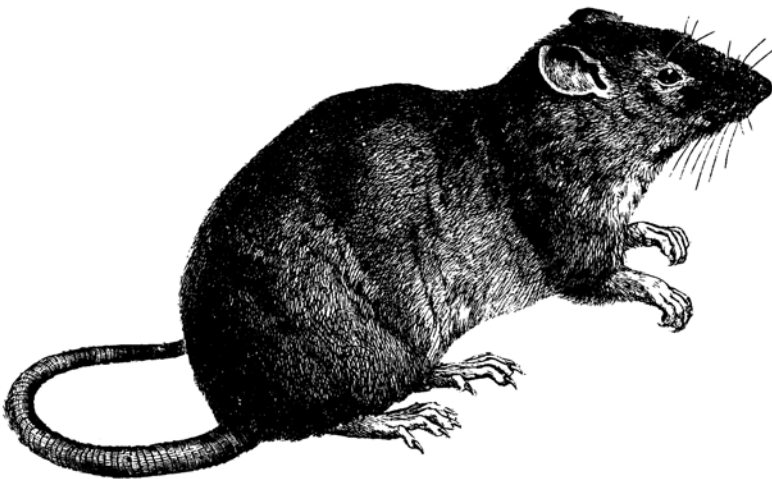


Rodent Control

*Maryland Pesticide Applicator
Training Manual
Category 7D*



Maryland Department of Agriculture
Pesticide Regulation Section
Licensing, Certification and Training

Rodent Control

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Preface

This training manual has been developed to prepare you for successfully passing the Maryland pesticide applicator certification exam for Category 7D, Rodent Control. The manual contains information that you should know when controlling rodents in and around structures.

Each chapter in the manual begins with a set of learning objectives. Read these objectives before beginning each chapter. They describe what you should know or be able to do after reading the chapter. Many of the questions on the certification exam will be based on these learning objectives.

Each chapter also includes a review quiz covering some of the material presented. After reading the chapter, take the quiz, then compare your answers to the key at the end of the manual. Review again the learning objectives to identify information you need to restudy.

Once you are able to correctly respond to the objectives and answer the review questions, you will be ready to take the certification exam. Good luck!

Acknowledgements

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CHAPTER ONE

Introduction to Rodent Control

Learning Objectives

- *Identify the major negative impacts of rodent pests.*
- *Select correct examples of major health concerns associated with rodents.*
- *Identify the rodents most often associated with (a) hantavirus and (b) Lyme disease.*
- *Identify the primary impact of rodents on human food supplies.*
- *Describe the major ways that rodents damage structures.*
- *Identify important differences between IPM and traditional pest control.*
- *Identify the basic components that are incorporated into most IPM programs.*
- *Define the basic components of rodent IPM monitoring.*
- *Describe the goals of rodent monitoring.*
- *Identify exclusion and good sanitation as the control tactics most likely to result in long-term rodent control and prevention.*
- *List examples of nonchemical tools that can be used to effectively control rodents.*
- *Identify the ways that rodent IPM programs reduce pesticide hazards.*
- *Identify the laws and regulations that cover those doing rodent control for a fee or using rodenticides.*



The vast majority of rodents are native species and are essential components of the natural environment. (Photo L. Pinto)

Commensal Rodents

The Norway rat, roof rat, and house mouse are called “commensal rodents” because they are so well-adapted to living around people. They are the major pest rodents in the U.S.

Many animal families and over 1500 different species make up the order Rodentia. The vast majority are native species and are essential components of the natural environment. Our three most common species of pest rodents—the Norway rat, the roof rat, and the house mouse—are in the family Muridae, the old world rats and mice. None of these rodents are native to North America. They were introduced here unintentionally in the ships of explorers and colonists.

Old world rats and mice adapted well to living around people. So well, in fact, that they are commonly called commensal rodents. The word “commensal” comes from the Greek word meaning “with” and menna meaning “table.” Commensal literally means a “companion at meals,” an apt description in many rodent infestations. Wherever there are people, there is food, water, and harborage for commensal rodents. Rats and mice most often become pests when people mismanage trash, provide easy access to food and water, allow entry inside buildings, and practice poor sanitation.

Commensal rats and mice live and breed inside buildings and granaries, in sewers and attics, in agricultural fields and warehouses, in ships and under concrete slabs. These pests are very happy to share the food on our table, and this training manual is primarily about managing those three pest species.

A few noncommensal rodents can also be pests in and around structures. In Maryland, white-footed mice, deer mice, and tree squirrels may sometimes require pest management action, and this manual also addresses these potential pests.

PEST SIGNIFICANCE OF RODENTS

Rats and mice are among the most important pests in the world. They cause economic loss and human suffering. If they aren’t controlled by effective pest control, they can become overwhelming. They invade our space. Breeding and nesting in and around our buildings, they feed on our food and garbage. Most significantly, they cause damage and impact our health.

Key Points**Negative Impact of Rodents**

1. Psychological
2. Food contamination
3. Structural damage
4. Disease and other health impacts

The negative impacts from rodents fall into four general categories: psychological, food contamination, structural damage, and disease and other health impacts.

Psychological Impacts

Rats and mice can generate strong feelings in many people. As expressions like “I smell a rat,” “you dirty rat,” “looks like a rat’s nest,” and “it’s a rat race” suggest, the rat is, for many people, their least favorite creature. The mouse gets off a little better...think of Mickey and Minnie, yet a mouse scurrying across a kitchen counter can trigger feelings of alarm, disgust, loathing, or even fear (rodentophobia is a real condition).

Rodents around a home have the added psychological burden of suggesting poor housekeeping, low social status, or worse (although, in truth, rodents are no respecters of income or social status).

The presence of rodents also impacts how people view a business or other facility. How would you feel about eating at a restaurant with rodent droppings on the floor, going to a hospital with rat burrows at the entrance, or sending your children to a school where rats and mice are seen regularly in the play area?

Food Contamination

Rats and mice are happy to eat almost anything that you eat! They compete with us for our food, feeding on food in the field, in storage, in processing plants, in retail stores, and at home. Worldwide, more than 20 percent of all food is lost to rodents. Rats may feed upon chickens and even attack the legs of domestic livestock.

But while rodents consume a lot of food worldwide, we in the United States are concerned more about food contamination by rodents than we are with consumption. Why? Because rats and mice are comparatively small and do not eat much. A well-fed Norway rat eats about an ounce of food a day, a house mouse about one tenth as much. It takes a large rodent infestation to eat enough food to cause a noticeable loss.



Worldwide, more than 20 percent of all food is lost to rodents. But in the United States we are concerned more about food contamination by rodents than we are with consumption. (Photo CDC)

Of course, such losses happens occasionally, particularly on the farm in bulk grain. But it is food contamination that is the most important issue. Rodents contaminate at least ten times the amount of food that they eat, and sometimes much more. So the greatest loss is not what mice eat, but what is thrown out because of contamination, either real or suspected. For example, in six months, one pair of mice can eat about four pounds of food and deposit about 18,000 droppings.

None of us wants the food we eat to contain rodent droppings or other contaminants. That is why inspectors in food plants, restaurants, and other food facilities look for evidence of rodent contamination, and then take action when they find it.

How Rodents Contaminate Food

Rats and mice contaminate food in a number of ways.

- Each rat or mouse produces between 50 and 100 fecal droppings every day. If you do the math, you discover that a family of 10 mice living in a food bin could produce over 5,000 droppings a week!
- Rodents urinate frequently, in small micro-droplets. That urine is a food contaminant. The house mouse produces hundreds to thousands of urine droplets each day, many of those onto the food it is feeding on.
- Rats and mice gnaw on solid food or on the packaging of food. If they have gnawed on it, their saliva is on it, and so the food product becomes contaminated. Gnawing damage to food packaging is usually considered evidence of contamination.
- Rodents regularly shed their hair. Rodent hair in or around food is generally considered by food or health inspectors to be evidence that the food is contaminated.

Structural Damage

Rodents cause physical damage to homes, commercial buildings, outbuildings, walls, railroad embankments, utility lines, sewers, and other structures. Rats and mice damage structures primarily through two regular rodent activities: gnawing and burrowing.

Gnawing

The name “rodent” comes from the Latin word meaning “to gnaw.” Rodents gnaw every day. Their teeth are hard and their jaws strong. They gnaw to gain entry into sites that may contain food, water, or material for nesting, or that may provide hiding or nesting sites.

Rodent Gnawing Damage

Here are some common examples of gnawing damage:

- Holes in the bottom of doors chewed by either rats or mice in order to gain entry.
- Holes in kitchen walls and cabinets caused by house mice.
- Damage to wooden beams and flooring from regular gnawing by Norway or roof rats.
- Severed computer wires in walls, attics, and conduits.
- Holes through fascia boards and soffits at the roof line caused by roof rats.
- Damaged brake lines and coolant lines from rats hiding or nesting in vehicles.
- Damaged water lines in houses and commercial buildings caused by rats.
- Building fires caused by electrical shorts when rodents gnaw on electrical lines.



Around structures, the preferred sites for Norway rat burrows are under concrete slabs and along foundation walls. (Photo L. Pinto)

Burrowing

Besides their gnawing, rodents also damage structures by burrowing. The main culprit here is the Norway rat, whose natural home is a burrow dug into the ground. A single burrow is 2-3 inches in diameter and perhaps three feet long. But Norway rats can dig lots of burrows!

In the wild, Norway rats prefer to dig their burrows under rocks and other protective objects. Around structures, the preferred sites for burrows are under concrete slabs and along foundation walls.

The burrowing of Norway rats causes structural damage by undermining slabs, foundation walls, and other structural elements (see box).

Rodent burrowing can cause damage indoors, too. Rats and mice make burrows in insulation inside walls and attics. They also burrow into the insulation in walk-in coolers, stoves, and other equipment.

Burrowing Behavior Can Cause Structural Damage

Here are examples of structural damage caused by Norway rat burrowing:

- Undermined foundation walls
- Settling patio slabs
- Undermined road beds
- Collapsed railroad tracks
- Eroded banks of irrigation levees
- Damaged sewer systems
- Settling sidewalk slabs
- Undermined support piers in crawlspaces

Disease and Other Health Impacts

Rats and mice have damaged people's health throughout human history, and continue to do so today. Historically, diseases associated with rodents have had the greatest impact on human health. Rats and mice have been responsible for more human illnesses and deaths than any other group of mammals. From plague to typhus to hantavirus, rodents are associated with about 60 different diseases worldwide.

Following is a list of diseases that are associated with rodents in Maryland that may be transmitted to people.

1. **Hantavirus.** The disease agent, a virus, is found in the saliva, urine and feces of deer mice and white-footed mice, and is spread to humans most often by inhaling aerosolized urine, other body fluids, or tiny fecal particles that are floating in the air after an area has been disturbed.

Rabies and Rodents

Rats and mice in nature do NOT typically carry the rabies virus. The U.S. Public Health Service does not recommend rabies shots in the case of a rat or mouse bite.

Key Points

Health Impacts of Rodents

There are five primary human health impacts from rodents.

1. Disease
2. Allergy
3. Asthma
4. Attacks
5. Ectoparasites (fleas, mites, etc.)

2. **Lyme disease.** White-footed mice and deer mice serve as “reservoirs” of the organism that causes Lyme disease. In other words, the disease is in the mouse’s blood, and is picked up by ticks and passed on to people when the ticks bite them.
3. **Food poisoning.** When mice or rats travel through or feed on stored food, or walk across food preparation surfaces or equipment, they leave behind deposits of feces, urine, hair, and saliva--all of which contain *Salmonella* bacteria and other food-poisoning pathogens.
4. **LCM.** Lymphocytic choriomeningitis, or LCM, is a virus that is spread to people primarily by the common house mouse, *Mus musculus*. Infection rates in mice range from 3 to 40%. People become infected with LCM when rodent urine, droppings, saliva or nest material come into contact with broken skin, the nose, eyes, or mouth, or if they are bitten by an infected rodent.
5. **Ratbite Fever.** Ratbite fever, or RBF, is a rare, systemic bacterial illness that can be caused by a bite or scratch from a rodent, or by ingesting food or water contaminated with rat feces. Cases have also been recorded as a result of bites from mice, squirrels, and gerbils, and from contact with dogs or cats that fed on these animals. Patients are treated with antibiotics and most cases clear up within two weeks, but 13% of untreated cases are fatal.

Disease is only one of the human health concerns related to rodents. Other health issues include:

1. **Allergy.** Those who react to rodent allergens (particularly mouse allergens) may have allergy symptoms such as a runny nose, tearing eyes, sneezing or worse.
2. **Asthma.** Those people who are most susceptible to mouse allergens may have severe allergy symptoms that include asthma, which can be debilitating or even life-threatening.
3. **Attacks.** Rodents, and in particular rats, have long incisor teeth and can give you a nasty bite. They are aggressive when cornered or handled, and will try to

bite and scratch. About 50,000 people a year, mostly children, are bitten by rats in the United States.

4. **Ectoparasites.** Rodents harbor a wide range of ectoparasites including fleas, ticks, mites, and lice. Some of these can transmit diseases to pets, wildlife, and people. In addition, some rodent ectoparasites will also bite or even feed on people.

RODENTS AND IPM

Rodent control is not simple. Rodents are intelligent, adaptable, prolific, and secretive. So secretive and wary, in fact, that hundreds of them can be living in, under, and around a complex of buildings and few people in the area will be aware of their existence. Rats and mice can also survive even in the most adverse conditions. Because they are so successful as pests, the most effective way to deal with rodent problems is to use an “integrated” approach to prevent rodent outbreaks and to manage rodent problems for the long term.

What is Rodent IPM?

Integrated Pest Management (IPM) is a system of managing pests that integrates prevention (through pest-proofing, improving housekeeping, good trash management, etc.) with corrective measures (trapping, baiting, product disposal, etc.) to kill or otherwise eliminate pests. At the same time, IPM minimizes risks to people and the environment from rodenticides and other control measures.

Rodent IPM differs most from traditional rodent control in that it does not normally depend on automatic application of rodenticides. Prevention of rodent problems is emphasized.

Take, for example, the case where rats have been seen by the dumpsters located behind an apartment building. The typical action of a pest control technician might be to install a dozen bait stations, which would be serviced at each subsequent visit and rodenticide replaced as needed. As long as the bait was being taken, the technician would figure he was doing his job. This could go on for months or years.

Key Points

Rodent IPM vs Traditional Rodent Control

Rodent IPM differs most from traditional rodent control in that it does not normally depend on automatic application of rodenticides.

But, of course, the technician has it backwards. If the bait continues to be taken, there are still rats at the site. Rats might be dying, but the problem is still ongoing, and the apartment manager still has a problem, and a larger crisis is just waiting to happen.

IPM approaches the problem differently. The causes of the problem need to be figured out prior to starting control. Some basic questions need to be asked, such as: Why did the rats suddenly appear? What are they feeding on? Where are they nesting? Where did they come from? What can be done to prevent them from invading the site in the future?

The first step would be to conduct a thorough inspection of the site and the surrounding areas. Perhaps the dumpsters are inadequately sized, regularly overflowing with spilled trash, and providing food for rats. Perhaps there is a thick groundcover with rodent burrows hidden below. Perhaps there is a construction site nearby with sewer relocation underway that is spreading rats into the neighborhood.

Whatever the root of the problems, in IPM the goal is to make the changes necessary to remove food and eliminate harborage that were attracting the rats to the site in the first place. Then, any control actions, such as baiting at feeding and nesting areas, would be much more targeted and effective. As a result, once the existing rats were eliminated, the area would be far less likely to be reinvaded with rats, thus preventing problems in the future.

Speaking of prevention, in a good IPM program, the rat problem at the dumpsters might never have occurred. IPM would have included regular monitoring of the site that should have identified the trash management problems, potential nesting areas, and adjacent problem sites before the rats began causing problems.

Where traditional pest control service tends to respond to a pest crisis, IPM programs can prevent the pests from building to a level where they cause a crisis.

Components of IPM

IPM programs differ in the details on how they may actually be carried out but most have certain common elements.

Key Points

A Major IPM Goal...

To make the sanitation, structural, and operational changes necessary to eliminate the conditions that attract rodents in the first place.

Key Points**Five Elements of IPM**

There are five basic elements of IPM:

1. Monitoring
2. Recordkeeping
3. Communication
4. Nonchemical Rodent Management
5. Rodenticides

Monitoring

IPM requires monitoring. It is nothing fancy, monitoring is simply documented, regular inspections. Rodent monitoring includes checking for rodent activity, estimating populations, identifying travel routes, and pinpointing where rodents are feeding, watering, nesting, and hiding.

Monitoring also includes identifying any factors that could provide rodent food or harborage, such as poor trash handling practices, debris piles, food and trash not disposed of properly, and overgrown weeds.

Recordkeeping

Good records help solve pest problems, meet legal requirements, give a historical perspective of pests, and anticipate seasonal pest problems. Information recorded includes pest sightings, control actions, housekeeping problems, structural deficiencies, and the location of sensitive areas where pesticides must be used with extra care, or not at all.

Typical reports or records consist of logbooks, service reports, sanitation reports, corrective action reports, annotated floor plans, and quarterly or annual quality assurance reports.

Communication

Communication includes not only two-way communication about pest problems, but also educating people about the relationship between sanitation, structural problems, and pests. It can be verbal (talking with people) but most often is written down in such documents as service reports, corrective action reports, and sanitation reports.

Communicate to Establish Areas of Responsibility

Responsibilities may include the following:

- Correcting sanitation and maintenance problems.
- Changing operational procedures that contribute to pests.
- Making structural modifications to correct conditions allowing pest entry or pest breeding.
- Providing entry to all areas for service.
- Enforcing staff compliance with service.
- Reporting pest sightings and any complaints about pests.

Communication also establishes lines of responsibility. Good cooperation is critical if IPM programs are to succeed. All parties involved need in order to cooperate to make the site less attractive to rodents.

Nonchemical Rodent Management

When a rodent problem requires action, IPM looks first to those methods not requiring rodenticides. Emphasis is placed on those methods that work over the long term, or that prevent pests in the first place, such as pest-proofing (exclusion) and improved sanitation (good housekeeping, proper trash management, etc.).



Besides rodent-proofing and improved sanitation, the primary nonchemical tools that IPM programs use to manage rodents are traps and landscape management. (Photo by CDC)

Besides rodent-proofing and improved sanitation, the primary nonchemical tools to manage rodents are traps and landscape management—getting customers to modify landscape design that attracts rodents. Often, nonchemical measures are combined for the most effective results, and sometimes used together with a limited application of pesticide.

Rodenticides

Rodenticides are acceptable tools in IPM but they must be used judiciously, and not automatically or on a schedule. They can be used when nonchemical control measures are unavailable, impractical, ineffective, or likely to fail. It is very important that, whenever rodenticides are used, they are used in a way that minimizes the risk to people and the environment.

Integrating the five major components of IPM together is the best and most effective way to minimize problems with pests, including rats and mice.

LAWS AND REGULATIONS

Individuals and organizations doing rodent control for a fee or who use rodenticides to control rodents are covered by various laws and regulations, both federal and state.

Federal

Federal laws and regulations governing the control of rodents in and around structures mostly concern the rodenticides that are used. A rodenticide is a pesticide, and a pesticide is de-

defined as any substance used to control, prevent, destroy, repel, or mitigate any pest.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), administered by the United States Environmental Protection Agency (EPA), rodenticides and other pesticides must be registered with EPA prior to their sale or distribution. As part of the registration process, pesticides are classified for either general use or restricted use. EPA bases this classification on the pesticide's potential for harm, its formulation, method of use, and site of application. A pesticide that is not likely to harm humans or the environment when used according to label directions is classified as a general use pesticide.

If there is reason to believe that a pesticide may harm humans or the environment, even when used according to label directions, it will be classified as a restricted use pesticide. Restricted use pesticides can only be applied by or under the direct supervision of certified pesticide applicators (see next section). All rodenticide tracking powders, for example, are classified as restricted use.

Maryland Subcategories

Pest Control Category 7:
Industrial, Institutional,
Structural & Health-Related

- A General Pest Control
(e.g., cockroaches, fleas, crickets, and other household pests found within or adjacent to a structure)
- B Wood-Destroying Insects
(e.g., termites and other wood-destroying insects)
- C Wildlife Control - (e.g., pest control involving birds, mammals, reptiles and other wildlife)
- D Rodent Control - (e.g., rodents found in and around a structure)
- E Fumigation (e.g., fumigation of commodities and structures)

Maryland Applicator Certification and Business Licensing Requirements

The Maryland Department of Agriculture (MDA) is responsible for regulating the sale, use, storage, and disposal of pesticides and for enforcing the Maryland Pesticide Applicators Law. MDA is responsible for establishing guidelines and requirements for the application of pesticides, the certification of pesticide applicators and the licensing of businesses to ensure that pesticides are applied properly by competent individuals.

There are several different types of pesticide applicator certificates and licenses issued by MDA, including: private applicator certificates, pesticide business licenses, pest control applicator certificates, pest control consultant licenses and certificates, public agency permits and applicator certificates, and "not-for-hire" business licenses and pesticide applicator certificates.

Commercial Pest Control

In order to control rodents, a pesticide business must be licensed in Category 7D (see chart: *Maryland Subcategories*). A pesticide business is any business that is offering pest control services or applying general or restricted use pesticides for hire as part of a service or contract agreement. Pest control means engaging in, or offering to engage in, recommending, advertising, soliciting the use of, supervising the use of, or using, a pesticide or device for the identification, control, eradication, mitigation, detection, inspection, or prevention of a pest in, on, or around any house, building, water, air, land, plant, structure, or animal. This includes firms providing structural pest control. A pesticide business license is required in order to provide this service.

Key Points

Requirements in Maryland

in order for a business to control rodents in Maryland, the business must be licensed in Category 7D, Rodent Control, and any rodenticides must be applied by or under the supervision of an applicator certified in Category 7D.

Furthermore, the use of any pesticide by the pesticide business must be by, or under the supervision of, a certified applicator. In order to become certified as a pest control applicator, an individual must be at least 18 years of age and have at least one year of practical pesticide application experience as a registered employee in the category, or categories, in which he/she wants to become certified. A degree in a biological field such as biology, botany, horticulture, entomology, agronomy, etc. may qualify in lieu of experience. The individual must pass examinations administered by MDA.

In addition to federal registration, all pesticides used within the State of Maryland must also be registered with MDA's State Chemist Section.

In summary, in order for a business to control rodents in Maryland, the business must be licensed in Category 7D, Rodent Control, and any rodenticides must be applied by or under the supervision of an applicator certified in Category 7D.

Consultants

A pest control consultant license and certificate in Category 7D are required if a person is engaged in the business of offering or supplying technical advice or supervision, inspecting for or identifying rodents, or recommending the use of specific rodenticides for the purpose of controlling rodents. A pest

control consultant will be certified in Category 12 - Consulting, and certification in this category is based on experience, or education, and passing the certification examinations in those categories of pest control in which consulting services will be offered.

Others

Other agencies, individuals, or organizations engaging in rodent control may be required to obtain a license and/or a certificate in Category 7D, Rodent Control. These include *private applicators, public agencies, and not-for-hire facilities.*

REVIEW QUIZ

1. Which one of these rodents is considered to be a commensal, or domestic rodent?
 - a. deer mouse
 - b. chipmunk
 - c. house mouse
 - d. tree squirrel
2. Which one of these rodents is most associated with the disease, hantavirus?
 - a. roof rat
 - b. deer mouse
 - c. house mouse
 - d. Norway rat
3. An example of an ectoparasite that can be found on rodents is:
 - a. blow fly.
 - b. book louse.
 - c. hide beetle.
 - d. flea.
4. When there is a rodent infestation in a food storage facility, the biggest concern is:
 - a. the amount of food eaten by rodents.
 - b. contamination of food by rodents.
 - c. diseases spread by rodents.
 - d. rodenticides sprayed on food.
5. Which one of these is a main way that rodents damage structures?
 - a. gnawing
 - b. nest building
 - c. fecal droppings
 - d. rub marks
6. Deer mice and white-footed mice serve as reservoirs of Lyme disease which is transmitted to people by:
 - a. fleas.
 - b. mosquitoes.
 - c. ticks.
 - d. lice.
7. The first step in a rodent IPM program for a rat infestation would be to:
 - a. apply rodenticide bait.
 - b. set snap traps.
 - c. rodent-proof openings.
 - d. conduct an inspection.
8. Which one of these is not a basic element of a rodent IPM program?
 - a. regular monitoring
 - b. automatic rodenticide application
 - c. communication
 - d. recordkeeping
9. Which one of these rodenticides is classified by EPA as a "restricted use pesticide?"
 - a. tracking powder
 - b. block bait
 - c. meal bait
 - d. liquid bait
10. In order to control rodents in Maryland, a pesticide business must be licensed in category 7D and rodenticides must be applied only:
 - a. by technicians with a minimum of 30 hours of training.
 - b. by applicators over 18 years of age.
 - c. by or under the supervision of a certified 7D applicator.
 - d. by applicators with wildlife handling-training.

CHAPTER TWO

Rodent Biology and Habits

Learning Objectives

- *Correctly identify pest rodents using key physical characteristics.*
- *Match the various pest rodents with their typical nesting habits.*
- *Identify the main reasons that rodent populations can rebound quickly after a knockdown.*
- *Choose correct examples demonstrating the physical capabilities of each of the commensal rodents.*
- *Recognize key aspects of each rodent's behavior that are most important in planning control.*
- *Identify the primary activity periods of each pest rodent.*
- *Contrast the behavior of deer and white-footed mice with the behavior of house mice.*
- *Define "neophobia" and explain why it is important in rat control.*
- *Select correct examples of how a technician can use a mouse's natural curiosity to improve control.*
- *Contrast the foraging ranges of the three commensal rodents.*
- *Define kinesthetic sense and identify why it is important when controlling house mice.*
- *Specify the smallest opening that each pest rodent is able to squeeze through.*
- *Recognize the significance of rodent food caches.*



Rodents are characterized by two pairs of large incisor teeth, as seen in this rodent skull. (Photo L. Pinto)

It is easy to distinguish rodents from other mammals. The feature most often looked for is the presence of two pairs of incisor teeth, one pair each in the upper and lower jaws. These teeth are extremely strong and sharp. Rodents are generally known for their gnawing habits and the ability to chew through a variety of tough substances, including cinder and concrete blocks, lead and plastic pipes, wood and aluminum. (Rabbits belong to another animal order, the Lagomorphs, because they have another pair of teeth, in addition to the incisors of the rodent.)

IDENTIFICATION KEY TO RODENTS

1. Hind legs not two times longer than front legs; external fur-lined cheek pouches absent. 2
 Hind legs two or more times longer than front legs; external fur-lined cheek pouches present 25
2. Tail bones longer than one half body and head length..... 3
 Tail (bones) length equal to or less than one half that of the head and body 15
3. Tail almost naked with fine scales and hairs..... 4
 Tail not scaled, not naked (although short hairs may make them appear so) 5
4. Adults less than 4 inches (10 cm) from nose to base of tail
 (Genus *Mus*).... House Mouse
 Adults, more than 6 inches (15 cm) from nose to base of tail
 (Genus *Rattus*).....Norway and Roof Rats
5. Tail with more or less distinct rings..... 6
 Tail without definite rings 7
6. Head short thick, no neck; fur coarser; tail usually dark above and beneath (Genus *Sigmodon*) Cotton Rat
 Head long and slender, neck evident; fur finer, tail usually dark above, pale beneath (Genus *Oryzomys*) Rice Rat
7. Tail round in cross section 8
 Tail flattened from side to side; feet partially webbed (Genus *Ondonatra*).... Muskrat
8. Half of tail nearest body slender and round not bushy 9
 Entire tail bushy or fluffy 11
9. Whiskers reach to or beyond base of front leg (Genus *Neotoma*) Wood Rat
 Whiskers do not reach to the base of the front leg 10

- | | |
|--|--------------------------------|
| 10. Tail same color above and beneath (Genus <i>Reithrodontomys</i>)... .. | Harvest Mouse |
| Tail bicolored, dark above and light below | |
| (Genus <i>Peromyscus</i>).. .. | Deer Mouse, White-Footed Mouse |
| 11. Whiskers reach to base of front leg | 12 |
| Whiskers do not reach to base of front leg..... | 14 |
| 12. Tail as long as head and body (Genus <i>Sciurus</i>)..... | Tree Squirrel |
| Tail shorter than head and body | 13 |
| 13. Membrane between front and hind leg (Genus <i>Glaucomys</i>)..... | Flying Squirrel |
| Membrane absent between front and hind leg (Genus <i>Neotoma</i>) | Wood Rat |
| 14. Stripes on cheeks (Genera <i>Tamias</i> and <i>Eutamias</i>)..... | Chipmunks |
| No stripes on cheeks (Genera <i>Citellus</i> , <i>Spermophilus</i> , allies).. .. | Ground Squirrels |
| 15. Tail round; feet not webbed..... | 16 |
| Tail flattened from top to bottom; feet webbed (Genus <i>Castor</i>)..... | Beaver |
| 16. Tail slender and pointed with fine hair | 17 |
| Tail hairy, not slender and pointed, with fluffy or brush-like hair | 22 |
| 17. Claws on front feet longer than on hind feet..... | 18 |
| Claws on front and back feet about equal length..... | 19 |
| 18. Upper front teeth grooved (Genus <i>Geomys</i>)..... | Eastern Pocket Gopher |
| Upper front teeth without grooves (Genus <i>Thomomys</i>) | Western Pocket Gopher |
| 19. Tail with white tip (Genus <i>Onychomys</i>) | Grasshopper Mouse |
| Tail without white tip | 20 |
| 20. Fur reddish on back contrasting with pale gray on sides | |
| (Genus <i>Clethrionomy</i>) | Redback Vole |
| Fur brownish on back and sides | 21 |
| 21. Fur grizzled, tail over 1 inch long (Genus <i>Microtus</i>)..... | Field or Meadow Mouse |
| Fur not grizzled, thick and short, tail 1 inch or less (Genus <i>Pitymys</i>)..... | Pine Vole |
| 22. Crown of head dark or black with or without a few white hairs | |
| (Genus <i>Marmota</i>) | Marmot and Woodchuck |
| Crown of head same color as back | 23 |
| 23. Feet dark brown or black (Genus <i>Marmota</i>)..... | Woodchuck |
| Feet same color as fur on body..... | 24 |
| 24. Back tan or light brown color, hair lies close to body like that of a short haired dog | |
| (Genus <i>Cynomys</i>) | Prairie Dog |
| Back dark brown or gray, hair soft like fur | |
| (Genera <i>Citellus</i> , <i>Spermophilus</i> and allies) | Ground Squirrel |
| 25. Tail has definite brush or hair on tip | 26 |
| Tail without definite brush at tip (Genera <i>Zapus</i> and <i>Napeozapus</i>) | Jumping Mouse |
| 26. White markings on head (Genus <i>Dipodomys</i>) | Kangaroo Rat |
| No white markings on head (Genus <i>Perognathus</i>) | Pocket Mouse |

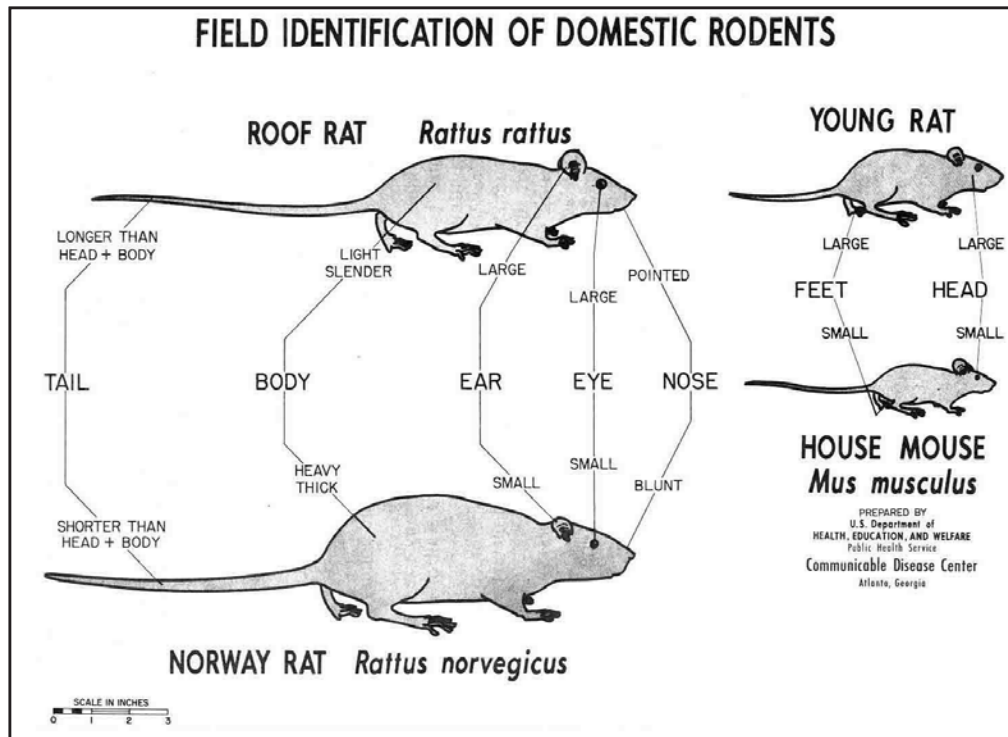
COMMENSAL RODENTS

The commensal rodents, the Norway rat, the roof rat, and the house mouse, are the most common pest rodents. The Norway rat is a large, stocky rat, as rats go. Typically weighing less than a pound, a mature Norway rat is 12-18 inches from the tip of the nose to the tip of the tail. Young rats are much smaller. Individual Norway rats vary greatly in color, but are usually in various shades of brown and gray.

