RODENT EXCLUSION TECHNIQUES

A Training Guide for National Park Service Employees
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INTRODUCTION

Rodents have been a common problem in living and working environments, probably, ever since humans began living in permanent dwellings. Even today many people believe rodent infestations are "inevitable". However, the recent appearance of Hantavirus (Sin Nombre Virus, Hantavirus Pulmonary Syndrome, HPS) in the Western states has re-awakened the public to the serious health problems posed by rodents and has prompted new inquiries into more effective ways to manage infestations. This manual is designed as a training reference for making rodent control in buildings an attainable goal.

METHODS USED IN MECHANICAL RODENT CONTROL

Control of rodents in buildings is not complicated but it is not easy and always involves much more than simply setting out a few mouse traps or a package of rat poison. To be effective, rodent control must be done in a professional manner and regarded as a cooperative effort between site occupants, pest management professionals and site management. At the very minimum, successfully controlling rodents in structures requires the following:

! a basic knowledge of rodent biology. A fundamental understanding of the habits and reproductive abilities of different species of rodents is helpful for knowing where to look for signs of animals and how to select the best control measures.

! a basic knowledge of NPS policy. Native rodents are protected under NPS policy. This policy promotes the use of rodent exclusion methods - keep them outside in their natural habitats. Management strategies will differ inside and outside and are prescribed on a case-by-case basis.

! a thorough inspection of the exterior and interior of a building. The main purpose of an inspection is to identify structural defects which allow rodents to enter buildings. Inspections also provide information on the species of rodents present, key shelter areas, locations where animals obtain food and water, and identify conditions around buildings favoring infestations. Those findings are used to set priorities for repairs needed to keep animals out of buildings and to recommend changes in conditions supporting rodent populations.

! effective exclusion. Rodent control in structures is based on one simple rule: **rodents must be prevented from entering a building or a room**. Excluding rodents by closing all possible holes where they can enter or leave a structure is always the most important measure against infestation.

! good sanitation practices that eliminate food, water, and shelter for rodents. Good sanitation removes essential resources (water, food and shelter) needed by rodents and limits the numbers of animals that can live in an area. Good sanitation is very important for controlling rodent populations, but even the best of sanitation measures will not prevent infestations where exclusion is not adequate.

! continually removing 85 to 95 percent of the rodents present capable of reproduction. Rodents mature quickly and produce large numbers of young. The numbers of animals present will not change much or may continually increase unless most of the breeding adults are removed.

! regularly checking for new rodent activity. Regular documented re-inspection (monitoring) of sites is important to determine if previous control efforts were effective; to find any newly opened holes animals could use; to watch for changes in sanitation and harborage conditions; and to determine if the numbers of animals present are increasing, decreasing, or unchanging. The importance of continual watchfulness is clear when it is known how rapidly rodent populations can increase and how difficult it is to control established infestations.

! cooperation between people. Rodent management must always be a team effort between building occupants (affected persons), maintenance workers (for repairs), and area managers

(decision makers). It is urgent for all involved persons to be totally committed to and have a clear understanding of the program needs.

! Assign responsibilities. Assigning responsibilities to the people involved in the rodent management project is essential to success. Responsibilities with completion dates should be determined by the participants and put in writing. This ensures each team member is aware of what is being done and their responsibilities.

None of the above activities are difficult to do but when any of them are overlooked or not sufficiently stressed, rodent control is often unsuccessful. Common failures in controlling rodent infestations in buildings are usually the result of one or more oversights:

! under-estimating the severity of a rodent infestation - either in regard to the numbers of animals pre

! failing to find or satisfactorily closing holes used by animals to enter rooms or buildings.

! using too few traps, trapping stations, or improperly placing traps.

! failing to have "buy in" or cooperation of site occupants and management. Usually the result of failure to assign responsibilities in writing.

! failing to remove trapped rodents which become food for surviving animals.

! failing to secure garbage and other food supplies.

! placing too much reliance on poison bait as a means of control.

REASONS FOR CONTROLLING RODENTS

There are two very important reasons for controlling rodent populations in and around structures occupied by humans. Rodents can be responsible for spreading disease and rodents can damage buildings and building contents.

Health risks

By far, the most basic reason to control rodents is because of potential health risks from human contact with rodents or rodent debris. Rodents are known to be able to carry over 200 disease organisms, many of which can be transmitted to man. Many of these diseases are spread while rodents wander about in buildings at night searching for food and mates. During those activities, they continually drop feces, urine, and hairs which can come in contact with human foods, eating utensils, bedding, etc. or can be responsible in other ways for the spread of diseases.

Old World house mice and rats (exotic rodents that were accidentally introduced into this country) can spread plague, typhus, rat bite fever, trichinosis, salmonella food poisoning and other infectious diseases. Native rats and mice (rodents naturally occurring in this country) can carry plague; tularemia, leptospirosis (in urine), endemic relapsing fever, Rocky Mountain spotted fever, and Q-fever. Sylvatic plague is endemic in the western United States. In 1992, deer mice were identified as the most important transmitter of **Sin Nombre Virus (Hantavirus Pulmonary Syndrome; HPS).** Humans can become ill with Sin Nombre Virus after coming in contact with rodents; rodent feces, urine, or body fluids; or after inhaling dust arising from rodent feces or nesting materials.

Rodent food caches, nests, and dead rodent carcasses (poisoned animals or animals dying from natural causes) cause secondary health issues when they attract parasites, flies, carpet beetles, and other pests - all of which can also become serious problems in buildings, damage building contents,

and also spread diseases.

The night time activities of rodents inside buildings can result in sleep disturbances to human occupants and, in rare cases, have been associated with paranoid fears and even serious accidents.

Damage

Many kinds of physical damage can be expected when rodents enter or infest buildings. The animals often build nests and store large amounts of food (acorns, nuts, seeds, etc.) behind walls or in attics and such storage can cause structural damage and attract other pests. Rodents often burrow into and re-arrange wall and attic insulation and, because of their habit for gnawing on objects, may damage upholstered furniture, museum collections, paper and leather goods, clothing, and electrical lines and equipment (including computers). Many structural fires each year in this country are thought to result from electrical wiring damaged by rodents.

Outside, rodent burrows near building foundations can increase the rate of structural deterioration by loosening soils, allowing for increased water penetration, and support excessive vegetation. And, the mere presence of rodent burrows attracts larger predatory animals that enlarge the burrows to cause additional structural damage. Rodent damage to buildings increases the potential for deterioration from weathering, moisture, and other sources. Rodents frequently enter and make nests in parked machinery and vehicles and damage electrical wiring and hoses. This can be quite serious should emergency-response vehicles be involved. Rodents often damage valuable gardens and ornamental plantings.

RODENT BIOLOGY AND HABITS

Rodents are one of the most numerous, successful, and adaptable of all living animal groups and differ from other kinds of animals by their front teeth which are specialized for gnawing. Rodent teeth grow continuously throughout the animal's life. Because of this, these animals have to gnaw frequently to keep the tips worn down. There are over 3,000 different kinds of rodents in the world that range in size from small (fraction of an ounce) to large (more than 100 pounds) animals. Rodents of one kind or another occur in every kind of environment from deserts to tundra.

Rodents have a keen sense of smell and the animals produce many natural odors (pheromones) which attract others of their kind. Once rodents have entered a hole, room, or building, their odors remain on the hole and may attract other rodents. Their scent is often left behind by grease marks made by oils in the skin and by urine markings.

Rodents present in this country may be either native (New World) or exotic (Old World) animals. It is very important to be able to accurately identify rodents causing problems because these animals resemble one another but have quite different habits and living requirements.
Native (naturally occurring) rodents include: mice (white-footed, pygmy, pocket, grasshopper, harvest, and jumping mice); rats (wood, cotton, kangaroo, and rice rats); voles; porcupines; pocket gophers; lemming; nutria; squirrels (ground, tree, and flying); chipmunks; marmots; prairie dogs; muskrats; and beaver.

Exotic rodents (animals accidentally introduced into this country from other countries) are house mice and rats (Norway and black rats). Exotic rodents are easily identified by their scaled, nearly hairless tails (giving them the name, "naked-tail" rodents").

Mice and rats are the most common structural pests in buildings. A basic description of their biology follows.

MICE

Mice, because of their size and adaptability, are the most common indoor rodent pests in buildings. In the Eastern part of this country, exotic house mice are the animals more often found inside buildings but native mice (especially, white-footed mice) are the most common indoor rodent pests in the West.

In general, rodents produce large numbers of young. This is necessary for the survival of rodent populations since they have a high mortality rate. House mice, for example, are able to reproduce all year indoors. During one year and under ideal conditions, a single pair of house mice is thought to be able to produce over 3,000 offspring. This is theoretically possible because young house mice can produce young when only about 30 days old and a female can become pregnant with a second litter even while the first litter is still nursing. Native deer mice, more adapted to life in the out-of-doors, do not reproduce year-round and produce fewer young. Yet, under ideal conditions, a pair of deer mice theoretically are capable of producing a population of about 800 mice during their 4-month-long breeding season. They are an important food source t many other animals. Under natural outdoor conditions, however, competition between mice for space and food and natural predation (from owls, foxes, etc.) removes 80 to 90 percent of all young mice soon after birth. It is not surprising that when ample food, water, and shelter are available and predation absent (conditions found indoors), mouse populations can explode. Indeed, mice will occupy as many spaces in a building as possible until a limitation in the resources available to them restricts the numbers of animals that can survive.

Mice are exceptionally agile animals and can jump 12 or more inches straight up from one flat surface to another. They can even jump against a flat vertical surface such as a wall and spring-board to even higher levels. They can jump down to the floor without being injured from an elevation of 8 or more feet. They can climb any slightly rough, vertical surface such as wood, plaster, brick, metal pipes, wire mesh, cables, etc. And, they have good balance and can easily run along horizontal electrical wires, ropes, and cables from one part of the building to another.

Mice are actually somewhat smaller than they appear and can squeeze their head through a hole only about 1/4-inch in diameter, about the same size as a wooden pencil. After getting its head through a hole, a mouse has no trouble getting the rest of its body through.

Although mice tend to prefer cereal grains, they will eat almost all foods consumed by humans and domestic pets. A mouse's daily food requirements are small, only about 1/10-ounce (1/2 teaspoon) of food and 1/5-ounce of water per day for survival and much of that water can come from food they eat. Mice are sometimes difficult to poison because they will only nibble on small bits of food from many locations. Unless the animals can be somehow encouraged to heavily feed on poison bait, they may not get a lethal dose. And, only eating small amounts of bait may only cause mild discomfort and make the bait repulsive to them. Some animals have definite food preferences and will not eat bait at all.

Mice are most active after sunset but are sometimes seen during the day when, in severe infestations, there is extreme competition for space between mice.

Activity habits are different between native and exotic mice. Native white-footed mice occupy a home range area of about 1/3 to 4 acres and may travel 200 or more feet from the nest to a food source. They do not hibernate but are less active during winter. Exotic house mice have much smaller ranges, seldom travel more than 20 feet from their nest site to a food source, and are active all winter. They are very curious as compared to the wary rat, and will investigate new objects such as traps.

Mice are strongly attracted to the warmth, shelter, food, and water offered by occupied human structures. Outdoors, native mice are most numerous during late summer and competition between animals for nest sites becomes high with the onset of cold weather. This is when

animals begin to enter buildings, however many mice that move into buildings during the fall will continue to feed outside on natural foods until winter. With the return of warmer spring weather, adult mice begin producing young. Shortly thereafter, rodent problems in buildings seem to suddenly come to an end when most animals return to outdoor habitats where they remain during summer.

RATS

The principal indoor rat-sized pest in the Eastern part of the country are Old World (exotic) rats. The most common, rat-sized structural pests in the West, are native wood rats, squirrels, and chipmunks. Both native and exotic rats quickly adapt to nearly all living environments provided them by humans (granaries, fields, sewers, attics, basements, etc.). Old World rats, similar to exotic mice, often live most of their lives inside buildings. In the West, chipmunks, wood rats, some ground squirrels, and tree squirrels may nest inside buildings, attics, crawlspaces, chimneys, etc. (especially during winter), but usually feed outside and seldom enter occupied portions of a building.

Old World female rats become reproductively mature when about 3 months old and can produce an average of 20 surviving young per year. Native rat-size rodents are less productive than mice but females can usually raise 3 to 4 surviving young each year.

Rats eat the same general foods as do mice but, being larger animals, require about 1-ounce (2 tablespoons) of food and **2** to 1-ounce of water per day for survival. Like mice, a water supply is not as critical as food because most water comes from their food.

Old World rats are very agile and can leap 3-feet straight up or 4-feet horizontally. They can also climb the outside of a 3-inch diameter pipe, walk on wires between buildings, swim 1/2-mile of open water, tread water for days, swim up-current in sewer lines and through toilet traps, and survive a fall of more than 50-feet. Native rats (tree squirrels, wood rats, chipmunks, and some ground squirrels) are also very agile.

Rats have powerful teeth and are able to gnaw holes through concrete block, aluminum siding, adobe brick, wall board, plaster, wood, and various other durable materials. Usually, there must be an exposed edge to gnaw; smooth surfaces limit their ability to initiate holes.

Although rats are much larger animals than mice, they can squeeze through holes only 1/2-inch in diameter.

Old World rats usually range within about 100 to 150-feet of their nest. They may sometimes nest indoors and forage outside for food - or - live outside and forage indoors. Native rats have relatively large forage areas and can move long distances from an indoor nest site to a food source.

INSPECTION

The underlying causes of most rodent infestations in buildings are structural defects (deficiencies such as holes, cracks, and gaps often which allow animals to enter. These defects can be discovered by routinely inspecting buildings. Observations made over long periods of time (**monitoring**) provides additional information on: the relative effectiveness of control efforts, changes in the numbers of animals present or renewed rodent activity, locations of greatest rodent activity, changes in the amount of food or shelter available for rodents, changes in the rates of structural deterioration, and other helpful information.

These two terms, "**inspections**" and "**monitoring**", commonly used by pest control workers, are sometimes confusing because they describe what seem to be similar activities. The difference is:

INSPECTION

A comprehensive initial written evaluation (a one time "snapshot" evaluation) where the "inspector" looks for presence of rodents and rodent signs, conditions favoring them, and potential sources of rodent access into buildings.

MONITORING

A continuing written evaluation that identifies and evaluates changing conditions over time including re-infestation and new sources of rodent access which have occurred since the last evaluation. Monitoring will be discussed in the section following the discussion of rodent control methods.

