enter - use sturdy wire mesh (1/4-inch hardware cloth or similar materials) to screen vents near ground level in houses and other structures. Tightly seal or fill in holes in foundations, attics, under porches and other outbuildings to prevent their access. All spaces beneath porches, stairs, and mobile homes should be closed off to keep skunks out. Install strobe lights, motion detector lights and freshly ground pepper. **Deny them access in the first place!**

Exclusion. Once skunks have made their home beneath a building, make sure the animals have left before you close off their entrance. This sometimes can be accomplished by sprinkling a smooth layer of flour, about 1/8-inch thick, on the ground at the suspected entrance to form a *tracking* patch and then examining the area for skunk tracks soon after dark. When tracks lead only out of the entrance, the opening usually can be safely closed off. Try repelling them with talcum powder, which also leaves a tracking patch.

Setting up a bright light near the entrance will eventually discourage a skunk from returning to a den. Some people have also recommended noise such as a radio (talk shows especially..."human sounds" or loud music with lots of thumping bass) but the Author does not know how well this works.

When you are sure that all skunks have left: Stuff a crumpled newspaper in the entrance holel

- Secure the hole to prevent re-entry. Make sure that all boards or wire screening extend at least 8" - 12" underground as skunks are excellent diggers.
- Backfill the area with dirt.
- Repair siding and holes in buildings.

- Place wood or wire screening around the base of porches and buildings, ensuring that you cover these areas to at least 8" - 12" below the ground.
- Eliminate piles of rock or debris and stack woodpiles neatly to eliminate holes.

If you are unsure of the number of skunks present, the tracking patch can be supplemented by hanging a section of ½-inch hardware cloth over the opening, hinged at the top and left loose on the other three sides. It must be larger than the opening, so it cannot swing inward. The skunks will push it to leave, but cannot reenter. When the skunks are gone, the entrance should be permanently sealed. Extend the hardware cloth or other materials used to block the entrance several inches below the ground to prevent the skunks from digging under the barrier; or better still, add a wire skirt at the bottom of the barrier or at ground level extending at least 12 inches in an "L" horizontally outward from the entrance.

When skunks have become trapped by falling into a window well, newly poured foundation, well pit, cellar or hole in the ground, a rough board or a cleated board carefully lowered into the hole will allow them to climb out and escape. **Keep all people and pets away until the skunk leaves on its own,** often after dark. The presence of skunks near homes and farmyards can be discouraged by removing brush piles, rocks, stacked lumber, wood piles and similar sources of shelter.

Excluding skunks from beehives: Skunks will eat bees and honey and damage hives; apparently they are not bothered by bee stings or yellowjacket stings; they will also eat those "nests" too. Sprinkle freshly ground hot pepper or string electrical fence around the hive about 3" above the ground or take a scrap piece of wood about 1 foot wide and as long as necessary, and drive nails through it placed 1" apart (2" long nails of any type will do). The result is a pin cushion arrangement which can be placed on the ground beneath the entrance to the hive to discourage skunks, but you must protect children, pets, etc. who may venture there too!

Making a skunk move: Use a water pistol or spray bottle to spray a short stream of water behind a skunk to make it move.

TRAPPING

Havahart®, http://www.havahart.com/nuisance/cagetrap_quickguide.asp and Tomahawk® live traps http://www.tomahawklivetrap.com/products/31.html are appropriate means of capturing and removing skunks. Traps should be baited with foods, e.g., fish (canned, smoked or fresh), honey, mayonnaise, eggs, fish-flavored cat food, chicken entrails or parts, greasy chicken bones, bacon, or peanut butter on bread. The trap should be set in the trail immediately in front of the burrow's main entrance. Logs, twigs, brush or stones placed on either side of a path between the burrow opening and the trap will aid in funneling the animal toward the trap. All traps should be visually checked in the morning and early evening. **You may not be able to legally release them in your area, so check with your local officials first.**

Hand-made live-catch traps constructed of wood, sheet metal or wire mesh can also be used to aid in removing skunks from beneath or around your buildings. The traps should be at least 10" x 10" x 30" or slightly larger. Place them where the animals are entering the building or in trails they are known to use. Bait can be fish (canned or fresh), fish-flavored cat food, raw or cooked bacon or chicken parts. Since an infestation beneath or around buildings normally involves only a few skunks, trapping should be the control method of choice. Skunks are relatively easy to trap if you place a 160-size Conibear trap over the den opening, but they can kill pets and other wildlife.

Fumigation - Dens away from buildings can be fumigated with "registered" gas cartridges, dry ice or carbon dioxide gas or lots of lit charcoal. **Be careful not to start a fire.**

To transport a live-trapped skunk without causing it to spray, slowly approach the trapped skunk and cover the trap with an old blanket or piece of thick burlap. Or, wrap the trap in heavy cloth or burlap at the time it is set (this also helps encourage the skunk to enter). When kept in the darkened trap, the skunk will be less fearful and less likely to release its scent. Carefully pick up the covered trap and place it gently in the back of a pickup truck for transporting it elsewhere. Avoid all sudden stops, jarring movements or loud noises which may frighten the skunk. It is more difficult to handle spotted skunks successfully in this manner, but striped skunks seldom release scent when these precautions are taken. **Be careful! Move very slowly at all times!**

Trapped skunks should be humanely destroyed where rabies is endemic in the population. Skunks can be destroyed via drowning by submerging the covered trap in water for 5 minutes or longer. Chloroform, carbon monoxide or carbon dioxide can also be used to kill a skunk in the trap. Because of the potential spreading of rabies, releasing trapped skunks elsewhere is not advised. **Do you want one released in your own backyard?** In addition, it may be illegal in your area to release trapped skunks.

Leghold traps and/or shooting are not recommended methods to dispose of skunks, as they often result in the release of a terrible odor. There are no toxicants (poisons) currently registered for use in controlling skunks, but they will die in their tunnels if enough dry ice (CO_2) or burning charcoal briquettes are placed inside their tunnels.

Shooting - If legal and safe, they can be spot lighted at night and shot - but, be prepared to quickly bury the skunk and control the odor! This is the way many golf courses handle skunk invasions.

Repellents. Rather than using several pounds of volatile, toxic mothballs in order to force a skunk to move (used as a repellent). Carefully mix 1 oz. oil of mustard and 2 oz. detergent in one gallon water and then spray this mix into the "den". Ordinary household ammonia has been effective for the same purpose if placed in shallow open-top watertight containers or soaked rags to permit the vapors to penetrate the space beneath the building. Sprinkle naphtha flakes or freshly ground hot pepper around the area and/or in their dens. Avoid breathing the vapors yourself.

The placement of several floodlights or strobe lights under the floor of the opposite side of the building from their normal entrance or directly over their entrance also has been useful in driving skunks out from beneath a building or from the interior of an outbuilding; two weeks later you can carefully install motion detector lights to save energy.

Mix 8 oz. lemon scented dish washing liquid with 8 oz. castor oil into 1 gal. water. Spray this mixture on your entire yard. (If a skunk is living in the yard, spray the yard at night, after the skunk has probably left in search of food.) Sprinkling human hair all around the yard is also suggested. **Notice!** Moth balls and moth flakes have been recommended at times to drive away skunks... these *MAY* work but these materials are not EPA registered and are dangerous to you and yours.

Intelligent Pest Management® Preventative Measures. If skunks around a house or farm are a problem, some simple preventative measures can be taken to discourage them. These involve removing sources of food and shelter from the area which can attract skunks. Keep your garage doors closed. Install motion detector lights. Remove brush piles, stacked lumber, wood piles and similar sources of shelter which skunks can find inviting. Dog or cat food left outside for family pets can be very attractive to skunks, as can corn and sunflower seeds for feeding birds/ducks/squirrels. Discontinue this practice if skunks are a problem. Block off or securely screen all openings which lead under structures such as under houses, farms and porches to prevent skunks from making homes there. You can use a sturdy wire mesh (¼" hardware cloth or similar material) to screen such openings. Trim or cut off any branches that touch or overhang the building - the Author has trapped skunks living in the attic! Bury the screen covering several inches below ground to prevent skunks from digging underneath. **Be careful not to lock skunks or other animals inside!**

A fence can be made to exclude skunks from landscaped areas, school yards, etc. Use 1" poultry netting in a 3' width is recommended. The bottom 12" should be buried below ground extending at least 6" down and at least 6" outward in an "L" shape to discourage skunks from digging under it.

Skunks are usually attracted to lawns and gardens after a rainfall when crickets, worms, grubs and larvae are near the surface. They will also eat mice, shrews and moles. They dig small round holes, and in some cases actually roll up large chunks of sod. Prevention methods include:

- Treating the lawn with diluted Safe Solutions Enzyme Cleaner with Peppermint to get rid of the grubs and larvae;
- Sprinkling pure soap flakes on the lawn and watering thoroughly.
- Spraying garlic on the lawn or sprinkling talcum powder to repel them.

Garbage. Garbage cans can provide a real feast for skunks, and once your free meal is found they will return again and again.Since skunks are such poor climbers, closing down your wildlife cafe can be accomplished by:

- Storing garbage in boxes or bins or above ground on platforms;
- Storing garbage inside the garage or basement until the morning of pick up;
- Placing oil of mustard or freshly ground pepper around and in the bottom of the garbage can;
- Fitting garbage cans with tight lids and securing them upright. If the lid does not fit tight, weigh it down with a rock or cement block. A bungie cord tied over the lid from side handle to side handle is also effective.

Gardens. They will consume ripening foods in gardens and/or compost bins.

Bird Feeders. Bird feeders are popular snack bars for skunks, raccoons and squirrels who especially love sunflower seeds, so give your bird feeder a spring cleaning and leave it empty until winter.