The roof rat is sleeker; black or nearly black with a gray belly. While its length from the tip of its nose to the tip of its tail is similar to the Norway rat, the roof rat weighs much less, usually from a quarter-pound to a little over a half pound for a mature adult.

The small size of the house mouse often surprises people. An adult mouse usually weighs less than an ounce, and will measure about seven inches from the tip of its nose to the tip of its tail. Its color is variable and typically there is no significant color change between the back and the belly.

Young rats and mature house mice can be difficult to tell apart.





*The Norway rat, *Rattus norvegicus*, is the largest commensal rodent, weighing about 1 pound with an overall length of about 16 inches from the tip of the nose to the tip of the tail. Rat Fact: There are no giant, cat-sized “super-rats”!*

Norway Rat

The Norway rat, *Rattus norvegicus*, is a stocky burrowing rodent, introduced into North America by settlers who arrived on ships from Europe. First introduced into the United States around 1775, the Norway Rat has now spread throughout the contiguous 48 states. It is generally found at lower elevations but may occur wherever humans live.

Also called the brown rat, house rat, barn rat, gray rat, sewer rat, or wharf rat, the Norway rat is the largest commensal rodent. Adult Norway rats weigh an average of 1 pound, which is about twice as much as the roof rat. They are about 16 inches from the tip of the nose to the tip of the tail, or approximately 25% longer than the roof rat. Rat fur is coarse and usually brownish or reddish-gray above and whitish-gray on the belly. Darker, blackish individuals may occur in some locations.

A cunning and aggressive rodent, Norway rats have adapted to feeding on our food and garbage, and living right along with us in and around our homes, farms, and businesses. In urban or suburban areas, they live in and around residences, in attics, cellars, warehouses, stores, slaughterhouses, docks, and in sewers. On farms they may inhabit barns, granaries, livestock buildings, silos, and kennels.

Life History

Norway rats can breed year round, but they tend to have breeding peaks in the spring and fall. Breeding may stop in the hottest part of the summer and coldest part of the winter. Females come into heat only a day or two after birthing a litter, and again every four or five days.

The litter can consist of 6 to 12 young. Gestation in the female is 21 to 23 days. Young are weaned in 2 ½ to 3 weeks, and become completely independent in 3 to 4 weeks. They are sexually mature at 3 months.

A female Norway rat can theoretically give birth to over 40 young per year, but she typically will only successfully wean about 20. The potential development of a large and rapidly growing population from this animal is significant.

Key Points

Reproductive Potential

The Norway rat's high reproduction rate results from three key factors: young age when it first breeds, large average litter size, and a high number of litters per year.

1. Females can breed at 3 months.
2. Average litter size is 10 pups.
3. Females average 5 litters per year.

Given plenty of food, water, and shelter, Norway rat populations can grow rapidly. In such ideal conditions, a small family of rats can grow into hundreds in less than a year.

Rats live in colonies. When conditions are right, rats live in large, ever-growing colonies. Periodic food shortages, disturbances, or breeding site competition, causes groups of rats to leave their colony and seek new breeding and feeding sites. Norway rat populations can quickly rebound after a knock-down because of the rat's ability to quickly colonize a suitable site. A site with a recently exterminated rat population will immediately attract these new rats because of the rat odors, cached food, rat runs, and burrows and other old nest sites that remain from the previous inhabitants.

While Norway rats living in a lab cage may live three, four, or more years, rats living in the wild rarely die a natural death. Life is precarious from the very beginning, with newborn rats being eaten by older rats, and many dying even before they are weaned. Rats are also killed by snakes, owls, foxes, cats, pest control technicians, disease, or even stress. The average life expectancy for a Norway rat living in the wild is only one year or less.

Senses

Norway rats have poor vision, and can only see for a distance of 30 feet. They are nearly color-blind. Therefore, for safety reasons, rodenticide baits can be dyed distinctive colors without causing avoidance by rats, as long as the dye does not have an objectionable taste or odor. However, even with poor eyesight, Norway rats can detect motion and recognize simple shapes, even in low light.

Four other common senses are strongly developed in Norway rats: touch, smell, taste, and hearing. Rats use their keen sense of smell to locate food items and to recognize other rats. Their sense of taste is excellent, and can detect contaminants in their food at levels as low as 0.5 parts per million (0.0005%).

Rats also have a sense that we don't have, a strong kinesthetic sense. This sense is a memory of the movements required to run their territory. For example, a rat running a

Key Points

Kinesthetic Sense

Rats have a strong kinesthetic sense: a memory of the movements required to run their territory. In the dark or when frightened, rats use this sense to escape to bolt holes and runways.



Rats are very agile, with great balance. Much of their success as pests comes from their physical capabilities.

Key Points

Rat-Proofing

If a rat can get its head through an opening, it can get the rest of its body through the opening as well. A rat can squeeze through a slot 1/2-inch high and an inch or more wide.

A young rat can squeeze through an even smaller opening.

section of its territory will always take the same 10 steps out from the hole in the wall, turn right at the corner, jump to the shelf on the left, and run 5 steps to the hole in the cabinet. Every time it covers that territory, the muscle movements will be the same, at least until he encounters something new. In the dark or when frightened, rats use this sense to escape to bolt holes and runways.

Physical Capabilities

Norway rats are really remarkable athletes, and much of their success as pests comes from their physical capabilities. For one thing, rats are very agile, with great balance. This agility permits them to walk from building to building on telephone or power lines. They also can scramble up the outside of a pipe 3 inches in diameter, and straight up brick and stucco walls. In addition, they can walk a mooring line from a dock to a ship.

Like a cat, rats always land on their feet if they fall. They can descend head first down a tree or a wall, leap 3 feet straight up and 4 feet horizontally.

A rat can compress its body surprisingly flat. If a rat can get its head through an opening, it can get the rest of its body through the opening as well. The skull of a typical adult Norway rat is 1/2 inch high and 3/4 inch wide. So, in order to rat-proof a building, at a minimum seal all openings that are 1/2-inch wide or larger. Think of this opening as a slot that is 1/2-inch high and an inch or more wide, rather than a circular hole. Be aware that a young rat, not to mention a mouse, can squeeze through a smaller opening.

Rats are also at home in the water and frequently nest along the edges of streams, in marshy places, and near sewers. They can swim up to a half a mile in open water and can tread water for 3 days. A rat's ability to swim well should always be kept in mind. Rats enter sewers at outlets and through manholes, catch basins, broken pipes, or drains. They often use sewers as highways, allowing them to move from one area to another.

Key Points**Rat “Neophobia”**

Norway rats are usually “neophobic,” which is a fear of anything new. Most rats at first avoid new objects in their territory. They will avoid that object for a few days until they become used to it.

Behavior

It’s a rat’s nature to be secretive. Norway rats avoid people, travel in the shadows, and are most active at night, starting at dusk. As a result, most of their feeding occurs between sunset and midnight.

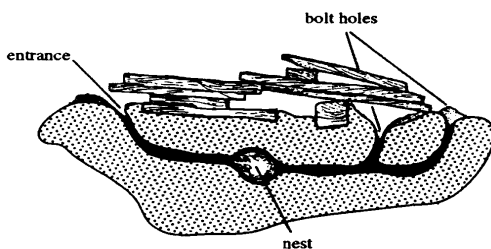
Norway rats build their nests under ground and in other out-of-the-way locations, and may live in sewers and tunnels. Their secretive nature helps Norway rats escape their enemies, such as snakes, owls, foxes, cats, and even people. They stay out of open areas and avoid light. Seeing Norway rats out in the open, or in bright light, is unusual because of their secretive behavior. When it happens, it often means a heavy infestation that is outgrowing its available nest sites or food supply.

Rats are also wary. Where mice tend to be extremely curious, investigating any new object in their territory, Norway rats do the opposite. They are usually “neophobic,” which is the fear of anything new. Most (although not all) rats will at first avoid new objects in their territory. They will avoid that object for a few days until they become used to it. Rats may also avoid new foods if they have been feeding on a particular food for some time.

Nesting Habits

Norway rats will nest wherever they can find safe protected sites near food and water. Their nests can be located outdoors or indoors. When nesting outdoors, Norway rats usually nest in burrows dug into the ground. The burrows are rarely more than 18 inches down and usually less than 3 feet long, but can be quite deep in order to get under foundations. Burrows are often dug under rocks, concrete slabs, or other heavy objects, or in thick ground vegetation. Sometimes, the rats simply nest in preexisting holes or eroded areas under slabs, walls, and similar areas. Burrow openings are 2 to 4 inches in diameter, and often have freshly excavated dirt around the opening.

Norway rat burrows have a central nest area with extra bolt holes for escape. The secondary bolt holes may be hidden under objects or lightly plugged with dirt.



Norway rat burrows have a central nest area with extra bolt holes for escape. (Graphic modified from Prevention and Control of Wildlife Damage)

Outdoor nests of Norway rats are not limited to burrows. They may nest in sewers, holes in walls, under dumpsters, in old cars, inside abandoned furniture and equipment, and in other protected sites. Inside, they usually nest in existing voids, underneath equipment or pallets, or in heavy clutter, and usually on lower levels of a structure.

Food Habits

Norway rats will eat nearly any type of food. When given a choice, they select a nutritionally balanced diet, choosing fresh, wholesome items often high in protein over stale or contaminated foods. They prefer cereal grains, meats and fish, nuts, pet foods and some types of fruit. Rats require $\frac{1}{2}$ to 1 ounce of water daily when feeding on dry foods, but need less when moist foods are available. Food items found in household garbage offer a fairly balanced diet and also satisfy their moisture needs.

Home Range

Norway rats commonly travel 100 feet from their nest looking for food and water and checking their territory. If food is close by, their foraging range is shorter. If they have to, they will travel several hundred feet to find food. As a general rule, though, think of the Norway rat's average nightly foraging range as being about 100 feet. The Norway rat travels back and forth along ledges, wall/floor junctions, pipes, and other construction elements that are mostly straight, or natural runways.

Key Points

Norway Rat Home Range

Norway rats commonly travel 100 feet from their nest looking for food and water. They travel along ledges, wall/floor junctions, pipes, and other construction elements that are mostly straight, or natural runways.

Roof Rat

The roof rat, *Rattus rattus*, is native to southeast Asia, but has become a major rodent pest around the world. In the United States, it is a major pest in coastal cities and seaports. Roof rats were common on early sailing ships and apparently arrived in North America via that route. The roof rat is also called the ship rat or the black rat.

The roof rat is rare in Maryland, only occasionally appearing in Baltimore and other commercial harbor areas. (Photo CDC)



Key Points

Roof Rat Facts

- Excellent climbers and jumpers.
- Nest in tree tops, in vines covering building walls, on fences covered with vegetation.
- Prefer fruits, berries, vegetables, seeds and nuts.
- Commonly forage 300 feet from nest.

This rat is rare in Maryland, although significant populations occur just to the south in Norfolk, Virginia. Occasional infestations of roof rats may be introduced into Baltimore and other commercial harbor areas, which is why technicians in Maryland should become familiar with this rat.

The roof rat has much in common with its cousin, the Norway rat. But differences in the biology and behavior can make the roof rat the more difficult rat to control. Rather than repeat common information from the previous section, this section will simply highlight the differences between roof rats and Norway rats.

Life History

The natural reproductive rate of roof rats is slightly less than that of Norway rats because roof rats have fewer litters per year (3-4) and fewer pups (average 6) per litter. Still, roof rat populations can grow rapidly under good conditions.

Senses

A roof rat's senses are equal to or sometimes slightly better than a Norway rat's.

Physical Capabilities

Roof rats aren't as good at digging or swimming as Norway rats, nor do they gnaw as much. But they excel in agility. Their long tails give them great balance, and they are excellent climbers and jumpers. They easily walk between buildings on telephone or power lines. They can scramble up the outside of a pipe 3 inches in diameter, and straight up brick and stucco walls. They move quickly through thick vegetation, even high up in trees. Roof rats can quickly scramble up a mooring line from a dock to a ship, or visa versa.

Behavior

Roof rats have behaviors very similar to Norway rats as far as being secretive, wary, and fearful of new objects in their territories (neophobia).

Nesting Habits

Roof rats always nest in hidden, hard to reach areas. They'll nest outdoors or indoors but, as a rule, nests tend to be up off of the ground, and sometimes quite high. Roof rats nest in tree tops, in vines covering building walls, and on fences covered with lush vegetation. In fact, overgrown landscaping of any sort is a good location for roof rat nesting. Older neighborhoods with lots of shade trees and thick landscape vegetation provide nearly unlimited nest sites for roof rats. These rats frequently enter buildings from the roof area or from accesses near overhead utility lines.

However, roof rats will nest outdoors in sites other than trees and thick vegetation. They nest off the ground in woodpiles, yard debris, equipment, and in attic areas of sheds and other outbuildings. Roof rats will even dig and nest in burrows if their typical nest sites are unavailable. They will burrow under a bush or other shrubbery, if possible.



Roof rats often enter buildings through openings at or near the roof. (Photo L. Pinto)

They often are found living on the second floor, or attics in buildings that may have Norway rats occupying the first or basement floor. Indoor nests are more likely to be found overhead than underfoot. Prime sites include attics, ceiling and wall voids, behind soffits, in pipe chases, on top of equipment, top levels of stacked, palletted materials, and on the upper surfaces of structural roof and ceiling beams. Roof rats can be found on any floor of high-rise buildings, even on top of silos. Structural nests will be lined with whatever is available to the rat, including insulation, foam padding, cloth, string, or paper.

Food Habits

The food habits of roof rats living outdoors resemble those of tree squirrels, in some respects, since they prefer a wide variety of fruits, vegetables, berries, seeds and nuts. They also feed on blossoms, slugs, and cockroaches.

Typical Roof Rat Runways

- Pipes and conduits
- Rafters, joists, and beams
- Wires and cables
- Ledges
- Tops of boxes and equipment
- Gutters
- Conveyors, elevators, augers
- Fences
- Tree branches

Like Norway rats, they are omnivorous and, if necessary, will feed on almost anything. In food-processing and storage facilities, they will feed on nearly all food items, though their food preferences may differ from those of Norway rats. They do well on feed provided for animals such as swine, dairy cows, and chickens, as well as on dog and cat food. There is often a correlation between rat problems and the keeping of dogs, especially where dogs are fed outdoors. Roof rats usually require water daily, though their local diet may provide an adequate amount if it is high in water content.

Home Range

Roof rats, as a rule, travel farther than Norway rats on their nightly excursions looking for food and water. They use the same travel paths, or runways, over and over when traveling from nest to feeding area, or from one feeding area to another. Those runways will be up off the ground, sometimes very high off the ground. They commonly travel 300 feet from their nest. If food is close by, their foraging range is shorter. If they have to, they will travel farther. As a general rule, though, think of the roof rat's average nightly foraging range as being about 300 feet.

House Mouse

The house mouse, *Mus musculus*, is a small, slender rodent that has a slightly pointed nose; small, black, somewhat protruding eyes; large, sparsely haired ears; and a nearly hairless tail with obvious scale rings. Do not confuse this animal with the timid "mousy" creature of cartoons. The house mouse is aggressive and surprisingly tough and adaptable. House mice have been found living in coal mines in England, in the Andes mountains at 15,000 feet, in the deserts of South America, and on an island near Antarctica. The house mouse, in fact, is the most troublesome and economically important of all vertebrate pests. It is much more common in residences and commercial structures than is any rat.

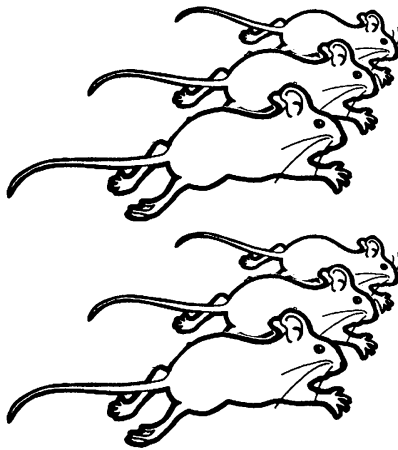


The house mouse is the most troublesome and economically important vertebrate pest—much more common in residences and commercial structures than is any rat.

House mice live in and around homes, farms, commercial establishments, and in open fields and agricultural lands. At times they may be found living far from human settlements, particularly where climates are moderate. The onset of cold

Key Points**House Mouse Breeding**

Mouse populations grow rapidly under good conditions. A female mouse may have 5 to 10 litters per year, and produce 50 young a year. Since these young mature in as little as 6 weeks, all of a female mouse's children, grandchildren, great grandchildren and great, great grandchildren can have young in the same year!



weather each fall in temperate regions may cause mice to move into structures in search of shelter and food.

Life History

Mice may breed year round, but when living outdoors, they breed mostly in spring and fall. Litters of 5 or 6 young are born 19 to 21 days after mating, although females that conceive while still nursing may have a slightly longer gestation period. A female house mouse is ready to mate again in just two days after the birth of young. A female may have 5 to 10 litters per year (up to 50 young a year).

Mice are born hairless and with their eyes closed. They grow rapidly, and after 2 weeks are covered with hair and their eyes and ears are open. At three weeks of age they begin to make short excursions from the nest and eat solid food. Weaning soon follows, and mice are sexually mature at 6 to 10 weeks of age. All of a female mouse's children, grandchildren, great grandchildren and great, great grandchildren can have young in the same year!

Mouse populations grow rapidly under good conditions, although breeding and survival of young decline markedly when population densities become high, despite the presence of excess food and water. The average life expectancy for a house mouse living in the wild is less than one year.

Senses

Mice are near-sighted, with poor depth perception. They are nearly color-blind, but their eyes are sensitive to light. In bright light they can detect motion up to 45 feet away, and can recognize simple shapes. However, in the low-light conditions under which mice live, they generally must be very close before they can recognize things by sight, perhaps as close as 1-2 feet.

As with rats, the five other senses are strongly developed in house mice: touch, smell, taste, hearing, and the kinesthetic sense. Their kinesthetic sense is stronger than that of most rodents. Every time a mouse runs his territory, his muscle movements will repeat the same patterns. This internal sequence is so programmed that a mouse will, at first, jump over an obstacle even after it has been removed. In the dark or when

frightened, house mice use their kinesthetic sense to quickly escape to protected areas.

Physical Capabilities

Mice have extraordinary physical abilities. They can jump from the floor 12 inches high to reach another surface, and they can jump down to the floor from a height of 8 feet. They can run up almost any vertical surface if it is rough, and have excellent balance. If they do fall, they land on their feet. They can climb and run along pipes, cables, and electrical lines. In addition, they can travel for a considerable distance upside down, and they can swim. House mice can adapt to almost any kind of environmental conditions, even surviving for generations in a frozen meat locker.

The small body size of the house mouse allows it to easily stow away and be transported to new sites. If a mouse can get its head through an opening, it can squeeze the rest of its body through as well. Therefore, a mouse can squeeze through a slot-like opening that is little more than 1/4-inch high. These abilities allow mice to easily move into a building and then move from floor to floor and from one room to another. This is why it is difficult to completely mouse-proof a building.

Behavior

House mice are secretive. They avoid people, travel in the shadows, and are most active at night. However, at some locations, considerable daytime activity may be seen. When traveling, mice favor dark corners and shadowy runways. They build their nests in out-of-the-way locations, and scurry in the shadows. They live and breed in little nooks inside homes, food facilities, granaries, attics, and in food packages, and even in our very beds, furniture, stoves and other appliances. Although mice can, and will, live most intimately with people, the general public often doesn't even know they are present.

The secretive nature of house mice often results in technicians seriously underestimating the size of the mouse population that they are dealing with. Under-estimating the size of the population is the major reason for mouse control failure

Key Points

House Mouse Behavior

Critical facts to keep in mind about house mouse behavior:

- House mice are secretive and favor dark corners and shadowy runways.
- Mice are extremely curious, and will investigate any new items or changes in their environment.

Where rats are generally wary of new objects (neophobic), mice tend to be extremely curious, and will investigate any new items or changes in their environment. (Moving boxes, pallets, furniture, and materials on shelves, or caulking or sealing holes and cracks, will increase the effectiveness of traps and baits as mice in the area investigate the changes to their habitat.) .

Nesting Habits

House mice nest in dark, sheltered locations. Indoors, mice nest inside walls and voids (including ceiling voids), under stoves and refrigerators, inside equipment, in boxes, behind kickplates, in clutter and debris, inside furniture and drawers, and in wire chases. Outdoors, mice nest in burrows, hollows of trees and logs, and in brush and debris piles.

Mice shred paper, cloth, plastic, burlap, string, insulation, plants, any soft material to make a nest. The nest is usually about four inches across. If there is plenty of nest material available, the female will assemble it into a loose, fibrous ball. If there is a shortage of nest material, the finished nest may consist of only a few pieces. Mouse nests often contain bits and pieces of hoarded food as well.

Key Points

House Mice Are Nibblers

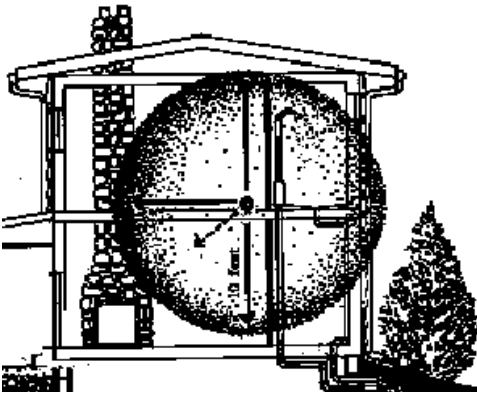
- A house mouse may feed 20 or more times a night at multiple sites.
- They are difficult to control with baits since they may not ingest enough bait at any one placement to kill them.
- House mice also hide or cache food to feed on later.

Food Habits

House mice eat many types of food, but prefer seeds and grain. Mice are rarely restricted by food or water since they feed on a wide variety of food and are not hesitant about trying something new, such as bacon, chocolate candies, butter, and nutmeats.

They do not need very much food to survive. A mouse eats an average of 1/10 ounce of dry food a day. Mice are nibblers, feeding 20 or more times a night at multiple sites. This feeding habit makes them difficult to control with baits since they may not ingest enough bait at any one placement to kill them. Multiple bait placements are essential. Mice also hide or cache food to feed on later, so even if a food source is eliminated, there may be plenty of food hidden away.

House mice can survive with little or no free water, although they readily drink water when it is available. They ob-



*When you find evidence of mice feeding, imagine a 3-dimensional sphere radiating out 10 to 20 feet in each direction from the food source in the center.
(Graphic by Pinto & Associates)*

tain their water from the food they eat. An absence of liquid water or food of adequate moisture content in their environment may reduce their breeding potential.

Home Range

Mice are very territorial. They seldom travel more than 30 feet from their nest. A mouse commonly lives its life within a twenty-foot radius of its nest. Male mice tend to travel in a slightly larger area than female mice.

If mice are infesting a building, don't think of the infestation as one colony (as you might with rats), think of it as consisting of many small colonies, each of which you must control separately. Baits, traps, and other control actions in the territory of one mouse colony will not affect other colonies. Also, remember that mice travel in three dimensions, not just along the floor. Visualize a mouse's potential territory as a three-dimensional sphere with a 10 to 20-foot radius; a sphere that might include the floors above and below and adjacent rooms.

OTHER STRUCTURE-INFESTING RODENTS

Other rodents may become pests of structures besides the three commensal rodents. The most common culprits in Maryland are the deer mouse, white-footed mouse, and tree squirrel. The deer mouse and the white-footed mouse are very similar in appearance, biology, and habits and will be addressed together.



We've heard much more about deer mice (pictured above) and white-footed mice in the last few years because of their connection with hantavirus, which can be a deadly disease. (Photo CDC)

Deer Mouse and White-Footed Mouse

Deer mice and white-footed mice are closely-related to each other, and are alike in appearance, biology, and behavior. Both mice are native to North America. We've heard much more about these mice in the last few years because of their connection with hantavirus, which can be a deadly disease. Hantavirus is spread when people inhale airborne dust particles that are contaminated with mouse urine, droppings, or saliva (see Chapter 1).

While the house mouse occupies urban areas, the deer mouse is more common in rural or semi-rural areas. The deer mouse, *Peromyscus maniculatus*, is in a completely different family than the house mouse. It's called a deer mouse because the color of its body resembles that of a deer -- grayish buff to deep brown on top with a white belly and white feet. The white-footed mouse, *Peromyscus leucopus*, is a very close relative of the deer mouse and looks similar. The white-footed mouse is found throughout Maryland, the deer mouse is mostly restricted to central, northern, and western Maryland.

The deer mouse and the white-footed mouse are roughly the same size as the house mouse, averaging 6 inches (155 mm) in length (including tail) and weighing 1/2 to 1-1/4 ounces.

Most people consider these native mice to be "cuter" than the house mouse because of the proportionally larger eyes, large, white feet, a hairy, two-toned tail, a brown back and a white belly. Besides the white belly, another way to tell these mice from the house mouse is that the tails of the native mice are covered with short fur while the house mouse has a mostly naked tail. Also, like their bodies, the native mice's tails are dark above and white below.

Life History

Breeding is seasonal, usually with two peaks, one in spring and the other in late summer or early fall. Breeding usually stops in summer and winter.

Deer mice and white-footed mice do not hibernate. They remain active and feed all year. But as winter approaches, they may try to get into homes, garages, out-buildings, unoccupied cabins, attics, and other structural sites. They often bring in their own food supply to tide them over.

These mice are less prolific than house mice. Female deer mice and white-footed mice give birth 3-4 weeks after mating, and can become pregnant again shortly after giving birth. The size of the litter is quite variable, ranging from 2 up to 11 young, depending on the size and age of the mouse, the availability of its food, and the climate. For purposes of compari-

Key Points

Seasonal Activity

As winter approaches, deer mice and white-footed mice may try to get into homes, garages, out-buildings, unoccupied cabins, attics, and other structural sites. They often bring in their own food supply to tide them over.

son, the average litter size is probably about 5, and the average number of litters per year is between 2 and 4.

The young are weaned in about a month. At that time they become independent, and usually quickly leave the nest to start families of their own. Many animals feed on these mice, especially the young ones. Although in a lab these mice may live 8 years, in nature they rarely live out a year. Because of the high predation rate on the young mice, a female will only raise about 10 young per year to breeding age.

Senses

In contrast to house mice, deer mice and white-footed mice have good vision. Both have large eyes well adapted to night vision, and for spotting and escaping from night predators. However, they do not see colors well. Deer mice and white-footed mice communicate with each other visually by posturing and with other visual signals.

Touch is also important. Long whiskers and guard hairs are sensitive, and the mice use them to guide their movements along edges.

Deer mice and white-footed mice have a highly developed and sensitive sense of smell. These mice also have good hearing, which they use to avoid predators. Both species drum with their front feet to create a warning signal for other mice.

Physical Capabilities

As with house mice, the small size of deer and white-footed mice permits them to get into and move through buildings. If one of these mice can get a head through an opening, it can get the rest of his body through as well, typically any slot 1/4-inch wide or larger.

Both deer mice and white-footed mice are good climbers. While deer mice in nature spend most of their lives on the ground, they can still effortlessly scamper up a tree, a pole, or the wall of a house. The white-footed mouse is even more adapted to climbing and, when living in forests or well-landscaped properties, will live a large portion of its life in trees.

Other physical capabilities of these mice are on par with house mice.

Key Points

Climbing Ability

While deer mice in nature spend most of their lives on the ground, they can still effortlessly scamper up a tree, a pole, or the wall of a house. The white-footed mouse is even more adapted to climbing and, when living in forests or well-landscaped properties, lives a large portion of its life up in trees.

Outdoor Nest Sites

Outdoor nest sites of deer mice and white-footed mice include:

- Underground in cavities below tree or shrub roots
- Old fence posts, logs, stumps
- Burrows made by other animals
- Beneath decks, under sheds and other out-buildings
- Abandoned nests of birds and squirrels

Key Points

The Importance of Caches

Both deer mice and white-footed mice store or “cache” large amounts of food near their nests. When they move into buildings, they often store seeds and nuts in hidden places. Food caches can become infested with stored product pests.

Behavior

Similar to house mice, these mice are secretive. They avoid people, travel in the shadows, and are most active at night. They build their nests in out-of-the-way locations, and scurry in the dark. Like house mice, they are also curious, and will investigate each change or any new object in their territories, rather than avoiding them as is the case with rats.

Nesting Habits

Deer mice and white-footed mice nest mostly outdoors around the roots of trees, under boards or logs, in tree stumps, sheds, garages, abandoned vehicles, farm equipment, wood piles, or in squirrel or bird nests, which they often cover with twigs to make an enclosed ball-like nest.

Inside of structures, these mice nest in most of the same sites as house mice do. Their nests can be over a foot in diameter and are lined with shredded paper, insulation, or cloth. They often nest in unused stuffed furniture or in cabinets, boxes, or equipment. A favorite indoor nest site for deer and white-footed mice is on top of the sill plate in the basement or crawlspace, particularly in the corners.

Deer mice and white-footed mice urinate and defecate directly in their nests. After a few weeks, the nests become foul, and the female moves on to a new nest. This nest fouling is important because long term nesting areas can become noticeably foul smelling. Also, as the mice continuously build new nests, an area can become full of nests and with the damage associated with nest building. For example, stuffing pulled from furniture, or stored papers shredded for lining the nest.

Food Habits

Both of these native mice will eat both vegetable and animal foods. Their primary food tends to be seeds of all kinds, both in nature, and from bird feeders and stored seeds. However, seeds are only one part of the diet of deer mice and white-footed mice. They also feed on fruits, flowers, nuts, acorns, mushrooms and other fungi, grains, berries, and some green vegetation.

Deer mice and white-footed mice are also meat eaters and will feed on insects, including many pest insects, other invertebrates such as worms, spiders, snails, slugs, as well as dead mice and birds. They sometimes even eat their own feces.

Both deer mice and white-footed mice store or “cache” large amounts of food near their nests. Most of these caches are made in the fall when seeds and nuts are abundant. They carry their food to their caches in their cheek pouches. When they move into buildings, they often carry in seeds and nuts and store them in hidden places. Sometimes they abandon these food caches which can become infested with stored product pests.

Home Range

The deer mouse occupies nearly every type of habitat within its range, forests to grasslands. The white-footed mouse prefers wooded or brushy areas. It is sometimes found in open areas. These mice have home ranges from 1/3 to 4 acres.

Tree Squirrels



*Tree squirrels, such as this eastern gray squirrel, are arboreal, meaning they live in trees and depend on them for survival.
(Photo USDA-APHIS)*

Tree squirrels belong to the rodent family Sciuridae, which includes a wide variety of other animals including woodchucks, chipmunks, ground squirrels, and prairie dogs. Tree squirrels are arboreal, meaning they live in trees and depend on them for survival. There are a number of tree squirrels common to the Maryland area. The eastern gray squirrel, (*Sciurus carolinensis*), and the northern and southern flying squirrels (*Glaucomys volans* and *G. sabrinus*). In addition, there is some overlap in the Western Maryland area with the red squirrel (*Tamiasciurus hudsonicus*). Other tree squirrels occur in Maryland but are not common, including the Delmarva fox squirrel, which is considered endangered.

Eastern gray squirrels are variable in color. Some have a distinct reddish cast to their gray coat. Some individual squirrels are primarily black and some populations have a high percentage of these black squirrels. Eastern gray squirrels measure 16 to 20 inches. They can weigh from 1-1/4 pounds to 1-3/4 pounds.

The red squirrel is smaller, 10 to 15 inches in total length and weighs 1/3 to 2/3 of a pound. Red squirrels are red above with white underparts. They have ear tufts and usually a black line separating the dark upper color from the light belly.

The two species of flying squirrels are small animals. They are the only fully nocturnal squirrels, first appearing at late dusk. The southern flying squirrel is 8 to 10 inches in length and the northern cousin about 2 inches longer. They both can both be colored in various shades of gray or brown with lighter bellies. The most distinguishing feature of these squirrels is the broad webs of skin that connect the fore and hind legs. They also have a flattened tail.

Gray squirrels inhabit wooded areas and are very often found in urban areas. Red squirrels prefer coniferous forests and flying squirrels live in deciduous forests.

Tree squirrels become pests of structures mostly by trying to find or gnaw their way inside attics and other voids to nest. In residential areas, squirrels sometimes travel powerlines and short out transformers. Flying squirrels can also be found in urban areas and can get into structures. All of these squirrels can become pests at bird feeders.



Flying squirrels have 2 litters per year with 2-6 in each litter after a gestation period of 40 days. Mainly a forest dweller, flying squirrels can also be found in urban areas and can get into structures. They can live up to 13 years.

(Graphic from USFWS)

Life History

Eastern gray squirrels breed in mid-December or early January and again in June. Young squirrels may breed only once in their first year. The gestation period averages 44 days. The average litter size is 3 young but can range from 3-5. Young begin to explore outside the nest about the time they are weaned at 10 to 12 weeks.

Red squirrels may have 1 or 2 litters per year with 4-7 young in each litter after a gestation period of 35 days. Weaning occurs after 7-8 weeks.

Flying squirrels have 2 litters per year with 2-6 in each litter after a gestation period of 40 days. Weaning occurs after 6-8 weeks. Maximum recorded life spans (in captivity):

- Eastern gray squirrels, 15 years;
- Red squirrels, 10 years;
- Flying squirrels, 13 years.

Nesting Habits

Eastern gray squirrels nest in tree cavities, in leaf nests, and sometimes in attics. Leaf nests are constructed with a frame of sticks filled with dry leaves and can also be lined with strips of bark, corn husks, or other materials. Red squirrels nest in tree cavities or outside in branches in a nest made of leaves, twigs, and shredded bark. Flying squirrels nest in old woodpecker holes or make nests of leaves, twigs, and bark, and may also nest in attics.