BACKGROUND INFORMATION FOR MAKING RODENT INSPECTIONS

Rodent infestations were studied in 1994 in a number of buildings in 3 National Park Service areas. Both interiors and exteriors of buildings were inspected for rodent activity, conditions favoring such rodent activity, and for structural defects allowing rodents to enter. The studies showed it is common to be able to initially trap animals outside of a building and then later re-capture the same animals inside the building. Animals first captured on the outside were often later re-trapped on the inside. This study showed the ability of animals to move between building exteriors and interiors.

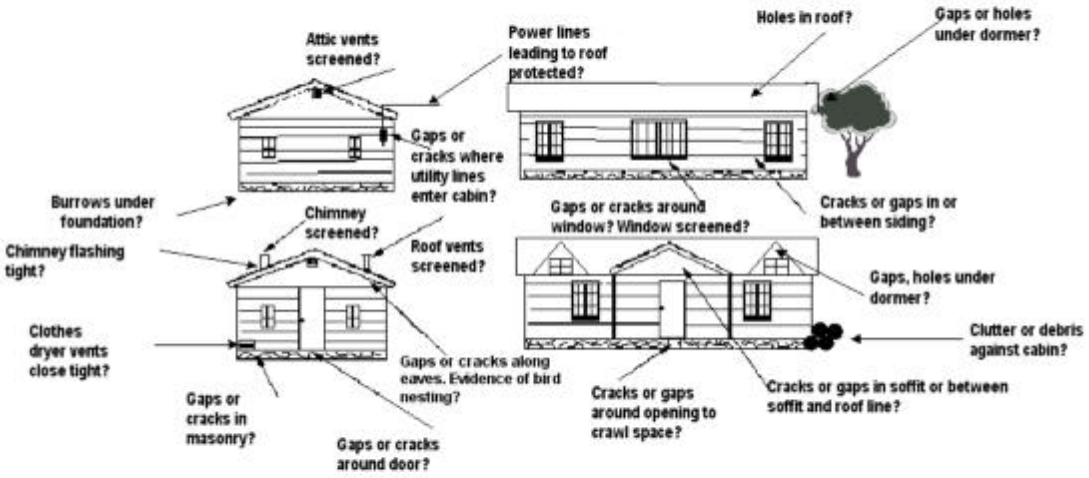
After identified sources of rodent access into buildings were repaired, overall rodent infestations decreased by more than 90 percent compared to similar structures not repaired. In most of the repaired structures no rodent activity was detected. This study clearly shows that identification of defects followed by relatively simple mechanical repairs can SIGNIFICANTLY reduce or eliminate rodent problems in most buildings.

To adequately rodent-proof structures takes knowledge of rodent behavior, great care in identifying and eliminating sources of rodent access and periodic follow-up to ensure all sources of rodent access were eliminated and no new sources were created through repair or replacement of utility lines, plumbing fixtures etc.

Information derived from inspections is very helpful to follow-up control programs. Information an inspector should gain and describe in a written inspection report include:

- the kind, extent, and severity of the rodent infestation,
- locations where rodents may be entering the building,
- any possible supporting reasons for the infestation (i.e., available food shelter or water),
- the presence and location of major rodent activity and harborage areas, and
- recommendations for the lowest risk and most appropriate rodent control strategies.

Figure 1



- **!** signs of rodent activity such as gnawing, rub marks, and piles of roach wings (Mice will each cockroaches leaving wings and legs in a pile.).

An example of a written inspection is provided in Appendix B..

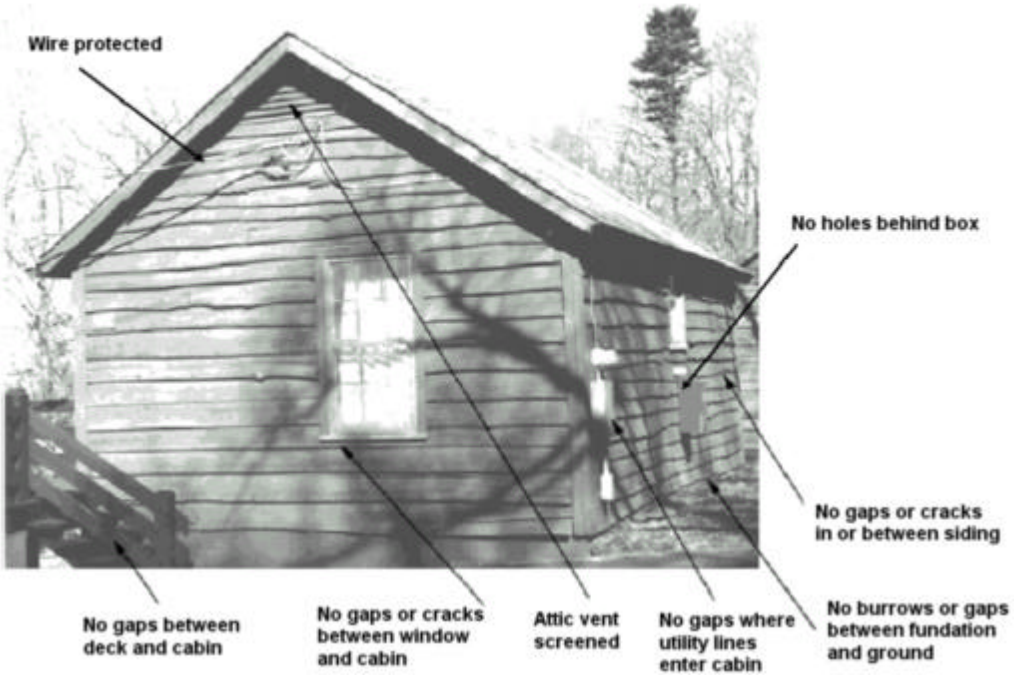
SAFETY NOTE. Because of the recent recognition of Hantavirus (Sin Nombre Virus; HPS) which has been documented nation-wide, anyone performing rodent inspections or monitoring duties and who might come in contact with dead or live rodents or rodent debris should follow all of the U. S. Center for Disease Control (CDC) guidelines for personal safety and wear unlined rubber or plastic gloves and goggles. Workers should wash their hands in disinfectant soap and water <u>before removing gloves</u>. In areas where Hantavirus has been confirmed present, persons cleaning up rodent debris or removing rodents from traps should follow those same CDC guidelines for personal safety (gloves and goggles) but also wear coveralls, rubber boots or disposable shoe covers, and appropriate respiratory protection (a half-face mask with a high efficiency particulate air <HEPA> filter). See Appendix C for a recommended "Hantavirus Kit".

INSPECTION EQUIPMENT

A clipboard, pencil or pen, and inspection forms are necessary for recording inspection findings. A bright flashlight should be used during inspections even in daylight hours. The light helps concentrate one's focus and better illuminates rodent sign, structural deficiencies, and likely

harborage. Other useful pieces of equipment may include: a hand and extendable inspection mirror;

Figure 2



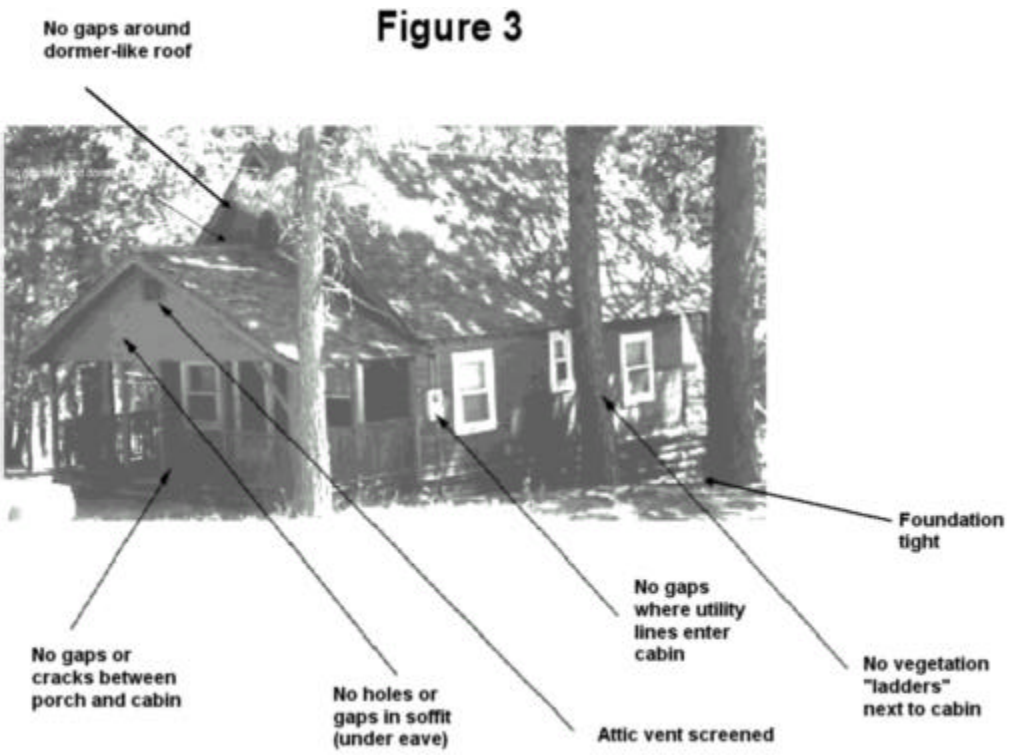
tape measure; Polaroid, 35 mm, and/or video camera; Phillips and slot screwdrivers; step ladder; compass; colored sticky labels (to mark areas needing repair); and a hard hat and knee pads if sub-floor or attic areas will be entered. Sometimes, an electronic moisture meter, stud finder and/voltage detector; pocket-sized tape recorder, jeweler's eye loop, and long forceps are also helpful.

BUILDING EXTERIORS

Exterior inspections of buildings should be made at least twice a year (once during spring to evaluate winter damage and a second time during the fall before rodents try to move into buildings). The two inspections should document any new structural defects or building repairs/accidents which may have opened new points of entry for rodents. Ideally, the same inspector does both inspections.

The first step in making an inspection of a building is to prepare a rough drawing of the building exterior. Show all major features where pests might find entry (Figure 1). These may be access points for electrical and plumbing service lines, doors and windows, crawlspace and basement openings, window wells, porches and decks, domer corners, chimneys, etc. Also note on the drawing an arrow to indicate the direction North, the point on the building where you begin the inspection, and a curved arrow to show the direction you moved around the building during the inspection.

From a point of beginning, slowly and systematically examine the entire building exterior from the ground to the roof while looking for defects that could allow for rodent entry (You must think like a rodent). When defects are found, note their locations on the drawing and describe them as possible rodent entry points. The aim of an exterior inspection is to obtain as much information as possible on any ways rodents might enter and on any existing conditions in or near the building which might support or attract rodent activity. Normally, deficiencies seen on building exteriors will give clues as to what will be found inside.



This all sounds easy but many inexperienced inspectors miss or under-evaluate the importance of defects rodents are able use to enter a building or fail to recognize conditions supporting rodents.

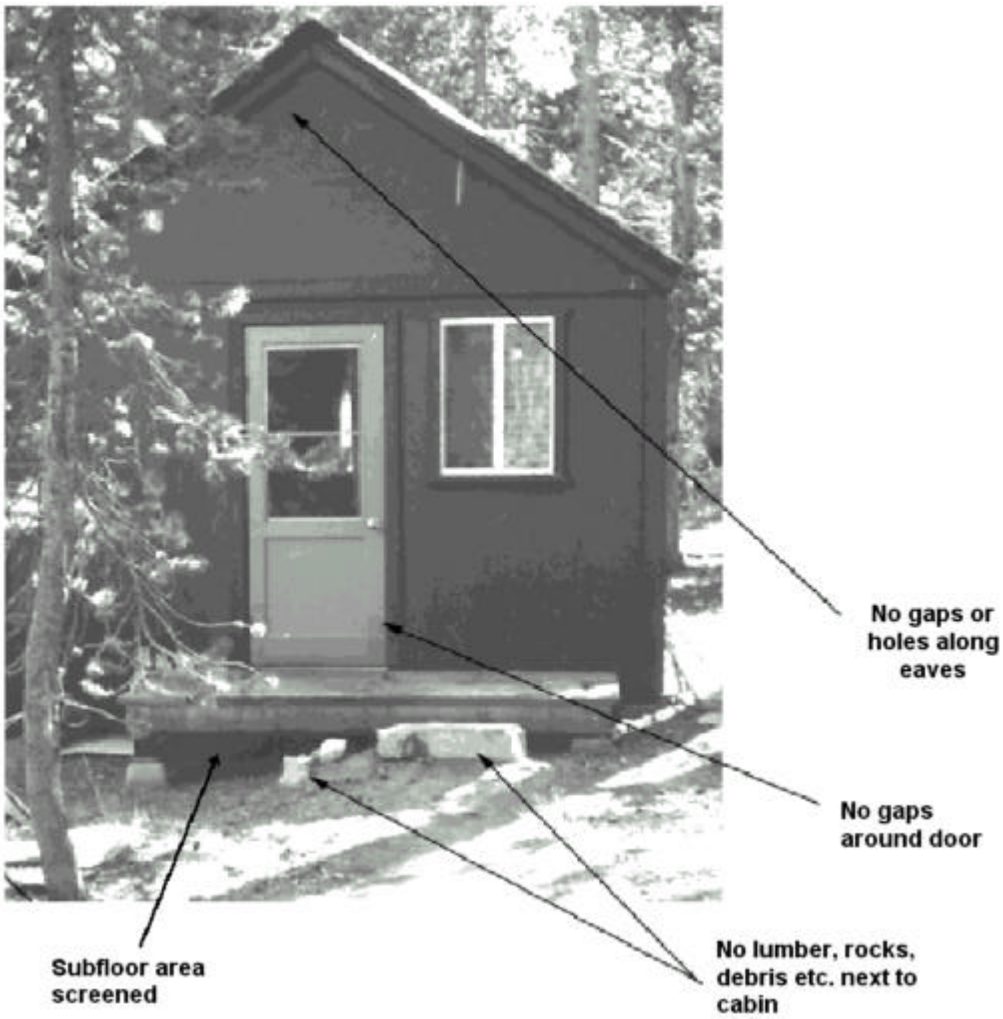
Understandably, it would be difficult to try to list here all of the many elements which could be found in the wide variety of existing building styles. Model inspection forms (for both interior and exterior inspections), found in Appendix A, will help in developing forms specific to needs. The following descriptions offer general guidance in some of the major deficiencies to look for. Sections of the manual that follow will discuss recommendations for repairs and specific repair materials.

Finally, a completed Work Order Form 10-238 for needed repairs needs to be given to maintenance for implementation.