Odor Control. Skunks are known for their obnoxious odor or spray which can persist and contaminate anything touched by it. Several products known as Big D Water Soluble Deodorant http://www.bigdind.com or Neutroleum Alpha or Safe Solutions Pet Wash can be used to counter their horrible odor. A tablespoonful of Big D in a water bath works well for dogs and humans unfortunate enough to be "hit", or you can use Safe Solutions Enzyme Cleaner with Peppermint. Both are also quite effective for scrubbing floors, walls, garages, basements, outdoor furniture and the like, using 2 oz. to each gallon of water. It can also be sprayed directly on contaminated soil or buildings. One home remedy to remove skunk odor inside is to mix 1 pack allspice with 1 bottle vinegar. Simmer the mix on stove until the odor is neutralized. When you need it (do not premix), mix 1 qt. 3% hydrogen peroxide, ¼ c. baking soda and 1 tsp. soap to completely destroy skunk odor by chemical oxidation. Keep this mix out of the eyes and thoroughly rinse. Substitutes for the above are chlorine laundry bleach or household vinegar, diluted 1 to 10 parts of water, with a little household detergent added to assist in wetting and saturating the area. Tomato juice is messy and won't work. Its supposed effectiveness is based on the fact that it contains a small quantity of the organic acid, aspartic acid. In large quantities this could be effective, but not so for tomato juice. It is better to take a warm bath using ½ c. dishswashing soap and ½ c. baking soda mixed into a paste and then you rub the mixture wherever it smells; Then use a vinegar rinse amd then shower with soap and water. Better yet, try using Safe Solutions Enzyme Cleaner with Peppermint or their Pet Wash. One of the best controls is simply wood smoke; it is a perfect natural antidote. The musk has a substance called mercaptan which is a very strong base.

Conclusion. Skunks in the yard nesting under the building, deck, porch or shed? Rig up a spot light or strobe light over the hole and leave on over night for several weeks; fill in the hole each day until it is no longer dug out. Then install motion lights where needed to cover your yard. Skunks hate the light. You can also live trap them: use cat food, egg salad with mayonnaise bait; carefully pick up the trap, cover with a blanket or insert in a large plastic bag and release in an authorized area at least 5 miles away or kill them, e.g., by drowning by lowering and submerging the entire trap in a stream or pond with at least 3 feet of water for at least 5 minutes and then burying them. Check with your local wildlife people regarding the best location to release and/or bury.

Live traps are highly effective in catching skunks. Good baits are fish-flavored cat food, sardines, fried chicken bones, bacon and other fatty meats. When setting live traps for skunks, be certain the trapped animal will not be disturbed by dogs after being caught. This will keep them from spraying their musk.

When approaching a trap, move slowly and talk calmly so as not to startle the skunk. Slowly cover the trap with dark sack, cloth or black plastic sheet or bag. When getting close to some skunks, you may notice an odor because their musk lingers for some time after each discharge. This does not mean the skunk has just released or is about to release its ill-smelling stench. **Check to see if it is legal before releasing them.**

Before setting the trap, carefully cover sides and bottom of the trap with wood or burlap so the skunk will not spray and will not be able to dig the trap full of dirt. If you use boards rather than burlap, cut two small holes in the side boards so you can look in. Carefully place the trap so the "blind side" is the way you must go to get the trap. The caught skunk will leave the trap on its own if you place it near low shrubbery and open the door. You can also shake him out (be sure you hold on to the bar that locks the door) over a bridge or small embankment so that when he gets up you are out of range or not in view. You can spray behind them with a water squirt gun to move them along.

Live Trap *Helper*. Secure a strong, new rubber band to each side of a Havahart trap close to the trigger pan. Then pull the free ends of the rubber bands up through the semi-circular holes on each side of the trap lid. Push the rubber band through the hole and then run a nail through the loop. When you set the trap, the rubber bands will put extra tension on the doors, decreasing the "lock time" of the lid falling under gravity pressure alone.

Final Notes: Skunks also feed on white grubs so if all else fails, control the grubs with a labeled use of milky spore disease, *Bacillus popillae or Bacillus thuringiensis "Buibui"* and/or neem or simply spray/soak the yard with diluted Safe Solutions Enzyme Cleaner with Peppermint or use Herbruck's organic fertilizer.

Rabies Caution: The ancient Greeks called rabies "lyssa" or "frenzy". Skunks that appear tame or listless or have no fear of humans or are aggressive or are seen during the day should be avoided at all costs because these are symptoms of rabies. Rabies can be contagious before any visual signs or symptoms appear - even healthy looking animals can and do carry rabies and can infect you. Skunks can only catch rabies if they are bitten by or eat the carrion of a rabid animal. Epizootics of rabies can sometimes break out if your local population of skunks is too high. Skunks are very susceptible to rabies, second only to raccoons. If bitten you will have to catch the animal and call your local health authority, doctor and/or veterinarian for information and/or help on how to proceed and/or how to submit the animal for rabies testing. **See bat and raccoon sections for more rabies information.**

SNAKES
CLASS -Reptila
ORDER - Squamata

All snakes are killers - none are vegetarians. People have worried about snakes since Adam and Eve. The temperature of their natural environment directly dictates most of their activities. The saliva of all snakes is toxic to some degree. They live virtually everywhere in forests, deserts, swamps, grasslands, mountains, and in both fresh and salt water. Some are diurnal and others are nocturnal. All snakes are predators and eat a variety of animal life, including frogs, toads, salamanders, insects, worms, small rodents and birds. A snake can consume a prey twice its body weight and 3 times the size of it head. Most of the snakes in the U. S. are harmless to man and seldom cause problems and are considered beneficial. Even so, many people become hysterical or are very frightened of snakes and will not tolerate any type or size of snake around them. If you don't believe this - get a crowd of people together and then yell ***snake*** and see what happens. Their recurved teeth are very small and have a backward hook to hold the prey in their mouths or jaws. Some snakes like rat snakes are excellent climbers. Poisonous snakes also have large, sharp, hollow fangs connected to venom glands located in the upper jaw that can fold back into the mouth when not in use. The lower jaw is hinged and can be dislocated to swallow their prey head first to allow swallowing larger prey. Snakes and lizards are closely related. Some snakes are nocturnal; others diurnal; all are deaf. Snakes have a superolfactory organ in their forked tongues that allows them to *smell* out their prey. They have no eyelids and never close their eyes. The acids in their stomachs can digest fur, beaks, feathers, bone and flesh. All (2700 or so) snakes are reptiles and are cold-blooded. Identification of species: http://www.pitt.edu/~mcs2/herp/sona.html.

Snakes reproduce in two ways. Some species lay eggs; others give birth to their young. The egg of the Rainbow snake more than doubles in size after it is laid. Young snakes develop rapidly and shed their skins to allow this growth; adults may shed several times a year. Some snakes hibernate in dens during winter, sometimes in large numbers. Snakes use their *slimy* scales to propel themselves forward; for greater speed they can undulate laterally. See http://www.csrees.usda.gov/Extension/

Snakes are among the most successful animals on earth, living in virtually every conceivable habitat: forests, swamps, grasslands and deserts and in both fresh and salt water. If a snake is in or under the building or yard, the first step is to identify the species causing the problem. Fortunately, of the 116 species of snakes found in the U. S., only 19 are poisonous. Of these 19, all but one are pit vipers. Pit vipers are so named because of their deep, heat-sensitive chamber or pit located between each eye and nostril that allows them to accurately strike creatures in the dark less than one degree warmer than the environment.

Pit vipers with rattles include: the rattlesnake, sidewinder and massasaugas. Pit vipers without rattles include both the venomous "moccasins", e.g., the copperhead and the cottonmouth. Remember the old saying, "Red on yellow, kills a fellow. Red on black, friend of Jack." Poisonous snakes in the U. S. are characterized by color (red, yellow and black rings or coral snakes); rattles; if their underside scales from the rectum to the tail run in a single row of wide plates as do those on the belly; a prominent rectangular head; elliptical pupils and/or a pit or opening near the nostril. Non-poisonous snakes in the U. S. have a round pupil, lack a pit between the eye and nostril, and usually have a narrow head. About 8,000 of the approximately 45,000 snake bites (in the U. S.) are from venomous or poisonous snakes. North Carolina leads the Nation on the incidence of snake bites. **If bitten call the Poison Center Hotline: 1-800-222-1222.** For further information visit: http://www.fda.gov/Fdac/features/995_snakes.html. But, virtually all snakes can bite, so if you are unsure whether or not a snake is poisonous, ask a local fish or wildlife official to positively identify the species causing the problem **BEFORE YOU PICK IT UP!**

Several of the more common poisonous snakes are described:

Eastern diamondback rattlesnake *(Crotalus adamanteus)* and the Western diamondback *(Crotalus atrox)* - are extremely large, heavy-bodied snakes, capable of attaining a length of about 8 feet. The diamondback likes relatively dry, low flatlands and hills and mountains. The burrow of the gopher tortoise often serves as a refuge, particularly during cold weather. Diamondbacks feed on mice, rats, gophers, ground squirrels, rabbits and less frequently on squirrels and birds.

Timber rattlesnake *(Crotalus horridus horridus)* - (sometimes incorrectly referred to as Canebrake rattlesnake *(Crotalus horridus atricaudatus)* - a very large, heavy-bodied snake that may attain a length of over 6 feet. It is most common in sparsely settled, forested areas. The timber snake feeds on a variety of small rodents and, infrequently, on ground-dwelling birds.

Pygmy rattlesnake (several varieties including Carolina, Dusky and Western) - small snakes, with a maximum length of 30 inches. They are seldom encountered except during late summer. The small rattle can scarcely be heard more than 3 feet away. They feed on mice, lizards, frogs, insects, and spiders.

Sidewinder - *Crotalus cerastes* - The sidewise locomotion, with the body moving in an S-shaped curve is characteristic of this snake. Normally it eats mice, rats, lizards, and occasionally birds.