*Eastern gray squirrels have a home range of 2-7 acres.
(Photo L. Pinto)*

Food Habits

Eastern gray squirrels eat wild tree fruits and nuts in fall, with acorns, hickory nuts, walnuts, and osage orange fruits being favorite fall foods. Nuts are often cached for later use. They also eat tree buds in spring and in summer they eat fruits, berries, and succulent plant materials. When food is scarce, squirrels may chew bark from a variety of trees. They will also eat insects and other animal matter. Red squirrels eat conifer seeds and most of the foods listed above. Flying squirrels feed on seeds, nuts, insects, bird eggs, and meat.

Home range

Home ranges of the various tree squirrels are as follows:

- Eastern gray squirrel, 2-7 acres;
- Red squirrel, less than 200 yards in diameter
- Flying squirrel, about 4 acres.

REVIEW QUIZ

- Which key tail characteristics distinguishes the deer mouse from the house mouse?
 - deer mouse tail is dark above, light below
 - deer mouse has a naked tail
 - deer mouse tail shorter than one-half body length
 - deer mouse tail is flat in cross-section
- Compared to the roof rat, the Norway rat has:
 - a longer tail.
 - a more blunt nose.
 - larger ears.
 - larger eyes.
- Compared to a young rat, the house mouse has:
 - a more blunt nose.
 - larger feet.
 - a smaller head.
 - smaller ears.
- Seeing rats during daylight hours usually means:
 - that is their normal activity time.
 - food is plentiful.
 - there is a high population present.
 - it is their breeding season.
- An adult Norway rat weighs, on average, about:
 - 1/2 pound.
 - 1 pound.
 - 1-1/2 pounds.
 - 2 pounds.
- What is the main characteristic that distinguishes rodents from other similar mammals?
 - belly lighter in color
 - tail shorter than body
 - webbing between toes
 - two pairs of incisor teeth
- The Norway rat is also commonly known as the:
 - brown rat.
 - roof rat.
 - cotton rat.
 - deer rat.
- The Norway rat is found only in what part of the United States?
 - the eastern half of the U.S.
 - only in Maryland, Virginia, Delaware
 - southeastern U.S.
 - the entire continental U.S.
- Which one of these is the most likely place to find a Norway rat nest?
 - in branches of a tree
 - in a building's attic
 - under a concrete slab
 - in a bedroom closet
- The scientific name for the roof rat is:
 - Rattus norvegicus*.
 - Mus musculus*.
 - Rattus rattus*.
 - Peromyscus maniculatus*.

11. Which one of these statements best characterizes the eating habits of house mice?
 - a. they are nibblers, sampling many foods
 - b. they avoid new foods in their environment
 - c. they will eat their fill at only one location
 - d. they eat only seeds, nuts, and grains
12. Which one of these is the primary food of the deer mouse?
 - a. fruit
 - b. seeds
 - c. insects
 - d. fats
13. During its daily travels, a house mouse usually covers an area that is:
 - a. 5 to 10 feet in diameter.
 - b. 10 to 30 feet in diameter.
 - c. 30 to 50 feet in diameter.
 - d. 50 to 75 feet in diameter.
14. Tree squirrels are “arboreal” which means:
 - a. they live in ground burrows.
 - b. they feed on garbage.
 - c. they invade bird feeders.
 - d. they nest in trees and feed on nuts.

CHAPTER THREE

Inspections and Monitoring

Learning Objectives

- *List and describe the primary goals of a rodent inspection.*
- *Identify the characteristics of a rodent infestation that should be assessed during an inspection.*
- *Identify locations where Norway rat burrows are most likely to be found.*
- *Define “conducive conditions” and recognize the reasons why these conditions need to be identified during inspections.*
- *List and describe the signs of rodent infestations.*
- *Identify basic inspection tools for rodent inspections.*
- *Identify ways to determine if a rodent infestation is active or old.*
- *Recognize the primary reason for using a UV light during a rodent inspection.*
- *Identify correct procedures for using tracking patches.*
- *List examples of critical inspection areas indoors and outside.*
- *List and describe 4 special tools or techniques for rodent inspections.*

You can go out on a rodent job armed with the best rodenticides, a wide variety of traps, good educational handouts, and an arsenal of special tools. But if you don't conduct an effective inspection, you simply won't have the information you need to succeed.

What Is Your Role?

How do you see your role when controlling rodents? You shouldn't be only a "servicer" of stations and traps. Your job is also to gather information about rodents and about conditions at the job site.

PRIMARY INSPECTION GOALS

Good inspections pay big dividends in the success of your rodent programs. You should have a series of goals when conducting an inspection for rodents:

Your first goal is to assess the rodent infestation:

- What kind (or kinds) of rodent is causing the problem?
- Is the infestation active or inactive?
- Where is the infestation located?
- What's the size of the population?

You will also need to identify conducive conditions. Conducive conditions are things that could be contributing to rodent problems, including such things as:

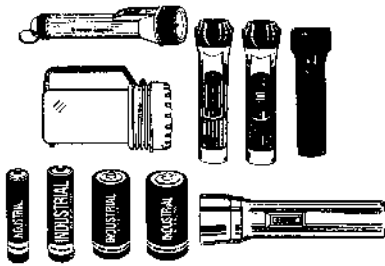
- Poor trash handling practices
- Openings for rodent entry
- Spilled food
- Piles of debris

Another goal is to identify service constraints and plan the service.

- What are the best ways to service this account to eliminate the rodent infestation?
- How can you prevent future infestations?
- What must you do to avoid hazards to people and other animals?

INSPECTION AND MONITORING TOOLS

Would you want your auto mechanic to inspect your vehicle without tools? Of course not. Likewise, a set of basic inspection tools greatly improves your effectiveness when inspecting for rodents.



The single most important inspection tool is your flashlight. Carry extra bulbs and extra replacement batteries. Also carry a small AA battery-powered flashlight or similar flashlight as a back-up.

Your single most important inspection tool is the flashlight. A wide variety of flashlights are available, and the technology is improving all the time. Flashlights for rodent work need to be tough and powerful, whether powered by standard or rechargeable batteries. A good feature to have is adjustable focus.

Don't use inexpensive homeowner flashlights. Their light is weak and they don't hold up under constant use. Some food plants require flashlights that are explosion-proof and shatter-proof. A belt holder reduces the risk that you will leave your flashlight behind.

Carry extra bulbs, and extra replacement batteries. In fact, it's a good idea to carry a small AA battery-powered flashlight or similar flashlight as a back-up.

In addition, there is a wide range of tools that are also used on a regular or occasional basis when conducting rodent inspections. Besides that ever-important flashlight, items that also should be considered as part of a basic inspection kit for rodents are listed below:

- A compact tool kit. It should include screwdrivers, nut drivers, and a knife to give you access to equipment, vents, and access panels in order to find droppings, nests and other evidence of rodents during your inspections.
- Kneepads. The pads reduce pressure on the knees when you have to crawl in crawlspaces, in attics, and under equipment. They make your inspections more efficient by enabling you to crawl without pain, discomfort or inflammation.
- Tracking patch material. Talcum powder or other inert powders are sprinkled lightly on flat surfaces to make tracking patches, which confirm rodent activity by providing clear tracks as rodents walk through the powder.
- Ladder. You should keep a ladder available on your vehicle, and be sure to use it to inspect inside suspended ceilings, attics without a built-in access, and on top of certain roofs.

Other Useful Rodent Inspection Tools

The basic tools for a professional rodent inspection help you access critical areas and find evidence of rodent infestations. But you may need to use other tools, depending on the site.

- Mechanic's mirror. A mirror with a telescoping handle lets you see behind and around equipment, and inside hidden areas.
- Digital camera. You can document conducive conditions with a digital camera, and compare before and after photos of evidence.
- Sound detector. You can listen for rodents inside walls with a stethoscope or electronic sound detector.

WHAT TO LOOK FOR

Earlier, we discussed the goals you should keep in mind when conducting an inspection for rodents (see review chart below). This section addresses the specific things you need to look for in order to meet these goals.

Rodent Activity

The accuracy of your assessment rests on your skill in evaluating rodent signs, things such as burrows, droppings, and gnawing damage.

Naturally, the first thing is to determine what species of rodent is infesting the account: Norway rats, house mice, deer mice? Also, is there more than one species present? It is

Review: Goals When Inspecting for Rodents

Good inspections require that you meet certain goals.

- Assess the rodent infestation. Is it active or inactive? Where is it located? What kind of rodent is it, and what's the size of the population? These are only a few questions that you need to answer.
- Identify conducive conditions. What conditions could be contributing to rodent problems, including such things as poor trash handling practices, openings for rodent entry, spilled food, or piles of debris.
- Plan service visits and identify service constraints. What's the best way to service this account in order to eliminate the rodent infestation and to prevent future infestations, while avoiding hazards to people and other animals and in dealing with other service constraints.

not uncommon to have both rats and mice at an account, or more than one species of both.

In rare cases, especially when rodent numbers are low and you can't find enough clear signs to make an identification, you may need to set traps and capture rodents in order to get a confirmed ID.

Rodent Droppings

Droppings (fecal pellets) are a key indicator of rodent activity, and probably your most useful indicator. Droppings can be used in many ways: their size and shape shows the kinds of rodents present at an account, their location helps pinpoint infested areas, their abundance helps estimate population size, and their color helps to determine what they are feeding on.

If you see only a few fresh pellets, it suggests that a single mouse or rat has been in the area. If you see large numbers of pellets of varying sizes, it is a good bet that there is a breeding population of rats or mice in the account. A single rat may produce up to 75 droppings daily, while a mouse may produce up to 100 droppings.

Roof rat droppings are generally smaller (up to one-half inch) than a Norway rat's (up to three-quarter inch). Roof rat droppings tend to be pointed at both ends and curved while Norway rat droppings usually have one end blunt and are mostly straight. Mouse pellets are much smaller: 1/8-1/4 inch in length. Deer mouse, white-footed mouse, and house mouse pellets look very much alike.

Squirrel droppings are slightly larger than rat droppings, up to one inch long, blunt, and are sometimes twisted in the middle so one dropping can appear like two connected together. Sometimes, squirrel droppings will look more or less like connected, round pellets.

However, telling rodents apart by their droppings isn't always easy, since the droppings vary with the rodent's diet and age. Very young rats, for example, produce droppings similar in size to those of mature mice.

Heavily used runways will have droppings scattered along their entire length. However, the highest number of droppings will be found in locations where rodents rest or feed.

Comparison of Rodent Droppings (Feces)



Top to bottom: Norway rat, roof rat, house mouse.
(Droppings are approximately 2x their actual size:)

Squirrel droppings below are not to same scale, and are approximately life-sized.





Norway rat burrows may be found singly or in groups, such as these along a school foundation wall.
(Photo L. Pinto)

Fresh droppings are soft, putty-like, and moist, but harden and dry out after a few hours or days. After a few weeks, the droppings become gray, dusty looking, and crumble easily. Note that sometimes old droppings moistened by rain may look like new droppings, by becoming black and shiny. However, if you crush them in your fingers they will crumble and won't feel like soft putty.

Burrows

Norway rats are the rodents most often responsible for any burrows you find, although roof rats and deer mice will sometimes burrow around buildings..

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

Where to Find Rat Burrows

- At the edge of a concrete dumpster pad
- Along stone walls and fences
- Under sheds, dog houses, kennel slabs
- Beneath dense ground covers and shrubs near foundation walls
- Above sewer line breaks or near cleanouts
- In dirt crawlspaces and dirt floor basements
- Under brush piles and wood piles, especially near bird feeders
- Along creeks and river banks, and near railroad tracks

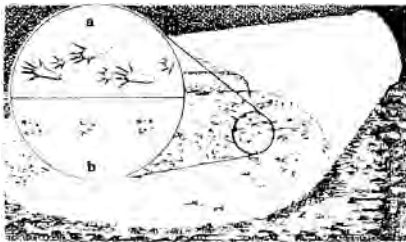
Gnawing Damage

Rodents like to gnaw on wood items such as floor joists, ceiling joists, door corners, kitchen cabinets, and around pipes found in floors and walls. They will also gnaw on electrical wires and cables. Mice commonly gnaw on food packaging, which is not only to feed but often times is simply to satisfy their need to gnaw.

The size of the gnawing damage can tell you who did the gnawing, with roughly 1/16 inch space between tooth marks

for mice and 1/8 inch for rats. This is also a good identifier for feeding marks found on rodenticide blocks or on nontoxic monitoring blocks. Gnawed holes may be 2 inches or more in diameter for rats, and are often nearly as large for mice. However, the edges of the holes gnawed by mice tend to be smoother than those gnawed by rats.

Gnawing damage on soffits, siding, and exterior trim can be made by squirrels as well as rats.



A rat's foot print (a) is about 3/4 of an inch long, and may show four or five toes. Mouse tracks (b) are much smaller, usually less than 3/8 of an inch long.

(Graphic from Prevention and Control of Wildlife Damage)

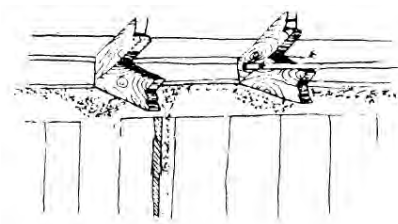
Tracks and Runways

Rodent tracks show up in dust, snow, or soft, moist soil. A rat's foot print is about 3/4 of an inch long, and may show four or five toes. Mouse tracks are much smaller, usually less than 3/8 of an inch long. Both rats and mice may also leave a "tail drag" line in the middle of their tracks.

Rodent runways are routes that rats or mice repeatedly follow. Outdoors, runways tend to appear as smooth and beaten paths on the ground next to walls, along fences, under bushes and buildings. Indoor runways are harder to identify, but may appear as well compacted trails, free of dust, which are often found along rafters, wall/floor junctions, and the edges of stored materials and equipment.

Sounds

In severe infestations you may hear rodent sounds, such as high-pitched squeaks, fighting noises, clawing and scrambling in the walls, or gnawing sounds. A stethoscope or electronic listening device can help pinpoint this activity. You are most likely to hear rodent sounds at night, when they are most active.



Grease marks (rub marks) are commonly found along junctions of floors and walls, on pipes and ceiling joists, and on sill plates where rats swing around obstacles.

(Graphic from Prevention and Control of Wildlife Damage)

Grease Marks or Rub Marks

Oil and dirt rub off of a rodent's coat when it rubs against things. These grease marks or rub marks build up in runways and soon become noticeable. They are commonly found along the junctions of walls and floors, on pipes and ceiling joists, and on sill plates where rats swing around obstacles. This type of grease mark is sometimes called a swing mark. Grease marks also occur at regularly used openings found in walls, floors, and ceilings.

Nests

House mouse nests vary in appearance, but often look like a 4-inch diameter ball containing fine shredded paper or other fibrous material. Deer mouse nests that are found indoors are similar to those of house mice but are often larger, sometimes over a foot in diameter.

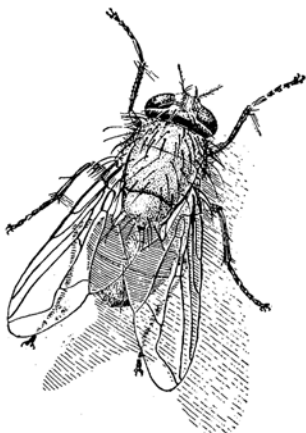
You usually will not find visible Norway rat nests in buildings due the fact that they will be located inside wall voids and ceiling voids. However, on occasions you will find Norway rat nests inside unused equipment or storage areas.

Roof rat nests are typically lined with leaves, paper, or cloth. You may find roof rat nests in the attics of buildings, or outdoors in dense vegetation.

Other Indicators

Rats and mice sometimes give other indications of their presence, but these can be hard to interpret. They may include:

- **Pet excitement.** Cats and dogs may “point” or stalk an area in a wall or floor where rodents are present, especially if it is a new infestation.
- **Odor.** Heavy rodent infestations have distinct odors from glandular secretions, urine, and feces. The odor of rats can be distinguished with practice from the “stale popcorn-like” odor of mice.
- **Scavenger insects.** Blow flies, bottle flies, flesh flies, and dermestid beetles may be attracted to and breed in rodent carcasses. Pay particular attention to window sills and inside light fixtures, since many of these scavenger pests also fly to lights. Sticky traps can be used on window sills to monitor for these “indicator” pests, which may pinpoint a rodent infestation.



Scavenger insects, such as this blow fly, along with bottle flies, flesh flies, and dermestid beetles may be attracted to and breed in rodent carcasses. (Graphic USDA)

Is the Infestation Active or Inactive?

You must determine if the infestation is active or inactive. Many times a site that has had a previous rodent infestation that had been eliminated still has remaining evidence of that infestation. Most customers do not sweep up rodent droppings, close burrow openings, repair gnawing damage, or remove rub marks from walls. As a result, just finding these

rodent signs doesn't mean that there are rodents infesting the site. Due to this, you need to investigate further.

How to Tell if a Rodent Infestation Is Active

Here is how to determine if the evidence that you find indicates an active rodent infestation rather than an old and inactive one:

- **Burrows**—Close burrows with paper or leaves and check again in a few days to see if they have been reopened.
- **Droppings**—Check for freshness to see if they are soft or dried out. Sweep up droppings and recheck after a week or more to see if new droppings appear.
- **Gnawing damage**—Fresh gnawing damage in wood will be light-colored with wood splinters found below the gnawed area. With other materials it can be difficult to tell. Sweep up splinters and debris, seal holes, eliminate damaged packaging, and recheck. Digital photos can be used as a benchmark for later inspections.
- **Hairs**—Sweep up and recheck.
- **Tracks**—Tracks and “tail drags” in dirt, mud, or dust usually indicate an active infestation because tracks rarely remain visible for long. However, in protected areas indoors consider confirming activity with a tracking patch.
- **Rodent sounds**—High-pitched squeaks, fighting noises, clawing and scrambling in walls, or gnawing sounds indicate an active infestation.
- **Dead rats or mice**—If only old dried out carcasses and skeletons are being found, it suggests an old infestation. Many fresh carcasses probably means that an active infestation is being poisoned.

Extent of Infestation

You must make some assessments of the size of the infestation. Is it small and localized, or large and widespread? A good inspection helps you avoid the most common mistake made in rodent control, which is underestimating the size and extent of the rodent infestation. If you underestimate the size of an infestation or, even worse, miss it completely, control will be unsatisfactory. As a result, you will probably not put out enough effort, fail to place enough traps, or put out enough bait to adequately suppress the rodent population.

How do you assess the size and extent of a rodent population? You are not sampling the actual numbers of rats or mice, but instead you are just making rough estimates. Is the population low, medium, or high? In a low infestation, signs of activity are rare, perhaps just a few droppings now and

What You Need to Know

- Species of rodents present
- Whether they are active or inactive
- Size of rodent population
- Extent of infestation
- Breeding state of population

then. In a medium infestation, there would be old droppings, gnawing damage, and occasional sightings. In a high infestation, fresh droppings, tracks, gnawing damage, and other evidence is common. This may also include an occasional rodent sighting during the day.

Next, determine if the infestation is localized or widespread. If it is widespread, what indoor areas and floors are infested? What outdoor areas are infested? Try marking the location of various rodent signs that were found on a floor plan. It can help you visualize the infested areas. As you conduct your inspection, mark your floor plan with as much information as you can uncover. Mark feeding areas, entryways, and runway, and areas with evidence of nesting.

Sometimes, you can get an idea about the breeding status of the population. If you find rodent nests, droppings of different sizes, or recent carcasses of young animals, you know you are dealing with a reproducing and growing population of rodents. As a result, your control actions will need to be more aggressive in order to deal with a constant influx of young rodents.

Conducive Conditions

Another goal of rodent inspections is to identify those conditions that are contributing, or could contribute in the future, to rodent problems. These are called “conducive conditions.”

Basic Requirements

Food, water, and shelter are the basic requirements for all animals including rats and mice. When these requirements are readily available to rodents, the site not only becomes more attractive to rodents, it is able to sustain a larger rodent popu-

Basic Requirements for Rodents

- Food. The availability of food for rodents is increased by poor trash handling and poor housekeeping, spilled food, and inadequately stored food.
- Water. Available water for rodents is provided by plumbing leaks, roof leaks, puddles, irrigation, landscape ponds, and condensation.
- Shelter. Rodent shelter is provided by clutter, debris, weeds, damaged packaging, poor landscaping choices, access to voids, and structural damage.



*The structural integrity of a building helps determine how easy it is for rats or mice to get inside.
(Photo L. Pinto)*

lation. Your inspection should identify all food sources that could be available and accessible to rodents.

Rodent Entry Points

Problems with a building's structure can be a conducive condition. The structural integrity of a building helps determine how easy it is for rats or mice to get inside, and, once inside, to move from room to room and from floor to floor. For example, missing or broken door sweeps allow rodents to squeeze under doors in order to enter buildings, along with unscreened vents that provide rats and mice with easy entry into and out of buildings. Rodent entry is covered in detail in the chapter on excluding rodents.

Identifying Service Issues

The third goal of a rodent inspection is to gather the necessary information to plan for future rodent control service, modify the current service, and to identify any special service issues. Here are some examples:

Are there active mouse runways along walls, pallets, and other edges? In this case, these are good sites in which to install multi-catch traps or snap traps.

Is there a fence line between a set of active rat burrows and a poorly maintained dumpster? If so, plan to establish a line of bait stations, while at the same time baiting the burrows and taking steps to upgrade the dumpster sanitation. You get the idea? During the initial inspection, you plan out your overall service strategy.

Also identify special service issues at the site. These are special conditions at the site that will require special action, or that will restrict what products you can use or what actions you can take. Every site is different.

Consider a food manufacturing plant. You will be constrained by the specific regulations and rules of USDA, FDA, or the food company itself. Among other things, the rules will restrict where, when, and how you can use rodenticides.

Schools are also a special case. You must take special precautions to keep baits, traps, and glue boards out of the reach of children. You may also have to follow special state or local

school IPM rules that may prohibit the use of rodenticides or further restrict how you can use them. In fact, the presence of children in any site requires you to take special precautions in order to make baits, snap traps, and other tools inaccessible to them.

Furthermore, any conducive condition can be a service issue (see box).

Examples of Conducive Conditions That Are Service Issues

- No inspection aisle in food warehouses. Rats and mice travel along walls and edges, and nest, hide, and feed in and around food storage boxes. No inspection aisles means ideal conditions for rodents and no way for you to inspect this high risk area.
- Dogs, cats, and other animals. Animals are a service issue because rodenticides and snap traps must be placed out of their reach. Be aware that large commercial accounts may use guard dogs at night.
- The presence of spilled food. This is a service issue because spilled food competes with your baits, making them less effective.
- Inadequate door sweeps. If you see a wide band of light coming under an exterior door, you can bet it's wide enough to provide entry for mice, maybe even rats. No matter your success indoors, replacement rodents can still enter the account.

CRITICAL INSPECTION AREAS

Certain areas are critical to any inspection for rodents because historically rats and mice concentrate in these areas or they contain conducive conditions that attract rats and mice into the area. Think like a rodent! Not all areas are equally likely to be infested. Rats and mice will concentrate in areas where they find food, water, nesting sites, or hiding areas.

Outdoors

The following outdoor locations should always be inspected when conducting a rodent inspection.

Dumpsters and Trash Areas

Dumpsters are often the focal point of rat problems at commercial accounts. The single most important recommendation relating to dumpsters is this: Don't ignore them. The first



The first stop for exterior rodent inspections should always be the dumpsters, compactors, and other trash receptacles. (Photo L. Pinto)

stop for exterior rodent inspections should always be the dumpsters, compactors, and other trash receptacles. If they are overflowing, if trash is spilled all around them, if they are surrounded by heavy vegetation, they are probably contributing to rat problems. Look for these conducive conditions, and also look for rat or mouse burrows nearby (within 100 feet), under vegetation or the edge of concrete slabs.

Receiving/Loading Docks

In facilities that get food deliveries via a loading dock, the area immediately around the dock is often a high activity site for rats and mice. Food spills provide food along with the odor of the food will attract rodents from nearby areas. Look for burrows, droppings, and other evidence.

Building Perimeter

Always walk the building perimeter looking for burrows, runways, and rodent entry points. Be sure to check for burrows where sidewalks, porches, patios, and other concrete slabs intersect the building perimeter.

Bird Feeders

Seed is a favorite food of rodents, and both rats and mice often feed under feeders at night. Look for tracks under the feeders, and for burrows nearby (within 30 feet for mice and within 100 feet for Norway rats).



Look for tracks under bird feeders, and burrows nearby (within 30 feet for mice, within 100 feet for Norway rats). (Photo L. Pinto)

Kennels/Pet Areas

Check for evidence of rodents, droppings, burrows, and tracks in kennels or pet areas. Such sites are very attractive to rodents, especially if the pets are fed there. Look for burrows under concrete slabs under kennels or runs.

Low Decks

The area under a low deck is a prime location for rodent nesting and burrows. These areas are often difficult to inspect, however, such areas should not be ignored. A powerful flashlight will help you see burrows that are located far back under the deck.

Rats in Sewers

Sewer rats are more of a problem in communities with sewers having certain characteristics:

- storm and sanitary sewers that are interconnected (typical of old systems from the 19th and early 20th centuries)
- pipes or vaults more than 50 years old
- street trees with invasive root systems (like elms or silver maples)
- low flow rates (so that the rats are not washed away)
- old vaults or manholes made of brick (which often deteriorate, providing entry and exit through crumbling joints and missing bricks)

Thick Vegetation

Inspect all areas where vegetation creates good rodent habitat such as heavy groundcovers, low and thick bushes, overgrown weeds, and other natural habitats such as wooded streams or ponds, drainage canals, and overgrown railroad embankments.

Debris/Wood Piles

Look for burrows wherever there are wood piles, piles of stored construction materials, debris, or old equipment resting directly on the ground, particularly if the area is weedy.

Fence Lines

Inspect fence lines at all commercial accounts for burrows, runs, and other evidence of rodents, particularly rats. Rodents follow straight lines and like to travel along fence lines, especially if they are weedy or overgrown. Fence lines located in construction sites that use hay bales to prevent sediment runoff are favored nest sites.

Sewers

Rats live in the sewers of most cities and use sewer lines, both sanitary and storm, as highways to move about town. Sanitary sewers, in particular, can supply all of a rat's needs: warmth, protection, water, and food in the form of floating or trapped food scraps or fecal material found at the bottom or sides of pipes. Rats also feed on the cockroaches living inside sewers.

Rats living in sewers often find breaks at faulty joints or where tree roots have invaded. They then burrow through the ground coming up in yards or under sidewalks.

Indoors

Trash Areas

Just like outside, food trash indoors is a powerful attractant to rodents, and the trash areas are the most likely sites to be infested. These areas need to be inspected at each service visit. In commercial accounts, check trash chutes, compactors, and container storage areas.

Food Areas

Always inspect locations where food is served, stored, or processed. Any rodents in the building will concentrate near these areas. Look for rodent droppings on kitchen floors and counter tops. In grocery stores, don't forget to inspect out-of-sight areas underneath shelves, coolers, and display units, as well as in back rooms, and particularly in the damaged goods/returns areas.



Inspect cluttered closets, storage areas, and other sites packed with "stuff." Mice in particular key into clutter. (Photo L. Pinto)

Clutter

Any cluttered area provides harborage for rodents, particularly for mice. Inspect cluttered closets, storage areas, and other sites packed with "stuff," particularly if they are near potential sources of food for rodents.

Base Voids

A favored nesting site for a house mouse is a void under cabinet bases, particularly in the kitchen. Look for mouse holes, rub marks, and droppings.

Wire Chases/Pipe Chases

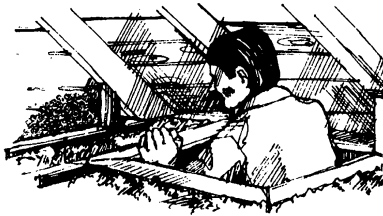
Rodents often travel through a building following pipe and wire chases. Some of these have inspection doors which you can open and shine a flashlight down to look for droppings, hairs, and other evidence. Grocery stores and food plants often have refrigeration lines running in voids beneath the floor, and these are prime travel routes for rodents. Check these for droppings whenever possible.

Garages

Mice often first enter residences under and around garage doors, and the garage is often the first area of a home to be infested. Check for droppings, gnawing damage, and feeding damage to stored bird seed, grass seed, pet food, or other food items stored in the garage.

Crawlspace

Norway rats in particular may nest in a crawlspace under a building, particularly older apartments, schools, and food handling facilities. Look for burrows, tracks, and droppings.



The attic is a prime inspection area when dealing with tree squirrels, mice, and roof rats. Look for nests, droppings, and gnawing damage.

Attics

The attic is a prime inspection area when dealing with tree squirrels, roof rats, and sometimes mice. Look for nests, droppings, and gnawing damage (be sure to check wires).

Commercial Coolers/Freezers

Both rats and mice are often found in the dead space found over cooler tops. Mice commonly nest in the insulation that is around coolers and freezers in commercial kitchens and food markets.

Equipment/Appliances

Mice nest in the insulation of stoves, refrigerators, and other appliances, attracted by the warmth and nearby food. Look for droppings, nests, and pulled-out insulation.

SPECIAL TOOLS AND TECHNIQUES

There are times when traditional inspection techniques fall short in assessing the rodent population or in identifying rodent-contaminated foods and packages.

Perhaps you or your customer feels that the regular inspection was inadequate. Or, because of special circumstances, you need more information about the infestation than usual. Maybe you need to detect food or food products that might have been contaminated by mice or rats. That's when you need to use special rodent inspection techniques that go beyond those used in a typical rodent inspection.

Technology provides equipment for some high-tech inspection solutions. For example, video cameras with low-light capability, infrared imaging, motion detectors, and sound detectors allow for remote sensing. These techniques may be used in rare cases, such as when a few elusive rats are hiding in a large food processing plant which is under government pressure to eliminate the rodents immediately. You may never use these high-tech options, but there are four special rodent techniques that you probably will use occasionally.

1. Nontoxic monitoring blocks
2. UV (blacklight) inspections to detect rodent urine

ID Using Nontoxic Monitoring Blocks

The size of the gnawing damage can tell you who did the gnawing: roughly 1/16 inch space between tooth marks for mice and 1/8 inch for rats. You should also be able to distinguish rodent feeding from that of crickets, slugs, squirrels, birds, and other wildlife.



The main reason that a pest control technician might use a UV light is to identify rodent-contaminated food products coming into a warehouse, or in storage, or being processed. But there are other uses (see text).

3. Night inspections for rodent activity
4. Applying tracking patches to detect rodent tracks

Nontoxic Monitoring Blocks

Tooth marks from feeding on nontoxic rodent monitoring blocks that are placed in bait stations and other sites provides positive evidence of rodent infestation. The advantages to these blocks over regular bait blocks is that (1) they can be placed in areas where toxic baits may not be permitted, (2) there are no safety or regulatory concerns, (3) they are more attractive to rodents than are toxic blocks, (4) they can be placed in many areas and only replaced with toxic baits once active rodent feeding has been confirmed.

UV Blacklight Inspection

Rats and mice urinate constantly during their waking hours. They will urinate in feeding area and travel areas. Rodent urine may be found in puddles but it is more typically dribbled in hundreds or even thousands of droplets each day. When rodents are feeding on food products, this urine is considered a food contaminant.

If dried rodent urine were visible, it would be a clear marker for rodent activity and food contamination. Unfortunately, it is very difficult to see with the naked eye. Fortunately, we have special equipment to make rodent urine visible. Stains from both wet and dry urine will glow blue-white under ultraviolet light, also known as blacklight. This light is invisible to people, and is called ultraviolet because its wavelength is just above the wavelength of visible violet light. In the food industry, portable ultraviolet lights, called UV lights for short, are used to identify rodent urine on food items.

Government inspectors are the primary users of UV lights, as they look for rodent-contaminated food in food processing plants and warehouses. However, pest control technicians at these food facilities may also use UV lights.

The main reason that a pest control technician might use a UV light is the same as the government inspector's, which is to identify rodent-contaminated products coming into a warehouse, storage area, or that are being processed. In addition, there are other uses:

- Find high-activity areas in which to place rodent traps and bait.
- Determine where rodents are entering a building.
- Find mouse urine deposits in homes of people allergic to mice.
- Demonstrate the extent of a rodent infestation to customers or potential customers.

The three primary ways to tell rodent urine from other fluorescing materials is by the droplet pattern, the color, and the location of the fluorescing material. However, it takes practice and training to interpret what you see under the UV light, and to distinguish true urine deposits from false positives.

Rodent urine glows bluish-white when it is new and then turns yellowish as it ages. Many other materials will glow with a different hue. Unfortunately, certain solvents, cleaners, and lubricants may also fluoresce a bluish-white or yellow-white. You will have to use other characteristics in order to distinguish them from urine stains.

Tips for Distinguishing Rodent Urine Under UV Light

- Fresh rodent urine glows bluish-white.
- Rodent urine typically is deposited in droplets in a straight line, starting with large droplets leading to smaller ones.
- Human and other animal urine, solvents, cleaners, and lubricants tend to show up as solid, splash-like patterns, which are very different from the linear droplets of rodent urine.
- Rodent urine droplets are usually found in typical rodent feeding, nesting, and travel areas. If you find materials glowing in a way similar to rodent urine you should question your findings if the material is in a nontraditional location.

Night Inspections

Most rodent inspections occur during the regular work day. Yet rats and mice are shy, and as a result are active mostly at night. This is when Norway rats, roof rats, and house mice do most of their feeding. These rodents do not feed steadily,

While most of rodent inspections will be conducted during the regular work day, on rare occasions, you may need a night inspection.

but typically have two activity periods. They do most of their foraging for food starting about a half hour after sunset and will continue until around midnight. In addition, they usually have a shorter food foraging period just before dawn.