General Building Exterior Carefully check the siding, eaves, soffits, cornices, gables, porches, chimney or furnace clean-out ports, loading platforms, and all other external areas for cracks or holes which are 1/4-inch or more in size (Figures 2-4). Carefully check around porches and decks adjoining the building, dormer corners, and chimneys, for any holes, cracks, or gaps which could allow rodent entry. The corner joints and cracks in log buildings require careful inspection. Check to see that exhaust flaps on clothes dryer vents close easily and are not blocked open by lint (Figure 5). When doubts occur as to whether or not to list borderline-sized holes, mark them anyway. A repair crew will follow most inspections and it will take them very little time to fill a few extra holes to assure the building is adequately sealed. Record the locations and severity of all defects found on the structural drawing.

Report any obvious harborage such as piles or stacks of lumber, firewood, rocks, trash, debris, vegetation, or tree stumps found within 50 feet of the building (Figures 3 & 4). Make note of any

Figure 4



shrubs with thick bottom leaves and stems that could provide shelter to rodents. Take note of tall vegetation growing next to the building; the wider the vegetation-free area around buildings, the better. Ideally an 18" vegetation-free zone is created around the outside of the building to discourage rodent activity around the building's exterior. Watch for "vegetation ladders" (shrubs or trees touching or overhanging a building) rodents could climb to get onto the building.

Watch for standing water near buildings, leaking pipes or hydrants, and inadequate water run-off (grade) from buildings.

Foundations

Foundations are particularly vulnerable to rodent attack (Figures 4, 6 - 7). Look for cracks and holes in or under foundations, improperly fitting crawl space or basement doors, openings around window wells, etc. Watch for signs of rodent activity next to buildings as shown by fresh burrowing

Figure 5

Exhaust flap closes easily and is not blocked open.

activity, burrows that lead under foundations, rodent runways along walls, plants damaged by

rodents, rodent tracks and droppings, rodent feeding stations, gnawing damage on structures, harborage for rodents (debris or tall vegetation), etc.

Doors and Windows

Doorways are one of the most common places rodents enter buildings. The animals are drawn

Figure 6

to outside doors, especially those with lights that attract night-flying insects and bats. Check doors and screen doors for self-closing springs, door sweeps, and screening made from metal and not loose or damaged. Carefully check around exterior door frames, thresholds, and windows for cracks and gaps (Figures 8 and 9). Examine closed doors from the inside of the building during daylight hours to evaluate the size of any holes admitting light.

Service Lines and Breaker Boxes

Gaps and holes around electrical, plumbing, and gas line entering the building are ideal entrance points for rodents (Figure 10. Check to see that there are no holes or gaps larger than 1/4-inch around where electrical lines and pipes pass through walls. Check to see if electrical breaker box doors fit tightly.

Roofs, Chimneys and Vents

Use a ladder to examine soffits, gables, and to inspect the roof (Figure 11). Check to see chimney and vent flashings are tight and fireplace chimneys are capped when not in use or covered

with a commercial rodent-proof chimney cover. Verify that all vent pipes are screened with 1/4-inch mesh hardware cloth or appropriate exclusion devices. Look for gaps around heating and air conditioning units and vents. Be sure the open ends of corrugated metal and Spanish tile roofing

Figure 7

Crawl space vent properly screened

are sealed. Check the general condition of the roof for defects and possible water leaks or depressed areas that might hold water. Take note of cables or electrical lines leading to the roof and of any overhanging vegetation.

Attics and Crawl Spaces

It is difficult to find suspected rodent entry points from the exterior of an attic or crawl space Figures 1 and 2). The best method for inspecting these areas is to enter them during daylight hours. Then, turn off all interior lights; possible entry points will be visible at locations where light enters from the outside. If holes in the roof are seen, insert a plastic straw or other thin item through the hole and return to the top of the roof and mark the locations.

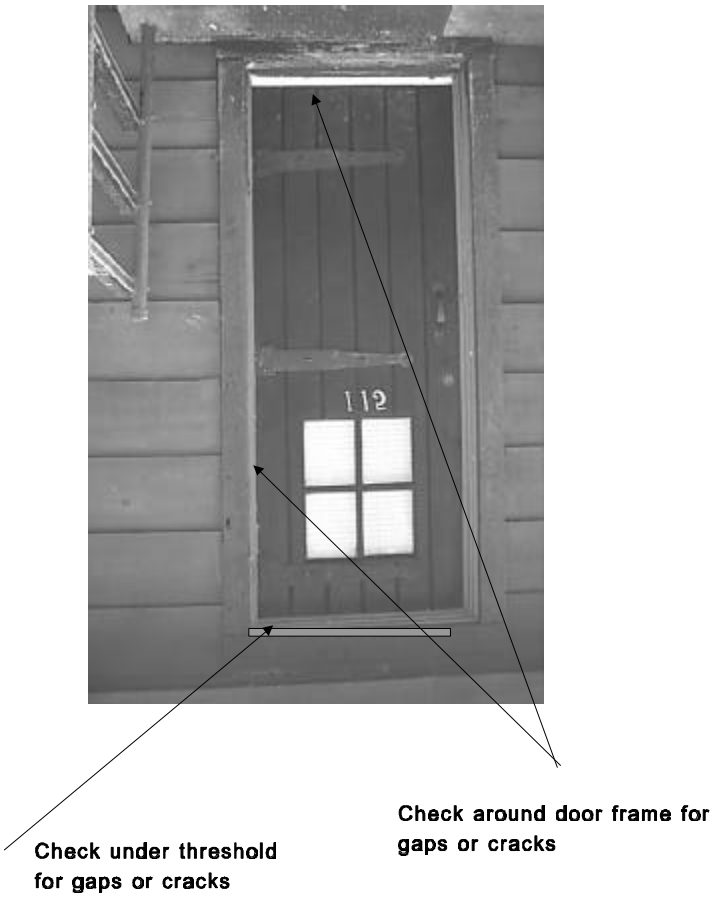
Garbage

Odor from garbage disposal areas attract rodents to buildings (Figure 12). Examine garbage containers and surrounding areas for obvious rodent activity and poor sanitation (garbage on the ground, improperly washed concrete pads), garbage cans located too close to buildings, and loose-fitting garbage can or dumpster lids. Rodents must be kept from feeding on garbage. Poor sanitation practices that support rodents should be noted in the inspection report and brought to the attention of building residents or managers.

HOUSE TRAILER EXTERIORS

The inspection of house trailers (whether used for offices or residences) are not greatly different from other buildings (Figures 12 and 13). However, trailers are more difficult to rodent-proof because of materials and methods used in construction and subsequent repairs (commonly seen in the crawlspace) which have damaged the integrity of the floors. Since it can be quite difficult to seal the

Figure 8



bottom of a trailer, the exterior inspection must center on ways to keep animals from entering the structure from the outside. In addition to items noted above, be particularly watchful for the following.

! The foundational skirting of the trailer must not have any sags, gaps, holes, or cracks which could admit rodents into the crawlspace beneath the trailer. If the trailer does not have a concrete (or other) rodent-proof foundation, the bottom of the skirting all around the trailer must be protected with a curtain-wire barrier (see Exclusion section) to keep animals from digging under it. In some situations it is better to remove the skirting to prevent a sheltered rodent habitat.

! Holes are commonly found around the trailer tongue when it has not been removed. Inspect the tongue area carefully for holes rodents could use to get into the crawlspace or walls.

! Electrical, water, gas, and (sometimes) sewer lines enter a trailer through or under the skirting. Check carefully around all service lines for gaps and holes.

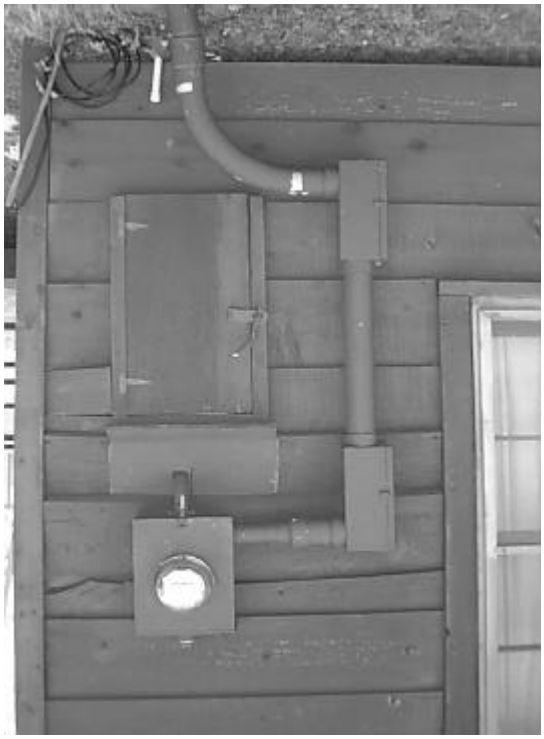
! Hot water heater closets on most trailers open to the outside, have pipes and wires that

Figure 9

Check around window frame for gaps or cracks

penetrate into the crawlspace, and are locations where rodents frequently enter trailers. Carefully examine hot water heater cabinet doors for warpage or damage and thoroughly examine cabinet interiors for holes or gaps that could allow animals to enter the trailer. It is not uncommon to find

Figure 10



Check for gaps or holes around electrical, plumbing and gas lines entering the cabin.

considerable wood rot in hot water heater cabinets. When bath tubs and plumbing repairs are made, workman sometimes fail to seal holes they make.

! Check all exterior doors for tight fit and check all windows for intact glass and screens. Exterior trailer doors are made of metal and often become bent during use and do not properly close. Temporary trailer residents sometimes remove window glass or make holes in screens for electrical extensions. Also check for weatherstripping around the edge of the door and, if present, its condition.

! Carefully check all roof-mounted air conditioners and other appliances to see flashings are tight and units are adequately screened with 1/4-inch mesh hardware cloth. Check to see that roof ventilation vents are screened and close tightly and are not partly open because of an electrical extension line or water line leading to the outside.

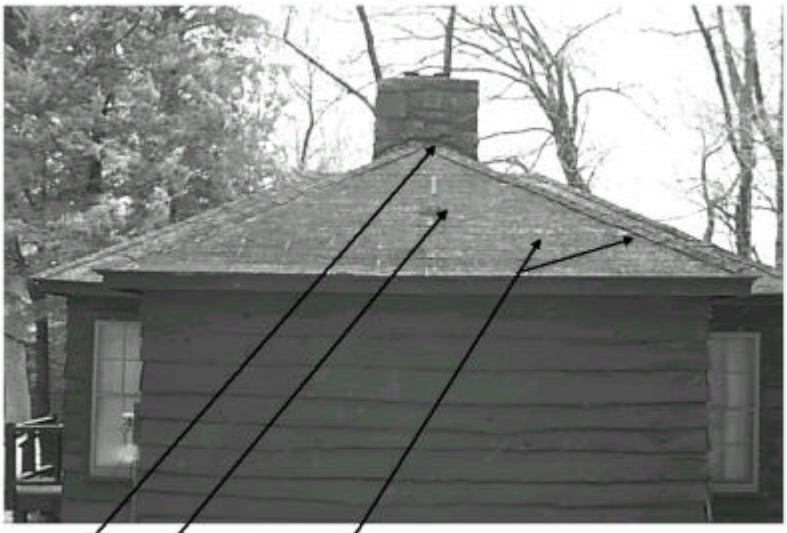
BUILDING INTERIORS

Similar to exteriors, building interiors should also be inspected at least twice a year. In addition, it is desirable to continually monitor building interiors to detect the presence of rodents or any changed conditions that could attract rodents or allow them entry. Changes in structures and the habits of occupants can come about quickly and, once introduced, rodent infestations are very difficult to control

An interior building inspection is normally performed after inspecting the building exterior. Interior inspections require the same careful, methodical examinations to be able to detect: places where rodents can enter; food, water, and harborage available to animals; signs of rodents; and sanitation practices (or habits) which might support rodents or allow them entry.

With a rough drawing of the building's interior floor plan in hand (Figure 14), begin at an identifiable point on the inside (usually, the front door) and systematically progress along each wall and through <u>all</u> rooms: living rooms and bedrooms, kitchens and lunch rooms, bath rooms, boiler and furnace

Figure 11



Check roof for defects such as holds or cracks and depressions that allow water to puddle.

Check vent pipes to ensure they are covered with 1/4 inch mesh screen or other appropriate exclusion device.

Check chimney to ensure flashing is tight and it covered with a commercial rodent-proof device or capped when not in use.

rooms, storerooms, offices, locker rooms, garages, attics, etc. Look for any possible points where rodents could enter and for conditions that might support their presence. Record defects found on the inspection report and/or building floor plan.

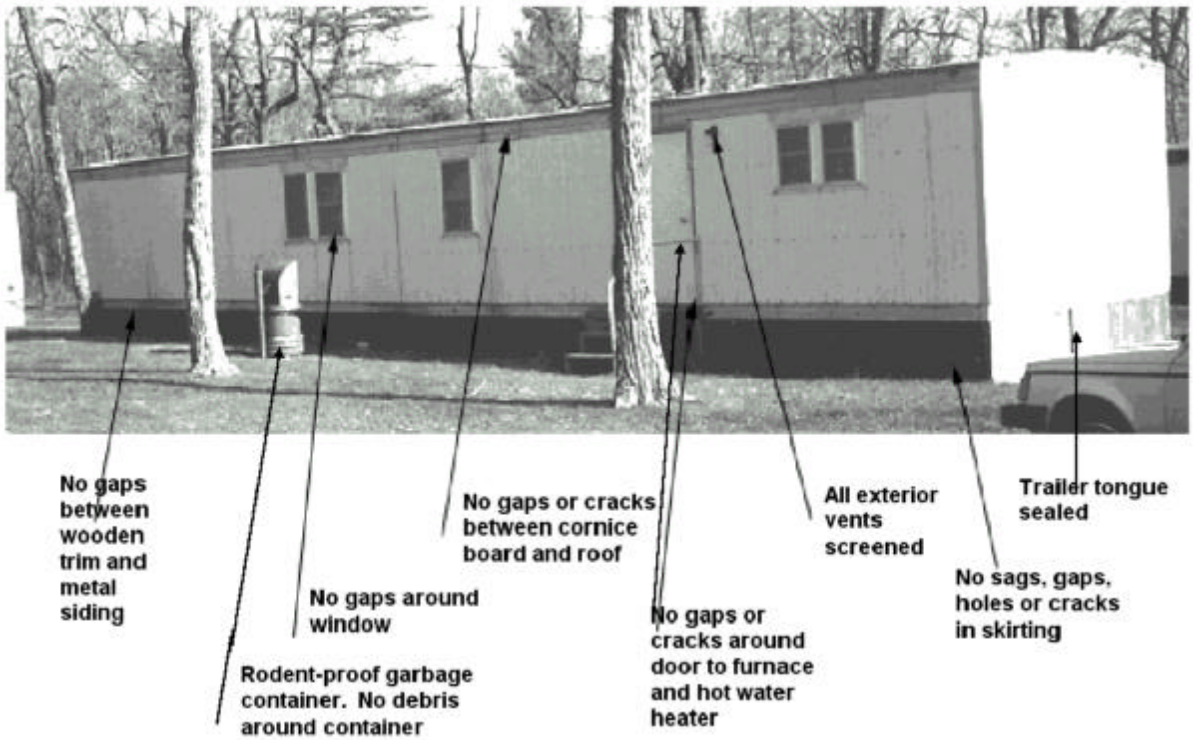
Finding Rodent Entry Holes

Thorough interior inspections is essential since rodents can enter rooms through any small hole, crack, or gap - just 1/4-inch or slightly larger which connects room interiors with the outside or with wall, floor, and ceiling voids or crawlspace and attic areas. The most common entry places are under doors and through the "larger-than-required" holes in walls and floors (chases) provided for passage of electrical, water, gas, and sewer lines and vents and conduits (Figure 15). Carefully check all thresholds and pipe and electrical chases. Holes and gaps around stone or brick fireplaces are also common entry places for rodents. Other, more difficult-to-find entryways may be hidden in dark corners of rooms and closets; behind or under built-in cupboards and around hot water heaters (Figure 16), radiators, furnaces (Figure 16), dish and clothing washers, and stoves. Use a flashlight to examine all corners and closets; remove and inspect behind and under the lower drawers of cupboards; and inspect around appliances.