Massasaugas - Including the eastern, *Sistruvus catenatus*; and *Sistruvus catenatus tergeminus*; which has been called the "swamp rattler" of the U. S. They eat lizards, snakes, frogs, mice, shrews, and other small mammals. They can be found in both wet and dry areas.

Copperhead - also called the "highland moccasins."
Genus - *Agkistrondon, e.g., Agkistroden controtrix* or Southern Copperhead

The copperhead is a medium-sized snake, with a maximum length of 4 feet. There are several varieties or species. Color patterns are highly variable, but the basic color is tan to brown with darker crossbands. Above the coastal plain, the copperhead prefers forested areas with rocky bluffs and ravines. In the coastal plain it prefers floodplains, swamp edges and hilly hardwood areas. Abandoned farms also provide ideal habitat conditions. The diet consists of small mammals, frogs, lizards and insects.

Cottonmouth, also called the Water Moccasins
Genus - *Agkistrodon, e.g., Agkistroden piscivorus*
There are several varieties or species. The cottonmouth is a large, heavy-bodied, aquatic snake, may attain a length of over 6 feet. Adults are variable in color, ranging from a solid dark gray to blackish-tan with brown bands. Young cottonmouths are tan with conspicuous bands. The cottonmouth lives in water. Its diet includes insects, snails, fish, frogs, baby alligators, lizards, turtles, snakes, bird eggs, small mammals and carrion. There are seven species of harmless water snakes often mistaken for cottonmouths.

Coral snakes, e.g., *Micrurus fulvis* or Eastern Coral Snake
Family - Elapidae

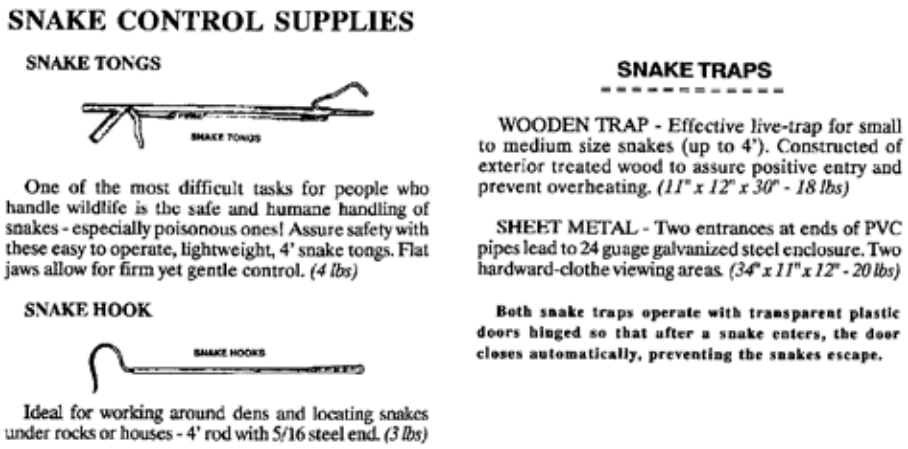
They are slender snakes with a maximum size of almost 4 feet. There are several varieties or species including Eastern and Texas. The top of the head and nose are black. The typical body markings are complete bands of alternating red and black, separated by narrow yellow rings. Coral snakes spend much time underground in loose soils. They will bite readily when restrained, and they have a habit of "balling the tail" and waving it about. This habit may cause the handler to mistake the tail for the head. The coral snake's venom is conducted through a pair of short, erect, grooved fangs near the front of the upper jaw. The best practice is to leave coral snakes alone and under no circumstances handle them - **the bite can be deadly.** Three non-poisonous snakes, the scarlet snake, the scarlet kingsnake, and the red milk snake, have markings similar to the coral snake. However, on these, the red and black bands touch, not the red and yellow. An easy rhyme can help you remember the difference: "Red on yellow, kill a fellow; red on black, friend of Jack." If you're on coral snake country and encounter a snake with red, yellow and black bands, the best course is to leave it alone.

GARTER SNAKES
CLASS - Reptila
FAMILY - Colubridae

The most common non-poisonous snake encountered is the garter snake. There are many varieties Garter snakes are usually olive brown to black in color with three narrow longitudinal stripes; these stripes are more or less pronounced in all of the various species found throughout the U. S. In some West Coast species the stripes and background color appear red or orange, hence the name "red-sided" garter snake. Being cold-blooded, garter snakes can regulate their body temperature only by moving to a place that will provide them with a suitable temperature. They prefer cool, dark locations like rock piles and other debris. In temperate climates all snakes hibernate.

Snake Bites - A small percentage of rattlesnake bites are "dry", meaning the snake has not injected venom, but you should always seek medical attention immediately to be evaluated anytime a snake penetrates your skin. **Don't panic. Don't apply ice or soak in ice water. Don't cut the bite site and suck out poison. Don't use electric shock. Don't look for the snake. Don't use a tourniquet. Don't waste time - seek medical attention immediately. A physician will treat your symptoms.**

INTELLIGENT PEST MANAGEMENT® SNAKE CONTROL - Remove what attracts snakes. Remember, snakes are usually protected; often a permit is required even to move them. Be very careful, especially when the daytime temperature stays above 82° F.



- Allow free-range Guinea hens to hunt down and kill your snake problems.
- Create a snake harborage site by laying plywood sections or metal roofing materials on the ground with one end slightly elevated with a large rodent glueboard under it. Once caught, a (non-poisonous) snake can generally be removed by covering it with a generous amount of cooking oil so that you can relocate it elsewhere.

- Control/eliminate/remove/repel the insects and rodents that are snake foods.
- Construct a snake-proof fence 18" - 36" high using ¼" galvanized hardware cloth with the bottom edge buried about 6 inches in the soil. Sloped fencing 30" outward is even better. Be sure gates are tightly fitted.
- Remove and or eliminate as much snake harborage and habitat from the yard as possible; remove all boards, ivy beds, rock piles, tall weeds or brush or dense shrubbery, piles of lumber or firewood and other items that might attract snakes in search of prey or simply to escape from the sun or cold.
- Keep lawns and adjacent fields, drainage ditches and vacant lots mowed and trimmed. Keep shrubbery away from foundations.
- Remove and/or eliminate trash, garbage, brush, rock piles and other debris from under porches and in crawl spaces. Screen all entrances and/or vents.
- Remove driftwood, logs, old boats, docks and brush along ponds, lakes and other waterways.
- Keep fence lines, parking lots and railroad beds weed-free. Cut high grass.
- If you must save them or store them, store firewood, lumber, rock piles, pallets and old equipment 12" to 18" off the ground outside and away from buildings.
- Inside sheds, carport, garages, basements and crawl spaces you should also remove and/or store boxes, containers and portable equipment 12" to 18" off the floor.
- Seal all holes and other small openings or cracks larger than 1/3" or better yet 1/4" around the foundation of the building and all pipes, conduits and electrical lines leading into the structure. All vents, louvers, windows, chimneys and exhaust fans also should be securely screened to prevent snakes/pests access into the building.
- Place damp rumpled cloths or towels covered with plastic or even a dry cloth in several locations near walls. Snakes are attracted to the moisture in the towels. Each pile should be propped up high enough so the snake can crawl under it. Once the snake has wrapped itself in the towels, pick up the entire pile and remove it from the premises, releasing the snake in a suitable location - far away.
- Snakes also can be captured in or under dwellings and released unharmed with rat-sized glue boards. By tying a long string to them, the glue boards can be pushed against the building foundation with a pole and easily retrieved via the string at a later date. Indoors, glue boards can be placed next to the wall for best results. If you have a very large snake take a 1/4" plywood board about 18" by 24" with several holes about 3/4-1" in diameter in the corners. Nail or glue two to eight rat glue boards (or use bulk glue) on one side, (you may have to trim off the plastic edges of the rat glue boards to provide a flat surface or use bulk rodent glue. Place the plywood (glue side up) against a wall where you have seen or suspect the snake is traveling, but away from any pipes or debris the snake might use for leverage to escape. Once the snake is caught, the holes allow you to use a long pole with a hook on the end to grab the board and pull it out. Snakes can generally be released from the glue boards by pouring a little common vegetable cooking oil on the boards, but it is still a mess best avoided.
- Snakes can also be trapped using expanded trigger rat traps. Place several pairs of these traps next to walls in areas where snake entry or activity is suspected. Snakes often follow walls as do rodents and they will be caught when slithering over the traps. No bait is necessary.
- Install sticky materials in 18" wide bands where you do not want them to cross or climb.
- A good way to remove a snake is to sweep it with a broom into a large bucket - then carry it outside to release or if you insist, kill it. A shovel will quickly decapitate a snake, but the head can still strike!
- Install plastic snow fence; the snakes will try to pass (head first) through the openings, but most of the time their larger bodies will eventually get stuck and their scales make it impossible for them to back out.
- Snakes where legally permitted can be killed with long handles hoes or claws or by shooting.
- Some dogs and cats kill snakes as do geese, ducks and chickens. Turkeys are proficient at locating snakes, giving *gobbling* alarms and clustering around the snake.

SUMMARY

Most snakes are non-poisonous, harmless, and beneficial. But few people want them in their home. Snakes can pass through very small openings (1/4" or more) such as cracks in the cement, under doors and/or around loose fitting pipes, screens, vents and/or windows. As a general guideline, poisonous snakes usually have a large triangular head, a pit between their eye and nostril, and vertical and elliptical pupils. They may also have rattles on their tail, noticeable fangs, and a single row of scales between their vent and the tip of the tail. When unsure assume that the snake may

be poisonous and protect yourself accordingly. Many snakes kill and eat rats, mice, frogs, lizards, other small snakes, insects, gophers and other animals that are often considered pests.

All snakes are predators; none are vegetarians. Depending on the species, the diet may include insects, rodents, frogs, birds, worms, or toads. Some snakes hibernate in dens during the winter, sometimes under houses. At certain times of the year, they may enter buildings for warmth, shade, or moisture.