A nighttime inspection during either of these high-activity periods is usually the fastest way to see live rats or mice at an account. This is a good way to confirm an infestation, and you can get even more information at night, such as:

- You are more likely to see fighting, feeding, chases and other interactions.
- You are more likely to hear the sounds of rodent hidden interactions, such as squeaks, squeals, fighting and scratching.

Night inspections can be done using a powerful flashlight. In some situations, pest control technicians may use special equipment like a night vision scope or an infrared camera.

Tracking Patches

Footprints and tail drags are signs of rodent activity, but they are hard to see on clean or uneven surfaces. You can place a “tracking patch” to obtain much better footprints and tail drags. Apply the patch in suspected rodent areas to show footprints and identify species, level of activity, and direction of movement.

A tracking patch consists of a light dusting of an inert material such as clay, talc (unscented baby powder), or powdered limestone. But don’t use flour, which may attract insect pests.

Guidelines for Using Tracking Patches

- Use clay, talc (unscented baby powder), or powdered limestone. Don’t use flour, which may attract insect pests.
- Apply in a layer paper-thin up to 1/32 inch.
- A good patch size is 12 by 4 inches.
- Apply in suspected rodent runways.
- When inspecting patches, shine your flashlight at an angle to increase shadows.
- Make sure your customer knows about the patches beforehand, and clean them up when finished.

A good patch size is 12x4 inches. Apply patches in suspected rodent runways and near rub marks. When inspecting tracking patches, shine a flashlight at an angle that causes the tracks to cast a distinct shadow.

Tracking patches are extremely simple to make and are useful tools when conducting rodent inspections. You should use them often.

INSPECTION CHECKLIST FOR COMMERCIAL SITES

Note to the Inspector. For ease of evaluation, this checklist has been designed so that responses listed in the right hand column indicate potential problems. This format will allow you to scan the checklist and focus on areas needing attention.

Address of Facility:

Principal Contacts:

Exterior Areas

- | | | |
|--|-----|----|
| 1. Is area around facility clear of weeds, grass, and brush? | Yes | No |
| 2. Is the fence line also clear? | Yes | No |
| 3. Is there 20 to 50 foot wide bare strip adjacent to the perimeter? | Yes | No |
| 4. Is there a 2 foot pea gravel strip to prevent rodent burrowing? | Yes | No |
| 5. Is there standing water on the grounds that may attract pests? | Yes | No |
| 6. Are outside garbage containers at least 50 feet from doors? | Yes | No |
| 7. Are garbage containers on concrete slabs and drained into sanitary sewers? | Yes | No |
| 8. Is frequency of garbage removal adequate? | Yes | No |
| 9. Do garbage containers have tight-fitting lids? | Yes | No |
| 10. Are walls reasonably clean and free of dust, mold, etc.? | Yes | No |
| 11. Do doors close tightly? | Yes | No |
| 12. Are all exit doors rodent-proof? | Yes | No |
| 13. Are door seals intact? | Yes | No |
| 14. Do windows or skylights have broken panes? | Yes | No |
| 15. Have all holes and cracks been filled to discourage pest harborage or entry? | Yes | No |
| 16. Are there signs of rodent harborage or burrows? | Yes | No |
| 17. Is there spillage or trash that may attract pests? | Yes | No |
| 18. Have discarded equipment and materials been placed next to building? | Yes | No |
| 19. Are pallets stacked away from building? | Yes | No |
| 20. Are materials and equipment stored on racks at least 12 inches off the ground? | Yes | No |

21. Is paving in good repair?	Yes	No
22. Are there rodent barriers on railroad siding doors?	Yes	No
23. Are there door gaskets at track entry to structure?	Yes	No
24. Are plumbing and electrical service entrances sealed?	Yes	No
25. Are there potential outbuilding pest hazards?	Yes	No
26. Are there exterior perimeter bait stations and traps in place?	Yes	No
27. Are exterior openings all protected/sealed?	Yes	No

Receiving Area

28. Is there an incoming inspection procedure for all receivables?	Yes	No
29. Are dock levelers clean underneath?	Yes	No
30. Are dock doors closed when not in use?	Yes	No
31. Are materials stacked against walls in this area?	Yes	No
32. Are empty cartons and cases taken to the trash disposal area immediately?	Yes	No

Interior Areas

33. Are there holes or cracks in walls?	Yes	No
34. Is there standing water in the facility?	Yes	No
35. Is product kept away from walls?	Yes	No
36. Are bait stations present?	Yes	No
37. Is there evidence of insects, rodents, or birds?	Yes	No
38. Are floors cleaned regularly?	Yes	No
39. Is there accumulated debris along wall/floor junctures?	Yes	No
40. Is there evidence of rodent activity along walls and equipment?	Yes	No
41. Is there evidence of rodent-chewed bags or nesting sites?	Yes	No

Product Storage Areas

42. Is there an incoming inspection procedure for all receivables?	Yes	No
43. Is the storage area too crowded?	Yes	No
44. Are all products stored on pallets?	Yes	No

45. Are pallets at least 18 inches away from the walls?	Yes	No
46. Is there a painted line on the floor along walls to indicate inspection aisles?	Yes	No
47. Is there evidence of a broken or exposed product in stacks?	Yes	No
48. Are there any unusual odors near food products?	Yes	No
49. Are there signs of rodents near shelving posts or overhead beams?	Yes	No
50. Is there accumulated product near shelving posts?	Yes	No
51. Are there any holes or cracks that would permit rodent entry?	Yes	No
52. Is there spillage?	Yes	No
53. Do resacking and repackaging conform to good manufacturing practices?	Yes	No
54. Is any product exposed to overhead contamination?	Yes	No
55. Are rodent control devices/glueboards present, clean, dated, and mapped?	Yes	No
56. Are doors self-closing?	Yes	No
57. Are there any holes in the walls permitting rodent harborage?	Yes	No
58. Are pallets or containers identified by date of delivery?	Yes	No

Morgue or Returned Merchandise Area

59. Are all spoiled products stored in a designated “Quarantine Area” (Morgue)?	Yes	No
60. Are there procedures for disposing of these products?	Yes	No
61. Is contaminated or infested merchandise promptly removed?	Yes	No
62. Are food and nonfood items separated by an aisleway?	Yes	No
63. Are rodent control devices/glueboards present in this area?	Yes	No

Shipping Areas

64. Are there objectionable odors?	Yes	No
65. Are carrier vehicles inspected before use?	Yes	No
66. Are there procedures for rejecting carriers?	Yes	No

Lunch Room and Locker Room Areas

67. Is there a designated eating area?	Yes	No
68. Is the area clean?	Yes	No

- | | | |
|--|-----|----|
| 69. Are locker rooms clean and free of debris? | Yes | No |
| 70. Are tops of lockers free of all materials? | Yes | No |
| 71. Are doors to areas self-closing? | Yes | No |
| 72. Are any food products or equipment stored in the restroom areas? | Yes | No |

Office Area

- | | | |
|--|-----|----|
| 73. Is overall sanitation good? | Yes | No |
| 74. Are there any obvious pest breeding areas? | Yes | No |
| 75. Are doors self-closing? | Yes | No |
| 76. Is area clean and free of spilled food? | Yes | No |
| 77. Are ceilings drop ceilings? | Yes | No |

Additional Comments:

REVIEW QUIZ

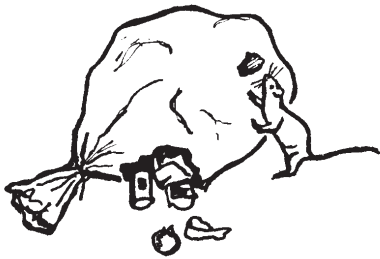
1. Why would you need a Phillips head screwdriver when inspecting for rodents?
 - a. to probe decaying wood
 - b. to open access panels
 - c. to detect rodent rub marks
 - d. to scrape snap traps clean
2. Why is a blacklight (UV light) a useful piece of equipment when conducting rodent inspections?
 - a. it makes it easier to see rub marks
 - b. house mice are attracted to the light
 - c. rodent urine glows under blacklight
 - d. rodents can't see the light
3. Which one of these statements describes Norway rat droppings?
 - a. about 1/2-inch long with pointed ends
 - b. about 1/2-inch long with ridges
 - c. about 3/4-inch long with blunt, rounded ends
 - d. rounded, and connected together
4. Fresh rodent droppings are:
 - a. soft in texture
 - b. light gray in color
 - c. crumbly
 - d. cigar-shaped
5. Which one of these would be considered a "conducive condition" when inspecting for mice indoors?
 - a. dry pet food stored in a sealed container
 - b. caulked openings around pipes
 - c. kitchen stove with grease buildup
 - d. woolens stored with moth balls
6. The single most important tool to have when inspecting for rodents is:
 - a. respirator
 - b. flashlight
 - c. gloves
 - d. talcum powder
7. A "tracking patch" is used during rodent inspections to:
 - a. kill rodents that are bait-shy
 - b. see rodents during night inspections
 - c. count the number of rodents in the account
 - d. detect footprints and tail drag marks
8. Which one of these is a standard goal during a rodent inspection?
 - a. to determine if the infestation is active or inactive
 - b. to convince the customer to do rodent-proofing
 - c. to check for insect pests at the site
 - d. to find out how much the customer can pay
9. Why is a digital camera a useful inspection tool?
 - a. to prove that you were at the site
 - b. to show the number of rodents present
 - c. to document conducive conditions
 - d. so you can remember the people involved
10. A house mouse nest inside a home will usually be made up of:
 - a. mulch and soil particles
 - b. shredded paper or fibers
 - c. dried, shredded leaves
 - d. grass and small twigs
11. Why are tree branches that touch a roof a possible problem in rodent control?
 - a. rats can use them to reach the building
 - b. deer mice feed on tree bark
 - c. house mice use leaves for nest material
 - d. dripping rainwater provides moisture

CHAPTER FOUR

Sanitation and Rodents

Learning Objectives

- *Recognize dumpster sanitation problems and provide guidelines for good practice.*
- *Recognize trash problems that can lead to rodent infestations.*
- *Rank landscape characteristics by their attractiveness to rodents.*
- *Provide examples of clutter conditions that contribute to mouse infestations.*
- *Identify critical food handling and storage issues that contribute to rodent infestations.*
- *Describe a proper inspection aisle for a food storage area.*
- *Provide examples of the ways that education about sanitation can help in rodent control.*



Many people do not realize the importance of sanitation in reducing rodent problems.

Like other animals, rodents require food, water, and shelter. When these resources are abundant, populations can explode. When they are in short supply, populations decline to a level that can be supported by the limited resources.

The “clean up” of an area will greatly influence the success of a rodent control program in two ways:

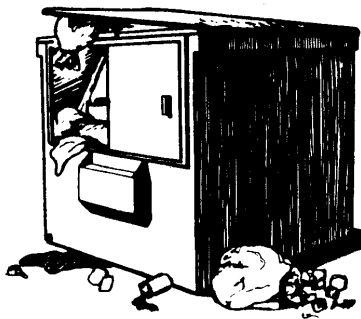
1. It will eliminate sites that the rodents use for reproduction and nesting, making them travel longer distances for food and water.
2. It places stress on the rodent population, exposing them to more predators, forcing them to accept baits more readily, and breaking the social structure of the population.

People often do not realize the importance of sanitation in reducing rodent problems. Their first reaction is to control the outbreak without due consideration as to how it came to be in the first place.

The principles of sanitation apply to any situation involving rodents, whether in commercial buildings, warehouses, farms, private residences, or neighborhoods.

TRASH MANAGEMENT

Rodents are opportunistic feeders and will feed on virtually anything that humans feed on. Any discarded food garbage, whether on the ground, in a gutter, or in a trash can becomes available food for a rat or mouse. When rats and mice invade garbage rooms, high-rise trash rooms, compactor rooms, or dumpster sites, it’s obvious that better trash management is necessary.



A dumpster can not only provide food for rodents, but can provide shelter as well.

Dumpsters

The closer a dumpster is to a place of business, the more likely it is to be the source of rodent problems. A dumpster not only provides food for rodents, but can provide shelter as well. Rats commonly locate their burrows underneath dumpsters where there is plenty of food available. Dumpsters should never be installed on bare ground. In addition, dumpsters should be located at least 50 feet from outside doors

Key Points**Dumpster Guidelines**

- Not damaged or rusted through
- Installed on concrete pad
- At least 50 feet from outside doors
- Lids kept closed
- Adequate trash pickup
- Drain holes closed



Rats or mice can live inside the block walls around a trash chute many floors up, and come down at night to feed in and around the compactor. (Photo L. Pinto)

and should be situated on a thick concrete pad that has foundation toes on the outside to keep rodents from burrowing under the pad.

Dumpster lids should be kept closed. If there's so much trash that the lid cannot close, the facility needs a bigger container or needs to schedule more frequent trash pickups. Drain holes in dumpsters should never be left open, except during cleaning. Plugs should be in place or the drain holes should be screened to keep rodents out.

Compactors and Trash Chutes

In apartment buildings and other high-rise buildings, garbage is often fed into compactors by trash chutes. These chutes can be grease-laden, sometimes damaged, with poor seals at the basement ceiling above the compactor. Rats and mice can live in the block walls around the trash chute, even many floors above ground level, and come down at night to feed in and around the compactor.

In older buildings, compactor rooms are often greasy and trash-strewn, and over the years numerous holes have been made for pipes, conduit, etc., thus allowing pests free access in and out of the walls, floors, and ceiling.

Doors into garbage or compactor rooms (including overhead bay doors) should be kept closed and should seal tightly with door sweeps and/or thresholds at the bottom.

Outside Yard Trash

Food trash should always be bagged before it is placed in a dumpster or trash chute. Bagged trash should never be left outside of a building or next to a dumpster. Rodents can easily chew into a plastic bag. Sometimes boxes or bags of forgotten garbage are left in unusual places like underneath loading docks or in maintenance shops. Check for overlooked garbage during your inspection.

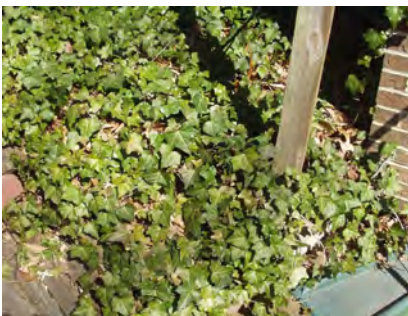
Trash receptacles located on the grounds of the property should have heavy-duty plastic liners (ideally two liners) and tight-fitting lids or lids with swinging doors. There should be enough receptacles in areas like school grounds and parks to handle a day's trash without overflowing. Trash bags should

never be filled to overflowing. There should be a good six inches below the top of the bag when it is twist-tied or knotted closed. The bags should be removed to the dumpster every evening.

Ripe fruits and vegetables are attractive to all rodents, but especially to roof rats. Fruits and vegetables should not be allowed to remain on the ground around homes or commercial properties. Also, bird seed is an attractive food for rodents. Bird feeders should have catch trays and spilled seed under the feeders should be cleaned up on a regular basis.

An accumulation of pet feces also attracts rats. In situations where pets are present, there must be a “cleanup after” policy in place for residents. Likewise, if the property has a bird problem, piled up bird droppings under a roosting site on a building can help support a population of rats. Property managers must see that the grounds are kept clean of food trash, animal feces, and rotting fruit.

LANDSCAPING PROBLEMS



Rodents like the cover of ground hugging plants, such as this English ivy, and low-growing shrubs like yews, junipers, and arborvitae because they provide perfect burrowing sites. (Photo L. Pinto)

Rodents like the cover of ground hugging plants and low-growing shrubs like yews, junipers, and arborvitae because they provide perfect burrowing sites. Thick foundation plantings, and especially thorny shrubs like barberry or pyracantha, conceal rodent burrows, accumulate garbage, and make inspection and control difficult. Shrubbery planted to conceal dumpster enclosures is a particular problem since it provides cover for rats while being in close proximity to food.

Instead of mound-shaped shrubs, recommend wineglass-shaped shrubs that have a central trunk with most of the foliage at the top of the plant and no ground level branches to provide cover for the rodents. The more open the plant is around its base, the better. This allows you to see whether there are rodent burrows and the customer can see if there is trash that needs to be cleaned up.

Make sure weeds or grass around building foundations and dumpster enclosures are trimmed. Ivy and other climbing vines growing up building walls provide nesting sites and a travel route for mice and roof rats to enter buildings. Tree



Weeds and plants along foundations provide rodents with hiding places, nesting sites, and hidden runways, while also making the area difficult to inspect. (Photo L. Pinto)

limbs that touch the building also provide travel routes for roof rats.

When possible, building foundations should have a 12 to 24 inch wide strip of pea gravel in a 4 inch deep trench lined with landscape cloth in order to prevent weed growth and burrowing by rodents. Adding a 3/4-inch stone mulch around the base of shrubs will also keep rats from burrowing.

Large rocks, railroad ties, and similar landscape structures are other areas attractive as burrow sites and should be avoided near buildings.

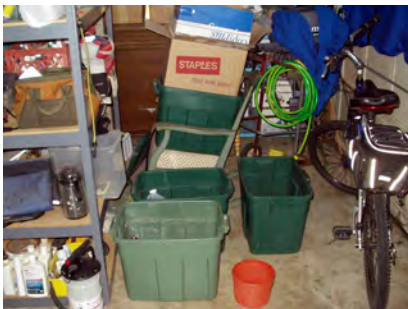
Commercial properties should avoid planting heavy seed-bearing plants, nut trees, or fruit trees since fallen nuts and ripe and rotting fruit are attractive to rodents, especially roof rats. Roof rats also feed on slugs, snails, and large insects that can become more abundant when outside vegetation is not managed and becomes overgrown.

CLUTTER

People often do not think of clutter as a sanitation problem that could contribute to rodents. There are several problems with accumulated clutter in an account. One problem is that the piles of “stuff” provide hiding, nesting, and traveling places for rodents. This is compounded by the fact that areas with large amounts of clutter are rarely disturbed by people, providing a safe haven for rodents. Cluttered areas are rarely inspected so a rodent problem can grow unseen for weeks.

In residences, clutter is often found in attics, basements, and garages and these are the sites that are most likely to be the focus of a mouse infestation. Removing clutter has many positive effects in a rodent management program. Because mice will investigate any disturbance in their territory, new clutter-free sites can actually improve trapping results. Clutter-free areas will be less attractive to new rodents looking to move in.

In high-rises and other commercial buildings, be on the lookout for accumulations in garbage areas such as compactor rooms and trash rooms. Residents may leave cardboard boxes



In residences, clutter is often found in attics, basements, and garages and these are the sites that are most likely to be the focus of a mouse infestation. (Photo L. Pinto)

and items too large for trash chutes on the floor of the trash room. In addition, maintenance staff often use the compactor room as an overflow storage area for boxes and building materials and cleaning supplies. Nothing should be stored in the compactor room except trash-related equipment.



*Cluttered offices that have stacks of boxes and papers can be the source of a mouse problem.
(Photo L. Pinto)*

In apartment properties, residents that are moving in or out often dump old mattresses, sofas, tables, etc. next to the dumpster. Most properties contract for pickup of large items on an irregular basis so these items can provide hiding places for rats for several weeks, and they are located right next to a food source.

In office buildings, cluttered offices that have stacks of boxes and papers can be the source of a mouse problem, especially if the workers in these offices also keep snack food in their desk drawers. Mouse nests can often be found in the back corners of desk drawers.

In commercial accounts, whenever possible, storage-free spaces should be left behind and beneath stored products and equipment. Inspection aisles (see box below) make the perimeter less attractive to rodents, and allow inspection and cleaning. Inspection aisles are a particularly good idea in food storage areas or in compactor and garbage rooms.

The Inspection Aisle

In commercial accounts, “inspection aisles” or “sanitation lines” are often placed around the inside perimeter of a storage area, and sometimes between rows of product. These are simply cleared areas that are 18 to 24 inches wide and that are free of any products or other materials. The aisle usually runs around the perimeter of a room next to the wall. It’s recommended that the aisle be painted white so that any food spillage or rodent droppings can be easily seen. The aisle must be wide enough that a person can move in it and use cleaning equipment. The inspection aisle also provides a convenient, clutter-free place to install rodent bait stations and traps. Because the aisle leaves a wide, clear space where rodents usually travel (along the floor/wall junction), it makes the site less desirable to rodents as well. It is important that management be diligent about maintaining the inspection aisle clutter-free.

Outside around warehouses and other commercial buildings, remove old pallets, boxes, discarded furniture, stacked building materials, and other debris that provides hiding and nesting places for rodents.

Firewood can be a problem, too, when it is stored inside buildings directly on the floor or against walls where it provides harborage for rodents.

FOOD HANDLING AND STORAGE

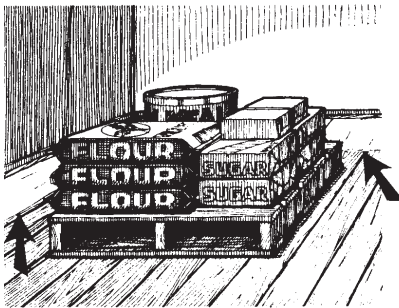
When rodents have easy access to food, either in residences or commercial accounts, control programs suffer because bait cannot compete with the rodents' preferred food. Reducing the rodents' access to food then forces them to feed on the rodenticide baits.

In residences, cereals, nuts, seeds, grain, and dry pet food should be stored in sealed glass, plastic, or metal containers with tight lids. Large bags of dry dog food or bird seed should be stored inside metal trash cans with lids. Bulk foods like onions, potatoes, and rice should not be stored in open bins.

Residents should not leave food sitting out on kitchen counters overnight. Pet food should not be left outside on porches or decks for extended periods, and definitely not overnight. Pet food that is spilled in pet feeding areas like garages or around dog houses should be swept up daily. Food scraps should not be placed in compost piles.

In food facilities, packaged products should be stored up off of the floor on shelves or pallets. Food spillage under shelves and pallets needs to be cleaned up on a daily basis. Damaged food packages need to be pulled and destroyed or sealed and stored until return in a secure site. Stock rotation (first in/first out) is important in rodent control since older stock is usually at the back of the shelf or the back of the warehouse and often overlooked...except by rodents.

Open grease barrels located outside the back doors of restaurants invite rodents. In addition, boxes of produce should not be stored on the back dock of restaurants.



In food facilities, packaged products should be stored up off of the floor on shelves or pallets. There should also be an inspection aisle (sanitation lane) to provide a cleared area 18-24 inches wide around the perimeter of the room.

CLEANING

In commercial accounts such as restaurants, a high-pressure stream of water is often used to remove accumulated debris, grease, and other food. You can add soaps, and degreasing and sanitizing chemicals to the power washer system. Power washing (or pressure washing) is especially suitable for commercial kitchens and trash rooms that have a floor drain.

Power Washing

Don't power-wash equipment or areas that are not waterproof or that could be damaged by a high-pressure stream. These sites are good candidates for power washing:

garbage cans	trash rooms
trash chutes	compactors
dumpsters and dumpster pads	loading docks
floors and drains	bird roosting areas
kitchen hoods	ducts
exhaust fans	grease filters
food carts/tray carts	

Dumpsters and dumpster pads should be cleaned and degreased periodically to remove food debris, grease, and rat droppings. Ideally, a dumpster area should slope to a sanitary sewer drain in order to handle runoff from cleaning. Dumpsters should be washed out regularly using high pressure and a degreasing solution. If there are liquids in the bottom of a dumpster, a dry absorbent should be added and the resulting residue swept up.

The property's maintenance staff should make daily rounds of the dumpsters and other outside trash areas at least twice a day, picking up any trash that didn't end up inside and hosing down any spills. It's important that garbage cans, dumpster and compactor areas be cleaned up at the end of the work day so there is no spilled trash to attract rats overnight.

Trash compactors, the compactor room, and the trash chute should also be steam-cleaned and degreased regularly.

It is helpful to paint trash rooms with a high gloss white paint that will clearly show when cleaning is needed.

Around warehouses and food plants, spills around railroad tracks and loading docks should be cleaned up immediately. No boxes or pallets should be stored near the loading dock or building foundations. The loading dock area should be hosed down daily.

Plumbing leaks or areas of standing water should be corrected. Even moisture condensation on ice machines or refrigerators can provide the necessary water for rodents.



People should not leave food or crumbs on counters and tables overnight. Dishes and pans should be washed immediately after use, not stacked on counters or in the sink. (Photo L. Pinto)

In residences, people should not leave food or crumbs on counters and tables overnight. Dishes and pans should be washed immediately after use, not stacked on counters or in the sink. Food scraps on the floor should be swept up. Residents should regularly clean under the refrigerator and stove. Food and grease under the stove top should also be removed. Containers for recycling should be rinsed out before disposal, and recycling bins should be emptied and washed out at least weekly.

People should avoid stockpiling paper bags, newspapers, and cardboard boxes, and should not stack clothes or blankets on the floors. Rodents use all of these materials for nesting.

EDUCATION

You can't permanently control a rodent infestation without some help from customers or employees at the site. It's important to communicate the need for improved sanitation and use of exclusion measures, along with the need for cooperation with other control efforts.

Ask those at the site to help: (1) by pointing out any evidence of rodents like nest material, stored seeds and nuts, gnawing, droppings, burrows, or holes, (2) by emptying floor-level kitchen cabinets for inspection and treatment, (3) by following good sanitation by not leaving pet food or people food out overnight, storing food in sealed containers, and regularly cleaning floors and appliances, and (4) by assisting with rodent-proofing by closing openings around pipes,



It's important to communicate the need for improved sanitation and exclusion measures, as well as the need for cooperation with other control efforts.

doors, drains, etc., and installing door sweeps and thresholds. Outside, piles of stone, boards, firewood, or debris should be moved away from the foundation and lumber and firewood should be stacked 12 inches off the ground.

In apartments and offices, managers should encourage tenants to take trash to the dumpster or trash chute each evening. Property managers need to remind residents to close dumpster doors and lids after they have deposited the trash.

Managers of commercial properties may have a hard time understanding how the landscaping around their property can be a factor in rodent management. Convince them to reduce or change some of their plantings and keep plants closely trimmed to reduce burrow sites.

As part of a rodent IPM program, supervisors will receive ongoing information from the pest management professional about the status of the program. Reports will identify sanitation, landscaping, pest-proofing, and other problems, along with the role of the individuals on site in correcting these problems. An on-site log book containing pest information, rodenticide product labels, Material Safety Data Sheets (MSDS) inspection reports, etc. also provides program information to the customer or manager.

REVIEW QUIZ

1. One way that sanitation is beneficial in a rodent control program is that cleaning up:
 - a. increases rodents' interest in feeding on baits
 - b. increases the number of rodent nest sites
 - c. decreases the distance rodents have to travel for food
 - d. also eliminates the rodents' predators
2. In food storage areas, why is a white band painted around the perimeter of the floor?
 - a. so rodent droppings and other signs can be easily seen
 - b. to indicate that the area has already been inspected
 - c. to show suppliers where to stack food products
 - d. to show where baseboard sprays should be applied
3. The best location for a dumpster at an apartment property is:
 - a. 25 feet away from the basement/maintenance shop door
 - b. on bare ground at the back of the parking lot
 - c. on a concrete pad 50 feet away from outside doors
 - d. next to heavy foundation shrubbery
4. What is the main reason that bird feeders are a problem in controlling rodents?
 - a. dead birds can provide food for rodents
 - b. rodents feed on bird seed that falls to the ground
 - c. rodents use bird feathers for nest material
 - d. rodent predators may avoid bird feeders
5. In food storage, the concept of "first in/first out" means:
 - a. the newest products should be used first
 - b. the oldest products should be used first
 - c. incoming products should be isolated from other goods
 - d. incoming products should be stored near the loading dock
6. Which one of these is the best choice for landscaping that will discourage rodents around the foundation of a commercial building?
 - a. a ground cover like ivy
 - b. low-growing, thorny shrubs like barberry
 - c. mound-shaped shrubs with many lower branches
 - d. wine-glass shaped shrubs with few lower branches
7. In food warehouses, stored foods susceptible to rodent infestation should be:
 - a. stored on a plastic tarp on the floor
 - b. stored in back corners so as not to infest other products
 - c. surrounded by an inspection aisle
 - d. marked with a sticker if they are rodent-infested

CHAPTER FIVE

Excluding Rodents

Learning Objectives

- *Recognize common entry points for rodents.*
- *Describe an easy and effective way to determine that a door might require rodent-proofing.*
- *Identify effective methods to keep rodents from entering structures at doors.*
- *Describe rodent “isolation” indoors and explain the benefits.*
- *List ways to keep rodents from entering buildings from the roof.*
- *Identify a method for preventing rats from burrowing under foundation walls.*
- *Provide examples of methods to keep rats from using pipes or overhead wires to access a building.*
- *Match the various pest rodents with the most likely way they will enter a building.*
- *Describe methods of keeping rats from entering buildings through sewers.*

Pest exclusion (also called pest-proofing or rodent-proofing) means finding and sealing all potential entry points into a building in order to keep pests from coming inside, or to keep them from moving into new areas inside. Pest exclusion also smooths and seals gaps found in structures to prevent rodents from finding an edge where they can gnaw an entrance hole.

Rodent exclusion can be as simple as repairing screens and caulking cracks, or as complex as major building repair. Exclusion can provide permanent control if it's done correctly, but it can be labor intensive. Exclusion should be a complement to any rodent trapping or baiting program.

Although it can also be expensive, rodent-proofing a building has other benefits besides excluding rodents. It improves the retention of hot or cool air in a building, decreases heating and air conditioning costs, reduces sound and light infiltration, and prevents water damage during heavy rains.

COMMON RODENT ENTRY POINTS



If a pencil fits under a door or into the space around a pipe, a young mouse could probably squeeze through, too. (Photo L. Pinto)

As homes, office buildings, hotels, hospitals, and other properties age, they become less rodent-proof. This is partly due to deterioration...boards warp, gaps widen, cracks open. In addition, building renovations, repairs, and utility work also create new openings and new ways for rodents to enter. In new buildings, mice and rats sometimes enter during construction, before the building is closed in.

If you think an opening is too small to be a rodent entry point, you might be wrong. An easy way to check is with a common wooden pencil. If it fits under a door or into the space around a pipe, a young mouse could probably squeeze through. An adult mouse only needs an opening about 3/8-inch wide, just slightly larger than the diameter of the average pencil. A young rat can get through a similar opening if it is wider than 1/2-inch. If a rodent can get his head through an opening, he can squeeze the rest of his body through as well.

Keep in mind that rodents are gnawing mammals. If an opening is not large enough to squeeze through, they will try to enlarge it with their teeth. Rodents have trouble chewing

on a hard, flat surface but if they have a rough surface or an edge to bite into, they can gnaw an opening large enough for them to squeeze through.

Potential Entry Points for Rodents

- cracks in concrete slabs, or in brick and concrete block walls
- openings around conduits for utility lines (electric, gas, phone, cable)
- unscreened roof and wall vents
- uncapped chimneys
- roof and wall joints and roof edges without properly installed metal flashing
- gaps around water pipes and lines for fire sprinkler systems
- poorly sealed heating and air conditioning ducts
- worn or damaged floor drain covers
- doors hung too high and without a threshold or metal weather strip
- gaps around air shafts, elevator shafts, trash chutes, laundry chutes
- spaces around loading dock doors or doors that don't seal tightly

Key Points

Residential Garages

Garages are a common entry point for mice into houses because of poor door seals.

Once rodents enter the garage they can travel throughout the building along utility lines or through the attic.

Doors, Windows, Loading Docks

Mice and rats can enter structures through doors and windows in obvious ways: the door or window doesn't close completely, it's purposely propped open, or the screen is torn. They can also get inside through what appear, at first glance, to be perfectly tight, closed doors. It doesn't take much of a gap for a mouse to squeeze through. Most of the rodents that enter buildings do so through gaps around doors or doors that are left open.

In homes, garages are a common entry point for mice because of poor door seals. Older garage doors rarely fit tightly to the floor. As a result, mice are able to squeeze under the door or between the door and the jamb. Once in the garage, mice can get into the house through laundry drains or by following pipes, electrical lines, or furnace ducts. Attics in attached garages may be shared with the main structure. Once rodents enter the garage and then get into the attic, they can travel throughout the house.

Well-used bay doors in commercial establishments present the same problems as residential garage doors. These large doors should close flush to the ground and should not be left open for extended periods. When rail tracks enter food plants, bay doors often leave rat-sized openings along the sides and under the rail that need to be sealed.

Another consideration with door gaps, especially in food establishments or compactor rooms, is that food odors can filter out through the door. This attracts rodents, and even if they can't find a large enough opening to enter the area, the odors provide enough incentive for them to gnaw around door edges in order to make an opening. Another factor is the warm air (in cold weather) and cool air (in hot weather) that can escape around doors. This temperate air attracts rodents who want to get inside. Doors into garbage or compactor rooms should be kept closed and tightly sealed with door sweeps and/or thresholds at the bottom.

Foundations and Exterior Walls

Foundations often crack and separate as they settle, allowing rodents to enter buildings through holes and large cracks. Rodents can gnaw through cinder blocks and uncured concrete. Foundation openings can be filled with hardware cloth, sheet metal, steel wool, copper mesh, or broken glass and then sealed to keep rodents from chewing through.

There are several types of utility conduits that can provide entry points into a building. These include underground electrical lines or gas lines, TV cable or telephone lines, openings around water pipes, outdoor spigots, and water discharge lines from sump pumps. In older raised foundation or basement homes, there may be abandoned holes where utilities used to enter the structure. The openings where pipes and utility lines enter buildings should be sealed.

Rodents can get into buildings with piers or shallow foundation walls by burrowing beneath the floor. Rodents can also enter buildings through gaps where the exterior framing or siding meets the foundation. Masonite or wood siding is especially vulnerable to warping and cracking near corners and at the base, creating gaps where rodents can enter the building.