If evidence of an active rodent infestation is found in a room, it is very important to concentrate efforts on finding where the animals entered. Beyond the initial inspection, this may require follow-up inspections after placing out rodent traps, or non-toxic tracking stations (wheat flour, talc, or corn starch sprinkled on the floor or on small boards around the room) to show those areas most used by rodents. Closing interior doors between rooms at night will limit rodent activity

and to find points of entry.

Figure 12

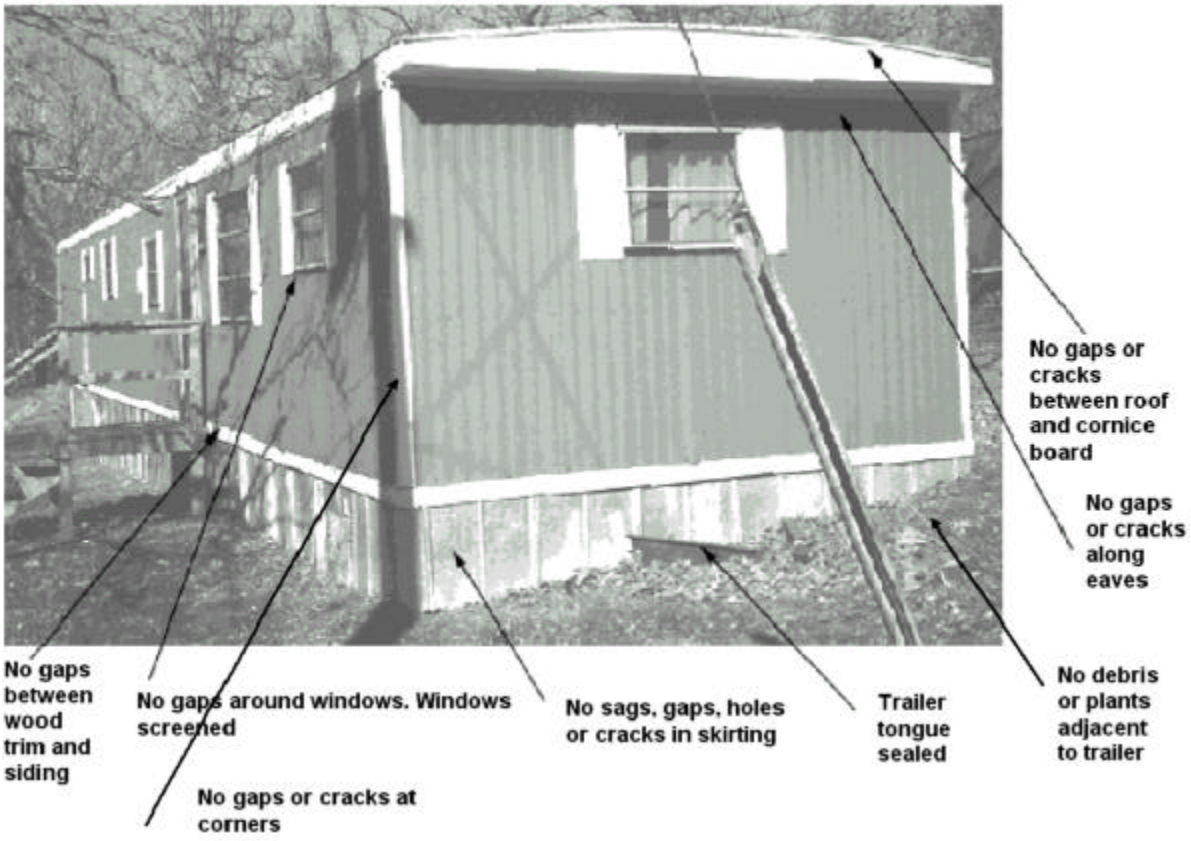


Finding Food and Water Available to Rodents

Watch for any sources of food or water available to rodents. These may be found in desks, kitchens and snack rooms, around pop and candy machines and coffee stations, indoor storage of empty aluminum cans destined for recycling, dead insects or rodents on sticky or snap traps, bars of soap in restrooms, garbage left overnight in buildings, broken packages or spilled foods in storage cabinets, open drains or leaking pipes, etc.

Always be on the lookout for rodent feeding stations when making inspections. These are semi-hidden sites where rodents feel it is safe to eat food they have collected from other locations. Usually, feeding stations are located in protected room corners; under or behind the bottom drawers of kitchen cupboards; under stoves, refrigerators, or sinks; and under or behind furniture. The stations are recognized by finding a greater than normal amount of rodent feces and urine deposits in some spot or finding remnants of a variety of foods (candy wrappers, nut shells, etc.) and remnants of cockroach

Figure 13



carcasses in a given location. The food remnants found in feeding stations can offer helpful clues for the need to inspect other locations for rodent activity. Determine if there are any sources of moisture available to rodents and other pests. Ask building occupants if they have known water leaks; be on the lookout for moist areas, swollen wood, and cracked paint. If necessary, use a moisture meter to check walls and floors for suspicious excessive moisture which may be coming from leaking plumbing, improper grade or drainage, clogged drain traps, condensation on cold pipes or windows, humidifiers and de-humidifiers, fish tanks, potted plants, etc. The presence of continual moisture supports mold, fungus, slime, lint, and insects (fungus-feeding beetles, flies, mites, and centipedes) and spiders and scorpions - all of which can be a source of food and water to rodents. Correcting sources of moisture in a building is not only important for pest control but also for the continued life of the building.

Note on the inspection report any poor sanitation practices which promote rodent infestations and bring these to the attention of building residents or managers.

Figure 14

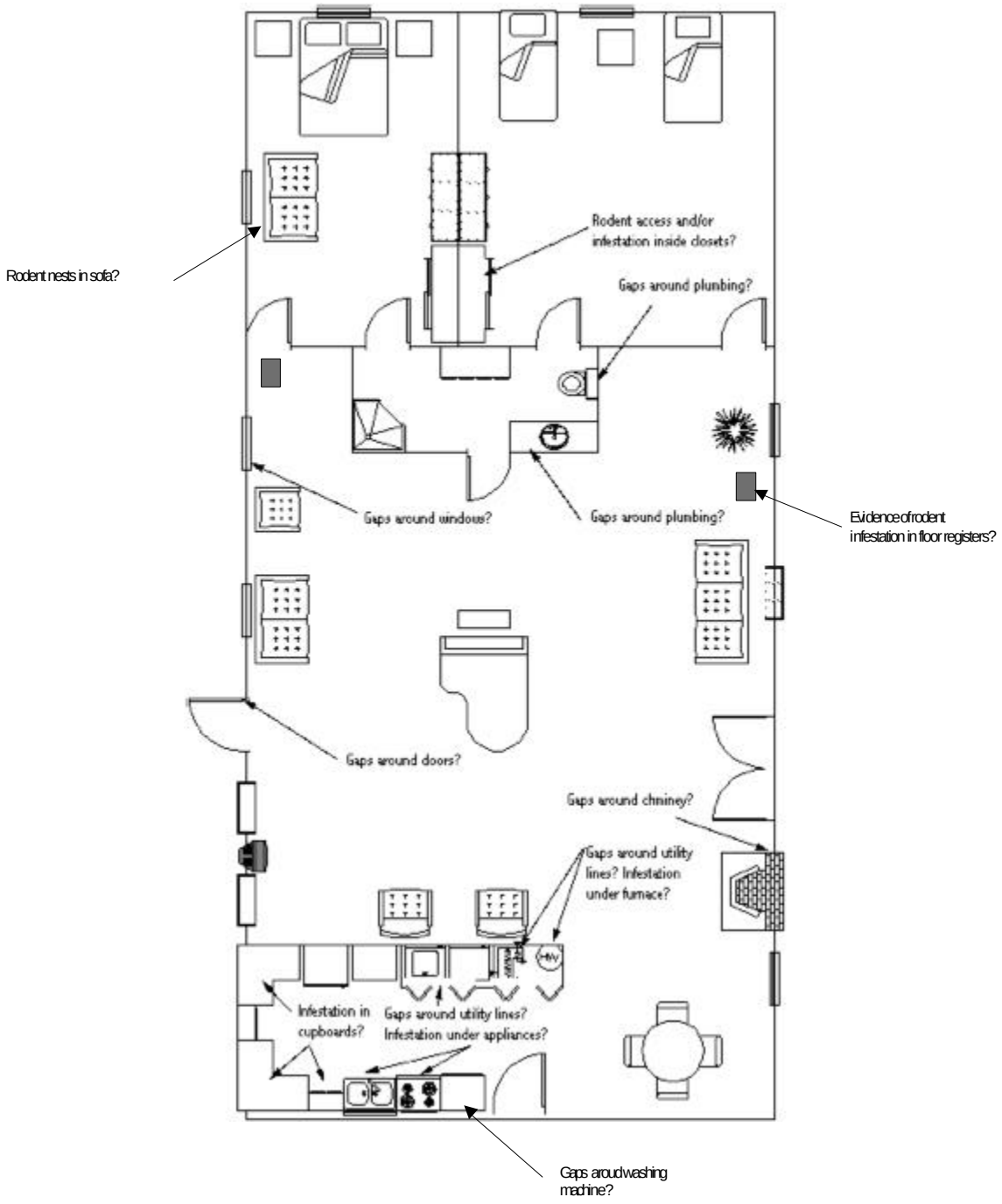
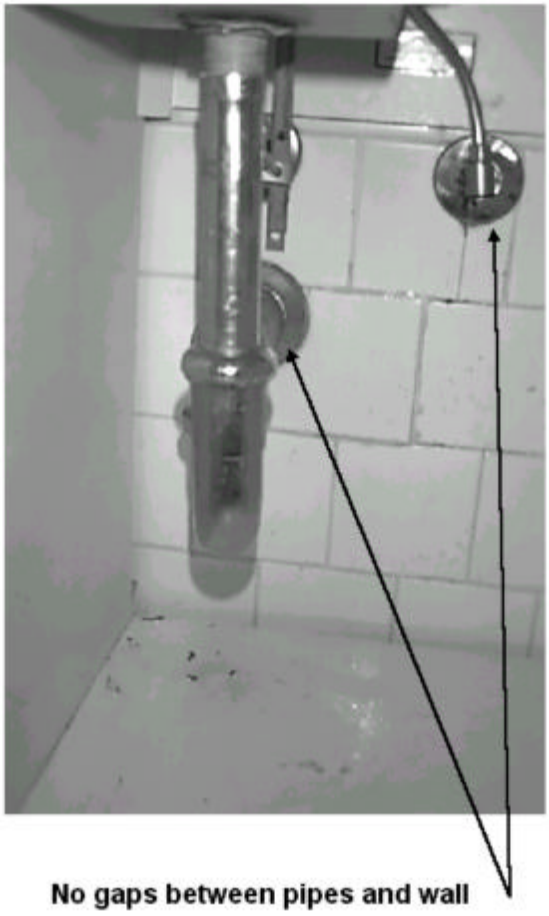

Rodent nests in sofa?
Rodent access and/or infestation inside closets?
Gaps around plumbing?
Gaps around windows?
Gaps around plumbing?
Evidence of rodent infestation in floor registers?
Gaps around doors?
Gaps around chimney?
Gaps around utility lines? Infestation under furnace?
Infestation in cupboards?
Gaps around utility lines? Infestation under appliances?
Gaps around washing machine?

Figure 15

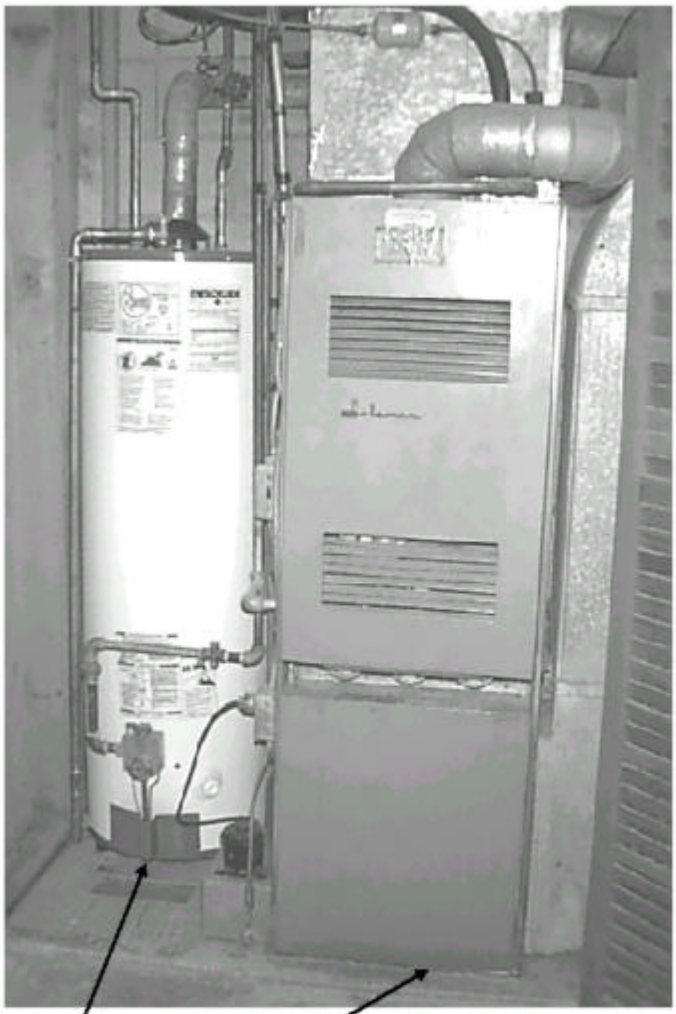


Finding Evidence of Rodents

- carcasses
- roach wings/legs
- seeds
- rub or grease marks
- droppings and urine stains

.