Intelligent Pest Management® and Control

If snakes are a regular problem, the best solution is to eliminate snake hiding places/entrances.

- Galvanized screen should be used to secure or cover drains and ventilators.
- Caulk/seal/insulate all openings, e.g., plumbing or gas pipes and cracks in the foundation especially at, near or below ground level. Use glue boards or funnel traps to catch them.
- Clean up brush piles, lumber or wood piles, rock piles, and other debris.
- Keep shrubbery away from foundations.
- Cut high grass and keep vegetation short. Install snake-proof fencing.
- If snakes are found in the toilet stool - they probably entered via the plumbing from the septic tank.
- Install a 3" layer of pea-size gravel or limestone around the entire foundation. Keep it weed free.

Often, snake problems follow rodent problems. Eliminate the rodents — the snakes' food — and the snakes will move elsewhere.

- Eliminate rodent food and harborage.
- Mow grass short to expose rodent runs.

Snakes often enter structures through broken block foundations, cracked mortar, utility openings and/or damaged vents. These should all be repaired. Lime will often repel snakes, but hydrated lime will not last long, so try limestone pieces/stones around the perimeter of the property and/or building. If you put down a geotextile fabric first - this decorative stone edging will also prevent weed growth. Try sprinkling lime, talcum or medicated body powder in infested areas. Snakes that eat mice stuffed with acetaminophen will die.

Raising Snakes with Scale Infestations (Blister Disease or Vescular Dermatitis) You probably have a high mite infestation, cool temperatures and damp, dirty conditions. Clean out the cage, washing with Safe Solutions Enzyme Cleaner (1 - 2 oz. per 1 gal. water) Soak the snake in the same dilution of enzyme cleaner or 50% Listerine or dilute organic iodine solutions for an hour a day; watch so the snake does not drown.

In a rattlesnake infested area, a snake-proof fence can be installed around a backyard or play area.

- Bury a galvanized ¼" hardware cloth (with a height of three feet) six inches in the ground and slant outward at a 30° angle.
- Keep all vegetation away from the fence.

Snake removal. If a snake gets into a house or other building, several methods are available to remove it:

- Place damp burlap sacks on the floor and cover them with dry sacks. Check them every few hours to see if the snake has crawled underneath. The snake and bags can be lifted with a shovel and taken outside. The snake can be killed or released as you choose.
- Rat glue boards or mats will capture all but the largest snakes. The glue boards should be tied down or attached to a plywood base. Place the glue boards along wall and floor junctions. Captured snakes can be killed, or they may be released. Before release, pour vegetable oil over the snake and glue board to help release/free the snake, or try a funnel trap.
- Expanded trigger rat traps set in pairs along wall and floor junctions can kill smaller snakes.

Repellents: Naphthalene and sulfur make it hard for some snakes to *see* at night. Pliny in book 20 of his Natural History noted that *snakes* are kept away by the sawdust of Greek Juniper (*Juniperus excelsa*) and that to rub the body with crushed berries mixed with oil has the same result! A commercial granular snake repellent can keep some species of snakes away from homes, camp sites, garages, and yards. Containing sulfur and

naphthalene, the repellent is applied in a narrow band around the area to be protected. Sulfur/naphthalene repellents are most effective against rattlesnakes, coral snakes, garter snakes, and pythons. **But only should be used as a last resort and with proper notification. (Our field research found this mix did not work.)** Plastic snow or protective garden fencing with 1" x 1" square holes are a deathtrap for snakes. The snake heads go through the openings, but their bodies eventually get stuck and the scales make it impossible for them to back out.

An old fashioned black snake control - Out of desperation a lady in North Carolina put wooden eggs in her laying house nests (years ago) - the snakes would dislocate their jaws and swallow a wooden egg - that they could not digest, dislodge or pass out their anal opening - they could not even escape out the hole they had entered and were found on the laying house floor the next morning. The lady would then kill the snake - remove the wooden egg and place it back in the nest to kill the next snake. She did this until she had removed all the black snakes. This *nasty* little trick should work with any egg-eating snakes. But, if you truly want to do the best - **try the natural way - just leave them alone**.

TREE SQUIRRELS - *Rattus arboreaus* (Tvedten)
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Sciuridae
GENERA - *Glaucomys, Scirus* and *Tamiasciurus*

The family name Sciurdae is from the Greek, it renders "shade tail". Various species of tree squirrels occasionally enter buildings and cause damage. The most commonly encountered squirrels include the gray squirrel *(Sciurus carolinensis)*, then the red squirrels *(Tamiasciurus spp.)*, and the flying squirrels *(Glaucomys spp.).* In California and some parts of the western U. S., the fox squirrel *(Sciurus niger),* is a troublesome pest. *Old bushy tail* has been described by the author as a tree rat because of their ability to go where you do not want them and to steal what you do not want them to take and chew through many materials to enter where you do not want them to invade.
Damages. Tree squirrels generally inhabit forests or other wooded areas and build their nests in trees, but as people expand their settlements into these areas, the squirrels frequently establish themselves inside our buildings, where they also store food and find shelter in our attics and garages. Probably the primary way squirrels become pests is by scrambling and scratching inside attics and in wall voids and running around from 5 a.m. to 7 a.m. Gray squirrels travel easily on power lines. The squirrels often gnaw on cedar shakes and shingles, on the exterior and interior walls and timbers, on cables and electrical wiring and on any items which may be in storage. They may also be very noisy in their activities, will bite if cornered, cause ectoparasite problems to occur in nesting areas, and damage trees, vegetable and flower gardens and strip the bark from trees and ornamental plants. Squirrels like to gnaw on wires, so they short out telephone and electrical lines and they also short out electrical power transformers during their activities around lines in residential areas and can cause fires in attics. They can quickly strip a backyard tree of nuts. They also will eat seeds and bulbs as fast as you can plant them and will chew off flower buds and leaves.

GENERAL DESCRIPTION

Most of the tree squirrels (or tree "rats") have two litters of young each year (early spring and late summer), although some flying squirrels may produce only one litter per year. The number of young varies between 2 and 7 squirrels. Many species have adapted extremely well to suburban and city life. Occasionally these squirrels enter buildings and cause damage or disturbance.

The legal status of squirrels varies greatly with geographic areas and species. Many are classified as game animals. Some are protected. Be sure to check with local game conservation officers if you plan any kind of lethal control or trapping program.

INTELLIGENT PEST MANAGEMENT® CONTROL OVERVIEW

Squirrel-proofing. Step number one in eliminating a squirrel problem in a building is to find out where the squirrels are entering. Remember, squirrels will be coming and going each day. Common points of entry include damaged attic louvers, ventilators, facias, soffits, joints of siding, knot holes, openings where utility wires

or pipes enter, chimneys and flashing. Squirrels may gnaw directly through siding and cedar shingles too.

- Install strobe lights to drive them out of your attic.
- Seal most openings with either heavy gauge ½" hardware cloth or sheet metal.
- Make other suitable repairs as for rat-proofing.
- Squirrels can be stopped from traveling on wires by installing two-foot sections of 2" - 3" diameter plastic pipe. Split the pipe lengthwise, spread the opening apart and place it over the wire. The pipe will rotate on the wire and the squirrel will tumble off. Be very careful near high voltage wires.
- String several plastic pop bottles or cans with a hole drilled in the bottom (and then strung on a wire, like a necklace) with a bird feeder in the middle and watch them fall off.
- Use a 3" - 4" diameter plastic pipe (with a flange to support a bird feeder). The pipe is so slick they can not climb it - put the feeder high enough so they can't jump to it.

Squirrels often use overhanging branches as highways to roof tops. Tree branches should be trimmed back 10' from the building. If the branches can't be trimmed, a 2-foot wide band of metal flashing fastened around a tree, 6' to 8' off the ground will help keep squirrels from climbing up the tree and jumping on to the building. Be sure to reattach it yearly or you will kill the tree. Spray pureed hot peppers and liquid soap in water sprays or sprinkle well-used cat litter, talcum powder, dried hot pepper or perfume to protect plants.

Repellents. Naphthalene has been used (in the same way as for bats) to keep squirrels out of attics, particularly in summer homes and camps that are unoccupied in winter, but we do not recommend its use. There is at least one sticky repellent product for squirrels. It is similar to the sticky repellents used in bird control. It can be applied to ledges, gutters, window sills and the like to keep squirrels off, but it is simpler to apply generous portions of Vaseline to poles, gutters, etc. Put cayenne pepper (or red) pepper or dried blood meal in the bird seed; the birds won't mind, but the squirrels will not eat it for long! Try one or a combination of talcum powder and aftershave in your attic or chimney to repel squirrels. Try putting ½ oz. of Tabasco sauce, 1 teaspoon chili powder, 1 pint of water and a dash of liquid soap - use as a spray where these animals are causing a problem. Cover the ground under the feeder with well-used cat litter or plant morning glories at the base of the feeder pole or sprinkle perfume or cologne there. Try Not Nice to Critters ultrasonic machines.

Trapping. Live trapping with box or wire traps can be used to remove one or a few squirrels from a building or from outside. Traps should be left open and unset for a few days, surrounded by bait, so that the squirrels get used to the trap. Good baits include oranges, raisins, dried fruit, pumpkin seeds, peanuts, nut meats, peanut butter, apples, whole corn, sunflower seeds or rolled oats. We have consistently caught squirrels with ½ apple and/or smeared with peanut butter. Then the trap can be set. Good trap locations include the roof, the base of nearby trees, or inside the attic itself. **Relocate where permitted and legal.**

Squirrels are nasty biters. Handle them very carefully. Experts differ as to whether squirrels should be released or killed. If they are released, do so in an approved area at least five miles away so they do not return. Where lethal control is permitted, rat snap traps can be used to kill squirrels in attics. The bait should be tied to the trigger and the trap nailed or wired to a beam. Even live trapping is not always legal in all locales. **Check with your local game authorities first.**

GENERAL DESCRIPTION

Tree squirrels are true rodents closely related to rats and mice, which are in a separate family (Muridae). These "tree rats" can invade your building, steal all your bird food, chew off the insulation on electric wires, make noise and create breaks in the weather seals of your building and can seriously damage stored materials. Most species are active in the morning and/or afternoon. The flying squirrel is active at night. Tree squirrels do not hibernate, although they may remain in their nests for several days during severe cold or wet weather. A litter of 2 - 7 young is born in the early spring. The young remain in the nest at least six weeks before going out on their own.