*Utility conduits that provide entry points into a building include electrical lines or gas lines, TV cable or telephone lines, openings around water pipes, outdoor spigots, and water discharge lines from sump pumps.
(Photo L. Pinto)*

Rodents can climb exterior walls and enter through bathroom vents, dryer vents, utility closets on balconies, or gaps around window-installed air conditioning units.

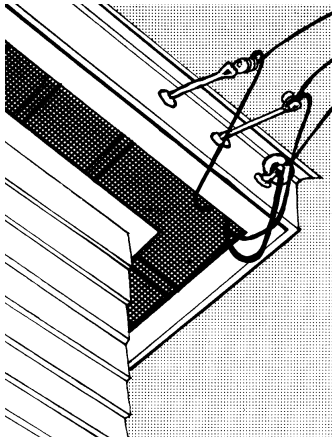
In older communities with poorly maintained sewer systems, rats have been known to enter buildings through the sewer. Rats enter sewers at outlets and through manholes, catch basins, broken pipes, or drains near their nest sites. Norway rats can dive and swim under water for 30 seconds at a time. In inner-city areas with rat-infested sewers, both Norway and roof rats occasionally enter buildings through toilet traps. Rats will also follow lateral lines directly into buildings and then swim through floor drains.

Roofs

Roof rats and squirrels will follow utility lines and tree branches to get onto the roof. Norway rats and even mice are excellent climbers. They can even climb up rain gutter downspouts, drain pipes, or rough textured exterior walls. Once on the roof, rodents can find their way into the attic through vents, louvers, unscreened eaves, loose or missing flashing, or other cracks and crevices. Roof rats can also enter structures through sewer vent pipes located on the roof.

Above ground power lines or telephone lines also provide access to roofs and attics. Roof rats, especially, use these high travel routes to enter buildings. Install metal rodent guards on overhead lines to keep roof rats from using the lines to reach buildings.

On roofs, rodents will nest in rooftop equipment, in air-handling units, and under or behind damaged flashing or roof coverings. Once a rodent gets onto a roof, it will work and gnaw to get inside if it cannot find obvious entry points, especially if enticing food smells are vented to the roof. Rodents can get directly into attics, sub-roof voids, or wall voids. Once inside, they can move into other areas of the structure.



Roof rats and squirrels will follow utility lines or tree branches to get onto the roof. (Graphic CES/IFAS)

Rodent Entry Via the Roof

Once on the roof, rodents can get into a building through:

- damaged fascia or soffits
- chimneys without caps
- unscreened vents or vents with tears in screens
- exhaust stacks, especially those that ventilate food areas
- openings around pipes or cables, where they enter near roof level
- openings around rooftop doors or elevator housings

Upon gaining entry into the attic, rodents (especially squirrels) may be able to get into the fireplace void by way of sheeting or metal collars that are improperly fitted. From there, they can then get into the fireplace itself from the damper or from the cool and warm air returns. Rodents can also get into the fireplace through cracks, missing mortar, poorly fitted siding, or a missing or damaged chimney cap.

RODENT “ISOLATION” INDOORS

Pest isolation is pest-proofing inside the building in order to confine pests to a specific area of the building, and keep them from moving into new areas. Compartmentalizing a building (like bulkheads do in a ship) isolates a rodent infestation in one area, and make the rodents easier to control. As indoor harborage sites are blocked, the building becomes less attractive to rodents, and those rodents that are inside are concentrated into fewer and fewer hiding places, making control easier.

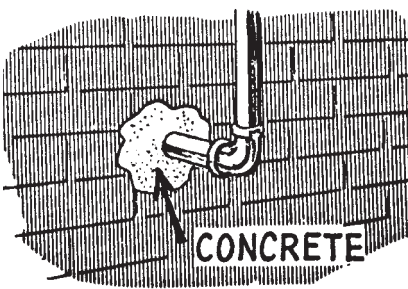


Mice easily move through wall and ceiling voids to disperse throughout a building. (Photo L. Pinto).

In most apartment buildings, mice can easily move through wall and ceiling voids to enter other apartments. In older buildings, often times over the years compactor rooms have received numerous holes for pipes and other utilities that have allowed pests free access in and out of the walls, floors, and ceilings. Openings around pipes, utility lines, and other entries into the voids between rooms should be closed to isolate the infestations in one area and keep rodents from spreading throughout the building.



Escutcheon plates can be installed around utility lines to prevent rodents from moving in and out of wall voids. (Photo L. Pinto)



Use a sealant to close openings around water pipes, electric wires, cables, and vents. For permanent repairs use hard materials such as concrete or sheet metal.

Pest isolation is especially useful in food plants and food stores. Loading docks, receiving areas, damaged goods storage, and other high-risk areas or infested areas can be physically isolated from the rest of the facility by rodent-proofing.

EXCLUSION METHODS AND TOOLS

Choose rodent-proofing materials carefully since rodents can gnaw through wood, lead, aluminum, plasterboard, and uncured concrete. You may need to use a combination of materials. Rodents can chew into foam caulk and they sometimes pull steel wool out of openings. For a temporary repair of a small opening, stuff the opening with steel wool or copper mesh and then seal it with foaming caulk to keep the stuffing in place. It helps to smooth off the corners of the caulk so rodents can't find an edge to begin their gnawing. This type of repair should only be used until a more permanent change can be made.

Consider the rodent that you are trying to exclude and concentrate your rodent-proofing to areas where that particular rodent is likely to enter. In other words, for roof rats, first seal openings up high. For Norway rats, you would concentrate on openings that are 1 yard above and below grade. Once this is done, then branch out to seal off other openings that rats can reach that are higher up.

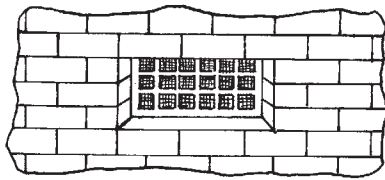
Foundations and Walls

Use a sealant to close openings around water pipes, electric wires, cables, and vents. Escutcheon plates can also be installed around utility lines to prevent rodent entry. Use materials that rodents cannot gnaw through, such as steel wool, copper mesh, sheet metal, or cement to seal holes and cracks around the foundation. To seal gaps in wood or siding, fit sheet metal collars, patches, or flashing around pipes, conduits, and other openings. Metal flashing should overlap the existing construction by at least 3 inches. Weather stripping should be installed around window air conditioners .

In buildings without basements, install a curtain wall or barrier around and below the foundation of the building in order to keep rats from burrowing beneath the foundation.

This wall can be made of metal, concrete, or brick and should extend 2 feet below the surface of the ground with an 8-inch horizontal L-flange extending away from the building. This way rats that dig down will be diverted by the “L” turn away from the foundation.

Install metal rat guards or collars around pipes to keep rats from climbing the pipes in order to gain access to the building, install metal rat guards or collars around the pipes. Use a 26-gauge sheet metal guard that projects out 12 inches from the pipe. Do not ignore pipes that run up into the structure from the crawlspace, this is a prime rat entryway. A flat metal guard can be used to keep rodents from traveling along vertical or horizontal wires and utility cables or conduits. Guards can be designed to fit any given situation.



*When screening vents, use screening material fine enough to exclude most pests but not so fine that it restricts air flow.
Graphic CES/IFAS*

Hardware cloth can be used to screen vents, floor drains, and other openings. When screening vents, use a material fine enough to exclude most pests but not so fine that it restricts air flow. For mice, use 18 gauge, 1/4-inch mesh, and for rats, use 18 gauge, 1/2-inch mesh or 16 gauge galvanized wire cloth. To avoid a fire hazard, do not screen clothes dryer vents if dryer lint could be trapped by the screen. In these situations, seal around the vent and make sure louvers or flapper valves close.

Doors and Windows

To keep mice from entering around a door, you need to close any space larger than 1/4-inch. Exterior doors should have thresholds and vinyl, brush, or rubber weather stripping, sweeps, or strip seals at the base. Older wooden doors should be fitted with a metal cuff and channel, a kick plate, or sheet metal around the bottom and three inches up each side. Older garage doors should be fitted with new compression seals and strips.



*To check doors for possible rodent entry points, stand in the dark and look at the closed door with bright light shining behind it.
(Photo L. Pinto)*

A good way to check doors for possible rodent entry points is to stand in the dark and look at the closed door with bright light shining behind it. This will allow you to see areas where the light leaks through and show you where there are spaces large enough to provide entry for a mouse. For double doors, check the seam where the doors come together.

In commercial facilities with rail tracks, special inserts can close up the spaces along the rail where it enters the plant. Interior doors in commercial facilities should be metal and should have automatic door closers. Wooden doors at food facilities should have metal flashing along the bottom edges and on door jambs to prevent gnawing by rodents.

All windows should be screened and cracks and gaps around them should be sealed. Use only metal window screen (not fabric screen) where rodents could enter. Pay special attention to windows that are at ground level or below grade.

Rodent-proofing Materials

- Galvanized sheet metal – 25 gauge or heavier
- Galvanized or rust-proof expanded metal – 28 gauge or heavier, mesh openings no larger than 1/4-inch
- Perforated metal – 14 gauge or heavier, perforations no larger than 1/4-inch
- Galvanized or rust-proof hardware cloth – 18 gauge or heavier, openings no larger than 1/4-inch for mice, 1/2-inch for rats
- Galvanized sheet iron flashing – 24 gauge for wooden door bottoms and jambs
- Aluminum – 22 gauge for frames and flashing; 18 gauge for kick plates and door guards
- Copper mesh – to close openings; does not rust
- Steel wool – to close openings; can rust over time
- Corrugated iron sheets – 29 gauge as a barrier to keep rats from burrowing beneath foundations
- Cement mortar – 1:3 mixture or richer
- Concrete – 1:2:4 mixture or richer, at least 2 inches thick
- Glass or ceramic tile
- Caulk – silicone sealant; if the caulk must be painted, use acrylic latex caulk
- Brick – regular size 3-3/4 inch with mortared joints
- Tension brushes and strips – for sliding or swinging doors
- Metal or rubber/plastic compression seals – for overhead door thresholds
- Vertical brush strips – for center seam of double doors



*Seal, screen, repair or otherwise rodent-proof openings on and around the roof that can let rodents into the building.
(Photo L. Pinto)*

Roofs

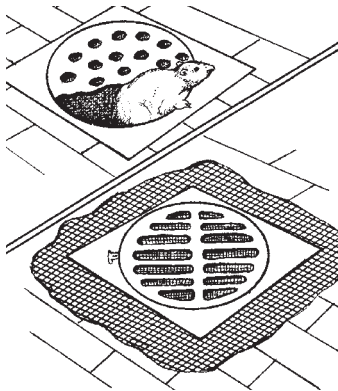
First, eliminate ways that rodents can get onto the roof. Trim back tree limbs by six feet and install guards on utility lines running to the roof. Second, seal, screen, repair or otherwise rodent-proof openings on and around the roof that can let rodents into the building.

Check roof joints for flashing. Look for damaged soffits and fascia boards. Also check roof vents and sewer vents to be sure they are tightly sealed and screened. Look for missing mortar or poorly installed flashing on chimneys. Make sure the chimney has a working chimney cap. Tile or shake shingle roofs should be sheeted with plywood or other material and tiles should be properly grouted. Vents should have tightly fitted double roof jacks.

Sewers

Breaks in sewer lines or laterals can be detected by fiber optic cameras that are snaked into the line, by smoke-producing leak detectors, or by running a special dye through the lines. Broken pipes should be replaced. If rats are swimming through the water trap and entering a toilet, a “rat guard” or one-way flap can be installed in the toilet.

Vent pipe openings can be covered with a piece of 1/4-inch mesh galvanized hardware cloth. Wire the screen tightly around the pipe. Floor drains should be covered with a brass drain cover or perforated metal cap. The cover must have vent holes but they should be no larger than 1/4-inch across. If larger, 1/4-inch mesh screen should be installed under the cover.



*A drain cover must have vent holes but they should be no larger than 1/4-inch across. If larger, 1/4-inch mesh screen should be installed under the cover.
(Graphic CES/IFAS)*

Exclusion Checklist

Look for and seal or screen these openings to keep rodents out:

In Residential Accounts:

- openings under, behind, and inside kitchen cabinets
- openings inside closets
- gaps around floor air vents and dryer vents
- missing louvers or flapper valves on outside vents
- gaps or missing mortar around the fireplace
- openings or damaged screen around windows and doors
- doors hung too high and without a threshold or metal weather strip
- pipe chases behind dishwashers, clothes washers, stoves
- around pipes under kitchen and bathroom sinks
- space around electrical, water, gas, cable, and sewer line entrances
- gaps around window air conditioning units
- openings around pipes behind or under hot water heaters, radiators, furnaces
- damaged attic and crawlspace vents or louvers
- loose or missing flashing or mortar on chimneys
- unscreened sewer roof vent pipes
- gaps around garage doors
- openings around the roof, eaves, gables, and soffits

In Commercial Accounts (in addition to the above):

- spaces around loading dock doors or doors that don't seal tightly
- cracks in concrete slabs, or in brick and concrete block walls
- gaps around water pipes and lines for fire sprinkler system
- poorly sealed heating and air conditioning ducts
- missing or damaged floor drain covers
- gaps around air shafts, elevator shafts, trash chutes, and laundry chutes
- openings entering trash rooms around pipes, wires, cables, and vents
- rooftop systems such as air-handling units, ventilation fans, stack flashing

REVIEW QUIZ

1. What is a common way that mice get into household attics?
 - a. they enter garages and move into the connected attics
 - b. they enter when attic stairs are down
 - c. cats bring them inside
 - d. they are carried into attics in storage boxes
2. What's an easy and effective way to check for gaps around doors?
 - a. hold your hand at the door edge and see if you feel air from outside
 - b. try to insert a screwdriver around the door's edges
 - c. stand inside, close the door, and look for light around edges
 - d. place newspaper around the door frame, then close the door
3. Which one of the following sealers is the most rodent-proof?
 - a. foaming caulk
 - b. cinder block
 - c. rubber gasket
 - d. galvanized sheet metal
4. To keep mice from entering, the minimum clearance for door flashing should be _____ from the sides and bottom of the door.
 - a. 1/8-inch
 - b. 1/4-inch
 - c. 1/2-inch
 - d. 3/4-inch
5. Which one of these solutions will discourage rodents from burrowing around a building's foundation?
 - a. plant the foundation with thick shrubbery
 - b. install a curtain wall barrier below the foundation
 - c. spread shredded hardwood mulch around the foundation
 - d. replace foundation soil with new, loose topsoil
6. A guard to keep rodents from climbing a pipe should be:
 - a. made of metal, projecting 12 inches from the pipe.
 - b. made of plywood and at least 12 inches wide.
 - c. made of plastic and at least 36 inches off of the ground.
 - d. made of rubber and at least 36 inches off of the ground.
7. The most common way for rodents to enter buildings is:
 - a. through and around doors.
 - b. in shipping boxes.
 - c. through holes in eaves.
 - d. through sewer lines.
8. Which one of these rodents is most likely to enter a building at the roof line?
 - a. Norway rat
 - b. house mouse
 - c. roof rat
 - d. deer mouse
9. Rodent "isolation" inside a building refers to:
 - a. discontinuing baiting to starve rodents out of a building.
 - b. confining a rodent infestation to one or a few areas by rodent-proofing.
 - c. caging captured rodents in a special holding area.
 - d. separating rats from mice inside a building.

CHAPTER SIX

Trapping and Other Physical Controls

Learning Objectives

- *List and describe three types of rodent traps.*
- *List advantages and disadvantages to traps when compared to other methods of rodent control.*
- *Describe how trap placement should differ between trapping house mice or trapping rats.*
- *Identify good locations to place snap traps for best control of mice.*
- *List precautions to take when using snap traps in sensitive areas.*
- *Describe special trapping tactics that can improve effectiveness.*
- *Match a bait used for trapping with a particular rodent based on feeding preferences.*
- *Describe how to maintain snap traps for optimum effectiveness.*
- *List placement differences when using glue traps compared with snap traps.*
- *Identify the major disadvantages to glue traps.*
- *Describe good trap placements when using multi-catch traps.*
- *List the steps to follow when checking a multi-catch trap.*
- *Identify procedures to insure humane live trapping.*
- *List and describe other examples of physical rodent control.*

Rodent control today is more about sanitation, rodent-proofing, and physical tools such as trapping than it is about rodenticides. The use of chemical toxicants, such as rodenticides, is being de-emphasized in sites such as schools, food plants, office buildings, and other sensitive sites. The public in general is increasingly interested in all types of nonchemical approaches to pest control.

TRAPPING



The primary physical control method used against rodents is trapping, and trapping offers significant advantages (see text). (Photo by CDC)

The primary physical control method used against rodents is trapping, and there are many kinds of effective traps available. The three most commonly used traps are the snap trap, glue trap, and multiple-catch trap.

Other kinds of traps are “live traps,” to capture squirrels in an attic or, in some instances, rats or mice so they can be disposed of or relocated. There are also electronic shock traps available that use batteries and an electrocuting plate to kill mice or rats that enter the trap.

Traps offer significant advantages in rodent control:

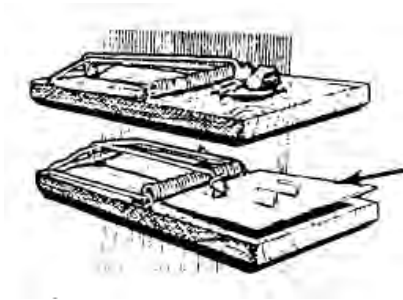
- No risk of environmental contamination.
- No toxicant for rodents to carry away or translocate to potentially contaminate other sites.
- Ideal for sensitive sites like food plants where the use of pesticides may not be acceptable, or where the amount of pesticide used must be kept to a minimum.
- Traps are effective against both large and small rodent populations.
- Traps show you immediately whether the control has been successful.
- A trapped rodent is out of circulation, no longer feeding or contaminating food (a poisoned rodent may stay active for days).
- Traps hold the rodent carcass so it can be disposed of, thus avoiding odor and insect problems that occur when rodents die in hidden locations.

There are disadvantages to traps that you need to keep in mind:

- Large infestations require many traps, which means a considerable expense in purchasing them along with the time required to set the traps.
- Dead rodents can be visible to the customer (unless you place the traps inside bait stations or under other cover).
- You'll need to revisit the site frequently in order to remove dead rodents, and rebait and reset the traps.
- Traps should not be used where there are children or animals unless they are placed inside a tamper-resistant bait station.
- Rodents that are caught by the leg or tail in snap traps, or that suffocate in glue traps, do not die humanely.

Snap Traps

The original standard mouse trap is the wooden base, spring-operated snap trap. Models are also made of plastic and metal. Many traps come with an expanded trigger design which means there is a larger bait treadle to improve trapping success. Larger versions of the mouse snap trap are used to kill rats.



*The original standard mouse trap is the wooden base, spring-operated snap trap. Most models today have an expanded trigger (arrow).
(Graphic CES/IFAS)*

The killing bar on a snap trap is powered by a spring and is released when a rodent steps on the trigger. When it works properly, the rodent is killed quickly when its neck, skull, or back is broken. Snap traps can be baited with a food bait, nest material, or they can be left unbaited.

In addition to these classic snap traps, there are now clam shell models that can be set with one hand.

Placing Snap Traps

Rats and mice react differently to traps. Rats are wary of anything new in their territory and will initially avoid it, while mice are very curious and will usually explore new things.

If a rat escapes a set trap, it is likely to avoid similar traps. At the beginning of a trapping program, place baited traps unset for a few days up to a week so that rodents, especially rats, get used to them.



Good trap placement improves results. Concentrate traps where you see or suspect rodent activity.
(Photo L. Pinto)

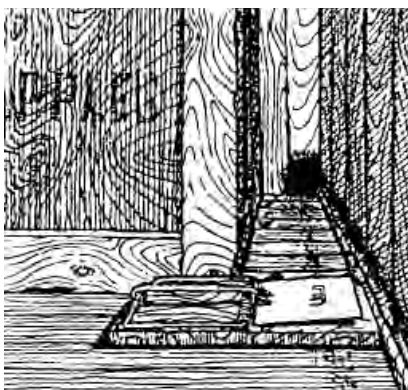
Since mice are curious, you can improve trapping results by moving boxes, pallets, shelves, or other objects in order to create new runways that lead to your traps. Mice will investigate the changed territory thoroughly. While getting rats used to the traps can take some time, mouse trapping can be successful in a short period of time.

Tips for Good Trap Placement

Good trap placement improves your results. Concentrate traps in areas where you see or suspect rodent activity, rather than evenly spacing them around the perimeter of a room or building. Place more traps in areas of high activity and fewer traps in other areas. Be sure to use enough traps, especially when trapping mice. Using too few traps is a common mistake. A large number of snap traps set for a short period of time will be much more effective than a small number that are set for a long time.

Where to Place Snap Traps for Best Results

- Space traps 5 to 10 feet apart for mice, and 15 to 20 feet apart for rats. Place more traps closer together if you're dealing with a large population.
- Place traps along rodent runways, perpendicular against walls, boxes, or other objects with the trigger end against the wall or other object.
- Move boxes and other objects around to create new, narrow runways to funnel rodents to your traps.
- Place traps near rodent droppings, nesting sites, nest material, feeding sites, or where you see gnawing damage.
- When trapping mice, rearrange traps often to appeal to their natural curiosity regarding new things in their territory.
- If rodents are jumping the traps, make multiple sets using three traps placed side by side with about a one inch space between them.
- Snap traps for rats should be fastened to the floor or other object, or placed in a heavy-duty bait station, so that the trapped rat can't drag the trap away.
- Snap traps can be wired or nailed to overhead pipes or ledges, or a hose clamp can be screwed to the bottom of the trigger end of the trap. Attach the clamp so the trap can be placed at a right angle to the pipe.
- If you haven't trapped any mice after 3 days, move the traps around. Wait at least 5 days before relocating snap traps for rats.
- In severe infestations, try "saturation trapping," also called "mass trapping." Place dozens or hundreds of baited traps unset in an infested area. After a few days up to a week, set all the traps at once. Continue resetting the traps for another week.



Place traps across obvious runways or create runways by placing a box or board to funnel the rodents to the trap. (Graphic by CDC)



Place snap traps inside bait boxes in sensitive sites. (Photo L. Pinto)

Caution

Outdoor traps that are not placed inside stations should be set only from dusk to dawn to avoid trapping nontarget animals like birds and squirrels.

Think in three dimensions when trapping rodents, particularly mice. Mice can be living above their main food supply inside suspended ceilings, or they may be below in floor voids or crawlspaces.

Also keep in mind that mice have small territories, typically only wandering 10 to 30 feet from their nests. If mice are sighted throughout a building, that means there are many locations where you will have to set traps.

With roof rats, you will need to change your approach to trapping. Roof rats' travel routes are usually found *above* the ground, along branches, beams, ledges, and sills. Inside trapping sites are usually dark corners inside suspended ceilings, in attics, or in overhangs and soffits. Outside, traps can be attached to chain link fence poles or tree branches using cup hooks and rubber bands or bungee cords.

Precautions with Snap Traps

While traps pose fewer risks than rodenticides, there are still precautions that should be taken when using traps in sensitive areas:

- Whenever possible, place snap traps in areas out of public access and view.
- Place snap traps inside bait boxes in sensitive sites where people cannot see dead mice, or where children, pets, guard dogs, birds, or other animals could come in contact with the traps.
- Traps should also be placed in bait stations if a trapped rodent could contaminate nearby food.
- Place snap traps inside lengths of PVC pipe or in heavy-duty bait stations in areas where they could be damaged by fork lifts and other heavy equipment.
- Don't place snap traps directly above food products or food preparation areas.

Baiting Snap Traps

Traps can work even without being baited. However, an attractive and fresh bait can increase a trap's effectiveness.

Mice like to nibble on many different foods while rats tend to prefer foods they are used to eating. But some

individual rats or mice may prefer one food while others may be looking for something completely different.

Trap Baiting Tips

- Peanut butter works well for both mice and rats, but beware of the potential for peanut allergies in people. (Do not use in food plants or schools.)
- Baits that work well for both mice and rats are nut meats, caramel corn, "kitty malt" (comes in a tube as a diet supplement to eliminate hair balls), cereal, molasses, bacon, hot dog slices. Mice also like gumdrops.
- Rats tend to prefer foods that they are used to eating. For Norway rats try a piece of raw bacon or sardines (packed in oil, not in sauce). Roof rats are more vegetarian, so if meats don't work, try fruits like raisins, prunes, grapes, or oranges.
- Check the bait frequently and replace rancid or moldy baits.
- Bait traps with nesting material (cotton balls, soft string, dental floss, strips of cloth), especially in accounts where food is already abundant.
- If your trap catch drops off, try switching to another type of bait.
- To prevent thievery of the bait without a catch, use a sticky bait like peanut butter that cannot be carried away or tie the bait onto the trap with dental floss.
- For a trapping program requiring many traps, prebait the traps with a variety of food baits plus nesting material. Try foods similar to what the rodents are feeding on at the site, and try some foods that are different than what they've been feeding on that may provide a necessary supplement to their diet. When you discover the rodents' preference, use that bait in your trapping program.
- You can also overcome bait shyness by preconditioning your traps. Smear a small amount of the chosen food bait on the sides and edges of the traps before actually baiting and setting them. The traps can also be stored in a sealed plastic bag along with some of the food bait.

Snap Trap Maintenance

How often should you service snap traps? It completely depends on the location. In some accounts, such as food plants, you may need to check snap traps daily. However, in most sites the service frequency will range from twice-a-week to monthly, depending on the sensitivity of the account and the chance for odor problems from dead rodents. In warm, summer weather, check traps more often since decaying carcasses can quickly attract flies and other pests. Dispose of the rodents in a sealed plastic bag.

Key Points**Cleaning Snap Traps**

- Traps that have previously caught mice or rats are more attractive to rodents.
- Generally, technicians simply scrape off dirty traps with a putty knife or brush them with a wire brush.
- In some circumstances, traps should be aggressively cleaned (see box)

How intensively should you clean snap traps? You hear it both ways, clean them (1) after every catch or (2) you should not clean your traps if you want to catch more rodents. It just depends on your trapping site (see box below).

In general, traps that have previously caught mice or rats are more attractive to rodents. The pheromones and smells left by previously trapped rodents help entice new rodents to the trap. These smells make them think that it is safe. The smell of food bait left on the traps also lures rodents. These familiar smells are even more important to rats who tend to be more trap-shy than mice.

Generally, technicians simply scrape off dirty traps with a putty knife or brush them with a wire brush to clean them. This gets rid of the gunk but does not eliminate the desirable odors. A nonstick food oil spray can be used to keep dead rodents from sticking to the trap. Always wear disposable gloves when cleaning traps in order to protect yourself from disease.

When Traps Should Be Kept Very Clean

There are three situations where it is not a good idea to use dirty traps:

1. In a food handling facility. These sites are regularly checked by health inspectors and a snap trap with rodent hairs and other debris that can cause food contamination can result in monetary fines or closure of the facility. Snap traps should be placed inside a bait/trap station and may have to be steam-cleaned after each catch.
2. Other sensitive sites, such as hospitals or schools, where management insists that you keep the traps clean and smell-free.
3. In an area with a history of hantavirus. In this case, you do not want your traps to get too grungy since you risk inhaling mouse urine and fecal particles that can pass on the disease. Traps should be regularly cleaned and disinfected.

Glue Traps

Glue traps (glue trays) for rodents are similar to sticky traps used for insects. A cardboard or plastic tray base is covered with a sticky material. Glue boards have a thinner layer of glue than the glue tray traps, although either style is often called a “glue board.”



Glue traps are most often used for mice, but larger glue traps with more sticky surface area can be used for rats. (Photo L. Pinto)

Regular cooking oil poured on a glue trap will dissolve the glue to release a child's hand, a snake or any other animal accidentally stuck.

Glue traps are mostly used for mice, but larger glue traps with more sticky surface area can be used for rats.

Some glue traps are perforated so they can be separated to fit specific areas, while others can be folded into a tent shape. Glue traps may be “prescented” with a food smell, or a food bait can be added to the center of the glue trap if desired. Avoid using oily food baits such as sardines or bacon on glue traps because they will reduce the effectiveness of the glue.

Glue traps have some distinct advantages and disadvantages when compared with snap traps. The advantages are that they are inexpensive, and easy to place. Large numbers can be carried by a technician since they store flat. Glue traps can also be used inside multiple-catch traps to hold captured mice. Once they trap a rodent, glue traps are simply disposed of into the trash, rodent and all.

The major disadvantage to glue traps is that many people consider glue traps to be an inhumane method of rodent control since the rodents usually die by suffocation when their face becomes trapped in the glue. They can struggle and squeal. Once caught in a glue trap rats, especially, do not die quietly or easily and may carry the trap away if it is not securely anchored. Other disadvantages of glue traps include:

- They are less effective in extreme heat or cold or if they become dusty or covered with debris. In dusty or damp areas, place glue traps inside rodent bait stations.
- They will stick to anything, whether it is a rodent, a cat, or a child. Like snap traps, glue traps should be placed inside tamper-resistant bait stations if children, pets, or other nontarget animals are present.

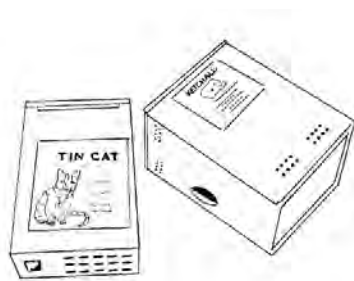
Glue Trap Placement

In general, place glue traps in the same locations and in the same numbers as you would place snap traps. There are some exceptions:

- Glue traps should not be placed in corners because mice slow down to explore corners and their whiskers may touch the glue warning them away (unlike snap traps which offer no advance warning).

- Avoid placing glue traps perpendicular to the wall (as with snap traps), place them lengthwise against the wall or other object that lines a runway.
- Avoid placing glue traps in direct sunlight. If you must, place them inside bait stations or shield the glue traps somehow.
- Don't place glue traps in extremely cold conditions (below 20 degrees F.), or near open flames or on hot pipes.

Multi-Catch Mouse Traps



Multi-catch traps work because mice are curious. There are many styles of multi-catch traps, each is suited to a particular location and condition at the site. (Graphic CES/IFAS)

The multiple-catch (or multi-catch) mouse trap--also called automatic repeating trap or curiosity trap is both an effective control tool and a useful monitoring device to identify active sites. Multi-catch traps are especially useful in food accounts such as food and drug manufacturing plants, warehouses, and commercial kitchens because a trapped rodent is contained and out-of-sight.

Multi-catch traps work because mice are curious and investigate all new things in their territory. They are drawn to the dark interior of the trap and will usually enter the small entrance hole without hesitation. If there are other mice in the trap so that it smells “mousy,” this increases the attraction of new mice to the trap.

There are many styles of multi-catch traps, and each is suited to a particular location and condition at the site. These include treadle activated, wind-up, high profile, low profile, metal, and plastic see-through.

Multi-Catch Trap Placement

Mice like it dark. They also habitually follow the same regular runways along walls and the straight vertical edges of pallets, boxes, and equipment. Place multi-catch mouse traps in runways in dark corners, and along walls, stored materials, and equipment.

There are two strategies of positioning multi-catch traps in relation to walls or other vertical surfaces: (1) place them flush against walls with the opening parallel to the runway or, alternatively, (2) place the trap with the opening facing the

wall, leaving an inch or two of space between the trap and the wall. Both strategies work because mice are curious and investigate the dark entrance.

Keep in mind the small size of the typical mouse territory. While rats travel hundreds of feet every night foraging for food, mice rarely travel more than 30 feet, and usually much less. As a result, traps must be placed fairly close together in order to protect a large area. Do not limit traps to ground level. Suspended ceilings are excellent sites, as are the tops of walk-in coolers and cabinets. In infested sites, look for droppings and place traps nearby.



You can place multi-catch traps flush against walls with the opening parallel to the runway as shown, or perpendicular, with the opening facing the wall, leaving an inch or two of space. (Photo L. Pinto)

Inside warehouses and other commercial sites, place multiple-catch traps every 20 to 25 feet on the inside of perimeter walls. Place them closer together if there is a lot of mouse activity, this could be as close as every six feet. If there is no evidence of mice, and the traps are only preventative, increase the distance up to 40 feet apart. Place traps on all sides of exterior doors, loading docks, or ramp doors (left side, right side, both indoors and out), near utility line openings, and against large objects in suspected activity sites. Also, position low-profile multi-catch traps under pallets in infested areas.

In cluttered areas, rearrange boxes, shelves, pallets, and other items near the traps. This alteration in the mouse's territory forces it to re-explore and redefine its territory, including the insides of multi-catch traps.

Multi-Catch Mouse Trap Maintenance

The frequency of service depends on the type of facility and whether it has an existing mouse infestation. Because of the sensitive nature of food plants and drug plants, multi-catch traps should be serviced weekly. In problem areas of these facilities, the traps may need to be checked more often. In other types of buildings, bi-weekly or monthly service may be acceptable if the mouse pressure is low, especially if glue traps are placed inside the multi-catch traps. In warm, summer weather, check traps more often since decaying carcasses can quickly attract flies and other pests.

Before opening a multiple-catch trap, make sure there are no live mice inside that could escape. If the trap does not

WARNING: If multi-catch traps are not serviced regularly, dead mice in the trap can cause odor problems.

have a see-through top, shine a flashlight through the ends of the trap. However, always open the trap, since mice may be hidden in the tunnels or in the back of the trap where you cannot see them. Some technicians first shake the trap violently to stun any live mice. Any live mice should be killed humanely, which most experts feel is best done with a sharp blow to the back of the head.

Use a putty knife or wire brush to remove any stuck remains from the trap. A non-stick food spray can be applied to the bottom of metal traps to keep dead mice from sticking to the traps. Put mice and trap debris into a sealed trash bag. Some food plants require you to clean and disinfect any trap that has captured a mouse.

Live Traps

There are small live traps for capturing squirrels, rats and mice. The animals then can be killed or released, depending on the circumstances.