Figure 16

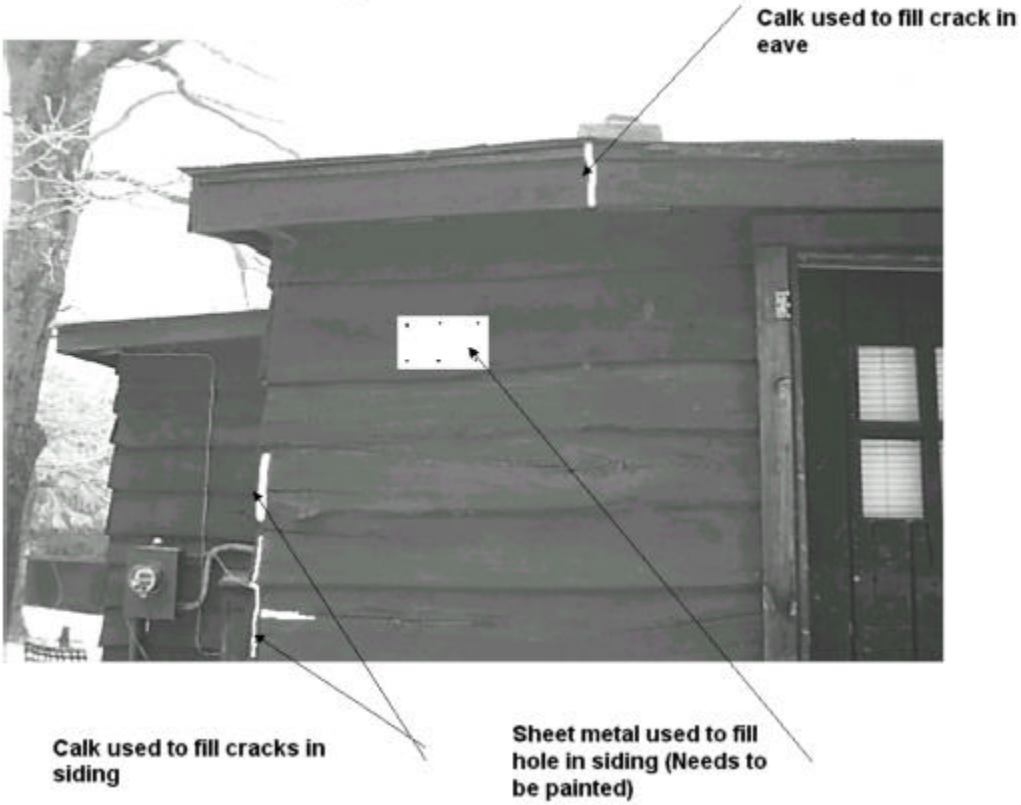


No entryways behind hot water heater or furnace. No evidence of rodent nesting beneath or behind these appliances.

! hair in openings. A good suspicion of the presence of mice in closed rooms can be had when detecting the unusual and easily recognized, musky odor left by mice. Building occupants are usually more than happy to discuss with you where they have seen mice in the building or where mice have gotten into their foods.

Be watchful for such signs of rodents as feces, partially eaten nuts, candy wrappers, shredded paper, etc.

Figure 17

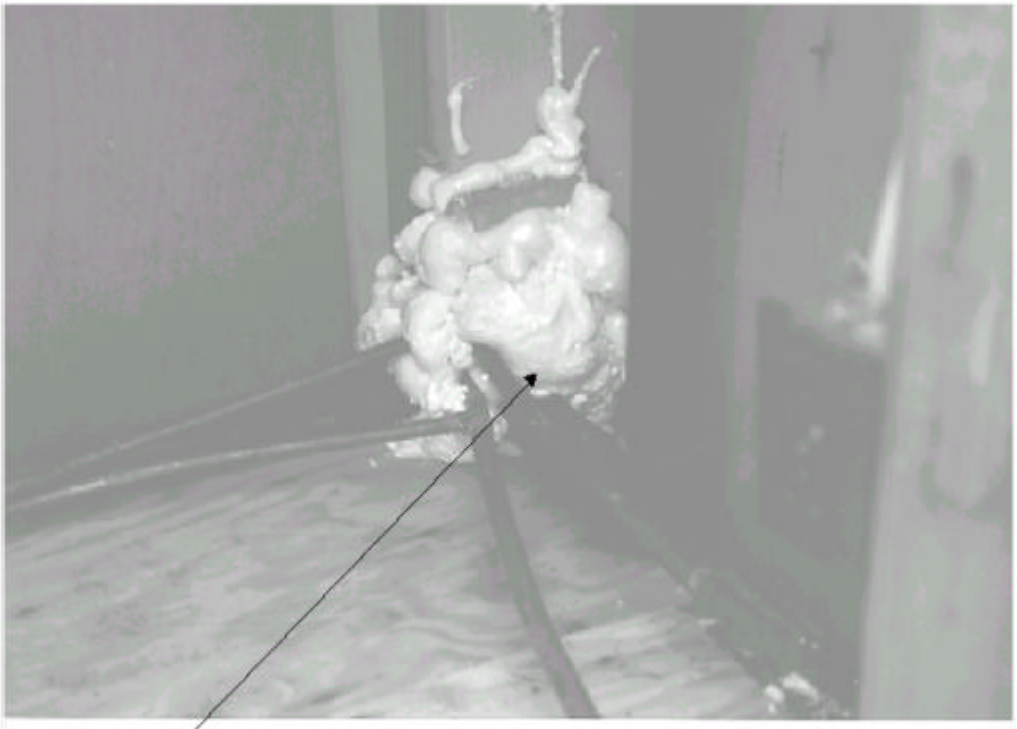


Finding Rodent Harborage

Use a flashlight to look for areas offering shelter to rodents. Such areas will be found inside cabinets, in and among boxes and other items stored on floors, under dressers and chests of drawers, behind and inside machinery (kitchen appliances, water coolers, etc.), around hot water heaters and furnaces, and in employee lockers. Sometimes overlooked sources of rodent harborage and activity are found under the lower drawers in kitchen cupboards or stoves, in refrigerator drip pans and coils, inside upholstered furniture or furniture having hollow legs, in attic and store room clutter, inside wall voids, and inside of electrical motor and computer cases.

Check to see that boxes and other items sometimes stored on floors are placed on shelves or pallets that are elevated off the floor 6 or more inches. Moving items up off the floor and away from rodent activity eliminates hiding places, allows floors to be cleaned and inspected, and provides locations for placement of rodent traps.

Figure 18



Expanding foam calk used to eliminate rodent access where utility lines pass through wall. Needs to be trimmed and painted

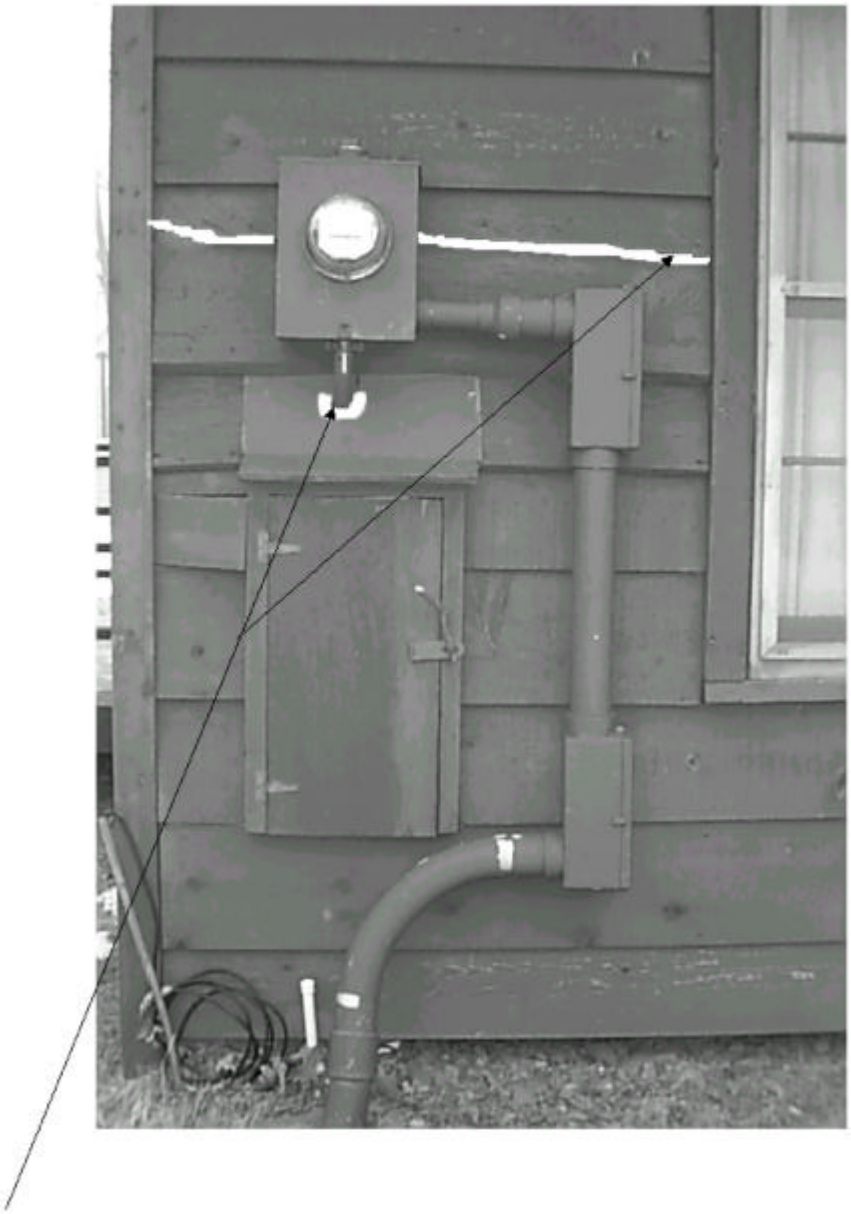
HOUSE TRAILERS INTERIORS

Methods and used in constructing and setting up house trailers can leave many small holes available to rodents that allow them to get into the maze of inter-connecting open spaces (voids) behind walls and ceilings and beneath floors. Once inside voids, the animals usually find a way to enter living spaces. Interior inspections of house trailers are very important and must check all of the items previously noted for other structures (Figure 14) and also particularly note the following.

! Carefully check all points where gas, water, electrical, and drain lines and vents penetrate floors, ceilings, or walls. Open gaps around pipes are often found under the kitchen sink (Figure 15). Check for loose pipe escutcheons which do not properly seal the chase around incoming water lines. If the hot water heater is located inside the trailer (Figure 16), carefully check the interior of the

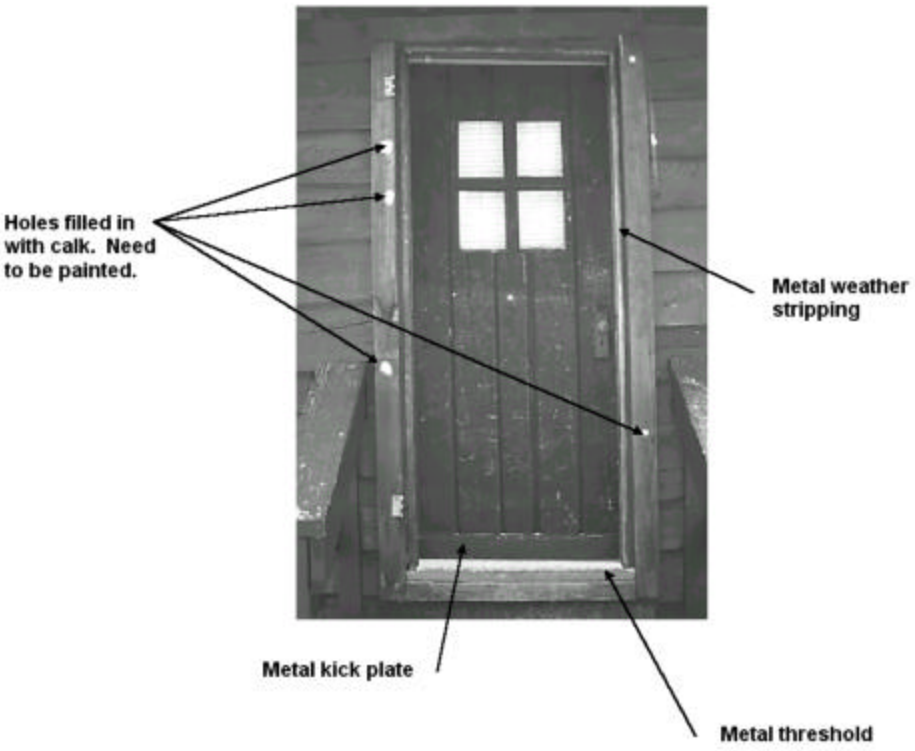
cabinet for openings. Look inside the kitchen cupboard above the stove for gaps around where the stove vent penetrates the top of the trailer ceiling. If the kitchen vent leads out through the side of the trailer, be sure that the louvers properly close or that the open end is screened.

Figure 19



Calk used to eliminate hole around utility line and crack in siding

Figure 20



! Thoroughly examine the interior of built-in furnace cabinets for gaps or holes (Figure 16). Look for rodent feces, grease marks or other evidence of their presence inside floor-mounted heating registers. Rodents sometimes gnaw through plastic heating ducts in the crawlspace and can then move up into rooms through heating registers. Sometimes, heating conduits under the trailer are open and not even attached to the furnace. Look for openings on ceilings and walls around air conditioning installations. Look for gaps around where the furnace vent

penetrates the upper-most portion of the trailer ceiling; this may require removal of a ceiling and/or wall panel.

! Check for gaps around clothes washing machine pipes and bibs. Inspect the exhaust flaps on clothing dryer to be sure the louvers are not restricted by lint build-up. If the clothing dryer is vented to the crawlspace, inspect the vent line for possible holes. If a clothing washer and/or clothing dryer are not present, verify that pipes and vents are tightly sealed.