GENERAL DAMAGE OVERVIEW

They will eat bird seed, apples, bread, bulbs, mushrooms, other fruits and nuts in season, tree and flower buds and twigs (only succulent shoots or outer bark are eaten) and, like rats, tree squirrels will eat almost anything

of food value. Squirrels can chew off hundreds of twigs including maple and spruce and chew off the bark on sugar maples looking for the nutrient rich cambium below the bark. Usually the damage is most severe in late winter when the sap starts to flow and food stocks are running low - the feeding injury can girdle branches and even central leaders on younger trees causing the branches to die and the tree to be disfigured. If not girdled completely the injury may provide an invasion route for decay and/or canker organisms - "bribe the tree rats" with food and they will stop destroying *your* trees. They may, however, chew their way into your buildings. Once you think you have removed them, "patch" the entrance with cardboard. If they do not chew through the cardboard in a week, then you can repair the hole with a double layer of ½" by ½" hardware cloth or sheet metal and then re-side.

They carry dangerous ectoparasites, e.g., ticks, chiggers, fleas and mites. They are infected with plague, relapsing fever and Colorado tick fever. These may also attack and bite man during control work or even after a nest has been removed. When squirrels bite and scratch painful infections may result, **so be very careful.** They can chew through most siding materials to enter your building and *nest*.

SPECIFIC EXAMPLES
EASTERN GRAY SQUIRRELS AND WESTERN GRAY SQUIRRELS AND ABERT SQUIRRELS
Sciurus carolinensis* (Gmelin) and *S. griseus and S. aberti

The eastern gray squirrel is the "cat" squirrel and is a well known forest animal in the eastern United States and the most common squirrel in urban areas. Its populations are cyclic and occur in five- to six-year intervals. The eastern gray squirrel occasionally has lemming-like migrations in certain areas and certain seasons. Mating occurs primarily in the spring and there is usually one litter per female and two to six young in each litter. A late summer litter may occur. Gray squirrels are tree dwellers that live in hollow trees and old woodpecker nests or living in leaf nests in the winter time in the North. There is also a *black* color variation of the gray squirrel.

The eastern species has also been introduced into some western locations. They have adapted and are thriving well in pine and fir forests.

RED ("PINEY" OR "CHICKADEE") SQUIRRELS AND DOUGLAS SQUIRRELS
Tamiasciurus hudsonicus and T. douglasii

Red squirrels are widely distributed and prefer pine forests with a mixture of hardwoods. They frequently live in hollow trees and store, throw or scatter food in many places. They can live in leaf nests although they seem to prefer not to, and in some northern areas where trees are scarce or stunted, they may live underground just as do chipmunks or rats. Ground burrows are used chiefly for food storage. This species will invade summer cabins, especially in the North. One indication of an infestation of red squirrels is many pine cones cut and dropped on the ground. The red squirrel probably breeds once yearly. They have five to six young in the average litter, but any one area may have two distinct nesting seasons. The latter season perhaps consists of young squirrels that did not breed in the spring. **Red squirrels are frequently infested with large numbers of fleas. Safe Solutions, Inc. Enzyme Cleaner and/or their food-grade DE can safely control fleas. See the Flea Chapter.**

FOX or EASTERN FOX SQUIRRELS
***Sciurus niger* (Linnaeus)**

These are the largest of the Northern American squirrels. They may grow to almost 30" in length and three pounds in weight. They come in a wide variety of colors. Fox squirrels live along wood edges, in open timber stands and generally in less dense, drier areas than do gray squirrels. They are most common in central and southern United States. The fox squirrel has been introduced into many western states. It is the most common tree squirrel in city parks and urban areas of California.

Fox squirrels live in leaf nests or in hollow trees. They breed in the spring and raise two to five young; some live to nine years or more. Their caches of nuts are more like those of the gray squirrel, in tidy heaps or cavities in the trees, than like the untidy scatterings of the red squirrel. However, the fox squirrel also will frequently dig in the ground and individually bury its caches.

SOUTHERN FLYING SQUIRRELS AND NORTHERN FLYING SQUIRRELS
***Glaucomys volans* (Linneaus) and *G. sabrinus* (Shaw)**

These are the smallest and most interesting of North American tree squirrels. They are also among the most difficult to deal with because **they are active only at night.** It is the flying squirrel which causes the mysterious and startling *thump* late in the night on the attic floor which frightens homeowners. Most times this noise is a result of the squirrel *gliding* down onto the attic floor from some area above. They will enter homes through unused fireplaces and/or any convenient opening and run around and glide over the furniture and move things about, usually without serious damage and without leaving any telltale rodent signs. Flying squirrels are much more gentle than the other squirrels and seldom cause a serious bite, but they do have sharp teeth. They are rather rare and because of their interesting habits and high aesthetic value, killing should be avoided whenever possible. Flying squirrels live outside in old woodpecker holes in dead trees; inside they are quite often found in our attics and not infrequently may establish themselves in cabin cupboards in vacant summer homes. Try securing a repeating mouse trap near their entrance.

Flying squirrels eat seeds, nuts and fruits, and frequently birds and nestlings, which they steal from the nests at night. A free water supply is extremely essential for the flying squirrels. These small, delicate animals are easily injured and will not live long in live traps, so try exclusion first. **You can eliminate all flying squirrels in a building simply by *baiting* your live trap with a red rubber ball, but check the traps frequently or try to install a one-way door over the opening they are using.**

Squirrels enter houses by many routes such as openings for utility wires, boxed eaves or corners, chimneys, vents, louvers, cellar windows, knotholes - practically any avenue through which they can squeeze or gnaw, so carefully seal these openings before they enter or after they leave.

INTELLIGENT PEST MANAGEMENT® - TREE SQUIRREL CONTROL - The first step in managing tree squirrels is to carefully inspect and determine how the squirrels are actually entering the building and then make every effort to exclude them. Areas to pay particular attention to include: utility lines, drain pipes, tree limbs, uncapped chimneys, ivy and other ornamental plants which cling to the house, and attic and/or basement vents and windows in disrepair. Tree squirrels will also occasionally gnaw straight through the exterior of some buildings such as cedar shingled homes to gain entry. **All existing openings should be sealed with sheet metal or ½" hardware cloth.**

Squirrels usually gain access to buildings from nearby or overhanging tree limbs. In these situations, all limbs should be pruned back 10' or more so they cannot reach the building. Squirrels can also be kept from climbing trees by placing a 2-foot wide metal band around the tree trunk, 6' to 8' above ground. **Remember, they are edible.**

Game laws generally protect squirrels. Most states require some type of permit or dispensation before you begin control. Nearly all states have some regulations or restrictions regarding the use of live traps on squirrels. They also will have laws and regulations regarding shooting, the use of steel leg or snap traps and the use of any poisons. **Consult your local wildlife officials before beginning any control.**

INTELLIGENT PEST MANAGEMENT® SQUIRREL CONTROL - **Building squirrels out of structures usually is the only permanent solution** to the problem, and it does not harm the squirrels nor create legal problems. **Remember most entry points will be above eye level.** Make a thorough inspection of the premises, make note of areas vulnerable to attack but which are not presently used as well as areas which are being used. Then protect these vulnerable areas. Materials such as ½" mesh hardware cloth, 26-ga.sheet metal or materials similar in hardness should be used. Squirrels can gnaw through wood, plastic and other *soft* materials as do rats. **Use hot pepper spray to stop gnawing. Use strobe lights to drive them out of your attic.**

Simple "one-way doors" can be made of by hardware cloth or sheet metal; then installed so that the squirrels can leave the structure but not reenter through these openings. Squirrels may jump onto roof tops from nearby trees, so cut back all tree branches at least within 10 feet of the structure. Metal bands 2 feet wide fastened around tree trunks 6' to 8' from the ground will keep squirrels from climbing isolated trees. You can install an electric fence along the top of the roof. Adjust bands yearly. Cats and dogs can be an effective squirrel deterrent. Squirrels also use utility wires to reach a structure and they can also easily climb drain pipes, shingles and even

brick and mortar walls, so you may have to be imaginative in your control efforts, e.g., install a 3-foot length of polyethylene tube or a series of plastic pop bottles with holes in the bottom and string over the wires. The tube or bottles will roll when squirrels contact it, causing the squirrel to fall off the wire. Put rat guards on the drains pipes, etc. Freshly cut human hair, aftershave or cologne is repulsive to squirrels, so put some in your attic or chimney to make squirrels move out temporarily.

Bird feeders are attractive feeding places for squirrels or *tree rats*. If they can not be left empty, they should be removed to an area as far as possible from the structure. Put Vaseline or metal squirrel guards on bird feeder poles and/or sprinkle cayenne pepper or blood meal in the bird feed to help foil squirrel theft. Cut the lips or edges off a 5-gallon pail remove the handle, drill a hole 1/4" to 1/2" larger than the pole through the bottom of the trimmed 5-gallon pails; put the pail upside down on the pole and place a cotter pin or bolt with a nut on the end through the hole - securing the loose bucket, if they try to climb up the side of the loose bucket that will *wobble* and throw them off. Sprinkle well-used cat litter or talcum powder at the base of the feeder. You also install one-way doors in infested areas. Household ammonia solutions, if you can vacate or stand using them long enough, will repel squirrels from inside eventually. Not all squirrels will vacate the area immediately due the presence of young, but most will leave within seven days. If all squirrels have left, remove the ammonia and/or one-way doors and seal of all openings permanently.