Squirrels are fairly easy to live trap because they rarely fear wire traps, and will enter them without inhibition. (Graphic Kness Mfg.)

For rats and mice, trap placement and strategy will be similar to that discussed for snap traps. Squirrels are fairly easy to live trap because they rarely fear wire traps, and will enter them without inhibition. Often, squirrels are trapped in order to remove them from an attic, and then simply released back outside after the structure is made squirrel-proof.

If there are several squirrels that need to be trapped, place the live trap with the doors tied open and baited with peanuts, other nuts, peanut butter, or sunflower seeds. Leave a short bait trail to lead the squirrels into the trap. After a few days, the squirrels will become used to feeding at the trap, and once the trap is set, the squirrels can be trapped one after another. If squirrels are using a tree to reach the roof, place the trap at the base of the tree.

Humane Live Trapping

Try to keep the trapped animal comfortable. Protect it from people, pets, predators, dehydration, and bad weather. First of all, that means checking traps frequently. You do not want a trapped animal that is destined for release to die slowly of starvation or dehydration before you can release it.

To protect trapped animals from the elements, place traps in areas that are protected and less exposed to the sun and rain. Cover metal traps with tarps, towels, or plywood. You should also try to protect trapped animals from undue stress. Placing the trap correctly will also hide it from children, pets, and predators which, at the very least, can harass or scare the trapped animal.

When relocating trapped squirrels to a new area, survival may depend on the time of year. During summer months, relocated squirrels may adjust to a new environment and survive. Experts suggest that squirrels should be released 5 to 7 miles away. However, if you release squirrels during the winter, they may die of exposure before finding shelter or they may starve because they will not have access to stored food caches.

Also, if you release an injured or traumatized animal into a new location, it may not be able to ward off the attacks of other animals that are already established in that location.

Know the Maryland trapping regulations that fall under the authority of the Maryland Department of Natural Resources (DNR) for any animal except the domestic rodent. You might not be allowed to release certain trapped animals, but may have to kill them instead. In other situations, you might not be allowed to kill a trapped animal, but you may have to release it instead.



Do not create orphans. Nursing and dependent young that are not old enough to take care of themselves will die if you remove the parent. (Photo JJM Wikimedia Commons)

Do Not Create Orphans

Know the nesting and birthing season of squirrels or any other animal you are trapping. Know when young are likely to be present, look and listen for them. Nursing and dependent young that are not old enough to take care of themselves will die if you remove the parent. If the young are left alone inside a home or other building, you will have a major odor and disposal problem to deal with as well. To avoid creating orphans, you may have to wait until the young are on their own before you remove or exclude the animal family from the site.

Killing (Euthanizing) the Trapped Animal

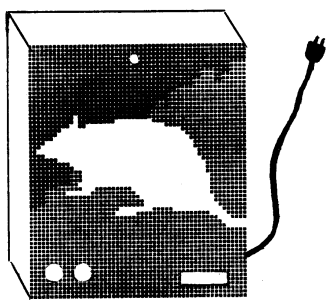
If you do have to kill an animal, always do it as quickly as possible or, first quickly make the animal unconscious, then kill it. There is no point in allowing animals to suffer. The recommended ways to kill an animal depends on the species of animal trapped and include carbon dioxide poisoning, cervical dislocation (breaking the neck), lethal blow to the back of the head, and chest compression to quickly stop the heart.

OTHER PHYSICAL CONTROLS**Repellents**

Naphthalene and similar repellent chemicals have been used to repel rats, mice, and squirrels. Typically, these products are applied around the perimeter of the structure to be protected, or inside a specific area. Only those products that are registered for this use must be used and when used according to manufacturer's directions, they have shown some effectiveness in repelling these animals.

Electronic Devices

Many kinds of electronic devices are sold with claims to control rodents. The best known of these devices are the ultrasonic repellers.



The general consensus among pest control professionals is that ultrasonic devices are not very useful, and research has also found that electromagnetic devices are ineffective against rodents.

While there has been some limited research supporting the effectiveness of ultrasonic devices against rodents, most studies have not supported their use as practical or cost effective. Testing of the most powerful ultrasonic devices has shown that about half of the sound energy is gone within 15 feet of the device and any object found in the room blocks the sound. A typical room would need a number of devices strategically placed in order to saturate the entire space. Besides, rodents quickly become used to regularly repeated sounds and return to their nesting sites and foraging routes. The general consensus among pest control professionals is that ultrasonic devices are not very useful.

Electromagnetic repellers work on a different principal, a magnetic field that “stuns” rodents. Independent research has also found that these devices are ineffective against rodents.

Shooting

Air rifles and firearms have been used to control rats and squirrels on very limited and restricted occasions. Shooting rodent pests is not an efficient method of control and is not generally recommended. However, if you choose to use this method, observe the proper firearms safety procedures and state regulations. A shotgun with No. 6 shot, a .22-caliber rifle, or a powerful air gun is suitable for rats or squirrels. Check with the Maryland Department of Natural Resources (DNR) for regulations pertaining to the particular species. Shooting will be illegal in most urban and suburban locations, but will be acceptable in some rural locations.



A shotgun with No. 6 shot, a .22-caliber rifle, or a powerful air gun is suitable for rats or squirrels. Check Maryland and local regulations before shooting any animal.

Squirrels are active in the day, but rats and mice are strongly nocturnal, so the best hunting for these animals is at dusk and after dark. Night vision scopes will aid you in seeing your targets without alarming them. A low budget alternative is a red or amber filter over your flashlight. Rodents, like most nocturnal mammals, do not see in color and do not seem to see in the red or amber wavelengths.

REVIEW QUIZ

1. The most important thing to consider when choosing the type of rodent trap is:
 - a. the time of year you are trapping.
 - b. whether you are trapping rats or mice.
 - c. the size of the rodent population.
 - d. whether the trap will be baited.
2. Which one of these traps usually results in immediate death for the captured rodent?
 - a. multiple catch trap
 - b. glue board trap
 - c. snap trap
 - d. live trap
3. Snap traps for rodents should be placed:
 - a. with the trap lengthwise and parallel to the wall.
 - b. in the open, away from any objects like boxes.
 - c. away from active rodent runways.
 - d. in areas with signs of rodent activity.
4. Which one of these mouse baits is most effective in a site with ample food available?
 - a. cotton ball
 - b. cheese
 - c. seeds
 - d. peanut butter
5. What is one advantage to using rodent glue boards instead of snap traps?
 - a. glue boards can be placed above food products in warehouses
 - b. rodents suffocate to death
 - c. trap and rodent can be simply disposed of in the trash
 - d. glue boards hide the catch from people's view
6. Which one of these can cause glue boards to be ineffective?
 - a. if the glue board is inside a bait station
 - b. if the glue board becomes dusty
 - c. if the glue board is placed in a rodent's runway
 - d. if the rodent has recently fed
7. What is one disadvantage to the use of multi-catch mouse traps?
 - a. they have to be reset after each mouse is caught
 - b. they have to be baited to be effective
 - c. they are only effective when flush against a wall
 - d. dead mice in the trap can cause odor problems
8. Which one of these is a disadvantage to the use of traps in rodent control?
 - a. traps are effective against both large and small rodent populations
 - b. traps hold the rodent carcass for disposal
 - c. large infestations require considerable set-up and maintenance time
 - d. there is no toxicant to potentially contaminate other sites

Rodenticides

Learning Objectives

- *Define the term “rodenticide.”*
- *List the advantages and disadvantages of using rodenticides.*
- *Describe how rodenticides are classified.*
- *Describe the physical characteristics of each rodenticide formulation.*
- *Match the rodenticide formulation to its best use in the field.*
- *Describe “translocation” of rodenticide and discuss its importance.*
- *Describe the conditions requiring a tamper-resistant bait station.*
- *Explain why and when a bait station must be secured.*
- *List reasons why bait should be secured inside a bait station.*
- *List the precautions that should be taken when using liquid bait and when using tracking powder.*
- *List common examples of rodenticide misuse.*
- *Describe the advantages and disadvantages of each rodenticide formulation.*
- *Describe good placement strategies for rodenticide bait stations.*
- *List steps to take when servicing a bait station.*
- *Describe the recordkeeping required when using rodenticides.*

Rodenticides are poisons designed to kill rodents. Historically, they have been the primary tool used to kill rats and mice in and around structures. Over the years they have been overused along with being misused. Remember, one of the goals of rodent IPM is to use rodenticides only when necessary. Pest managers should view rodenticides as a tool of last resort when other measures are deemed unsuitable for some reason. However, there is an exception to this “tool of last resort” approach. That would be for the preventative baiting of exterior perimeters to kill rats or mice migrating into a structure or onto a property.

Professionals use rodenticides because they do offer a number of advantages:

- Rodenticides are effective when used properly.
- Rodenticides come in a wide variety of formulations and products. Baits are available in blocks, pellets, seeds, meal, liquid, and granules that are mixed with various food attractants. If one formulation is not accepted, there are others that can be substituted. Also, if baits are not working, tracking powders may be another option, or even the use of fumigants.
- Rodenticides are economical, both in terms of their direct cost, and because the use of them does not require much time on the part of the technician.

There are also disadvantages to using rodenticides.

- Nontarget poisoning. Every year there are accidental poisoning incidents, usually involving dogs and cats, as well as nontarget wildlife, livestock, and zoo animals.
- Secondary poisoning/ingestion. Nontarget animal sometimes eat dead or dying poisoned rodents and are poisoned by the residues of rodenticide that may be found in the rodents’ flesh, or as undigested rodenticide bait in their digestive system or mouth.
- Odor. Dead, poisoned rodents produce foul odors. This is particularly true of rats. A single dead rat can produce a sickening odor for weeks, and the odor from a major kill can be overwhelming.



Because of their inherent hazards, pest managers should view rodenticides as a tool of last resort.

- Unexpected hazards. A build-up of tracking powder in building voids from repeated treatments can pose a risk to workers and others when the tracking powder is disturbed during repairs or renovation.
- Overdependence. A major disadvantage to using rodenticides is that technicians along with customers become dependent on them. It seems easier and cheaper to apply rodenticides every month rather than addressing improper trash handling practices, poor sanitation, or structural deficiencies.

A rodenticide's characteristics are determined by two factors: (1) the active ingredient and (2) how it is formulated. The active ingredient is the chemical within the rodenticide that actually kills the rodent. While the formulation of the rodenticide is the form in which the product is sold. This can be as a bait, either dry or liquid, in blocks, seeds or pellets, or as a tracking powder or a fumigant.

HOW RODENTICIDES WORK

There are less than ten active ingredients currently used in rodenticides. They are classified in two ways:

1. By their mode of action (how they kill)--whether they are anticoagulants or non-anticoagulants, or
2. By their feeding characteristics—whether they can kill rodents with a single feeding or require multiple feedings over time.

Key Points

Anticoagulant Rodenticides:

1. Prevent blood from coagulating (clotting).
2. Rodents that ingest a toxic dose die from internal bleeding.
3. Kill slowly over a period of days.
4. Usually require multiple doses to kill (some newer products may require just one feeding).

Anticoagulant Rodenticides

Anticoagulant rodenticides act just as their name implies, by preventing blood from coagulating (clotting). Rodents that have eaten a toxic dose of anticoagulant bait die a painless, although slow, death from internal bleeding. Because they weaken slowly over several days, mice and rats do not develop "bait shyness." In addition, they do not associate feeding on the bait with their condition.

Anticoagulants are generally less toxic to people and pets than the rodenticides with other modes of action. In fact, low doses of some anticoagulants are given to humans who are at

risk of blood clots or a stroke. Because there is a time delay between when the bait is ingested and the onset of severe symptoms, people, pets, or livestock can be given vitamin K₁ as an antidote in order to prevent poisoning.

First Generation Anticoagulants

The earliest anticoagulants are called first-generation anticoagulants. The two most commonly used active ingredients in today's market are chlorophacinone and diphacinone. These are multiple-dose poisons, that usually require the rodent to eat the bait repeatedly over several days in order to get a toxic dose. The bait must usually be available continuously over a 2 to 3 week period of time in order to kill the rodent.

Second Generation Anticoagulants

Some rats and mice have developed a genetic resistance to warfarin along with other early anticoagulants, thus prompting a new group of active ingredients (brodifacoum, bromadiolone, difethialone). These second-generation anticoagulants can often kill rodents after a single feeding, or, at most, after feeding for a couple of night's. Second-generation anticoagulants are also toxic at a much lower dose. Some of these products can kill a mouse with just a few pellets or bites of a block. However, it still takes three or more days for poisoned rodents to begin dying. Rodents will often continue feeding for days after they have consumed a lethal dose.

Non-Anticoagulant Rodenticides

There are currently three rodenticides that are not anticoagulants, but these active ingredients have nothing in common besides the fact that their modes of action are different from the anticoagulants.

Bromethalin

Bromethalin is categorized as a "stop-feed" because rodents that eat a toxic dose will stop feeding even though death may not occur for 1 to 4 days. Only small amounts of bromethalin are necessary to kill rodents and a toxic dose can be consumed in a single night's feeding. In addition, bait shyness is not a problem.

Rodents poisoned with bromethalin typically die with their back legs stretched out behind them. While there is no specific antidote for an accidental poisoning with bromethalin, treatment therapies are available.

Cholecalciferol

Cholecalciferol is vitamin D3. In small doses this vitamin is beneficial but in large doses it is poisonous, especially to rodents, dogs, and cats. Large doses cause a chemical imbalance, where calcium is withdrawn from the bones into the bloodstream, kidneys, and other organs. Death results from heart failure.

Key Points

Non-anticoagulant Rodenticides:

1. Have nothing in common besides the fact that their modes of action are different than the anticoagulants.
2. Zinc phosphide is the fastest-acting rodenticide, but has no antidote and may cause "bait shyness."

Cholecalciferol is also a "stop-feed" rodenticide, but usually requires multiple feedings for several days before the feeding stops. There is also no bait shyness associated with this active ingredient.

Treatment of an accidental poisoning is necessary if the serum calcium levels become elevated, which is called hypercalcemia.

Zinc phosphide

Zinc phosphide is an acute, single dose rodenticide. When zinc phosphide comes in contact with stomach acids it releases toxic phosphine gas. Poisoned rodents usually die from heart failure, and are often found lying on their stomach with their tail and legs extended behind them. Zinc phosphide is fast-acting, and kills rats in anywhere from less than one hour to overnight.

The odor of zinc phosphide is attractive to rodents but somewhat repellent to people and most animals, which reduces the potential for nontarget poisonings. There is no antidote for a zinc phosphide poisoning, and an accidental poisoning must be handled as an acute emergency. A victim should be transported immediately to the nearest hospital and animals taken immediately to a veterinarian.

Rodents that survive after eating a sublethal dose of zinc phosphide often develop bait shyness and will not feed on zinc phosphide again.

RODENTICIDE FORMULATIONS

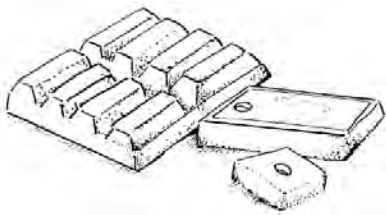
Rodenticides come in a wide variety of formulations. The main formulation categories are baits, fumigants, and tracking powders. The baits themselves come in various formulations: blocks, pellets, meal, seeds, and liquids, and place packs.

Food Baits

Rodenticide baits come as food baits and water (liquid) baits. Food baits are the formulations of rodenticide that are used most often.

Bait Blocks

Rodenticide bait blocks are made by combining a rodenticide with a food bait to which paraffin has been added. Most blocks are formed by extrusion, and they typically include holes and grooves for securing them on rods or with wire or string so that rodents cannot carry them to a different location (translocation). Blocks are weather-resistant and hold up well in damp sites. They are also attractive to rodents not only as a food but for gnawing.



Bait blocks are weather-resistant and hold up well in damp sites. They are also attractive to rodents not only as a food but for gnawing. (Graphic from Prevention and Control of Wildlife Damage)

Rodenticide Pellets

Pelleted baits combine a rodenticide with a food bait which is then compressed and formed into small pellets that are attractive to both rats and mice. Pellets are the most cost-effective solid bait, but their main disadvantage is that they are easily translocated by rodents to new locations.

Meal Baits

Meal baits contain food-grade ingredients, such as seeds and grains, much of which are ground into a meal, that gives rodents a variety of textures and flavors. Meal is the least weather resistant bait because it can absorb moisture and spoils quickly. Meal baits are also susceptible to insect infestations. The main advantage is that they cannot be translocated easily by rodents.

Seed Baits

Seed baits consist of a rodenticide that is combined with various types of seeds such as millet or a canary seed mix that mice find palatable. They are designed specifically for mice,



Rodenticide pellets, meal, and seed baits may be packaged in bulk or in small packets sometimes called “place packs.” (Graphic from Prevention and Control of Wildlife Damage)



Liquid rodenticides come as a liquid concentrate that is mixed with water and then dispensed in tamper-resistant bait stations, “chick fonts” or other receptacle. (Graphic from Prevention and Control of Wildlife Damage)

and are very effective against house mice, deer mice, and white-footed mice. Bait acceptance is high because mice like hulling the seed. These baits also compete well against other food sources in the rodent’s environment, and will typically outperform other bait formulations. Seed baits are also very prone to translocation.

Packet Baits (Place Packs)

Packet baits and place packs are pellet baits, meal baits, or seed baits that are packaged in small packets. The packets keep the bait fresh. Another advantage to place packs is that when rodents chew open the pack to get at the bait the damage provides a positive indicator that rodents are present.

Packet baits and place packs used to be called “toss packs” because applicators would “toss” them back into hard-to-reach areas. This casual method of application is not a good practice since the packs were typically not placed into secure locations away from children and pets, and the packs often could not be easily retrieved. Other disadvantages of toss packs include ease of translocation and higher cost.

Liquid Baits

Rats need water daily and mice will drink when liquids are available. Liquid baits, also called water baits, are particularly effective for rats in infested sites where water is scarce. The formulation comes as a liquid concentrate that is mixed with water and then dispensed in tamper-resistant bait stations, water dispensers used for poultry (“chick fonts”) or other receptacle that is located away from pets and other non-target animals.

Liquid baits are most useful in grain storage structures, flour mills, and other dry food facilities. The disadvantages of liquid baits are the service requirements, risk of spillage, and the potential of nontarget animals (particularly guard dogs) to drink the baits.

Tracking Powders

A tracking powder is simply a rodenticide that is combined with talc or powdery clay. It is applied into inaccessible areas where rats and mice live and travel. Tracking powders make



*Rodenticide tracking powders are applied into inaccessible areas where rats and mice live and travel, or inside bait stations.
(Graphic adapted from CDC)*

use of the rodents' behavior to groom themselves by licking their fur. The powder sticks to their feet and fur, and is swallowed when the animals groom themselves.

Tracking powders can kill rodents even when food and water are plentiful. They may prove to be the only effective formulation in infested sites where rodents have become bait- or trap-shy.

All tracking powders are classified as restricted use pesticides because of their toxicity and the risk of inhalation when misapplied or disturbed.

Fumigants

Fumigants were once widely used to control rodents, but are not used very much today. Fumigation of outdoor rat burrows is done with aluminum phosphide, chloropicrin (tear gas), or a variety of "smoke bombs" that asphyxiate rodents in their burrows. Rarely will a rodent-infested building be fumigated with methyl bromide or sulfuryl fluoride. Fumigants are highly hazardous materials, and because fumigation requires separate licensing and certification, fumigants will not be discussed in detail here.

APPLICATION GUIDELINES

Rodenticides pose risks of accidental poisonings to children, pets, and nontarget animals. They must be applied properly in order to minimize these risks. Always read the rodenticide label carefully each time you use the product. Do not assume that you know the directions and safety information contained on the label from the last time you read it. Labels are complex, with each having its own specific directions that are often updated. Due to this, there may be labels of the same product with different application directions, rates, and precautions on containers or packages. Be sure to review the sample labels provided later in this chapter.

All rodenticides have warnings on the label telling the applicator to place the bait "in locations not accessible to children, pets, wildlife, and domestic animals, or in tamper-resistant bait stations."

Key Points

Rodenticide Placement

All rodenticide labels include the following directions:

"Place in locations not accessible to children, pets, wildlife, and domestic animals, or in tamper-resistant bait stations."

What is “not accessible”? No one can give you a list of safe, inaccessible areas. Whether a particular placement is “not accessible” to children and nontarget animals will depend on the location and the children and animals that may be present. So, before you apply any rodenticide, always first ask yourself questions such as:

- Is it possible for a child to get at the rodenticide?
- Could a cat walk through the tracking powder?
- Is there wildlife in the area that could feed on the baits?
- Does a commercial facility have a guard dog in the evening that could get at the bait?

Do everything you can to minimize the risk of an accidental poisoning. If you are not sure if a particular placement will be inaccessible, then place the rodenticide into a tamper-resistant bait station.



Rodenticide bait stations come in two classes: (1) tamper-resistant and (2) nontamper-resistant. Whenever a child or nontarget animal could get access to the bait you must use a tamper-resistant station.

(Graphic from Prevention and Control of Wildlife Damage)

Baits and Tamper-Resistant Bait Stations

There are two classes of bait stations: (1) tamper-resistant stations that significantly reduce the risk of accidental poisoning, and (2) nontamper-resistant stations which are basically open trays.

A tamper-resistant bait station is designed so a child or pet cannot get to the bait inside, but a rodent can. The stations must also be resistant to destruction by dogs and by children under six years of age. In addition, they must be used in a manner that prevents such children from reaching into bait compartments to get at the bait. Tamper-resistant stations differ in the type and quality of construction, but they are usually made of metal or heavy plastic with a locking lid.

Bait trays and other nontamper-resistant bait stations do not protect children and animals. Their use is normally limited to indoor applications where there are no children or nontarget animals that could get at the bait.

Bait stations fall short when technicians do not install, maintain, or service them correctly. Rodenticide labels require that a bait station be secured or otherwise immobilized whenever two conditions exist: (1) if there is a risk that children,

Special Situations

Extra-strong bait stations are required by rodenticide labels in areas open to hoofed livestock, raccoons, bears, or other potentially destructive animals, or in areas prone to vandalism.

Key Points

Liquid Bait Precaution

The safest way to remove liquid baits is to place the entire dispenser inside a 5-gallon bucket, or similar container, and then deal with disposal off-site.

pets, and other nontargets can get at the bait station, and (2) if the station is so designed that bait can be shaken out of it.

Tamper-resistant bait stations provide other benefits besides greatly reducing the chance that children, pets, livestock, and wildlife could be poisoned accidentally. They are excellent tools for monitoring rodent populations if you regularly check the stations for rodent droppings and gnaw marks. The stations also protect baits from the elements and help keep baits fresh. (See additional discussions on bait stations later in this chapter.)

Precautions When Using Liquid Baits

The same safety considerations apply to the use of liquid baits as those used for other rodenticides. However, there are special considerations in order to minimize the risk of spillage and cross-contamination. These include:

- Use plastic containers, not glass, and put the proper labeling on every container.
- Do not use liquid baits where a spill could contaminate food, feed, food surfaces, food containers, or where people might contact spillage directly.
- Be sure to dilute liquid baits carefully and avoid dribbles and spills while filling liquid bait dispensers, which are typically either tamper-resistant bait stations, special liquid bait dispensers, or “chick founts.”
- The safest way to remove liquid baits is to place the entire dispenser inside a 5-gallon bucket, or similar container, and then deal with disposal off-site.

Precautions When Using Tracking Powders

Because tracking powders are more concentrated and are potentially more hazardous than baits, an applicator needs to be especially careful when using these products. The active ingredient in these rodenticides is generally 5 to 40 times more concentrated than that what is in the baits.

As with all pesticides, be sure to read the label carefully. Never use tracking powders in suspended ceilings, around air ventilators, near food or feed, or food preparation areas. The



Tracking powder labels have many restrictions. For example, this rat burrow is not located along a building's perimeter. As a result, it is not a legitimate treatment site for using a tracking powder.
(Photo L. Pinto)

powder can easily become airborne and drift into nontarget areas.

One common mistake made by applicators is to use a tracking powder outside in burrows that are not located along a building perimeter. This type of application is a misuse. When used in rodent burrows, tracking powders can only be applied when both of the following two conditions are met: (1) when those burrows are located along a building's perimeter, and (2) when the burrows are likely to serve as routes of entry into the building.

RODENTICIDE LABELS

The product labeling found on every rodenticide is the main method of communication between the manufacturer of the product and the user of the product. The information must be printed on or attached to the rodenticide product or package. The label is a legal document that tells the applicator how to use the rodenticide.

“Labeling” includes the label itself plus any other brochures, leaflets or other information provided with the rodenticide product or referenced on the label. If you use a rodenticide, you are required by law to comply with all the instructions and directions on the label as well as any other labeling provided by the product manufacturer.

The label itself provides specific instructions telling you how to correctly use the product. Among other things it provides the following information:

- The sites where the rodenticide product can be used
- What pests are controlled
- Directions for mixing and applying the product

The label also briefly describes how toxic the product is to people, and discusses ways to reduce risks.

Misuse of Rodenticides

As with any pesticide, “the label is the law.” It is illegal to use a rodenticide in any way not permitted by the label. You must follow all label directions.



The information that is printed on or attached to the rodenticide product or package is the label. This is a legal document that tells applicators how to use the rodenticide.

CONTRAC[®]

All-Weather Blox

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
READ THIS LABEL: Read this entire label and follow all use directions and use precautions.

IMPORTANT: Do not expose children, pets, or nontarget animals to rodenticides. To help prevent accidents:

1. Store unused product out of reach of children and pets.
2. Apply bait in locations out of reach of children, pets, domestic animals and nontarget wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from bait stations when they are lifted, units must be secured or otherwise immobilized. Stronger bait stations are needed in areas open to hoofed livestock, raccoons, bears, or other potentially destructive animals, or in areas prone to vandalism.
3. Dispose of product container and unused, spoiled, or unconsumed bait as specified on this label.

USE RESTRICTIONS: For control of Norway rats, roof rats and house mice. Do not place bait in areas where there is a possibility of contaminating food or surfaces that come in direct contact with food. When used in USDA-inspected facilities, this product must be applied in tamper-resistant bait stations. Do not broadcast bait.

Urban Areas: This product may be used in and around the periphery of homes, industrial, commercial, and public buildings. May also be used in transport vehicles (ships, trains, aircraft) and in and around related port or terminal buildings. May also be used in alleys. Do not use in sewers.

Non-Urban Areas: This product may be used inside of homes and agricultural buildings.

SELECTION OF TREATMENT AREAS: Determine areas where rats or mice will most likely find and consume the bait. Generally, these areas are along walls, by gnawed openings, in or beside burrows, in corners and concealed places, between floors and walls, or in locations where rodents or their signs have been seen. Protect bait from rain and snow. Remove as much alternative food as possible.

APPLICATION DIRECTIONS:

Each bait block in this container weighs approximately one ounce.

KILLS RATS AND MICE

KILLS WARFARIN RESISTANT NORWAY RATS

Norway rats and house mice may consume a lethal dose in one night's feeding with first dead rodents appearing four or five days after feeding begins.

ACTIVE INGREDIENT:
 Bromadiolone (CAS #28772-56-7):0.005%
INERT INGREDIENTS*:..... 99.995%
 100.000%

*Contains Denatonium Benzoate

**KEEP OUT OF REACH OF CHILDREN
 CAUTION**

**FIRST AID
 HAVE LABEL WITH YOU WHEN OBTAINING TREATMENT
 ADVICE**

IF SWALLOWED:
 •Call a poison control center, doctor, or 1-877-854-2494 immediately for treatment advice.
 •Have person sip a glass of water if able to swallow.

•Do not induce vomiting unless told to do so by the poison control center or doctor.

IF ON SKIN:
 •Wash with plenty of soap and water.

NOTE TO PHYSICIAN OR VETERINARIAN

If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. If ingested, administer Vitamin K₁ intramuscularly or orally as indicated in bishydroxycoumarin overdoses. Repeat as necessary based on monitoring of prothrombin times.

NET WEIGHT: 4 lbs. (1.8 Kg)

Manufactured by:



Bell Laboratories, Inc.
 Madison, WI 53704

EPA REG. NO. 12455-79

EPA EST. NO. 12455-WI-1

DIRECTIONS FOR USE (Continued from other panel) APPLICATION DIRECTIONS (Continued from other panel)

RATS: Place 3 to 16 bait blocks (usually at intervals of 15 to 30 feet) per placement. Maintain an uninterrupted supply of fresh bait for at least 10 days or until signs of rat activity cease.

MICE: Place 1 block per placement. Space placements at 8 to 12 foot intervals. Two blocks may be needed at points of very high mouse activity. Maintain an uninterrupted supply of fresh bait for at least 15 days or until signs of mouse activity cease.

FOLLOW-UP: Replace contaminated or spoiled bait immediately. Collect and dispose of all dead, exposed animals and leftover bait. To prevent reinfestation, limit sources of rodent food, water, and harborage as much as possible. If reinfestation does occur, repeat treatment. Where a continuous source of infestation is present, establish permanent bait stations and replenish as needed.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds and other wildlife. Do not apply this product directly to water or to areas where surface water is present or to intertidal areas below the mean high water mark.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
Storage: Store only in original container in a cool, dry place inaccessible to children and pets. Keep containers closed and away from other chemicals.

Pesticide Disposal: Wastes resulting from the use of this product may be placed in trash or delivered to an approved waste disposal facility.

Pesticide Container: Do not reuse empty container. Dispose of empty container by placing in trash, at an approved waste disposal facility or by incineration or, if allowed by state and local authorities, by burning. If burned stay out of smoke. Call your Local Waste Agency for any questions on proper disposal.

WARRANTY: Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

101504

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL: Read this entire label and follow all use directions and use precautions.

USE RESTRICTIONS: Use against the Norway rat, Roof rat and House mouse inside of homes, industrial and agricultural buildings and similar man-made structures. DITRAC TRACKING POWDER may also be dusted into rat burrows that are located along the periphery of buildings and that are likely to serve as routes of entry into these structures. Tracking powder must be placed in locations not accessible to children, pets, domestic animals, or wildlife. Do not place powder in areas where there is a possibility of contaminating food or on surfaces that come in direct contact with food. Do not place near ventilation duct openings.

SELECTION OF TREATMENT AREAS: Determine dry areas where rats and mice will most likely pick up the powder on their feet or fur and ingest it during grooming. Generally, these areas are along walls, by gnawed openings and burrows, in corners and concealed places, in spaces between floors and walls or in locations where rodents or their signs have been observed. Remove goods piled directly on floor and place on skids. Use boxes or other obstacles to force rodents to travel through constricted areas. Give special attention to the climbing ability of roof rats. For this species, use suitable PVC, sheet metal, cardboard or similar rigid tubing securely attached to rafters or other horizontal surfaces where rats will pass. Employ tubes long enough to prevent spillage of powder through the ends.

APPLICATION DIRECTIONS: Evenly sprinkle 1/2 oz (3 level teaspoons) of DITRAC TRACKING POWDER in patches 12 inches long and 6 inches wide. Apply the powder into the rodent burrow or holes or within walls with a hand bulb or similar duster. Do not use power dusting devices. Sprinkle the powder in patches in such a manner as to expose the rodent to it. Patch size may be (but not limited to) 6" x 12" and should be adapted to each situation. For rat burrows that are located along the periphery of buildings and that are likely to serve as routes of entry into these structures, place about 5 grams of tracking powder in each burrow with footpump duster (about 15 pumps). Close burrows with soil, loose leaves, or paper. Repeat if burrows are reopened.

RESTRICTED USE PESTICIDE

Due to Acute Oral Toxicity
For retail sale to, and use only by, Certified Applicators, or persons under their direct supervision and only for those uses covered by the Certified Applicator's Certification.

DITRAC[®]
TRACKING POWDER
KILLS RATS AND MICE

ACTIVE INGREDIENT: Diphacinone (CAS #82-66-6)..... 0.2%
INERT INGREDIENTS:..... 99.8%
TOTAL..... 100.0000%

KEEP OUT OF REACH OF CHILDREN

WARNING

FIRST AID

HAVE LABEL WITH YOU WHEN OBTAINING TREATMENT ADVICE IF SWALLOWED:

- Call a poison control center, doctor, or 1-877-854-2494 immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by the poison control center or doctor.
- **IF ON SKIN:**
 - Rinse skin with water for 15 – 20 minutes. Remove contaminated clothing. Get medical attention.

NOTE TO PHYSICIAN OR VETERINARIAN

If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. If ingested, administer Vitamin K₁ intramuscularly or orally as indicated in bishydroxycoumarin overdoses. Repeat as necessary based on monitoring of prothrombin times.

NET WEIGHT: 25 lbs.

Manufactured by:



Bell Laboratories, Inc.
Madison, WI 53704

EPA REG. NO. 12455-56

EPA EST. NO. 12455-W1-1

DIRECTIONS FOR USE (Continued from other panel)
APPLICATION DIRECTIONS (Continued from other panel)

Maintain powder in treated areas for at least 20 days. Where accessible, collect and dispose of all dead animals and used powder promptly. Repeat treatment when infestation recurs. Where a continuous source of infestation is present, establish permanent tracking powder stations and replenish the powder as needed.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
WARNING

May be fatal if swallowed or absorbed through the skin. Do not get in eyes, on skin, or on clothing. Wear protective clothing and rubber gloves. Wash arms and face with soap and water after mixing or handling and before eating, drinking, or using tobacco. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds and other wildlife. Do not apply this product directly to water or to areas where surface water is present or to intertidal areas below the mean high water mark.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store only in original container in a cool, dry place inaccessible to children and pets. Keep containers closed and away from other chemicals.

Pesticide Disposal: Wastes resulting from the use of this product may be placed in trash or delivered to an approved waste disposal facility.