! On many trailers, the main electrical circuit breaker box is mounted on a wall in a bedroom. Check to see the box is properly installed and does not have open spaces around or inside of it.

! If evidence of rodents is found inside the trailer, carefully inspect the interiors of upholstered furniture for possible nesting sites.

Figure 21

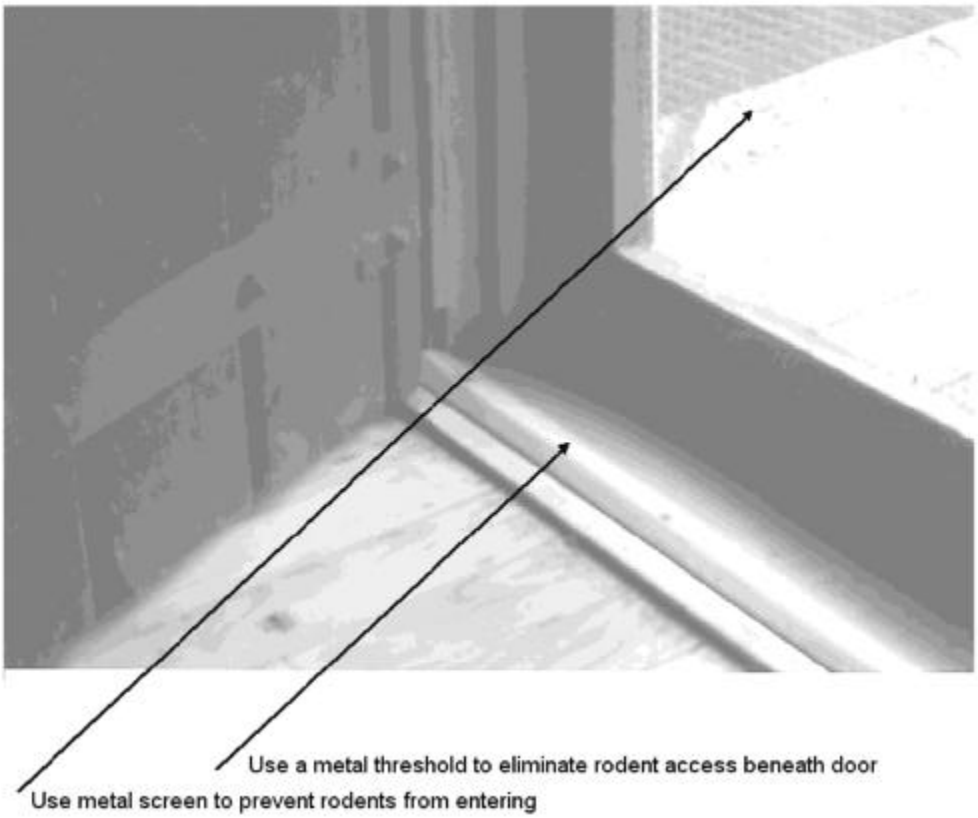
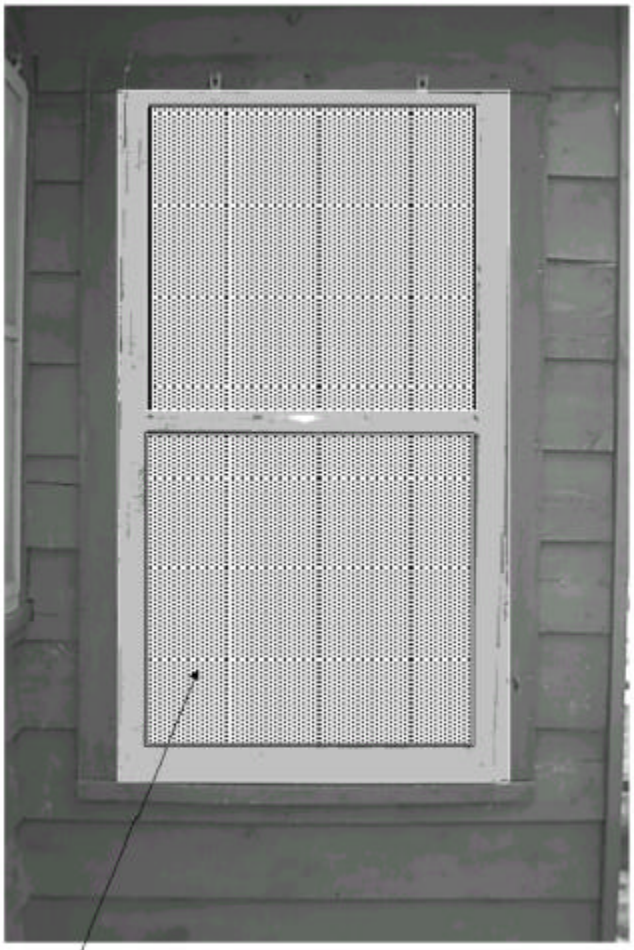


Figure 22

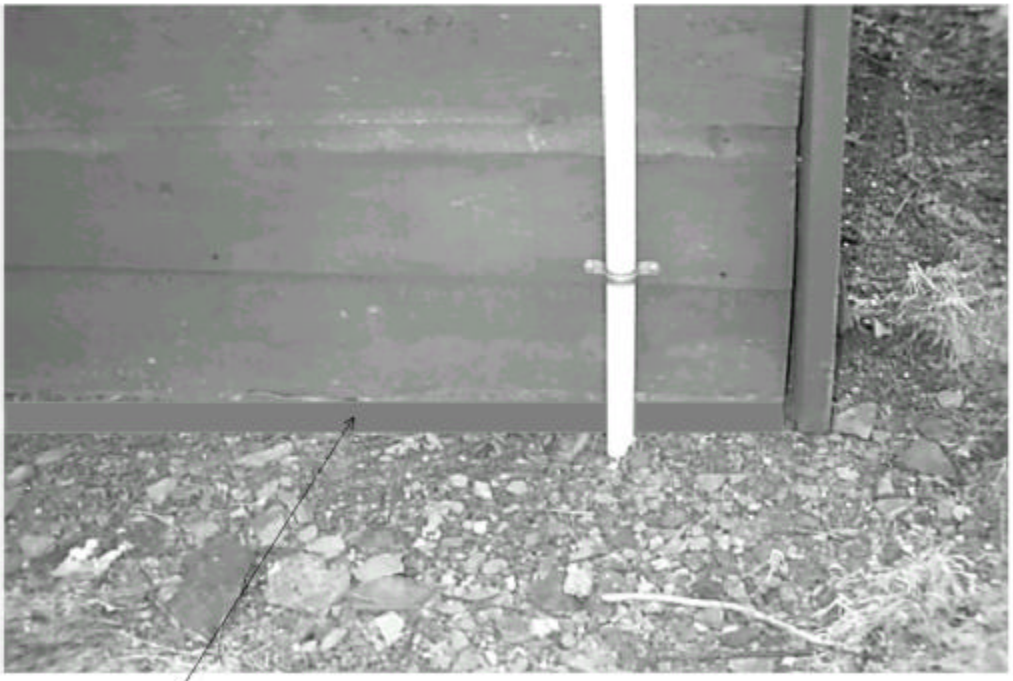


Use metal screen to prevent rodent access through windows/doors

PREVENTION AND CONTROL OF RODENT INFESTATIONS

The second step in preventing and controlling rodent infestations is to exclude rodents by correcting defects in the building. Some types of building construction (or when there are mandates to maintain a given historical appearance) may not allow building exteriors to be altered to prevent rodent entry. If so, rodents will enter the inner structure of a building and move around in open spaces behind walls and floors (voids) but the animals can usually be kept out of interior (living or working) spaces by carefully sealing all possible points of entry. The needs for exclusion in rodent control are evident. Be sure to contact the cultural resource management staff to determine if prescribed repairs are acceptable if the building is an historical structure.

Figure 23



Use concrete to seal holes under foundation

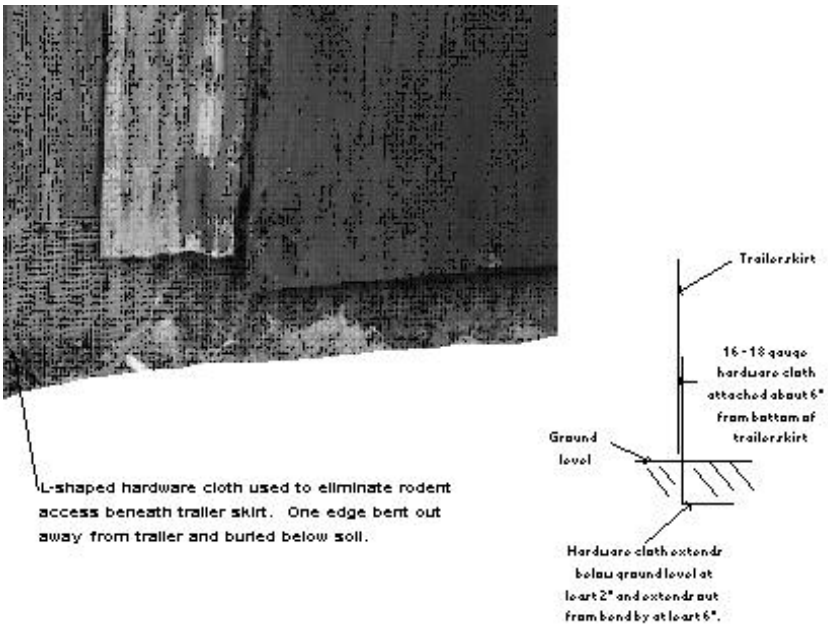
Excluding Rodents

The next step after exclusion (or, rodent-proofing) is to prevent and control rodent infestations. And, it is rather simple: eliminate (or minimize) all holes, cracks, and gaps of 1/4-inch size or larger where rodents can enter or leave buildings, rooms, or equipment or where the animals can reach food, water, or shelter. It is usually easy to be able to find a good number of those entry points in buildings, especially in buildings with active rodent infestations. Common points of entry are those beneath exterior doorways; around water, electrical, gas, vent, and sewer line chases; through unscreened pipes, exhausts, chimneys, and vents; through broken screens and through gaps in window and door facings; under/through building foundations and trailer skirting. The importance of closing such passageways was shown in the 1994 study of rodent infestations in 3 national park areas. That study reduced rodent infestations in structures by more than 90 percent with good exclusion methods. The work, done by maintenance crews with no specialized training in rodent control and at an average cost of about $600 per structure, only used standard construction methods and materials. Descriptions of various rodent-proofing materials are noted at the end of this chapter.

It must always be remembered, however, that exclusion is never permanent. Continual and on-

going inspection, exclusion, sanitation, and monitoring are required to keep buildings tight enough to prevent or control re-infestations and to deprive rodents of food and harborage.

Figure 24



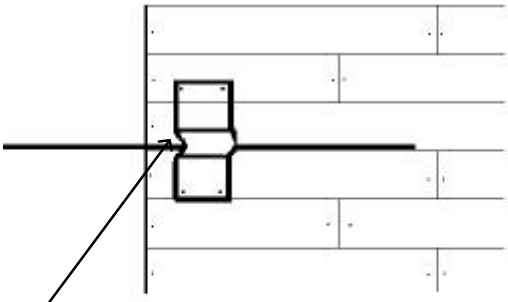
BUILDING EXTERIORS

Sidings and window and door frames

Most small holes and cracks in building siding can be filled with painter's caulking (Figure 17) of an appropriate color or painted after the caulking dries. Larger holes may require a filler (such as wire mesh or foam) before applying caulking. Expanding foam (Figure 18), sometimes used for difficult to seal cracks, is very messy and expensive material to work with and its use requires follow-up after it dries. The foam breaks down under sunlight and presents an unfinished appearance unless it is sealed with paint or caulking.

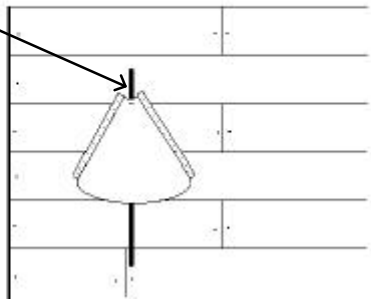
Holes with large open spaces behind them (voids) which prevent the use of fillers, such as holes made through sidings by squirrels or woodpeckers, are usually covered with thin, galvanized sheet metal and then painted. When attaching sheet metal, be sure all edges are securely attache

FIGURE 25

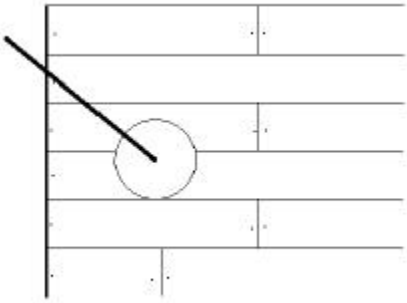


CALK SPACE IF LARGER THAN 1/4 INCH

FLAT RAT GUARD FOR SMALL PIPES AND WIRES. MADE OF 26 GUAGE OR HEAVIER GALVONIZED SHEET STEEL. MINIMUM WIDTH = 24". 18" FROM WIRE TO TOP OF GUARD, 12" FROM WIRE TO BOTTOM OF GUARD.



CONE RAT GUARD MADE OF 26 GUAGE OR HEAVIER GALVONIZED SHEET STEEL. METAL CURVED TO A DIAMETER OF AT LEAST 12". CONE AT LEAST 12" IN HEIGHT.



CIRCULAR RAT GUARD MADE OF 26 GUAGE OR HEAVIER GALVONIZED SHEET STEEL. METAL WITH A RADIUS OF OF AT LEAST 18". ANCHORED BY ONE OR MORE ARMS ON THE SIDE OPPOSITE TO THAT ACCESSIBLE TO RODENTS .

Utility Lines

Most of the many small gaps and holes around electrical lines, plumbing and drain pipes, conduits, gas lines, air conditioners and ducts, and TV lines which enter the building can be sealed with caulking compounds, hardware cloth, or sheet metal (Figure 19). Sheet metal is sometimes used to fabricate conical or flat, rodent-proof guards around wires to prevent animals from climbing onto roofs.

Vents and chimneys

Where permitted and safe, screen open ends of plumbing, exhaust, heating and air conditioning vents and other pipes with 1/4-inch hardware cloth (Figure 11). Terminal ends for clothing dryer vents are available that exhaust the air vertically rather than horizontally and seem more effective in excluding rodents than the usual flapper-type vent ends.

Install commercial, rodent-proof chimney guards over fireplace chimneys if hardware cloth could cause a fire hazard (Figure 11).