Trapping. When exclusion techniques, e.g., screening, repelling and removing tree limbs, will not solve the problem, live trapping/removal or kill/lethal trapping the squirrels may be necessary. Squirrels in buildings can be kill trapped with ordinary rat-size snap traps. The trap itself should be nailed or secured with wire to prevent the squirrels from dragging them away. Any of the various nutmeats, sunflower seeds, fresh orange or apple slices, sweet corn and oatmeal can be used as baits for tree squirrels. Snap rat traps should never be used outdoors unless placed under cover as non-target animals including birds will be killed. Larger containers, half filled with water, covered with floating whole bird seed or sunflower seeds with a board to the rim, will quickly kill most squirrels. **Be sure you can legally kill them before you do any control.**

Live trapping. Where squirrels cannot be killed, trapping with live traps is usually the best method of control Live traps such as the Havahart® No. 1078, No. 2 or 2A, or Tomahawk® 103 or 104 are the appropriate size traps for tree squirrels. Traps should be placed unset, i.e., doors wired open, until the squirrels become accustomed to them. Once they have become accustomed to the traps, a few settings will usually capture enough squirrels to eliminate the problem. Place the live traps near the bases of trees, roof areas or immediately inside or outside the opening of the attic or area in which the squirrels are seen entering your building. All traps should be checked twice a day to remove live trapped animals, birds or pets as soon as possible after their capture. Quickly release any pets or birds. Place a blanket or similar cover over the trapped squirrel; this will cause the squirrel to remain relatively calm. Live trapped squirrels may be humanely destroyed if legal, or taken at least 5 miles from the trap site and released in an approved area where they will not cause a problem for someone else**. Never, never attempt to handle live trapped squirrels as they are vicious biters and possess extremely sharp teeth and powerful jaws**. If they are trapped or removed during the breeding season without removing the young from the attic area you will have a subsequent odor/insect problem. Squirrels, like rats, will nest inside double-wall construction and are very difficult to remove. **Be sure you can legally release them; before you do, check with your local authorities.**

Lethal traps. As a last resort, squirrels may also be trapped (if lawful) using unbaited No. 0 or No. 1 steel traps carefully placed on trees or in attics where the squirrel will be apt to run or travel. Snap rat traps also may be used inside and can be nailed to rafters or other places where the squirrels travel. These snap rat traps should be new so the springs are strong and have expanded triggers. Their use inside buildings seldom violates any state game laws, **but ask before using them**. Bait these inside traps with grains, cracked walnuts, peanuts, molasses on bread, prunes, peanut butter, large seeds, or apple or orange slices or a combination of these. Sometimes whole corn is attractive, but the best bait would be to use what they have been eating, including fresh red meat. Place traps carefully so children, birds and pets cannot reach them. Snap rat traps should never be used outside unless they are securely placed under cover (even if legally permitted) as non-target animals including pets and birds may be killed.

Shotgun control. In some localities tree squirrels can also be eliminated by shooting with a .410 gauge shotgun, but be sure that no laws are violated. Before shooting in urban areas, check local firearms codes and notify local police.

Shooting should never be used as a tool in squirrel control if there are large numbers of individuals present. **Never use a rifle - they simply are too dangerous to use around people and homes.**

Stop squirrels from decapitating flowers by mixing 2 T. cayenne pepper in 1 qt. very hot water. Allow the brew to steep until it cools; then strain through cheesecloth and add 1 tsp. canola or horticultural oil and 1 tsp. dish soap; then spray the stems below the tulip or rhododendron buds or sunflower heads.

There are no toxicants currently registered for the control of tree squirrels. It is far better for your public relations and relations with enforcement agencies to control squirrel pests without killing them. **The best control procedures are exclusion, repellents and traps.**

TURTLES -
Common Snapping Turtle (*Chelydra s. serpentina*) - Florida snapping turtle (*Chelydra s. osceola)*
FAMILY - Chelydridae

Turtles - If you are trying to remove snapping (or other pest) turtles from your pond - place an empty 55-gallon can in the water - cut off the metal that protrudes more than 2" - 4" above the water - put several rocks in the bottom - place in the water and fasten 6 - 7 layers of burlap on the rim. As the snappers climb up to sun themselves they fall in - remove daily and transport wherever you want (and are allowed) to release them. Remember they are very ill-tempered and prone to bite - so be careful and handle appropriately! Snapping turtles are found from sea level to around 6,700 feet. Another variety, the Alligator snapping turtle (*Macroclemys temmincki*), is usually found in the SE U. S.

VOLES - *Microtus spp.* (See also meadow mice)

Prairie Voles - Small torpedo shaped rodents slightly smaller than rats - are prolific breeders. A healthy female can produce litters of 3 - 8 voles every 21 days or so. A vole's favorite foods include succulent legumes, grasses high in protein, the soft whirl center out of young corn plants and emerging soybeans. They have lived in filed borders, fence rows, soil bank areas and other unmowed and/or ungrazed areas like road-sides where they have permanent overhead cover and now are exploding in no-till planting systems that provide them this same cover.

The meadow vole is about 6" long, yellowish-, reddish- or grayish-brown with a long tail and can be very destructive to ornamental plantings, including annual and perennial flowers, turf, shrubs and small trees. Voles are compact animals with stocky bodies, short legs and short tails. Their eyes are small and their ears are partially hidden. The underfur is generally dense and covered with thicker, longer guard hairs. They usually are brown or gray, though many color variations exist. Meadow voles are more active than prairie voles and they have less tolerance for low cover; they prefer lush, grassy areas.

The woodland or pine vole is about 5" long, reddish- or grayish-brown with a short tail. It lives in underground burrows and feeds on roots and tubers. They can cause extensive damage in orchards, but tillage will disrupt their shallow tunnel habitats, so till the ground.

Voles are active day and night year-round. They construct extensive tunnel systems and surface runways with numerous entrances. Several adults and young may live in one tunnel system. Voles are mouse-sized rodents with small ears and short tails commonly found in grassy settings, and are often confused with the mouse clan. They are even usually called *meadow mice*, but they are actually more closely related to lemmings and muskrats. They will clip off leaves and twigs of seedlings, clip the smallest seedlings at ground level, and girdle the stems of larger seedlings and even sapling oaks as large as 2.5 inches in diameter.

You can detect the presence of *Microtus* by the silver-dollar sized entries to their burrow and by their surface runways and tunnels in thick, grassy cover. Parting this vegetation, you can follow these foraging pathways often paved with little green droppings and newly clipped foliage. Unlike mice, which prefer a diet of seeds, voles eat green vegetation too; including the bark of young oaks. Seedlings and saplings with the bark stripped up to five inches from the ground are a sure sign of voles. Smaller seedlings may be entirely gnawed off, as if cut down by a miniature beaver, leaving a pointed stub. (Gophers may also feed this way, but can tackle larger stems and usually bite off bluntly below ground, and leave large tooth marks.)

The real destructive power of voles lies in their numbers, for they are among the most prolific of mammals. Peak populations may number up to 450 individuals per acre, and females are capable of breeding when only two weeks old! Meadow voles have been recorded producing 17 consecutive litters or 83 offspring in a single year! Fortunately, these population bursts are only reached at three to five year intervals depending on food availability, cover, climate and other stress factors. Predators help keep populations in check. Nature rewards reproductive excess with a population crash, but peak populations can cause serious problems to orchards and other planted trees.

Vole Damage

Voles are exterior pests that can damage plant materials by their feeding habits and their tunnel systems, which can ruin turf as well as interfere with irrigation water patterns. Voles will girdle fruit and forest trees causing commercial damage. They also cause damage to ornamental plants. Their teeth marks are very haphazard leaving no particular pattern on the bark or inner portion of the plant material. Voles will feed on trees year-round with most of their damage occurring in fall and winter. Also, in late summer and fall they will store seeds, tubers, bulbs and rhizomes for winter feeding. They love to eat the bark, the plant and/or (juicy new) roots of hostas, azaleas, lilacs, dogwood, oaks, flowering plum and tulips.

An extensive well defined and visible surface runway system with numerous openings is the most easily identifiable sign of voles. Vegetation near well-traveled runways may be clipped close to the ground. Feces and vegetation may be found in the runways.

Pine voles differ from the meadow vole in that they spend most of their lives exclusively in a system of underground tunnels or burrows and stay in an area as small as 1000 square feet for their entire lives.

Intelligent Pest Management® Vole Control

The easiest way to prevent vole damage is to deny them cover. Raptors, cats and dogs often stalk and eat them. Voles like dense cover over their heads - they do not like to be in the open. Clean cultivation to bare earth or severely mowing a 4- to 6-foot diameter circle around the base of each tree discourages them for they prefer to forage close to their runways. You can eliminate vole problems by using four-foot-tall plastic tree shelters sunk six inches into the ground. Saplings protected this way can easily be given weed-free maintenance with boiling water, and voles fail to burrow beneath or climb them. A heavy mulch is an invitation to voles to move in. If you must mulch - two inches of mulch is adequate and not so inviting, but 1” is even better. Some gardeners say they have had success planting with a generous quantity of ground oyster shells or pouring fine to medium gravel mixed with talcum powder into the individual holes. **Give them baits with vitamin D.** Fumigate burrows with dry ice, carbon dioxide gas or lit charcoal briquettes (carbon monoxide).

Cultural - Hardware cloth also can be used as a barrier around young trees or as a 12” high fence, however, since voles are excellent diggers, you may want to place the bottom of the wire 6 inches below the soil surface. Habitat modification may also be helpful. You may want to repel them with predator urine. Voles like vegetative covers or litter piles or heavy mulch, as they provide and cover. Elimination of these areas can help reduce populations.