Pesticide Container: Do not reuse empty container. Dispose of empty container by placing in trash, at an approved waste disposal facility or by incineration or, if allowed by state and local authorities, by burning. If burned stay out of smoke. Call your Local Waste Agency for any questions on proper disposal.

WARRANTY: Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

101504



*Rodenticide labels typically require the applicator to collect and dispose of all dead, exposed animals.
(Photo L. Pinto)*

There are certain directions found on particular rodenticide product labels that are commonly ignored or not properly followed that lead to misuse:

- Some rodenticide labels limit the use of a product to outdoor use only, or indoor use only, or for use against a particular rodent.
- Some labels specify sites where the product cannot be used.
- Rodenticide labels typically require the applicator to promptly collect and dispose of all dead or exposed animals along with any spoiled bait.
- Rodenticides require placement “in locations not accessible to children, pets, wildlife, and domestic animals, or in tamper-resistant bait stations.”
- There are additional label requirements for bait station security.
- When used in rodent burrows, tracking powders can only be applied in those burrows located along a building’s perimeter and likely to serve as routes of entry into the building.

Key Points

Choosing the Right Product

For each site, you need to consider safety, formulation, speed of kill, and the application directions on the label, including the permitted sites of application, before deciding which rodenticide product to use.

MATCHING THE PRODUCT TO THE JOB

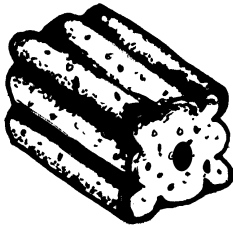
Rodenticide applicators need to avoid the trap of depending on a single rodenticide product, using it the same way at every job, whatever the circumstances, whether against rats or mice. Rodent baiting should never be an “automatic pilot” task, that is no single rodenticide product is effective in all situations.

For example, the rodenticide formulation best for rat burrows along a foundation wall could easily be the worst choice from a hazard standpoint for mice inside an office building. Also, rodents can be finicky and unpredictable. What works best today might fail tomorrow.

When choosing a rodenticide product, you need to consider a range of factors, such as safety, formulation, speed of kill, and the application directions on the label, including the permitted sites of application.

Choosing Rodent Baits

Block bait, pellet bait, packet bait, liquid bait, meal bait... these are all options that are available when baiting for mice or rats. Some technicians automatically use the same bait formulation, no matter what the situation. Think about your treatment site and the level of safety needed there. Some bait types are better suited to certain situations, which is why manufacturers make different formulations.



Bait blocks are preferred in sites that are damp, have insect infestations, or where translocation (rodents moving the bait) could be a problem.

Block Baits

Preferred uses for block baits include the following:

- Sites that are damp or have insect infestations. The paraffin in the block protects the bait against both of these issues.
- Sites where translocation (rodents moving the bait) could be a problem. Block baits secured inside a bait station are the least likely form of bait to be moved or hoarded by rodents.
- For sewer rats, where the blocks are wired to the top rung of the manhole ladder, and hung down to the bottom just above the water or to a ledge.
- For roof rats, where the blocks are wired to trees, pipes, or other overhead sites.
- Any time you need to closely monitor rodent acceptance of your baits. Tooth marks on block baits tell you when rodents have been feeding.

The following uses may cause an increased risk of poisoning to nontarget animals:

- Outside burrow baiting where rats can kick the blocks out of the burrow.
- Areas with dogs present (unless placed in secure, tamper-resistant bait stations).

Loose Pellet Baits

Preferred uses for loose-pellet baits include the following:

- Outside burrows. Loose pellets that are placed into a burrow are less likely to be kicked out of the burrow than are blocks or packets.



Loose pellets dropped into a burrow are less likely to be kicked out of the burrow than are blocks or packets. (Photo L. Pinto)



Packet baits are a good choice in damp areas and whenever you need to closely monitor rodent acceptance of your baits. (Graphic from Prevention and Control of Wildlife Damage)

- Damp areas where using meal bait would be a problem.
- Confined, nonresidential sites like an office maintenance shop where there is no possibility of children or other animals getting into the bait.

Avoid application of loose-pellet baits in these sites:

- Wherever pellets could contaminate food or nontarget sites. Rodents tend to hoard pellets, moving them away from the baited area.
- Where children or nontarget animals could get into the bait. Avoid open trays of pellets in these sites. Use only tamper-resistant bait stations.

Packet Baits (Place Packs)

Preferred uses for packet baits include the following:

- Damp areas. The packet provides more protection from moisture than if the bait is loose.
- Sites with infestations of stored product insects. The packet helps protect the bait from infestation.
- Any time you need to closely monitor rodent acceptance of your baits. If you've had feeding activity, the pack will be chewed open.
- Mouse control using seed packet baits because of the high bait acceptance, since mice like to hull the seeds.

Avoid the following uses with packet baits:

- Outside burrow baiting where rats can kick the packets out of the burrow.
- Tossed into unreachable areas where there is no possibility of retrieving the bait. (Note: The label requires you to collect and discard unused bait.)
- Where hoarded bait could contaminate food, feed, or nontarget sites.

Grain or Meal Baits

Preferred uses for grain or meal baits include the following:

- Anyplace where there is a problem with rodents hoarding or moving bait. The small particles are not easily carried to new sites.

The following are not the best uses for grain or meal baits:

- Food handling areas or anyplace where meal bait could be confused with flour or other food or feed products.
- Where there is a stored product pest infestation.
- Anyplace with excessive moisture or dust.

Liquid Baits

Preferred uses for liquid baits include the following:

- In areas where there is no water available, like warehouses or attics.
- Where there is heavy competition from outside food sources and food baits may not be accepted.
- When rodents are hoarding food baits.

The following are not good uses for liquid baits:

- Where nontarget animals could drink the liquid.
- Where the liquid could be easily spilled or contaminated by dust.
- Where the liquid bait could freeze. Adding sugar or glycerin slows freezing.
- Laundry rooms, and other sites where there is water already available.

When to Use Tracking Powder

Rodenticide tracking powders are powerful tools for controlling rodents in certain circumstances. They can be effective in sites and situations where baits and traps will not work. However, because tracking powders are more concentrated and are potentially more hazardous than baits, tracking powders are not suited to all sites.

Potential Uses for Tracking Powders

Consider using tracking powders in the following situations:

Application Methods for Tracking Powders

Apply with a shaker, a spoon, or a hand-operated bulb or bellows duster (not a power duster). There are three application methods:

- As a light dusting in an unprotected patch in out-of-the-way locations (only suitable for certain sites without children, animals, or risk of food or feed contamination).
- Inside covered tracking stations, bait stations, or tubing.
- Inside voids and rodent burrows.

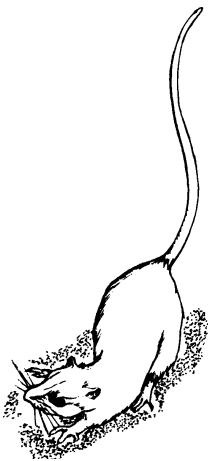
- When the rodents you are trying to control are mice. Tracking powders work better against mice than against rats because mice groom themselves more often than rats. Also, since mice are smaller than rats, they do not have to ingest as much tracking powder in order to receive a deadly dose. Some tracking powders are registered for the control of mice only.

- In sites where there is an abundance of food for rodents, so acceptance of bait is poor.
- When rodents have become bait-shy or trap-shy. Rodents generally do not avoid tracking powder.
- When mice are living and traveling primarily inside voids. These are tough places to bait but ideal places for using tracking powder.
- When you need a long residual. Tracking powders, if they remain dry, can be effective for months.
- When your control efforts involve outside burrows. Dusting tracking powder into dry burrow openings can be very effective. Make sure the tracking powder is labeled for this outdoor use (some are indoor use only).

Unsuitable Sites for Tracking Powder

Avoid using tracking powders:

- If you do not first know the travel routes of the rodents. Since tracking powders by themselves do not attract mice or rats, you must locate runways and voids that they use before application.
- Where they may be accessible to children, pets, wildlife or other nontarget animals.
- Near food or feed storage, food preparation, or serving areas. Most tracking powders cannot be used in USDA-inspected food plants.
- In overhead sites like drop ceilings or on pipes unless the powder is placed in a station or in a piece of PVC pipe. Never place tracking powders where they could sift down onto surfaces and people below.
- Underneath large appliances such as refrigerators or stoves where fan motors can blow the powder into the air or repairmen could come in contact with it.
- If there is a chance that rodents could track the powder on their feet and contaminate a sensitive area. For example, mice may be moving through a treated wall void onto a food service counter.
- Where the tracking powder could get wet, such as in damp crawlspaces or boiler rooms.



*Do not use tracking powder if there's a chance that rodents could track the powder on their feet and contaminate a sensitive area.
(Graphic adapted from CES/IFAS)*

- If there is too much air movement. Do not apply tracking powders near fans, blowers, ventilation ducts, air curtains, or outside in windy weather.
- If building renovations are planned that might later expose homeowners, electricians, or other workers to the powder inside wall voids.
- If the odor of dead mice in wall voids would be particularly offensive, for example, in a hotel. Better to use traps so you can remove the carcasses.

BAIT STATIONS

Go beyond the basics when using tamper-resistant bait stations. You will provide better protection to children, pets, wildlife, and domestic animals from exposure to rodenticides. Plus, you will make your baiting program more effective.

Placement Strategies

Be creative. For example, when installing bait stations outdoors, do not automatically install them every 30 to 50 feet around a building perimeter or along a fence line (unless contract specifications require it). Instead, consider the rodents' traffic patterns, areas of attraction, and points of entry. Place extra bait stations:

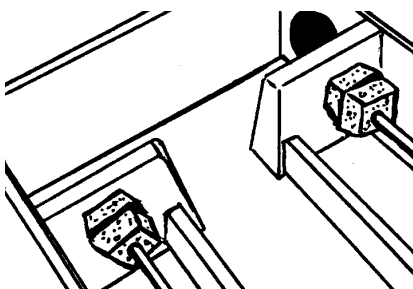
- In areas of high rodent activity (indicated by burrows, tracks, droppings, sightings)
- Near dumpsters and trash cans
- Where food trash accumulates
- Where rodents are harboring under thick cover (low bushes, creeping juniper, etc.)

In some areas you may need to place your stations unobtrusively in order to minimize tampering or theft. Install them under bushes, out-of-sight from walkways, or hidden under lumber. Another option would be to use bait boxes disguised as rocks.

If used indoors, place bait stations in areas of rodent activity, preferably in corners, behind equipment and appliances, or other protected areas. If baiting for mice, use mouse-size stations. Place stations in ceiling voids if mice are active in



To secure a bait station to a fence, use chain, wire, or plastic cable ties. Attach the station in two places, and make sure the attachments are short so that the station cannot be lifted and tilted.
(Photo L. Pinto)



Anchoring bait keeps rodents (or other animals or children) from dragging or shaking the bait out of the station and scattering it.

these areas. If mice are coming in from outside, place stations near exterior doors and other potential entry points.

Securing Bait Stations

You will often need to further secure tamper-resistant bait stations. If they could be accessed by children, pets, or non-target animals, you need to make sure the bait cannot be shaken out. To attach a bait station to the ground, use a rod anchor or earth anchor. Bolts, screws, industrial strength glue, or nails can be used to secure a bait station to wood, concrete, or masonry. A heavy, cement patio block can also be used.

For attachment to a fence, use chain, wire, or plastic cable ties. Attach the station in two places, or make sure that the chain or wire is short enough that the station cannot be lifted and tilted.

Anchoring Baits Inside Bait Stations

Most rodent bait stations come equipped with either vertical or horizontal rods designed to hold block baits. Place packs can also be secured inside bait stations by threading or clipping them onto a rod.

While not mandated by law, there are good reasons to anchor bait blocks inside a rodent bait station. Most importantly, anchoring the bait keeps rodents, other animals, or children from dragging or shaking the bait out of the station and scattering it. Anchoring also keeps the bait fresher and drier since it is up off of the bait station floor.

Labeling Bait Stations

All bait stations should be clearly labeled with a precautionary statement to warn workers and other people in the area that they contain a poison. The specific rodenticide that is being used needs to be listed on the station's service record card so that the proper treatment can be given in case of an accidental poisoning.

Bait Station Maintenance

When checking a rodent bait station, do not limit service to simply initialing the card. Service and maintain the bait sta-

Avoid Unsecure Stations

Common problems with bait station security in areas with children and animals include:

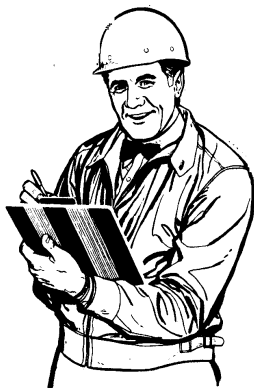
- The bait station is unattached to anything.
- The station is “secured” with a long spike driven into the dirt. Spikes used in this way are inadequate because children, dogs, raccoons and other larger nontarget animals can pull the station loose.
- The station is attached to a fence with a chain or wire long enough to allow the station to be tilted and shaken to get at the bait.

tions at each visit. Be sure to carry adequate supplies. That includes station keys and wrenches, putty knife/scrapper, brush, punch for plastic log cards, bait bucket, plastic bags (for old bait), gloves, markers/pens, multi-tool (example: Leatherman®), and rags.

Number or code each station and have a location map or diagram. Also, have a marking system to help find each station, even if it's buried under stored materials or snow.

Follow a regular routine when servicing bait stations:

- Inspect the bait (or monitoring blocks). Look for evidence of feeding and learn how to determine the culprit, whether mice, rats, crickets, slugs, or other pest.
- Look for fresh droppings inside the station. The droppings will pinpoint the kind of rodent, insect, or other animal that has been feeding on the bait. Record these findings.
- Clean the station. Brush and scrape droppings, crumbs, leaves and other debris out of the bait station. Then, at the next inspection, any new droppings will confirm that the station is still active.
- Replace bait as needed. Two months is about the length of time that can be expected before a bait becomes unpalatable to rodents. Do not just add new bait to the old bait. Replace bait periodically in order to detect evidence of new feeding.
- If the station contains sticky traps, replace them if they contain dead rodents or insects or if they are overly dusty or dirty. Wear plastic gloves or use tongs when handling dead rodents. Remove them to a sealed plastic bag for disposal.
- Be proactive. Relocate stations that have gone months without action. Change the bait formulation or brand when you have no activity in your bait stations but you know that rodents are still active at the site.
- Record your information. Record on the bait station's service record every time you check the station and every time you replace bait. Replace log cards and labels when they become full.
- Make sure the station is locked when finished.



Recordkeeping is a two-part process: (1) gathering the information in written form, and (2) reviewing that information on a regular basis to improve service at the site.

Maryland Recordkeeping

Maryland regulations require that applicators record the following information when a rodenticide is applied:

- Applicator name
- Date
- Type of pest
- Description of site
- Address of site
- Owner or tenant
- Common name of rodenticide
- Total amount used
- Type of equipment used
- Time of day
- Wind/weather

RECORDKEEPING

Recordkeeping is an essential part of proper rodenticide use, no matter what type of formulation is used. For example, in commercial locations or large facilities, each bait station should have a unique number, and the locations should all be plotted onto a diagram/floor plan of the plant and grounds. Each station should then have a corresponding service ticket with the name and phone number of the contact person. At each service visit, record the date, the rodenticide applied, if any, and initials of applicator.

Record findings at each station or trap in a service record. This would include signs of activity, such as feeding and droppings, as well as actions taken, such as replacing rodenticide, along with the name and amount of rodenticide used.

Recordkeeping is required by various government regulations. Many commercial sites (such as food plants) and schools have recordkeeping requirements of their own. However, recordkeeping is also important because it helps in evaluating the effectiveness of the treatment, and also identifies problem areas.

Recordkeeping is really a two-part process. First, gathering the information in written form, and then the second part would be reviewing the information on a regular basis to improve the service at the facility.

REVIEW QUIZ

1. Which statement is true about anticoagulant rodenticide baits?
 - a. they kill rodents by affecting their calcium levels
 - b. newer anticoagulants are “single-feeding”
 - c. death occurs within 3 hours after feeding
 - d. they contain high concentrations of active ingredient
2. Rodenticide baits come in which of these formulations?
 - a. foggers, blocks, meal
 - b. sprays, meal, pellets
 - c. liquids, blocks, pellets
 - d. blocks, pellets, aerosols
3. If you are trying to control deer mice, which bait formulation is the best choice?
 - a. liquid bait
 - b. aerosol bait
 - c. meal bait
 - d. seed bait
4. Liquid rodenticide baits are most effective:
 - a. against rats, rather than mice.
 - b. when there is plenty of water available.
 - c. when rodents are also feeding on meal bait.
 - d. when mice are found in bathrooms.
5. Which one of these would be an acceptable site in which to apply tracking powder?
 - a. in a bedroom closet
 - b. inside a wall void
 - c. under the kitchen sink
 - d. on top of attic insulation
6. The reason for the use of tamper-resistant bait stations is:
 - a. to prevent vandalism of bait stations.
 - b. to ensure that the bait remains fresh and dry.
 - c. to keep children and other animals from reaching the bait.
 - d. so rodents cannot remove the bait from the station.
7. If a nontarget animal eats anticoagulant rodenticide:
 - a. there is no ill effect.
 - b. the animal dies quickly.
 - c. the animal becomes paralyzed.
 - d. an antidote can reverse toxic effects.
8. When using rodenticides, “secondary poisoning” refers to:
 - a. the accidental poisoning of other animals that eat poisoned rodents.
 - b. the fact that it may take two or more feedings to kill a rodent.
 - c. a workers’ exposure to tracking powder residues.
 - d. when mice are killed along with rats.
9. The best rodenticide formulation for application in sewers is:
 - a. place packs.
 - b. bait blocks.
 - c. tracking powder.
 - d. meal baits.
10. You know that a rodenticide bait can be used outdoors if:
 - a. it is in pellet form.
 - b. it is specified on the label.
 - c. it is waterproof.
 - d. it is dyed green.

CHAPTER EIGHT

Rodent Program Evaluation

Learning Objectives

- *List questions to be answered during the evaluation of a rodent control or rodent IPM program.*
- *List the records that should be reviewed during the evaluation.*
- *List the kinds of technical information to be included in the evaluation.*
- *Identify examples of information to be gathered from people/staff on site.*

Rodent problems change at a site through time. The change might be seasonal, or caused by operational changes at the site, or due to the successes and failures in the rodent control program. Consequently, rodent control programs need to be reevaluated periodically. These evaluations may be small-scale, that are conducted by the applicator, or more intensive, that involves supervisors and managers. They may be conducted quarterly, twice a year, or annually.



Evaluations may be small-scale, conducted by the applicator, or more intensive, involving supervisors and managers.

Information from pest sighting reports, visual inspections, service reports, trap catches and other sources are reviewed to see if rodent control is working satisfactorily, or if changes to the program are needed. The evaluation tries to answer questions like the following:

- ✓ Were the recommended operational changes, sanitation improvements, rodent-proofing procedures implemented? If not, why not?
- ✓ Are rodents under acceptable control? If not, why not?
- ✓ Are the same rodent problems reappearing repeatedly (chronic reinfestation)?
- ✓ Were pest populations reduced in a timely manner?
- ✓ Have rodent sightings, as recorded in the logbooks, decreased or increased?
- ✓ Is the monitoring program adequate? Should monitoring be increased?
- ✓ Can the amount of time and effort spent now be reduced without sacrificing effectiveness?
- ✓ Were there any negative effects from control measures used?
- ✓ Were there any safety concerns with control measures used? If so, how were they addressed?
- ✓ If control measures used were ineffective, should they be repeated?
- ✓ Should other control measures be tried that have not been used?
- ✓ What problems have been identified? Are they being adequately addressed?
- ✓ Was there adequate cooperation? If not, how can this be improved?

- ✓ Were there any communication problems between those responsible for implementing different aspects of the program?
- ✓ Have all objectives been achieved?
- ✓ What changes are necessary in the program? Who should be responsible for those changes?

EVALUATION METHODS

In reviewing the rodent control program, look at the service being provided along with the satisfaction level of those at the site. Since there are many steps involved in the service side of the business it is always good to have a checklist as a reminder of items that will need to be reviewed. Examples of the different kinds of information that should be included in the checklists for a rodent control service, and for customer (or staff) satisfaction and cooperation, are provided in the sections below.



When evaluating a rodent control program, first review the records from the account, and then, interview management and staff.

When evaluating a rodent control program first review the service reports, reinspection reports, and other records from the account. Second, interview management and staff. The success of rodent control is ultimately tied to the satisfaction of the people at the facility.

All service tickets and other written reports associated with the account should be up to date and in the account file. This would include the original inspection report, diagrams of trap or bait placements, and reports on the number of rodents sighted, rodents trapped or found dead after baiting programs. The file should also contain records of phone calls or complaints. In addition, there should be updated inspection reports from the technicians, noting any new problems, or repairs made to problem areas that were initially documented. This could include sites such as rodent harborage or access areas.

If the rodent control is part of an overall, formal IPM program, also review the IPM logbook and other IPM records.

EVALUATION CHECKLISTS

A checklist is an excellent way to insure that all proper questions are asked when evaluating a rodent control service. The specific items on the checklist will vary with the company and the site. However, you should include checklists for the service, along with a set of checklists for customer satisfaction and customer (or staff) cooperation.

Checklist for Rodent Control Service

A checklist for evaluating the success of the rodent control service should include information to help you answer the following questions:

- Are all service tickets up to date? All the service tickets must be current and in order. If the customer has any questions you can always refer to the ticket for information. At a minimum it is required that all service tickets list the common name, EPA registration number and amount of product used for each rodenticide.
- Are diagrams and inspection reports in files and up to date? The diagrams and reports made during the control program are important pieces of information. You can tell instantly how many traps, bait stations, or areas of rodent activity are in the account. Upon more in-depth evaluations, you may find a pattern of rodent activity that is coordinated to the time of the year, or a particular event, that may have happened during the control program. An example would be the remodeling of the facility leading to increased reports of rodents.
- Have complaints been addressed to everyone's satisfaction? Review any complaint logs. This will be an extremely important piece of documentation when you go in to discuss the program. You want to be able to address any concerns the client may have, along with being able to report on the efficiency in which complaints were handled.
- Has the rodent problem decreased, increased or stayed the same? This, of course, will dictate further steps to be added or deleted from the control program. If

the rodent problem has increased, why? Do you have enough traps or baits in place? Are there new harbor-age areas that have been reported, but not cleaned up? Has there been an increase in pressure on the account because of construction or deterioration of adjacent properties?

- Have sanitation reports or corrective actions noted on service tickets been addressed?
- Do you need a more intensive quality control program? Quality control is having a third party (supervisor or independent person), visiting the site, inspecting the traps or bait stations to see if the service records have been filled out, whether rodenticide amounts and applications are accurate, whether new or more traps or bait stations are needed.

Checklist For Customer and/or Staff

A checklist for evaluating customer and staff satisfaction and cooperation should include information to help you answer the following questions:

- What is their opinion of the program? Ask them their assessment of the quality of service, promptness to emergency calls, courtesy and communication.
- Do they need any educational materials? Do they want their people to have literature that explains rodent habits or how to look for rodent signs, etc.
- Has the customer or staff at the site followed recommendations for correcting sanitation problems, making structural repairs, changes in operations that are contributing to rodent problems? It is difficult and sometimes impossible to satisfactorily control rodents without correcting these types of deficiencies.
- Has staff been utilizing any service logs (see sample log page on page 137)? A copy of the log is placed at each location for the service technician to refer to on regular service visits. People at the site can also list, in the log, items to be checked by the service technician. This would include any sightings of rodents since the last visit.

- Are there any complaints from the staff? These should be addressed with the staff member's supervisor, and if possible with the employee.
- Are there any concerns on site about the use of rodenticides, or rodent traps at the facility? It is always good to ask this question so that the program can be adjusted to reduce staff concerns.
- Are there any plans for remodeling or other operational changes in the near future that could affect the rodent control program?

PEST MANAGEMENT LOG					
Report of Pest Sighting				Corrective Action	
<i>Date</i>	<i>Location</i>	<i>Pest/Number</i>	<i>Name/Phone</i>	<i>Action Taken</i>	<i>Init/Date</i>

REVIEW QUIZ

1. Why is it important to periodically evaluate a rodent control program?
 - a. rodent problems at a site change through time
 - b. the evaluation is required by state law
 - c. to find out if you've used enough bait
 - d. because rodents can multiply rapidly
2. During a rodent control program evaluation, information is reviewed from many on-site sources, except:
 - a. visual inspections.
 - b. service reports.
 - c. this training manual.
 - d. trap catches.
3. Which one of these is NOT a question that would be addressed by a rodent program evaluation?
 - a. are rodents currently under control?
 - b. was there adequate cooperation with the program?
 - c. can the amount of time and effort be reduced?
 - d. should a termite inspection be performed as well?
4. When evaluating a rodent control program, the first thing that should be done is:
 - a. interview the site supervisor.
 - b. remove all bait stations.
 - c. review all written records.
 - d. change the type of bait being used.
5. Why should a rodent control program evaluation include review of "complaint logs?"
 - a. so you know which people are causing the problem
 - b. to determine if complaints have been addressed satisfactorily
 - c. to determine if complaints are real or fake
 - d. to find out when most of the complaints were made
6. In a rodent control program, the term "quality control" refers to:
 - a. making sure rodenticide baits are fresh.
 - b. making sure food products are rotated.
 - c. inspecting baits and traps on a regular basis.
 - d. having a third party evaluate control efforts.
7. Why should a rodent control program evaluation include a checklist for customers or staff?
 - a. to evaluate their level of satisfaction and cooperation
 - b. so you know who is not doing their job
 - c. to keep track of who is in charge at the site
 - d. so that they can record dates that they were on the job

CHAPTER NINE

Safety

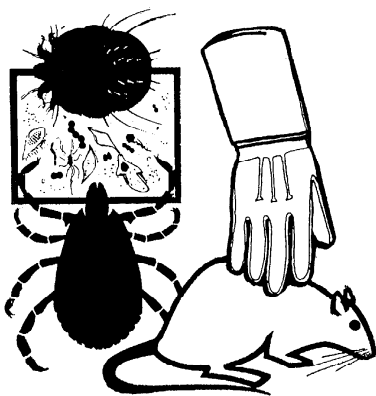
Learning Objectives

- *Describe the five risks that rodents pose to technicians.*
- *List three human diseases associated with pest rodents.*
- *Identify safety procedures to protect yourself from rodent hazards when doing rodent control.*
- *List PPE to use in sites heavily infested with rodent.*
- *Identify the rodenticide formulation posing the greatest risk to the applicator, and describe safety procedures to reduce the risk of accidental poisoning.*
- *List the safety procedures to follow when using snap traps and glue traps around children and nontarget animals.*

Rodents and the tools used for their control can present safety risks to technicians doing the work and to people living or working in the area.

TECHNICIAN/APPLICATOR SAFETY

Health and safety concerns when controlling rodents include bites and scratches, ectoparasites (fleas, ticks, mites, lice), allergies, disease, and accidental poisoning. These concerns obviously overlap, because, for example, you can catch a rodent-borne disease from being bitten by a rodent (ratbite fever) or from a ticks or fleas that may be found on the rodent (Lyme disease). The safety precautions that will need to be taken will depend on the species of rodent and the geographic location of the infestation. If you work in an area that is known to have hantavirus or Lyme disease you will need to take special precautions against these diseases. Know where these diseases occur within your region and what safety precautions are necessary. Also recognize the risks to you as an applicator when using rodenticides.



Health and safety risks for technicians controlling rodents include bites and scratches, ectoparasites, allergies, disease, and accidental poisoning.

Rodent Bites and Scratches

Rats have long incisor teeth that can give you a nasty bite. They are aggressive when cornered or handled, and will try to bite and scratch. Mice will also bite. If you need to handle live rodents, wear animal-handling gloves or trappers' gloves.

If you are bitten or scratched by a rodent, immediately wash the wound with soap and water. Clean the bite by allowing it to bleed, and be sure to see a physician. Wild rodents can transmit diseases such as ratbite fever, and cause other infections, including tetanus. Rabies, however, is not considered a hazard that is associated with rodent bites.



If you are bitten or scratched by a rodent, immediately wash the wound with soap and water.

Ectoparasites

Rodents harbor a wide range of ectoparasites including fleas, ticks, mites, and lice. Some of these pests can transmit diseases to pets, wildlife, and people, while some rodent ectoparasites will move onto people. Be alert to the risk of ectoparasites when controlling heavy populations of rodents. Use



Keep in mind that repeated and prolonged exposure to mouse allergens can cause those predisposed to allergies to experience symptoms.

HE Filter is the New HEPA Filter

An HE filter is a “high efficiency” filter...what used to be called a HEPA or “high efficiency particulate air” filter. HE filters are color coded magenta or red-purple—any N100, R100, or P100 filter is classified as an HE filter.

repellents when necessary and wear gloves. In heavy infestations, consider treating the area with an insecticide/acaricide before beginning a control program.

Mouse Allergy

Allergies associated with rodents were previously discussed in Chapters One and Two. Rodent control technicians should keep in mind that repeated and prolonged exposure to mouse allergens can cause individuals predisposed to allergies to experience hay fever-like symptoms such as a runny nose, stuffed-up head, itchy dermatitis, or asthma.

Given the recent evidence about the high incidence of mouse allergies, technicians may need to take steps to protect themselves from mouse allergens. When doing intensive treatments (“clean-outs”) of heavily infested accounts, using vacuums, moving furniture, or doing other work where a mouse-infested area will be disturbed, technicians should wear a respirator equipped with an HE 100 level filter. It will filter out any allergens that become airborne.

Rodent-borne Diseases

Diseases associated with rodents were also previously discussed in Chapters One and Two. The specific safety precautions that need to be followed depend on the disease, risk in the area, and extent of the infestation.

Hantavirus

When working with rodents in areas where hantavirus is suspected, follow the special recommendations of the Centers for Disease Control (CDC). As of this writing, those recommendations include medical monitoring, using a respirator with a “HE” (High Efficiency) filter (any N100, R100, or P100 filter is classified as an HE filter) and gloves when removing rodents from traps or whenever handling rodents, washing and disinfecting gloves before removing them, and regularly disinfecting traps and other rodent control equipment.

LCM-Lymphocytic Choriomeningitis

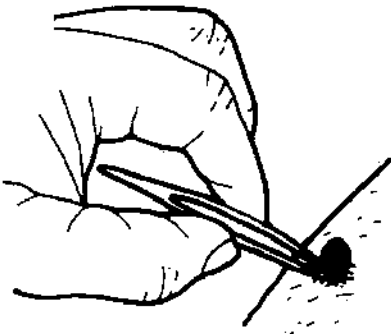
The precautions for LCM are basically the same as those you would take to protect yourself from hantavirus. The Centers for Disease Control advises the following:

- Wear rubber, latex, vinyl, or nitrile gloves when doing rodent control. After removing gloves, wash hands with soap and water.
- Avoid stirring up dust or mouse droppings. If cleaning up a mouse-infested site, wet down droppings and the contaminated area with a disinfectant solution.
- Spray dead rodents with disinfectant and double-bag rodents, nest material, and cleaning materials for disposal.

Lyme Disease

When controlling rodents outdoors in heavily tick-infested areas where Lyme disease has been reported, consider the following precautions:

- Avoid dense undergrowth and long grass or weeds.
- Wear long sleeves and long pants. Light-colored clothing helps you see ticks. Tuck pants legs into your socks and boots, and keep your collar buttoned.
- Use wide masking tape to tape your socks to your pants and tape your sleeves to your wrists. The idea is to eliminate any gaps that allow ticks to crawl up under clothing.
- Spray shoes, clothing, and exposed skin with an insect repellent that contains DEET. Tick repellents containing permethrin are also available for use on clothing only.
- Wear gloves if you are trapping or handling deer mice or white-footed mice. Dispose of dead animals in plastic bags.
- Shower at the end of the workday and check yourself for ticks.
- If you are bitten by a tick, remove it immediately and save it in alcohol.
- If you become sick within two weeks after being exposed to a tick, get a rash, or experience a loss of



If you are bitten by a tick, remove it immediately and save it in alcohol.

coordination or partial paralysis, see a physician immediately.

Guidelines for Handling Rodents

- If handling live rodents, wear animal-handling gloves or trapper's gloves.
- Wear gloves when handling dead rodents.
- Dispose of rodent carcasses by placing them in a sealed plastic bag. If you are working in an area with suspected rodent-borne diseases, add a sufficient amount of a general-purpose household disinfectant to thoroughly wet the carcasses (a hypochlorite solution prepared by mixing three tablespoons of household bleach in one gallon of water may be used in place of a commercial disinfectant).
- If working in an area with a heavy rodent infestation, consider spraying the area with an insecticide/acaricide to eliminate ectoparasites.
- When working in areas known to have Lyme disease or plague, spray yourself with DEET or other insect/tick repellent.

PPE in Heavily Rodent-Infested Sites

Hantavirus, LCM, and various allergies are associated with the saliva, urine, and feces of rodents. If you are working in a heavily-infested site, particularly if you provide clean-up services, protect yourself with PPE (personal protective equipment), and try to prevent rodent-contaminated dirt or dust from becoming airborne. Here are some specific guidelines to follow:

- Wear rubber, latex, vinyl, or nitrile gloves. Wear a respirator with an HE filter (N-100, R-100, or P-100).
- Use a paper towel to pick up rodent droppings and urine. Place the paper towel in the garbage.
- Before you handle dead rodents, spray them along with rodent nests using a disinfectant or a chlorine (1:10) solution, soaking them thoroughly.
- Place the dead rodents or rodent nests in a plastic bag, seal the bag, then place it into a second plastic bag and seal that bag. Dispose of the double bags by discarding



If you are working in a heavily-infested site protect yourself with PPE and try and prevent rodent-contaminated dirt or dust from becoming airborne.

them in a covered trash can that is regularly emptied, or by burning or burying the bags.