Doors and windows

Most small holes around door and window facings can be filled with painter's caulking of an appropriate color or painted after the caulking dries Figure 20). Install metal kick plates (Figure 20), tight-fitting door sweeps, or metal thresholds (Figures 20 and 21) on all exterior doors that allow no more than 1/4-inch clearance between the door and floor. Windows must properly close and have intact screening, preferably made from metal (Figure 22). Seal all cracks or gaps around window and door frames with caulking or repair the facings.

Foundations and trailer skirting

Repair cracks in stone and cement foundations with concrete or mortar (Figure 23). If rodent burrows are found that extend under foundations or trailer skirting, animals must be removed of the animals, protect the entire perimeter of foundations or skirting with a buried "L-shaped", 1/4 inch, 16-19 gauge hardware cloth "curtain-wire barrier", about 14-inches wide (Figure 24). The taller, vertical edge of the wire is tightly attached to the building siding about 5 to 6-inches above ground-level and the other end of the wire is buried below ground-level 2 or more inches. The bottom edge of the wire extending below-ground is bent out horizontally (about 5 to 6 inches) away from the building. The horizontal edge of the below-ground wire should be made tight by staking it to the ground every foot or so of length and then covering it with 2 or more inches of soil and rocks.

Most animals attempting to burrow under a wall begin digging downwards where the wall meets the ground. The buried, horizontal portion of the curtain-wire barrier extending out away from the wall makes that impossible.

Old World (exotic) rats are more aggressive in their attempts to burrow under foundations and may require construction of a concrete Acurtain wall@. This is an AL-shaped@, 4-inch thick wall of concrete which abuts the foundation. It extends above ground for 6-8 inches and below ground for a minimum

of 2-feet. The lower and horizontal portion of the curtain wall extends out away from the building for at least a foot. Although this type of construction can be used for nearly any type of foundation, it is expensive to retrofit to structures because a 2-foot ditch has to be dug around the building and concrete forms constructed.

Attics and crawl space vents

Install tight doors or commercially-available, screened, self-closing vents over attic and crawlspace openings or screen them with 1/4-inch mesh hardware cloth (Figure 2).

Trailer tongues

Usually, 1/4-inch-mesh hardware cloth wire is the best material to use for closing irregular openings around trailer tongues (Figures 12 and 13). Its use may require considerable ingenuity, however, to find secure ways to attach the wire to both the tongue and trailer siding. Extreme cases may require the use of quick-setting, construction cements or epoxy compounds.

Vegetation

To keep rodents from being able to use vegetation as a way onto roofs, trim all trees and shrubs away from buildings and remove limbs which overhang or come close to roofs. An 18" vegetation fire zone should be maintained around all structures if possible. This will deter rodents and other perimeter pests. Filling the 18" zone with gravel will create a neat, aesthetically pleasing look. This method should be approved by cultural resources before.

Garbage and trash areas

Repair trash can and dumpster lids so they fit tightly and screen any large drain holes in the bottoms of those receptacles with 1/4-inch mesh hardware cloth (Figure 10). Insert a metal disc in the bottom of tulip style cans to prevent rodent access from the bottom.

Automobiles and machinery

It is impossible to try to keep rodents out of machinery like automobiles, loaders, construction equipment, fire engines, etc. when parked outside. Machinery can only be kept free from rodent damage by parking it in enclosed, rodent-proof garages. The same general guidelines as previously described for other buildings apply to the exclusion of rodents from garages and outbuildings. Specially designed door seals and gaskets are commercially available.

BUILDING INTERIORS

All holes, gaps, and cracks in walls, floors, ceilings, cupboard interiors and around bath tubs or chimneys must be sealed to keep rodents from entering rooms.

Similarly, all open chases and gaps must be sealed around conduits, electrical wires, circuit breaker boxes, water pipes, gas lines, drains, exhaust vents and ducts, air conditioners, or other elements penetrating walls, floors, and ceilings. Different from the exterior, the use of hardware cloth wire or sheet metal to cover cracks and holes inside buildings does not produce a desired finished appearance and caulking, plastering, and/or painting usually has to follow repairs.

Screen floor drains in custodial closets, laundry rooms, and lunch rooms with stainless steel grates having openings less than 1/4-inch in diameter.

Fit exterior doors with self-closing devices (springs) and reduce the threshold gap to 1/4-inch or less. Interior doors may also be fitted with close-fitting door sweeps to make it possible to contain or isolate indoor rodent problems to specific rooms or areas.

Install 1/4-inch, 16-19 gauge hardware cloth over heating registers and cold air return vents if these pathways are used by rodents.

RODENT-PROOFING MATERIALS[1]

The object of rodent exclusion is to physically prevent or discourage rodent penetration. However, the sharp teeth of rodents are adapted for gnawing and allow the animals to penetrate many commonly used construction materials. Materials selected for rodent proofing must be those that are as resistant as possible to penetration by rodents, used in manners that discourage rodents from penetrating them, and are as easy as possible to work with. Regardless of the materials used, no holes should be left open on the inside or outside of buildings that are more than 1/4-inch in diameter.

SOLID METAL MATERIALS

Sheet Metal

Galvanized sheet metal, 24 gauge or heavier, is recommended for most general uses to exclude rodents.

[1] Also see Sources for Pest Control Supplies and Equipment in Appendix D for the addresses of manufacturers.)

"Tyrne" Sheet Metal

Some pest control technicians prefer to use a 40-pound weight, tin-coated steel, called "Tyrne" sheet metal. This is soft, bendable (annealed), and can be had with a rosin coating which allows it to readily take paint. Tyrne is extremely animal resistant and comes on a 14-inch wide by 50-foot long roll (Follansbee Steel).

Kick Plate

Where necessary, door bottoms can be protected from gnawing rodents by installing a 12-inch wide kick plate at the bottom of the door made from 24 or 26 gauge metal (galvanized steel or brass).

Rodent Guards

Flat or Tunnel-Shaped Rodent Guards for single vertical utility lines leading into buildings can be made from sheet metal (Figure 25). Multiple vertical utility lines require more elaborate guards. Protect horizontal lines leading into buildings with 18-inch-radius metal disk-guards set far enough away from buildings to keep animals from jumping from the line to the roof.

Aluminum Coil Stock

Soft, easily shaped, and excludes birds (except woodpeckers) and bats but mice, rats, and squirrels can easily gnaw through aluminum. If at all possible, use galvanized sheet metal rather than aluminum.

SCREENING MATERIALS

Expanded Metal

Galvanized (non-rusting) expanded metal, 28 gauge or heavier, resembles heavy-duty hardware cloth and, although it is bulky and somewhat difficult to work with, is very resistant to most animals.

Perforated Metal Galvanized (non-rusting) perforated metal, 24 gauge or heavier, is also very resistant to most animals and is also somewhat difficult to work with.

Hardware Cloth

Hardware cloth is the best and one of the easiest materials to use for screening foundation vents, open pipes and other holes. It effectively excludes mice and most native rats. Light gauge hardware cloth, however, is not entirely resistant to more aggressive animals such as Old World rats.

Use 16-19 gauge, welded-at-each-joint, 1/2-inch by 1/2-inch mesh, galvanized-after-welding wire screen to exclude larger animals or aggressive rats. This is extremely strong material and will last 10 to 20-years due to its heavy zinc coating.

Use 19 or heavier gauge, galvanized, 1/4-inch (or smaller) mesh hardware cloth to keep smaller animals (mice) out. Covering hardware cloth with metal window screening also keeps insects out.

Stainless Steel Hardware Cloth

Cover floor drains with heavy 16-19 gauge, 1/4-inch mesh, stainless steel hardware cloth and be careful to not leave any openings around the sides larger than 1/4-inch. Covering drains will increase clogging - be sure to inform maintenance when you install these screens.

Metal Window Screening

Metal window screening is not an adequate protective material for rodent proofing and should only be used on windows to keep insects out. Plastic window screening does not provide any rodent-proofing qualities at all.

Weather stripping

Many different kinds of weather stripping are commercially available for sealing small spaces between movable parts like doors and windows. However, special kinds of weather stripping can also be had for even unusual applications. Refer to manufacturer catalogs for specific designs needed.

Compression Seals

Compression seals are commonly made from felt, foam, or sponge materials and are not very resistant to gnawing rodents. Compression seals are best used for non-uniform gaps, are inexpensive, and easy to install; however, they are less durable than other kinds of weather stripping.

"Bump"-Type Seals

Include vinyl tubular gaskets (with or without reinforcing molding) and may be backed with vinyl, felt, wool pile, or foam strips. These are unobtrusive and also suitable for non-uniform gaps. Heavy duty types of seals function better but even these are not resistant to gnawing rodents.

Metal Tension Strips

Come in a variety of designs in brass, bronze, and aluminum wafer-like strips. These are not difficult to install but are not suitable for non-uniform gaps. They are permanent, tight, unobtrusive, and only offer moderate resistance against rodents.

Interlocking Seals

These are made in two pieces and form a double seal on door jambs, door bottoms, and windows. These are relatively expensive and may require installation by a carpenter. They are not suitable for non-uniform gaps but are permanent, highly effective, unobtrusive, and offer moderate resistance against rodents.

Door Sweeps

Although frequent repair is required, good door sweeps are one of the most important means for keeping rodents out of structures. To keep rodents from gnawing on door sweeps, install metal kick plates on the outside of doors allowing less than 1/4-inch clearance to the floor. Gustatory repellents (bad-tasting substances) are sometimes applied to rubber and vinyl door sweeps and seals to keep rodents from gnawing on them.

Door bottom or Threshold Seals

These are compressible rubber or vinyl seals that fit on door bottoms or thresholds. They are relatively expensive and somewhat difficult to properly install but are suitable for uneven gaps.

Common Door Sweeps

These Include felt, vinyl, and stiff bristle sweeps which are inserted in a metal holder and are used to weather-seal door bottoms. These are suitable for slightly uneven gaps, moderately priced, and easy to install but are quite visible. Sweeps with elongated mounting holes for screws allow readjustments as the sweep wears. Automatic door sweeps are also available; these drop to seal against the floor when the door closes but may require professional installation.

Garage Door Strips

Weather striping used on overhead garage doors are usually either flap-type door sweeps or round, rubber gaskets that compress under weight of the door. Garage door sweeps are suitable for somewhat uneven gaps, durable, moderately priced, and easy to install unless they somehow interfere with the door-locking mechanism. Damage to garage door sweeps and compression gaskets from rodents trying to gain entrance is usually confined to gasket corners which can sometimes be protected with metal flashings.

FILLER MATERIALS

Lath Screen or Lath Metal

This is a galvanized, light-gauge metal mesh and is installed over wooden walls before plaster is applied. This material is extremely malleable and can be wadded up and pushed into holes; it is very rodent proof. Lath screen is galvanized and does not rust/bleed through caulking. This is an excellent filler material and can be easily compressed to completely fill even very odd-shaped holes. After

forcing lath screen into holes, slightly expand its sharp edges with a screwdriver to better fill the cracks and force the metal into the edges of the hole. Be careful of sharp edges when handling this material.

Steel Wool

If steel wool must be used, only use 00-size material. Steel wool is a good and easy-to-use filler for small holes but it rusts and cannot be used where moisture is present. Rodents often work their way between the steel wool and edges of the hole; always caulk over steel wool to seal it and to make it easier to determine if rodents have penetrated the seal.

Copper Screen

Copper is a soft metal and may be penetrated by rodents. Aluminum and plastic screening do not exclude rodents at all.

Copper Mesh

"Stuff-It" is a compressible copper mesh that is commercially available and is reported by the manufacturer to be rodent-proof. However, it is still best to caulk over holes filled with copper mesh.

CAULKING Use the best available caulking and in colors which match the structure.

Oil resin Based Caulking

This caulking is preferred by some because it is long-lasting (1 to 4 years) and has superior smoothing qualities, even in cold weather. Although easy to apply and inexpensive, oil-resin caulking may discolor, shrink, or poorly adhere to porous (brick) surfaces. It cures slowly and requires paint thinner for cleanup. Oil-based caulking is adequate for filling small holes and cracks which are not subject to stress (between wooden frames and siding).

Latex Caulking

Can be either acrylic or vinyl caulking. Acrylic latexes are good for non-moving joints, last longer, and have better weathering characteristics but are more expensive than vinyl latexes. Both of these products are easy to apply, quick curing, do not stain or bleed, clean up with water, durable (3 to 10 years), have good adhesion, and do not shrink greatly. However, latex caulking may freeze before it hardens when used during cold weather.

Butyl Caulking

Although this material is slow curing, it is very good for sealing gaps between metal and masonry and for joints up to 3/4-inch wide and 3/8-inch deep. Butyl caulking is slightly more durable than latex but is harder to apply. Butyl, however, has good resistance to shrinking, excellent adhesion, and is good for use below ground-level. It is flammable when wet and requires paint thinner for clean up.

Elastomeric Sealants

These materials include silicones, polyurethanes, polysulfides etc. They are best used for joints subject to movement (between masonry and wood, metal, or fiberglass siding). Silicones can be used in cracks even larger than 1-inch wide and 1/2-inch deep and are quite durable (up to 20 years). Elastomeric sealants cure rapidly, are waterproof, remain flexible in a wide range of temperatures, show excellent resistance to shrinking, and adhere well to most materials. However, only certain formulations can be painted, they are more expensive than other caulking, and require solvents for clean up.

Asphalt Sealant

This is a tough, outdoor caulking that mice have been seen to gnaw on but not penetrate. This material requires mineral spirits for clean up and thinning. It stays flexible between expanding and contracting surfaces; resists oil, grease, salt, and heavy traffic; and sets up tack-free in about 30-minutes. Color selection is limited.

Roof Cement (in caulking tubes)

This material is softer and thinner than canned roofing cement and easier to apply. The best types contains fiber.

Roof Cement (in cans)

This material is waterproof and pasty. It sticks to nearly everything it touches as long as the items are dry and not dusty. It is available in 1 and 5-gallon sized cans. This is good material for cementing around chimney flashings and caps because it expands and contracts with changing temperatures. Roof cement lasts twice as long as mortar when applied to clean and dry surfaces and it is relatively inexpensive, compared to other types of adhesives.

Epoxy and Fiber Glass Resins

They can be used as caulking and hole-filling material. These materials are available from auto and boat repair supply sources; many formulations harden quickly and are very durable, weather-resistant, and rodent-proof.

MORTAR/CEMENT

Cement and Mortar

Although these materials are excellent barriers to wildlife, they are not practical in most situations because they harden so slowly and require considerable time to mix and clean up.

Cement/Concrete

These materials are good for larger jobs (steps, sidewalks, tuck pointed foundations, chimneys, and barriers around slabs and sidewalks). The best mixes for cement are 1 part cement to 3 parts sand or richer. For concrete, use 1 part cement to 2 to 4 parts sand or richer.