Trapping - Use of snap-type mouse traps may be effective in eliminating small populations. Traps should be placed with the bait side in the runway. Baits of peanut butter and oatmeal or rolled oats or apple slices may be effective. Unbaited, expanded trigger mouse traps can also be placed in the middle and at the beginning of the runways and a couple of inches from the burrows beneath the natural cover. Cover the traps with a cardboard tent, or enclose them in PVC pipe, so birds will not be killed. You may need 35-50 traps for a large garden. **Wear gloves to release dead voles from your traps**.

Poison Baits - Pelleted baits containing zinc phosphide or strychnine are effective only when placed in the runways or burrow openings, but are very toxic and dangerous so we do not advise their use. Parafinized, anticoagulant baits are also effective, though multiple feedings are required for control. Keep other baits as dry as possible e.g. glue them inside waterproof paper tubes (5”x1-1/2”) long. **See Meadow Mice.**

WOODCHUCK and/or MARMOT
CLASS - Mammalia
ORDER - Rodentia
FAMILY - Sciuridae
(A/K/A ground hog, marmot, rockchuck, whistle pigs, whistler, yellow-bellied marmot)
***Marmota monax* (Linnaeus) *Marmota flavientris* (Audubon & Bachman)**

There are 6 species of woodchucks or ground hogs in North America, e.g., the woodchuck *(Marmota monax)* is found in the eastern part of the country. In the western U. S.; the five other members of the genus *Marmota* are commonly referred to as marmots and they, too, become pests in some situations. In the West, the yellow-bellied marmot, *Marmota flavientris*, has been found to be infected with plague. Woodchucks and marmots belong to the squirrel family Sciuridae in the animal order Rodentia. They are the largest animals of the squirrel family.

DESCRIPTION

A stocky vegetarian that will eat just about everything that grows, the woodchuck, sometimes called the groundhog, is noted for its raids on gardens, its bent for burrowing in inconvenient (to people) places, and its folkloric ability to predict winter's end by emerging from hibernation on February 2 and from going back to sleep for six weeks if it sees its shadow. While that date is too early for woodchucks to wake up in northern parts of their range like New York State. The majority of males come out it mid-to-late February and females appear from late February to the middle of March.

The period from mid-March to May is a time of ravenous appetite and hyperactivity as woodchucks rush to mate and raise a litter by June so the young will have time to eat and to prepare for hibernation. Woodchucks born after the end of April probably won't survive the winter. That's why the breeding season is early and short. While the food intake of laboratory woodchucks increased twenty-fold in the spring, "just as in the wild, there is little weight gain. The animals are hard-pressed to keep up with their energy expenditure and the 100 percent increase in their metabolic rate.

In early June, however, the woodchucks' metabolism slows, and while their food intake also decreases, the animals can increase their weight as much as 100 percent during the summer. Most of their energy goes to producing the fat deposits on which they will live during hibernation as well as in late winter when fresh grass in unavailable. Woodchucks will stop eating altogether by September, and they will be asleep in their burrows by mid-October. Unlike bears, which are "pseudo-hibernators" whose body temperature in winter remains near normal levels, woodchucks really hibernate and allow their temperature to fall to 40 degrees. **They would freeze if their burrows were not below the frost line!**

Large, ground-dwelling rodents, woodchucks and marmots have broad heads, small ears, heavy bodies, powerful short legs and short (4" - 6"), bushy tails. Their fur is long, coarse, in various shades of grizzled, stocky, grayish-brown (dark or blackish animals are also fairly common) with a frosted appearance. It is lighter over the belly. Length is 16" - 32"; weight usually is 4 - 14 pounds, but is quite variable as the woodchuck puts on considerable fat and loses it during hibernation. There are 4 clawed toes on each front foot and 5 toes on the hind feet. Its short, stocky appearance gives the impression that the woodchuck is crouching close to the ground as it moves about. Thus, the animal is often referred to as a *groundhog*. Try repelling them by planting onions, garlic or other alliums near their burrows. Woodchuck and marmots are herbivorous (vegetarians). Various grasses, clover, alfalfa, plantain and other types of tender, green succulents make up their diet; 1 to 1½ pounds of vegetation is consumed daily. These fat, lazy rodents are major nuisances to farmers and gardeners.

Woodchucks and marmots are least active on cool, rainy days. They enter hibernation beginning mid-October and emerge during February. They mate shortly after emergence, with a single litter of four to six young born about a month later (March-April). The young leave the nest in early July to establish their own burrows and territories. Woodchucks live an average of 4 - 6 years.

The woodchuck/marmot burrow system is located about 2' - 4' underground and may extend horizontally 15' - 25' or more. The main nest chamber is generally located at the end of the burrow system. The main entrance to the burrow is characterized by a mound of fresh earth around the opening. Woodchucks are found in open

pastures, woodlots, cultivated and fallow fields and along railroad embankments, ditch banks, roadsides, fence rows and levees. In residential areas, they often place themselves beneath homes, patios, garages and stored lumber. One or two woodchucks are capable of ruining a small garden almost overnight. The woodchuck is found in the hills and agricultural lands of the Northeast and Midwest going up through Canada as far as Alaska. It even appears in a small pocket in the Northwest, in Washington-Idaho-Montana. The (yellow-bellied) marmots are found throughout the mountainous regions of the West. First simply try removing all attractive woodchuck cover around its entrance. Last choice: Fumigate burrows at night with carbon dioxide.

Control caution. While the woodchuck has no federal protection and is considered vermin in most states, usually a state hunting license is needed and there may be individual state and/or local regulations regarding methods and seasons in which woodchucks can be taken. Call your local fish and game authority **before** beginning any control program.

Danger. Woodchucks raid gardens to feed on vegetables such as tomatoes and on plants used for landscaping. An adult woodchuck can eat a pound of vegetation daily. Riding horses and farm animals may be injured by stepping into their burrows. Their burrows endanger farm machinery and can cause cave-ins of railroad embankments and roads. Extensive burrows under buildings can cause structural damage. Woodchucks are considered agricultural pests. They eat oats, barley, corn, wheat, peas, beans, melons and other crops. Their trampling destroys plants and causes as much damage as the amount of food they eat. They will climb and bark trees to get at fruit. They have been implicated in the spread of plague, tularemia and spotted fever. The ground hog tick, *Ixodes cookei* (Packard), which infests woodchucks, occasionally migrates into human dwellings, especially in the northeast. A police officer in Laconia, NH tried to euthanize a woodchuck that would not let people out of the municipal water treatment facility by running the perpetrator over with his patrol car. When he got out of the car to inspect his kill, the woodchuck leaped up and attacked him. The officer jumped on top of his vehicle, injuring his knee, and finally killed the varmint with at least 8 shots from his 9 mm pistol.

DESCRIPTION

Upon awakening from hibernation in February/March, the males travel some distances in search of mates. Females have one litter per year and their gestation period is about one month. The males may stay with the females until the 2 - 9 young are born, but then they leave and return to solitary lives in their old habitats. After about four to six weeks the young come out of the den to feed. They feed mainly in the early morning and later afternoon hours, through they may be seen sunning themselves near the den at other times of the day. However, they may also be out foraging on moonlit nights. Woodchucks rarely move more than 300 feet from their dens or hiding areas. They are very alert and spend much of the time watching for possible enemies while they continue to feed. They will eat leaves, flowers, buds and soft stems of green forage such as grasses, alfalfa, clover, dandelion, etc. Tree bark and fruits are also favored. About 1% of their diet is insects. Gluttons - they eat about 1/3 of their total weight per day. Spray pureed peppers and soap or cat urine {used kitty litter) around to repel them.

The woodchuck is essentially a forest animal but prefers to live along the edges of sunny openings rather than the darker interior portion of the forest. High, dry gravely ridges, bramble thickets, ravines and rock fences are also favorite habitats. **Try fumigating with several pounds of dry ice or lots of lit charcoal.**

Woodchucks are true hibernators, sometimes spending as much as three-fourths of their lives in deep sleep. They may retire as early as September. Respiration and metabolic rates are slowed and the temperature drops to that of the burrow. They live on the stored fat, losing as much as one-third to one-half of their total weight as they sleep through the cold seasons.

The burrow systems usually have two or more a large doorways or entrances (12”), but the tunnel itself is very narrow (4” - 5”). They usually have several “turn-arounds” and chambers in the narrow tunnels may extend 10’ - 45’ down and as deep down as 6½’.

They warn each other with a shrill whistle. While clumsy aerialists, they can and do climb trees in search of food or to escape dogs. They are adequate swimmers.

INTELLIGENT PEST MANAGEMENT® CONTROL - Try dumping well-used cat litter, stinky old perfume or

cologne or after shave, freshly ground red, black, or cayenne pepper, blood meal, rotenone, dried blood, blood meal and/or talcum powder down their burrows/holes and near-by areas, by nightfall mom, dad and the kids usually hit the dusty trail. Make sure it is well-used cat litter and be sure to put it in **all** the entrances and exits. If the woodchucks relocate, reapply freshly soiled litter in the new holes. If you simply remove all tall grass, weeds, bushes, stumps and wood piles - this will make the entire area less inviting. **Try to fumigate burrows with carbon monoxide or carbon dioxide. The Author prefers to use carbon dioxide.**

Fencing. The fence or hog panels must be of heavy wire mesh with no more than 4" spacing and sunk into the ground for 1' - 2', about 3' high and can be electrified at the top or it should have a 1' overhang, or you can also install an electric fence 4" - 5" off the ground around the area you want to exclude them from.

Shooting. Where legal and safe, the quickest and surest method of eliminating woodchucks is to shoot them with a medium caliber rifle or varmint rifle, e.g., scope-sighted .243 or .22 caliber. A patient marksman can significantly reduce even a large local woodchuck population in a few days. Shooting, obviously, will be most productive during periods of greatest activity and on fair weather days.