- Disinfect any items or areas that might have been contaminated by the rodents or their urine or droppings. Do not vacuum or sweep rodent urine, droppings, or contaminated surfaces until they have been disinfected.
- Disinfect gloves before removing them. Use a disinfectant or soap and water. After you remove your gloves, wash your hands with soap and water.

Avoiding Applicator Poisoning

The biggest risk of poisoning to applicators from the use of rodenticides (not including fumigants) comes from tracking powder. Hazards associated with their use include absorption through the skin, exposure to eyes, and inhalation of the powder. Inhalation can be a hazard especially if you are working in a poorly-ventilated, enclosed space like a crawl-space or attic. Wear protective clothing, use rubber gloves, and wear a respirator if the powder becomes airborne.

PROTECTING PEOPLE AND ENVIRONMENT

Rodent control is all about protecting people from the hazards and negative impacts of rodents. However, technicians also need to be concerned with protecting the people, nontarget animals, and the environment from the hazards associated with rodent control tools, in particular, rodenticides and to a lesser extent, traps.

Rodenticide Safety

The safety precautions that are needed when using rodenticides were previously discussed in Chapter Seven, along with an earlier discussion on IPM. The following is a short review of these precautions.

The risks associated with the use of rodenticides can be minimized by using them only when needed and only after consideration of nonchemical control options. When the use of a rodenticide is necessary, choose an effective product that poses the least hazard to people and the environment. Young children are a particular concern with rodenticides because



Technicians need to protect children, nontargets, and the environment from the hazards associated with rodent control tools, in particular, rodenticides and to a lesser extent, traps.

they may view rodenticide bait as a possible food, and because children are generally more susceptible to pesticide poisoning of any sort. Children must always be protected from eating bait.

Always read the rodenticide label before every application, and always follow the label directions. Follow exactly all mandatory statements and instructions on a label. A mandatory statement will contain such key words as “must,” “shall,” and “will,” or it will use an expression such as “do not,” “use only,” or “for use only by.”

Follow proper rodenticide application procedures and label instructions to avoid injuring wildlife, pets, livestock and other nontarget organisms. When using rodenticide baits and tracking powders, apply them out of the reach of children, pets, and wildlife, or inside tamper-resistant bait stations.

You will often need to further secure tamper-resistant bait stations. If they could be reached by children, pets, or nontarget animals, you need to make sure the bait cannot be shaken out of the station by securing them to the ground, to a fence, or other stable platform. Also anchor your bait inside the station.

Choose formulations of rodent bait that are least susceptible to bait translocation. This is when rodents (or other animals) carry the bait out of the treatment site into a new area. Finally, secondary poisoning can occur when nontarget predators or scavengers feed on poisoned rodents.



Traps should be enclosed in stations if children (or even adults), pets, guard dogs, birds, or other nontarget animals can come in contact with them.
(Photo L. Pinto)

Trap Safety

Snap traps and glue traps can also pose injury risks to children and nontarget animals. Traps should not be placed where children (or even adults), pets, guard dogs, birds, or other nontarget animals can come in contact with them. If this is a possibility, they should be placed inside a bait station, in a piece of PVC pipe, or in some other way protected from contact by anything other than rodents.

Traps should also be placed inside stations if a captured rodent could possibly contaminate food or food preparation equipment with hairs, droppings, or urine.

Many food plants require that snap traps or glue traps be “enclosed” in a bait station or other type of cover.

Outdoor traps that are not placed inside stations should be set only from dusk to dawn in order to avoid trapping nontarget animals like birds and squirrels.

In situations where a child’s hand, or a snake or other animal is accidentally stuck in a glue trap, regular cooking oil can be poured onto the glue trap. The oil will dissolve the glue and release whatever is stuck.

REVIEW QUIZ

- Each of the pests listed below is an ectoparasite that can be found on rodents, except the:
 - flea.
 - bed bug.
 - louse.
 - mite.
- If you are handling live rodents, what kind of gloves should you be wearing?
 - cotton jersey gloves
 - rubber gloves
 - vinyl disposable gloves
 - trappers' gloves
- If you are bitten by a rodent, the very first thing you should do is:
 - see a physician.
 - bandage the area.
 - wash the area with soap and water.
 - take an antibiotic.
- When working in a site heavily infested with rodents, the best way to protect yourself against mouse allergens is to:
 - wear long sleeves.
 - use repellent.
 - treat the area with a pesticide beforehand.
 - wear a respirator.
- All of the following precautions will help protect you against Lyme disease, except:
 - wearing long sleeves and pants.
 - wearing an HE-100 respirator.
 - using repellent.
 - avoiding long grass or weeds.
- If you are working in an area that is suspected to have rodent-borne disease, the safest way to dispose of rodent carcasses is to:
 - wrap them in newspaper and take to landfill.
 - wet them with disinfectant, then dispose in newspaper.
 - place them in a plastic bag.
 - place them in a plastic bag with a disinfectant solution.
- Which one of the following is the proper procedure to follow after handling rodents in a heavily-infested site?
 - remove your gloves and bag them for storage
 - remove your gloves, then wash hands with soap and water
 - remove your gloves, then disinfect them
 - wash your gloves before removing them, then wash your hands
- What should be your primary concern when placing rodenticide baits in areas with young children?
 - that they might steal the bait
 - that they might mistake the bait for food
 - that they might move the bait stations
 - that they might tell their parents
- If snap traps are being placed in an area where children might come in contact with them, you should:
 - leave the traps unset.
 - use only food bait in the traps.
 - place the traps inside a bait station.
 - place warning signs on the traps.

CHAPTER TEN

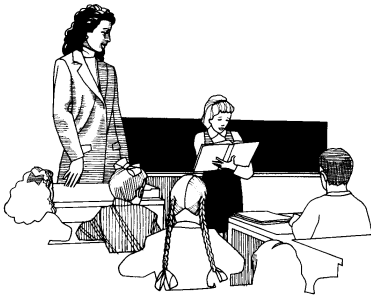
Site-Specific Guidelines

Learning Objectives

- *Identify key staff members in a school that technicians should communicate with during service visits.*
- *List specific concerns when using rodenticides in a school.*
- *Define and describe notification and posting at a school.*
- *Describe procedures for preventing mouse infestations in apartments.*
- *List the steps that must be taken to conduct an intensive program for controlling an outbreak of mice in an apartment building.*
- *Specify how often infested apartment units should be reinspected.*
- *List the critical areas for mouse infestations in a private home.*
- *List critical areas for doing rodent inspections in a food handling facility.*
- *Identify the disadvantages of using rodenticides inside a food handling facility.*
- *List critical sites for the placement of bait stations when conducting an exterior rodent baiting program in a food handling facility.*

SCHOOLS

Maryland public schools have formal and structured IPM programs. There will be a written IPM policy statement, IPM plan, and requirements for detailed recordkeeping. Records must be maintained in regards to pest sightings, pest control procedures, and communications to students and staff regarding pest control along with pesticide application records. In addition, there may be a logbook, an IPM committee, and a schedule of staff responsibilities. Many private schools have similar IPM requirements.



Controlling rodents in a school is more about sanitation and rodent-proofing by school staff than anything else.

Communication with School Personnel

After reviewing the logbook or other pest sighting records, technicians should talk with the staff at the school during service visits, and, whenever possible, the principal, custodial foreman, and cafeteria manager. Educate building maintenance and grounds staff about pest-proofing and other steps they can take to keep pests from entering buildings. Point out sanitation problems to housekeeping and custodial staff. Explain to food service workers about the connection between inadequate sanitation and pests. Give school nurses information on the hazards that pests may cause, along with information on the pesticides that may be used and how they will be applied.

Sanitation/Maintenance

Controlling rodents in a school is more about sanitation and rodent-proofing by school staff than anything else. Rodent-proof by caulking and sealing openings around pipes and utility lines, along with repairing any gnaw holes. Install door sweeps and weather stripping under doors, and screens on vents. Clean up left over food and food spills and store food in sealed containers. Do not leave animal food out overnight.

Appliances should be cleaned of any grease or spills and the floors carefully mopped. Repair water leaks and install metal grates on floor drains. Remove bags, newspapers, and other stored or stacked items. Place garbage in sealed bags or in receptacles with tight-fitting lids. Remove garbage from the school along with all outside trash cans at the end of each

day. Make sure dumpsters are in good repair with drain plugs in place and tight-fitting lids. Clean up debris from around dumpsters, compactors, and outside trash cans daily. Remove any heavy shrubbery or other plants around dumpsters and building foundations that can hide burrows and trash. In addition, clear away any brush, weeds, and stacked materials near foundations.

Vacuum rat droppings so that any new droppings will be apparent. When vacuuming, wear a face mask and use a unit with an HE (100-series) filter in order to avoid breathing airborne dust from the droppings.

Trapping

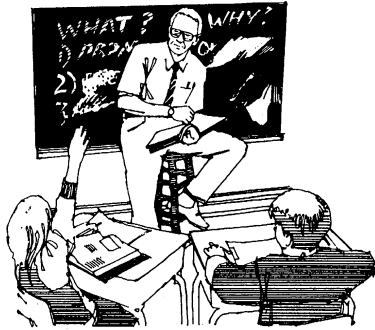
When trapping rats, use expanded trigger snap traps that have first been pre-baited for several days without setting the trigger. If using glue boards for rats, make sure they are rat-size and anchor them with a nail or a wire. When trapping for mice, the snap traps do not have to be prebaited first. Place traps and glue boards along walls and other edges that are common mouse runways. Multiple-catch traps can also be placed along runways to catch several mice at a time.

In all situations, place traps out of the reach of children or in tamper-resistant, bait stations that are anchored securely.

Rodenticides

In the past, pesticides, including rodenticides, were often applied on a schedule inside and around school buildings, whether they were actually needed or not. Parents, advocacy groups, and the scientific community challenged the practice of routinely using any pesticides where children study, eat, and play. Today, Maryland's public school districts have IPM programs that involve requirements on how and when rodenticides, along with other pesticides, can be used.

While they should never be your first choice, sometimes rodenticides are necessary to suppress rodent populations around schools. Great care needs to be taken in their use because of their toxicity to people, especially children. First and foremost, children must be protected from eating the bait. All rodenticides have warnings printed on the label that direct



Whenever you are using a rodenticide bait in or near a school, ask yourself -- is it possible for a child to get at the bait?

the applicator to place the bait "in locations not accessible to children, pets, wildlife, and domestic animals, or in tamper-resistant bait stations."

Unfortunately, no one can give you a list of those locations in and around a school that are considered safe or inaccessible. Whenever you are using a rodenticide bait in or near a school, ask yourself if it is possible for a child to get at the bait.

Use Guidelines

Follow these guidelines for the use of rodenticides in schools and similar sites:

- Use rodenticides only as a last resort. Use glue traps or snap traps (placed inside bait stations) whenever possible.
- Follow all use directions and precautions on the label of each specific rodenticide product to assure that children and nontarget animals are not exposed to the rodenticide.
- All rodenticides used on school property must either be placed inside a tamper-resistant bait station or applied deep inside a rodent burrow, out of the reach of children, pets, or other nontarget animals. A bait tray is NOT a tamper-resistant bait station.
- Place bait only where documented rodent activity has been shown by droppings or other signs. Install bait stations outside near burrows and travel routes.
- Rodenticide bait in the form of blocks should be the primary rodenticide formulation used in bait stations since it can be anchored on rods inside the bait station. Put loose bait inside burrows. Both methods reduce the risk that rodents could drag the bait into the open.
- Bait stations must be anchored securely to the ground or other surfaces to prevent them from being moved or the bait shaken out. Lids must be locked or secured in some fashion.
- All spoiled and unused bait should be disposed of as specified on the product label.

Maryland School Notification Requirements

The notice or sign posted as part of the in-school notification requirements when using a bait station in Maryland public schools must include the following information:

- “Caution--Pesticide Application”
- Common name of the pesticide applied
- Date bait station was placed
- Contact person for additional information

- Avoid the use of water baits and rodenticide tracking powders. The active ingredient in tracking powders is generally 5 to 40 times more concentrated than that found in baits.

Notification and Posting

When bait stations containing rodenticide are used in or around any Maryland public school, the school must post a sign or notice on the door of the room or the primary entrance to the treatment area. The sign or notice must remain posted until the bait station is removed.

The additional requirements for pest control using IPM and pesticides used on public school property are contained in a separate set of regulations under the Maryland Department of Agriculture, which are the *Regulations Pertaining to Integrated Pest Management and Notification of Pesticide Use in a Public School Building or School Grounds*.

HOUSES AND APARTMENTS

Houses and apartments have similarities and differences when it comes to rodents and their control. The greatest similarity is that you are trying to control rodents in and around rooms and buildings where people live, so you have all the concerns about the risks associated with children and pets. The biggest difference is that in apartment buildings you are dealing with a far more complex structure, sanitation issues, and procedural problems (scheduling, access, etc.). Sometimes rats will infest apartment properties and homes, but the real difficulty lies with mouse infestations.



Once mice become widespread in an apartment building, you face the toughest job in urban pest control--eliminating dozens, or even hundreds, of small and separate colonies of mice. (Photo L. Pinto)

Preventing and Controlling Mice in Apartments

There are two options for dealing with mice in apartments: (1) prevention or (2) control. The first option is far easier than the second. Once mice become widespread in an apartment building, you face one of the toughest jobs there is in urban pest control, which is eliminating dozens, or even hundreds, of small and separate colonies of canny, tough, and adaptable social animals.

Prevention

Widespread mouse infestations do not appear overnight. They take months or even years to develop. Time and effort need to be invested before mice become a problem, to ensure that they never do. Conducting thorough inspections is the key.

At every service visit, thoroughly inspect for mice in each unit scheduled for service. Concentrate on the kitchen. Look for droppings on the stove and countertop. Check under the sink and inside floor-level cabinets, and along the wall around the perimeter of the kitchen. Also check around the stove and refrigerator. Use a mechanic's mirror to look behind them. Finally, be sure to talk with the residents.

If you find holes in the walls or cabinets that could be used by mice, either seal them yourself (preferred) or report them, in writing, to the property manager for repair. Carry rodent control supplies with you during the service visit. If you find an infestation, take action by setting traps or applying rodenticide, and then reschedule the unit for follow-up. Be sure to sweep up any droppings so at your next visit you can see if the mice remain active. Follow-up is essential to having a successful rodent control program.

In the fall, control mice outside the building before they try to move inside with the onset of cold weather. Find and seal (or report to the property manager) cracks and openings in the foundation, around windows, doors, and utility lines. Also report any doors that are missing their sweeps.

Controlling an Outbreak of Mice

When mice are located on various floors and sections of a building, it is not a single large colony (as is often the case with rats), but rather numerous small, separate colonies. As a result, each must be addressed.

Eliminating a widespread mouse problem demands aggressive action by the technician, the property's management, and even the residents. Otherwise, you are simply harvesting young and dumb mice, which has little overall impact since they are soon replaced by other offspring.

Serious Mouse Trouble!

A well-established mouse colony in a kitchen might include a dominant male, two breeding females, and a dozen or more immature mice, a total of fifteen or twenty mice. If twenty percent of the units in a 200-unit building become infested, the population could be 800 mice.

Those mice would be depositing fifty-six thousand droppings a day! They would also be breeding, where each mature female could produce 30 to 60 young per year, and with each of her offspring becoming sexually mature in two months. With that reproductive force, successful control can be tough to achieve.

Here is an example of an intensive control program:

- In the initial service, which takes place over a day or two, every room in every unit is inspected (no skips) and then treated as warranted by the level of infestation.
- Before the service visit, residents are required to empty all floor-level cabinets in the kitchen, removing all items from the top of the stove and refrigerator, along with items from closet and pantry floors.
- A maintenance worker accompanies the technician to open utility closets, to pull out the stove and refrigerator, and to help with sealing holes and vacuuming.
- Droppings are swept and vacuumed so that any new droppings can be identified at the next service.
- Report forms are used to document the level of infestation and any special problems such as poor house-keeping or structural deficiencies.
- Mouse holes are repaired or blocked, the small ones during the service visits, while the larger ones are done by the property maintenance staff within one week.
- Every unit having evidence of mice is put on a follow-up list for service within 2 to 4 weeks. At that time, depleted baits are replaced, traps reset or replaced, and droppings swept up or vacuumed.
- Traps are available for residents at the rental office.
- Reinspections/retreatment of each mouse-infested unit continues every 2 to 4 weeks until there are no new signs of new mouse activity. It can take four or five months before all units are certified mouse-free, but intensive follow-up is essential for success.

Control methods vary with the conditions at the property and might include the use of traps in utility rooms and next to appliances and in other protected sites. The use of tracking powder that is applied into wall voids along the length of wall located behind the kitchen sink, along with floor-level voids found under kitchen cabinets is another method. Baits can be placed into inaccessible sites, such as under and behind appliances, behind kick plates and under cabinets. Also, tamper-resistant bait stations can be used where there are

large accumulations of droppings. Mix and switch the baits between blocks, seed baits, and other formulations, because mice are such finicky nibblers.

Control Methods for Mice Inside Homes

When treating residential homes for rodent, the first thing you need to determine is if there are children or pets. The answer to this question will determine which control measures you choose and how you use them. In any area of the house that children or pets may have access, place traps, glue boards, or baits in inaccessible sites or inside tamper-resistant bait stations. Consider all of the possibilities. Even if there are no children living in the house, grandchildren (and pets) may still visit.

Garage



An attached garage is often the first stop for mice moving into residential homes. (Photo L. Pinto)

An attached garage is often the first stop for mice moving indoors. From here, they sneak through openings around doors and pipes where they get into living areas. While not part of the living areas of the house, garages and other entryways are still "high traffic" areas, so rodenticides must be used carefully. Attached garages are areas where pets are often fed or sleep. As a result, it's best to place rodenticides, as well as sticky traps and snap traps in inaccessible locations or inside bait stations.

Basement

The control method used in basements depends on how it is used by the residents. Is it used as an unfinished storage area or is it used as a playroom for children? Also, are pets confined to the basement? Your options are snap traps, glue traps, or rodenticides placed in inaccessible sites or in tamper-resistant bait stations. Place traps near doorways or where mouse droppings have been found. Again, if children or pets might enter the basement, put traps inside tamper-resistant bait stations. Remember—think three dimensions. Finally, do not forget the drop ceilings, if they are present.

Kitchen

The kitchen is the number one location for mice because of its food and warmth. The three most common nesting sites in



The three most common nesting sites in kitchens are: (1) voids beneath the sink cabinet, (2) the base void of the refrigerator, and (3) the base void of the stove.

(Photo L. Pinto)

kitchens are: (1) voids beneath the sink cabinet, (2) the base void of the refrigerator, and (3) the base void of the stove. The use of toxic baits may not be the best choice in a kitchen because there are so many other food choices available. Also, mice tend to hoard or scatter bait pellets. Use traps, or consider using a tracking powder in voids.

Make sure to place traps in mouse runways that go from harborage sites to feeding areas. Good protected trap locations are found behind or under refrigerators, stoves, and other large appliances. In other sites, consider placing glue traps inside bait stations in order to keep them from being stepped on or getting dusty.

Bathrooms

Mice are drawn to bathrooms due to the availability of water. Advise customers to repair any leaky pipes or dripping faucets. Glue traps can be used and may be placed inside the vanity or in other protected locations. Avoid using baits unless the mouse infestation is severe.

Living Room/Family Room/Bedrooms

Mice are usually not a problem in the living room, family room, or bedrooms since food and water are not readily available. Avoid using any traps or baits in these locations unless absolutely necessary. When they have to be used, make sure to follow standard safety precautions.

Attic

Since an attic is generally inaccessible to children and pets, you have a number of control options. The use of bait place packs is a good choice for attics since they are easy to use and do not require frequent follow-up. But do not toss them in the attic, "place" them. Other options are the use of snap traps, sticky traps, or tracking powder.



Thorough inspections and a quick response to problems are essential in a food facility in order to avoid rodent infestations.

FOOD HANDLING FACILITIES

Food handling facilities are sites such as restaurants, cafeterias, food markets, even food manufacturing plants, warehouses, or anywhere food is prepared, manufactured processed, or stored. These sites attract rodents since food processes give off food odors and heat, and there are often spills. Food plants and warehouses are often located in rural and agricultural areas, or in the rundown areas of cities, both of which have existing rodent populations. Restaurants and markets may be in urban areas with high rodent populations. Mice and rats are also delivered directly into food facilities inside pallets and packaging. For all these reasons, food facilities often face heavy pressure from the invasion of rodents.

Critical Rodent Areas

Thorough inspections and a quick response to problems are essential in a food facility in order to avoid rodent infestations. Certain areas are critical, these include:

- Dumpsters, compactors, and other trash equipment along with the surrounding areas
- Loading docks and receiving areas
- Food processing or food loading equipment located outside
- Exterior perimeter of building
- Abandoned equipment, supplies, and construction materials found along the building perimeter
- Weedy areas and thick landscaping
- Roofs
- Food processing and preparation rooms
- Food storage areas and stock rooms
- Rework and damaged goods areas
- Cooler/freezer tops
- Under refrigeration units, display cases.
- Where aisles of soft goods are displayed, particularly those for pet food, bird seed, and grains
- Sub floor voids, wire chases and refrigeration line chases
- “Abandoned” rooms, particularly if cluttered
- Ceiling voids

High Contamination Risk

In a food handling facility, even a few rodents can contaminate large amounts of food in a short period of time, causing financial losses, regulatory action, and a ruined reputation.

Exterior Baiting Program

Typically in food handling facilities, rodenticide bait blocks are placed inside tamper-resistant bait stations:

- Along fence lines.
- Around the perimeter of the property.
- Around the outside perimeter of buildings.
- In areas of high rodent activity.
- Adjacent to loading docks and receiving doors

Rodenticides

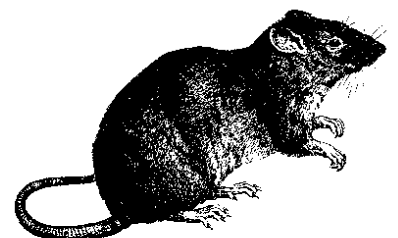
Exterior rodent baiting is a common strategy for protecting food handling facilities from rodents. The number and spacing of stations is dependent on the history of rodent pressure at the site and the ease with which rodents can invade the plant.

However, there are many reasons to avoid the use of rodenticides inside the same facilities. They should be used only as a last resort. These reasons include:

- When rodents are poisoned, they may crawl off and die where they can contaminate food, create foul odors, and attract scavenger insects such as dermestid beetles.
- The baits themselves can become infested with stored product pests.
- Rodenticides can be carried (“translocated”) by rodents into food areas where food products can be contaminated.
- Bait stations can be damaged by heavy equipment such as fork lifts, thus spilling rodenticide onto floors located in food storage or food processing areas.
- Rodent-proofing and exterior control can keep most rodents from entering the facility.
- There are good alternative control methods available that pose no risk of food contamination if rodents do get inside.

When a rodenticide must be used inside a structure, bait blocks are the most common rodenticide formulation used since they can be secured by rods and wires inside a bait station. By doing this the bait cannot be carried by rodents to a different location (translocation).

Because of the risks of food contamination, avoid using tracking powders inside food handling facilities. In addition, the powder could become airborne and drift into nontarget areas, or be translocated to other areas of the facility on the fur of rodents.



REVIEW QUIZ

- Which one of the following would be your first choice for controlling rodents in a school IPM program?
 - snap traps
 - rodenticide block baits
 - rodent-proofing
 - tracking powder
- In a school IPM program, you should:
 - apply rodenticides on a regular, weekly schedule to prevent rodent outbreaks.
 - place rodenticide bait inside shallow bait trays in corners.
 - place glue traps inside bait stations.
 - use tracking powders whenever possible.
- Inside apartments, the rodent that you are most often dealing with is the:
 - house mouse.
 - white-footed mouse.
 - Norway rat.
 - roof rat.
- Which one of these areas is the most likely place to find evidence of mice in an apartment?
 - bathroom.
 - laundry room.
 - hall closet.
 - kitchen.
- What is the main reason for sweeping up rodent droppings in a home?
 - to prevent disease outbreaks
 - to be able to see when new droppings appear
 - so that children do not get into them
 - so the resident knows you were there
- Which of the following is one of the top three nesting sites for mice in a home kitchen?
 - cabinet above the refrigerator
 - area behind the garbage can
 - spice cabinet
 - void beneath the sink cabinet
- Why are mice sometimes found in the bathroom of a home or apartment?
 - water is available
 - there is food spillage
 - they come up through drains
 - they nest inside pipes
- Why are bait blocks the most commonly used rodenticide formulation inside a food facility?
 - they are the easiest to hide
 - they can be secured inside bait stations
 - they do not compete with other food
 - rodents like them best
- Why should you avoid using rodenticide tracking powder in food handling facilities?
 - because it could get damp
 - because rodents avoid it
 - because of the risk of food contamination
 - because rodents have plenty of food available

APPENDIX

Glossary

Acaricide – a pesticide specifically formulated to control mites and ticks.

Anticoagulant – a type of rodenticide that affects the blood clotting ability of an animal.

Baiting – the act of placing rodenticides or food in locations or on traps for rodent control.

Bait shyness – avoidance of a rodenticide bait by a rodent that has eaten the bait and gotten sick.

Bolt hole – a rodent’s emergency exit from its burrow.

Burrow – a tunnel or digging in which animals nest or shelter.

Cache – a place where rodents store food, usually near their nest.

Carcass – body of a dead animal.

Chick fount – metal pan with a bottle reservoir above, used in chicken houses to dispense food or water; also used to hold liquid rodenticide bait in rodent programs.

Clutter – stockpiled or large amounts of stored objects such as boxes, newspapers, old clothes, furniture, etc.

Commensal – living and eating with man.

Conducive condition – something that could contribute to rodent problems, such as overflowing dumpsters or areas with spilled food.

Conduit – a channel for a pipe or utility line (phone, electric, cable, gas) that enters a building.

DEET (diethyltoluamide) – active ingredient in insect repellents that can be sprayed on skin and clothes to protect from biting pests.

Ectoparasite – a parasitic organism like a flea, louse, or mite that lives and feeds on another animal

Environment – the conditions that surround the development of an organism.

Escutcheon – ornamental or protective plate.

Euthanizing – process of humanely and quickly killing a trapped or injured animal to minimize its suffering.

Exclusion – sealing off an area by various methods to limit pest entry.

Fascia board – construction element that uses a flat, horizontal board between moldings.

Feces – rodent droppings, pellets, or excrement.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) - the federal law, administered by the U.S. Environmental Protection Agency (EPA) that governs the use, storage, and disposal of rodenticides and other pesticides.

Food handling facility – any place (other than a private home) where food is held, stored, processed, prepared, or served.

Foraging range – the distance a rodent will travel to find food or water.

Formulation – the ingredients and physical appearance of a pesticide product.

Fumigant – pesticides, either liquid or solid, that when exposed to air release a lethal gas; when used rodent control it is most often used in burrows.

Habitat – an area or region where an animal lives.

Hantavirus – a virus transmitted to people by the saliva, urine and feces of deer mice and white-footed mice.

Harborage – a place that offers safety or protection to an animal.

HE – abbreviation for High Efficiency filter, recommended 100-level filters for respirator use to protect against airborne disease or allergen particles.

Home range – the area normally occupied by an animal.

Inaccessible – cannot be entered.

Inspection aisle – cleared area (18 to 24 inches wide) around the inside perimeter of a storage area that allows inspection, cleaning, and placement of control devices.

Integrated Pest Management (IPM) – a system of managing pests that combines prevention and sanitation with other control measures to minimize the risks to people and the environment.

Kinesthetic sense – a rodent's memory of previous muscle movements needed to run its territory.

Landscaping – the flowers, shrubs, trees, and other plantings on a property.

Litter – the young that are born to an animal.

Live trap – a trap, usually of metal screen, that captures animals alive by luring them into the cage through a trap door.

Lyme disease – a bacterial disease transmitted to people by ticks. White-footed mice and deer mice are reservoirs for the disease.

Lymphocytic choriomeningitis (LCM) – virus transmitted to people primarily by urine, droppings, saliva, or nesting material of the house mouse.

Mechanical – any method that employs physical methods of rodent control, for example snap traps or rodent-proofing.

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- Monitoring – regular visits or sampling at a site to check for rodent activity, estimate populations, identify travel routes, or to evaluate the effectiveness of a treatment.
- Multiple feeding – a rodenticide that requires several feedings to provide a lethal dose.
- Native – those animals that are naturally found in an area; not introduced into the area.
- Neophobic – having a fear or the avoidance of new objects.
- Nocturnal – active during nighttime hours.
- Nonchemical – control method such as trapping that does not use chemicals.
- Nontarget – an animal or plant that is not the intended pest to be controlled.
- Nontoxic monitoring block – a wax block bait that contains no rodenticide and is used to detect rodent feeding activity.
- Omnivorous – eating a wide variety of food materials, including meat and plants.
- Place packs – (also called packet baits) small bags containing pellet, meal, or seed rodenticide baits.
- Quality control – involvement of an overseer in evaluating a site, program, or control efforts to insure proper standards are met.
- Ratbite fever – bacterial disease usually caused by a bite or scratch from an infected rodent.
- Repellent – a material or chemical that will keep animals away from an area.
- Reservoir – a vertebrate host, other than man, that can carry a disease organism in its blood.
- Rodent-proofing – sealing or protecting an area to make it inaccessible to rodents.
- Rodenticide – a pesticide specifically formulated to repel or kill rodents.
- Rub mark – an oily deposit (from rodents' hairs) left on surfaces where rodents have been moving.
- Runway – a route that mice or rats repeatedly follow.
- Saturation trapping (mass trapping) – trapping technique that involves first placing a large number of baited, unset traps which are later set all at once.
- Scavenger – an insect or animal that feeds primarily on dead animal flesh or other decaying organic matter.
- Secondary poisoning – poisoning that occurs to other animals that have eaten rodents that have died or are dying from eating a rodenticide.
- Sensitive account – any site, such as a school or hospital, where residents may be concerned about the use of pesticides or certain types of traps.
- Single feeding – a rodenticide that can provide a lethal dose to a rodent with only one feeding.
- Soffit – element of construction that is found on the underside of an overhanging beam or cornice.

Stop-feed – a type of rodenticide that causes rodents to stop feeding after they have eaten a toxic dose even though they may not die for 1 to 4 days.

Tamper-resistant – a term referring to those rodent bait stations that meet the EPA criteria for construction and safety that prevents children or nontarget animals from reaching the rodenticide bait inside the station.

Tracking patch – a dusting, usually of inert material like talcum powder, that will show evidence of rodent activity when rodents walk through it.

Tracking powder – dust-like formulation of a rodenticide that clings to a rodent's hairs and is then ingested during grooming.

Translocation – the movement of rodenticide bait away from the baiting site to nontarget areas, usually when carried there by rodents.

Ultraviolet light (UV) – also called blacklight; portable UV devices are used to detect rodent urine.

Answers to Review Quizzes

CHAPTER 1

1. c
2. b
3. d
4. b
5. a
6. c
7. d
8. b
9. a
10. c

CHAPTER 2

1. a
2. b
3. c
4. c
5. b
6. d
7. a
8. d
9. c
10. c
11. a
12. b
13. b
14. d

CHAPTER 3

1. b
2. c
3. c
4. a
5. c
6. b
7. d
8. a
9. c
10. b
11. a

CHAPTER 4

1. a
2. a
3. c
4. b
5. b
6. d
7. c

continued...

CHAPTER 5

- 1. a
- 2. c
- 3. d
- 4. b
- 5. b
- 6. a
- 7. a
- 8. c
- 9. b

CHAPTER 6

- 1. b
- 2. c
- 3. d
- 4. a
- 5. c
- 6. b
- 7. d
- 8. c

CHAPTER 7

- 1. b
- 2. c
- 3. d
- 4. a
- 5. b
- 6. c
- 7. d
- 8. a
- 9. b
- 10. b

CHAPTER 8

- 1. a
- 2. c
- 3. d
- 4. c
- 5. b
- 6. d
- 7. a

CHAPTER 9

- 1. b
- 2. d
- 3. c
- 4. d
- 5. b
- 6. d
- 7. d
- 8. b
- 9. c

CHAPTER 10

- 1. c
- 2. c
- 3. a
- 4. d
- 5. b
- 6. d
- 7. a
- 8. b
- 9. c

Additional Information

Books and Manuals

Applying Pesticides Correctly: A Guide for Private and Commercial Applicators. EPA and USDA Extension Service.

The Mallis Handbook of Pest Control. GEI Media. Cleveland, OH. 2004.

NPCA Field Guide to Structural Pests. E. H. Smith and R. C. Whitman. National Pest Management Association, Fairfax VA. 1992.

Pesticide Safety Education: Category 7a. A Training Program for Certification of Commercial Pesticide Applicators. CES/ Cornell University. 2006.

Prevention and Control of Wildlife Damage. S. Hygnstrom, R. Timm, and G. Larson. University of Nebraska Cooperative Extension. 1994.

Rodent Control: A Practical Guide for Pest Management Professionals. R.M. Corrigan. GEI Media. Cleveland OH. 2001.

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Urban Integrated Pest Management: A Guide for Commercial Applicators. EPA, Pesticides and Toxic Substances (EPA 735-B-92-001). 1992.

Periodicals

Pest Control Magazine. Questex. 7500 Old Oak Blvd., Cleveland OH 44130. Published monthly.

PCT Magazine. GIE, Inc. Publishers. 4012 Bridge Ave., Cleveland Ohio 44113. Published monthly.

Techletter. A training newsletter for pest control technicians. Pinto & Associates, Inc., 29839 Oak Road, Mechanicsville MD 20659. Published biweekly.