Remove their cover: *Landscape* the areas directly around woodchuck burrows by removing all brush, tall weeds and grasses, and other forms of protective cover. Replace the native plants with onions and garlic, which repel woodchucks.

Strobe lights - Install strobe lights (if possible) in crawlspaces, attics, wall voids, etc. and leave on most rats and nuisance wildlife will leave the area in a few days.

Put out the *unwelcome mat*. If you have a dog, give your pet a small scrap of carpet remnant (sold inexpensively at carpet stores) to sleep on for a week or two. Then place the canine-scented unwelcome mat where you want to repel woodchucks and give your pet a new carpet bed. Periodically swap the unwelcome mats or dog beds every few weeks, keeping the rotation going for the whole season. Throw in well used kitty litter.

Make them hot under the collar: Sprinkle freshly ground cayenne pepper in and around woodchuck burrows and among the crops they like best.

Trapping. It is fairly easy to live trap woodchucks using wire mesh live traps such as the Tomahawk® Nos. 103, 105 or 1094 or the Havahart® Nos. 3 or 3a. They do not readily enter solid box traps made of wood or metal, so prebait. The trap should be set in the trail immediately in front of the burrow's main entrance and baited with bean sprouts, squash, pears, apple slices, fresh beans, sweet corn, peas, other fresh fruit, carrots or lettuce. Both doors of the trap should be left open. Logs, twigs or stones placed on either side of the path between the burrow opening and the trap will aid in funneling the animal into your the trap. All traps should be checked in the morning and early evening so that captured animals may be dealt with in a humane manner. If possible, release the trapped animals at least five miles from the point of capture (Be sure this is legal in your area). As a last resort, Nos. 1 1/2 or 2 steel leg traps can be used around the burrow mound. These should be carefully buried in the ground in pairs and securely staked own. **Be very careful. Snap traps can severely injure people and pets, and we do not recommend their use!** If you use them, use only Conibear-type lethal body grip traps.

Rat Poison Caution - Over 40 years ago the Author remembers placing rat bait directly into a rat hole and minutes later he found the rat poison in a dish rag drawer in the kitchen. The rats remove poison baits from secure stations and bring them to their nests.

Dry Ice - As a last resort try fumigating the tunnels with several pounds of dry ice or a cylinder of CO_2. Be sure to quickly cover all holes where you see gas escaping. Do this in early spring when you can locate the dens more easily and the young are not yet born. An alternative (if it is legal) would be to drop lots of lit charcoal briquettes down all tunnel openings - leave the tunnels open so carbon monoxide forms and fills all of the tunnels.

Safety Equipment - Nuisance wildlife control creates a variety of job hazards, such as animal bites, diseases, and working in high places. Wildlife Management Supplies division of Critter Control has added climbing safety and fall-stop equipment to their specialty catalog. New products include safety ropes, saddles and full-body fall arrest harnesses, ascenders, figure 8s, and carabiners. In addition Wildlife Management Supplies will carry instructional books, as well as a 25-minute videotape on ropes, knots and climbing. For a free catalog, call 1-

800-451-6544, web site: http://www.wildlifemanagementsupplies.com/

Remember exclusion and sanitation are always your Best Controls! Never touch or handle any (dead) animal without proper protection!

Rodents - Typical First Strikes by Housekeeping & Maintenance

1. **Sanitation**: Institute good daily cleaning procedures, food storage and garbage removal. Vacuum and use diluted Safe Solutions Enzyme Cleaner with Peppermint and/or borax to remove rodent droppings and urine and food particles in all infested or suspect areas on a routine basis. All fiberglass insulation should be removed from around refrigerator and freezer condensers and motors. Keep exterior areas clean, close mown and trimmed. Glue traps should be checked daily and any trapped mice removed and disposed of in a dumpster. Live traps should be checked daily and mice drowned in a pail then disposed of in a dumpster. All trash bags should be removed as soon as possible. Doubled trash bags should be used to prevent leakage. Also, it is important that both of these bags be securely tied shut to prevent l leakage into the dumpster. Dumpsters should be cleaned with diluted enzyme cleaners and/or borax twice per month in winter and weekly in summer to remove any food residue. All equipment, floors and walls also need to be routinely sanitized to remove food residue and mouse urine and/or excrement. Keep all materials and debris off the floors. **Clean, clean, clean.**
2. **Exclusion**: All gaps around plumbing pipes and holes in walls and floors should be repaired or at least plugged with steel wool and/or aerosol foam insulation. Remove all exterior debris.
3. **Eating Areas**: All eating must be in clearly designated areas only so that custodial staff can ensure it is cleaned up. **Please don't feed the rodents!**
4. **Food Storage**: It is extremely important that all food be stored in heavy duty plastic, glass or metal containers. Items such as noodles, flour and grain products that are open must be stored in these containers to prevent contamination. Storage pallets must be 18+" away from walls (and then paint that area white or yellow) so inspections can be made. **Please remember that proper sanitation, exclusion and food storage and proper stock rotation are the key elements to successfully combating any rodent problems. Trapping or baits will not eliminate the reason for the mice being present anywhere.**
5. **Set live multiple catch traps** or baited glue boards or snap traps; if they are stealing your bait, tie some dental floss to the trigger and then put peanut butter on the floss or put pieces of Alka-Seltzer tightly wrapped with bread or chocolate Ex-Lax or the active ingredient, Phenolphthalein wherever you see any droppings.
6. **Other Rodents Controls:** Make a "Walk-the-Plank®" trap as detailed in **The Best Control II**. Beer or Pepsi that still has its "fizz" will kill rats and other rodents. Mice and voles die when fed baits with vitamin D and/or aspartame. Dried pea diets sterilize mice. Traps should be placed in attached garages and near doors to intercept invading rodents and/or other pests. Most pest problems are not carried in, but crawl or fly in from outside, so install a pair of free-range Guinea fowl.
7. **Outside: "Fumigate" burrows with carbon dioxide or carbon monoxide.**
8. **Inspection/Monitoring:** Be sure you use strong flashlights, red lights and/or black lights in a variety of routine inspections, including nighttime and incoming goods.
9. **If you are still seeing rodents read the appropriate sections in this chapter**.
10. Contact Get Set, Inc. at 1-616-677-1261 or Safe Solutions, Inc. at 1-888-443-8738.

The American Institute of Baking has a video on rodent control. Call them at 1-800-242-2534 or 1-785-537-4750 and ask for "Rodent Control Strategies for Food Processing and Distribution Facilities."

Note: Fourteen cents was the rat-tail bounty for the 1997 rat season in Bangladesh. In 1996, Bangladesh bounty hunters killed 2.6 million rats. Anyone who kills 10,000 rats wins a color television.

At the American Academy of Allergy, Asthma and Immunology annual meeting in March of 1999, researchers presented the results of a study that shows mouse allergen to be a major cause of asthma and allergic rhinitis in susceptible individuals in inner-city homes. Routinely clean with 1% Safe Solutions, Inc. Enzyme Cleaners to help remove this and cockroach allergens.

Check out this nuisance animal control web site - http://www.entm.purdue.edu/wildlife/ID.htm

Control Caution: You must learn all applicable federal and state and local regulations and/or laws. There are regulations regarding hunting, trapping, control devices, euthanasia and/or release. There are moral and ethical issues that must be taken into consideration. In some states or areas it may be illegal to use any control mentioned in this chapter, e.g., drowning a skunk. Some states may not allow you to kill anything; others, e.g., New York and New Jersey, may demand you do so by drowning or by carbon monoxide. In Pennsylvania you may only kill via lethal injection. Your local veterinarian, the American Humane Society and/or PETA may be able to help you. You may then need a permit to transport "bio-hazardous waste" to a landfill. The animals may need to be bagged and a dumping permit issued, etc. Always check with all of the proper officials before beginning any control. Move slowly - You are dealing with a scared animal that perceives you as a big predator. A sudden movement or scream can make it attack you. Move slowly. Once an animal is in a live tap, cover the entire trap with a blanket. When releasing the animal, stand behind the trap - usually it will run straight out and away from you. Raccoons and striped skunks make up about 75% of reported rabid animals. The simplest control is to make your area inaccessible or uninviting.

Secondary Poison Caution: When predators, e.g., kestrels, hawks, owls and/or mammals, e.g., cats, etc. feed on dead or dying mice or rats poisoned by anticoagulant poison baits that kill rodents by internal bleeding; the predators can also die by secondary poisoning - exasperating your rodent problem.

"It is not the critic who counts. The credit belongs to the man who is actually in the arena...who at the best knows in the end the triumphs of high achievements and who at the worst, if he fails, at least fails while daring greatly, so that his place will never be with those cold and timid souls who know neither victory nor defeat." — **Theodore Roosevelt**

Bubonic Plague Caution: The 1/30/00 issue of the Grand Rapids, MI Press had an Associated Press article about Debra Welsh who lives in Alburque, NM. Debra is the first confirmed bubonic case this year in New Mexico. She thinks she knows how she got it, "Those little drunken, wobbly mice would get into the house and you could get right up to them and pick them up by their tails and drop them in the toilet," she said from her bed at St. Joseph Hospital. Bubonic plague between 1346 and 1351 wiped out an estimated third of the population of Europe! **Never pick up any dying animals with your bare hands!**

Finding a dead animal: To find a dead animal inside of a building is often quite difficult. Ask the occupants where did the odor start? Close all doors, turn off all heat or air conditioners and any fans. Close all windows. Let the building "sit" for at least an hour and then follow your nose to the source. A bore scope is a great tool to see behind walls and ceilings. You can use flesh flies to locate still hidden dead animals; just follow the fly to the dead creature. Note: Make sure there are no broken sewer lines, decaying garbage or food not properly stored, that the freezer still is working or any other kind of odor. **Always remember there can be multiple dead animals.**