Cement Mortar

This is a mixture of several materials and is designed to be an elastic spacer for ceramics (bricks). Cement mortar it is not as hard as cement, weathers faster, is not a substitute for cement, and not generally recommended for rodent exclusion. If mortar must be used, use a 1:3 mixture or richer.

Cement Patching Powder

This material has similar physical characteristics to cement . Is available in small-sized containers and is easier to mix. Most brands harden in less than 4 hours and provide good to moderate rodent exclusion.

WOOD

Even wooden patches on holes can effectively repel most smaller rodents if there are no gnawing edges (butts, joints, holes, or other surface breaks) where rodents can begin gnawing. Use the smoothest and best grades of wood available.

SANITATION AND HABITAT MODIFICATION

Rodents can be extremely difficult to eliminate from buildings, even when excellent sanitation is practiced. They enter buildings through small, hidden holes, live in extremely confined spaces, and only require very limited amounts of food. To make matters worse, rodents may only nest and reproduce inside structures while satisfying their food needs outside buildings. And, other rodents may actually live outside and only enter buildings to feed. Although it is clear that excluding rodents is the most important key in preventing infestations, good interior sanitation is always important in controlling rodents. Good sanitation practices have tremendous impacts in limiting the size or increase of rodent populations by limiting resources available to them. Major guidelines in good sanitation practices include the following.

INSIDE

Food and Water

- Reduce and eliminate ALL possible food and water available to rodents.
- Store all foodstuffs (dry pet food, grass seed, groceries, etc.) in glass, metal, or durable plastic rodent-proof containers.
- Keep indoor and outdoors garbage cans tightly covered, remove garbage from buildings every night, and empty outdoor garbage containers at least twice a week.
- Promptly remove left-over food not eaten by pets.
- Check for and remove foods stored in desk, cupboard, or filing case drawers.
- Continually clean up all crumbs in kitchens and snack rooms and never leave left-over food or dirty dishes out.
- Do not take food into rooms other than the kitchen or snack room.
- Do not store empty aluminum cans for recycling inside buildings.
- Keep stove-tops clean and frequently clean under and behind stoves and behind lower stove drawers.
- Frequently clean under bottom drawers in built-in kitchen cabinets.
- Frequently clean lint from refrigerator cooling coils, drip pans, and from under refrigerators.
- Promptly repair all water leaks.
- Ensure that all occupants understand that their cooperation is essential.

Harborage

Mice will nest in anything that doesn't move. Continually rearrange furniture, boxes, clothing, etc. to discourage nest development. Store everything up off the floor. Raise hollow-base furniture off the floor on legs or blocks. Remove all stacks of paper or plastic sacks, cardboard boxes, and other items rodents could use for shelter. Reduce clutter.

Importation of Rodents

Be sure rodents are not imported into buildings from the outside. Animals are sometimes brought in with grocery sacks, boxes, patio furniture, firewood, and other items. Do not bring any more firewood inside than will be immediately burned.

Preventing Rodent Damage in Unoccupied Buildings

Rodent damage occurring over-winter to furniture and contents in unoccupied cabins/houses can be reduced by removing or limiting food and available harborage and nesting sites. Remove bed linens and hang mattresses on taut lines between ceiling beams. Remove padded cushions from furniture and store cushions on edge, separated from one another, and up off the floor. Store all boxes and other materials on raised pallets or shelves. Remove drawers from cupboards or chests, empty them, and re-insert them upside-down. Place all stored food in rodent-proof containers or cabinets.

OUTSIDE

Remove as much grass, weeds, and debris as possible from around buildings. These provide food sources and harborage sites for rodents. If possible, maintain an 18-inch wide, vegetation-free zone around buildings. Continually clean up all outside and inside clutter/litter. Trim the bottoms of hedges and other ground-hugging plants up from the ground to eliminate rodent harborage. Trim plants that touch or overhand buildings back 3 to 4-feet. Promptly repair all water leaks.

Store firewood, lumber, rubbish, equipment, construction materials, and other items on pallets raised at least 18-inches off the ground and located at least 30 feet from buildings, walls, and fences.

It is better to place exterior lighting on poles out and away from structures and shine the light back onto buildings from a distance. This prevents the attraction of night-flying insects which can serve as a food source for rodents.

POST-TREATMENT MONITORING AND EVALUATIONS

Continual documented monitoring for rodents is the last important step in managing rodent infestations. Before beginning a monitoring program, use diagrams of exterior and interior floor plans to identify locations where traps or non-toxic tracking stations will be placed. Assign specific persons to do monitoring and establish a fixed schedule for those activities.

Keep written records on a monitoring form showing rodent signs around the outside of structures and any developing structural deficiencies which could allow animals to enter a building. Increasing numbers of rodents around a building (resulting from changes in weather or seasonal changes in the amount of food or shelter available to rodents) and newly developed structural deterioration clearly indicate the potentials for rodents to move into structures.

To monitor for possible rodent activity inside buildings, place traps and non-toxic tracking stations in all areas of likely rodent harborage. It was recently found that tracking patches may be a more effective tool to monitor for the presence of mice in structures than traps. Regularly check traps and tracking stations and individually record them on a floor plan drawing along with the numbers

and types of rodents captured (or tracking stations showing rodent activity). Make records of any snapped traps that failed to catch rodents and of traps not snapped that had the bait removed.

Watch for and record the presence and locations of any rodent sign (feces, food damage, feeding stations, gnawing damage, rodent holes, etc.) and ask building occupants if they have seen rodents or evidence of rodent activity.

Over time, the written monitoring record will provide very helpful information on the actual presence of rodents, on relative increases and decreases in the number of animals present, and clearly point out those areas in the building where rodent activity is heaviest.

Monitoring records will also show the effectiveness of treatments. This information can be used to show the needs for developing more effective management strategies or control methods. This information should also be presented at regularly scheduled meetings with site occupants and site manager to ensure their cooperation.

SUMMARY

Controlling rodents in buildings is very important from the standpoints of both human health and possible structural damage. Rodent control can be an attainable goal but it always demands more than randomly setting out a few traps. Most important, **rodents must be prevented from entering the building (or room)**. This demands cooperative efforts between all involved persons (maintenance persons, building occupants, and managers) in frequently inspecting buildings and promptly closing small, seemingly unimportant, holes. And, it also requires good sanitation practices and implementing effective trapping and monitoring programs. None of these measures are complicated nor excessively difficult; however, rodent control is usually unsuccessful when these critical steps are not fully undertaken.

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APPENDIX A

INSPECTION AND MONITORING FORM

DATE:_____ INSPECTED BY: _____

GROUNDS AND BUILDING EXTERIORS

This list is a helpful reminder of things to look for during inspection/monitoring; however, do not fail to watch for other things that could support pests.

1. **TRASH CANS:** Location(s)? Plastic can liners? Regularly emptied? Cans regularly washed/cleaned? Can bottoms under plastic liners clean? Can bottoms with holes? General can conditions? Lid conditions? General sanitation around cans? Food-waste only in special cans? Schedule for emptying?

2. **TRASH DUMPSTERS:** Dumpsters located at a distance from building? Clean? Regularly emptied? Regularly steam-cleaned? Lid conditions? Secure against rodent entry?

3. **FOOD:** Evidence of animals being fed by people? Other potential sources of food for rodents seen?

4. **EXCLUSION:** Buildings tightly sealed? Vehicles parked in rodent-proof garages? Fences/walls tight? Wires into building pests could travel on? Attics/crawlspaces screened? Foundations protected by curtain wire or concrete curtain wall? Chimneys/vents screened? Door sweeps tight? Window/door frames good condition?

5. **WATER:** All pipes/downspouts/gutters in good condition, not leaking? Standing water near/around facilities? Evidence of animals using water sources? Erosion problems? Grade against buildings? Peeling paint? Roof edges in good condition?

6. **HARBORAGE:** Cracks and crevices in walls? Rodent harborage under nearby rocks/storage? Debris on ground supporting/attracting animals? Weed-free area around buildings?

7. **LIGHTS:** Type and location? Evidence of live/dead insects around lights? Rodent evidence?

8. **VEGETATION:** Plants that attract rodents? Foundations and wall bases with weed-free zone? Vegetation touching/overhanging building? Wall bases clear and trimmed close to ground? Tap-rooted plants present to attract gophers? Hazard trees?

9. **SANITATION:** General cleanliness? Rubble or stored items near or adjacent to buildings? " Bone yard" neatly arranged, storage up off ground? Presence of pests?

10. **ANIMALS:** Open burrows and locations? Gopher burrows in visitor use areas? Active animals seen? Young animals? Dead animals? Raptors? Predators? Ant nests? Evidences of pest infestations? Factors contributing to continued pest presence? History of animals present and types?

11. **GENERAL BUILDING CONDITION:** Type of construction material? Shade available for rodents?

12. **PHOTO RECORDS:** Pictures made?

NOTES

APPENDIX A (Continued)

INSPECTION AND MONITORING FORM

DATE:_____ INSPECTED BY: _____

BUILDING INTERIORS

This list is a helpful reminder of things to look for during inspection and monitoring; however, do not fail to watch for other things supporting pests.

1. **WINDOWS:** Tightly sealed, glass complete, screens in good repair? Opened regularly? Frames intact?

2. **DOORS:** In good repair, effectively seal off rooms/areas? Seals and sweeps tight (no light showing through)? Close properly?

3. **FACILITY AREAS:**

   PIPES: Routinely inspected? In good repair? Leaks? Pipe traces open or sealed?

   MECHANICAL ROOM: Free from debris or water? Cracks or crevices in walls? Openings directly to outside? Vent and exhaust chases sealed? Suspended ceilings? Pests in dust collectors or central vacuum systems? Door sweeps too high?

   ELECTRICAL ROOMS: Conduits and lines open or sealed? Holes, cracks, or crevices in walls? Openings directly to outside? Suspended ceilings? Pests inside seldom-used equipment? Door sweeps too high?

   CUSTODIAL CLOSETS: Cleanliness? Personal item storage? Food stored/eaten here? Walls, floors, sink areas with cracks, crevices, holes? Excessive or long term storage of paper or supplies? Suspended ceilings? Mops off floor?

   BOILER/STEAM ROOMS: Standing water? Holes in walls, floors, or ceilings? Pest evidence? What? Suspended ceilings? Door sweeps too high? Grates on drain?

4. **WATER SOURCES:** Standing water? All cracks, crevices, holes sealed? Pipe traces sealed?

5. **MUSEUM COLLECTION STORAGE:** How often inspected? Cracks, crevices, holes in walls, floors, ceiling? Temperature and humidity monitored/controlled? Control on materials moving into and out of storage? Inspect seldom used storage areas, out-buildings, old books. Is there continual pest monitoring? How? Who? Doors/windows seal tightly? Storage on floor? Air conditioner sealed? Procedures for pest identification, isolation, preservation, record keeping? Suspended ceilings?

6. **GIFT AND ACQUISITION AREA:** Procedures for de-infesting new acquisitions/gifts? Regular inspection for pest infested materials? Isolation from primary collections storage? Route that materials take in entering area? Specific unpacking area away from primary collections area? Suspended ceilings? Storage conditions?

DEFECTS NOTED

DEFECTS NOTED

7. **INTER-LIBRARY LOANS:** Procedures for examining incoming materials? Are pests or damage identified? Isolation of suspected books? Food, beverage, etc. present? Suspended ceilings?

8. **CONSERVATION LABORATORIES AND PRESERVATION OFFICES:** Separated from collection storage and other areas? Treatment area present? Insect identification collection? Is collection kept pest free and in pest-free drawers/containers? Suspended ceilings?

9. **GALLERIES/EXHIBITS/VISITOR CENTER:** Vacuumed regularly? Custodian reports pest signs? To whom? Materials moving into/out of galleries checked for pests? Food/drink allowed in galleries? Exhibit preparation/manufacturing areas clean? Holes in walls, ceilings, floor; cracks, or crevices? Pest presence? Continually monitored for pests? By whom? Monitoring documented? Doors and windows in/adjacent to galleries seal tightly? Suspended ceilings? Air/heating vents filtered? Door sweeps too high?

10. **GIFT AND SALES AREAS:** Ongoing monitoring for pests? Display cases with pest harborage under/around them? Infested materials immediately removed, isolated for identification and treatment? Food, drinks eaten here, properly stored, disposed of? Proximity of area to museum galleries? Administrative offices? Pipe, electrical line traces sealed? Suspended ceilings?

11. **STAFF LOUNGE AREA:** In same building as museum and museum storage? Refrigerator (including defrost drain pan and coils) clean? Is only central area where food allowed? Sink/counters in good repair, clean? Pest presence? Microwave/stove/oven clean? Coffee pot/other appliances clean? Trash can has liner, lid? Emptied every night? Regularly washed? Empty pop cans stored in building? Floors regularly mopped/ dusted/vacuumed? Personal lockers present? All pipe, electrical line traces sealed? Suspended ceilings? Door sweeps too high?

12. **WATER SOURCES:** In good repair? Floor drains screened? Water fountains with pipe traces sealed, pipes insulated to prevent condensation? Leaks? Sinks, lavatories in good repair, without leaks, clean? Bottled water dispensers leak? Aquaria? Plants?

13. **STAFF AREAS, WORK STATIONS, AND OFFICES:** Food, water present; coffee/cold drinks allowed? Candy/snacks/foods in desks? Trash cans with liners, lids? Only food/paper or mixes of trash put into cans? Dried/live flowers/plants present? Pest evidence? Pipe, electrical line traces sealed? Proper storage of supplies, equipment, other materials? How long paper/envelopes stored? Doors, windows close tightly? Suspended ceilings? Pests behind/under desk drawers, cabinets, etc. Air and heating vents covered with filters? Door sweeps too high? Monitored for pests?

14. **ATTIC AND BASEMENTS:** Holes to outside? Pest evidence? Inspect under attic insulation. All pipe, wire traces sealed? Ducts, vents screened and sealed? Water leaks? Damaged wood? Moisture present? Doors, windows tightly seal? Proper storage? Suspended ceilings? Grates on drains?

15. **WALL VOIDS:** Inspect for insects, dead animals, or odors.

16. **CRACKS AND CREVICES:** Present? Inspected for accumulated hair or lint and pest harborage.

17. **OTHER:**

Appendix B

Example of a Written Inspection Report

Evaluation of Trailers

Trailer # 1

I was finally able to inspect the interior of this trailer and speak with the resident before I left the park. The resident and his room mate have only been in the trailer since early October and said they have had considerable problem with mice and have lost food items to rodents. Mouse feces were common in the trailer and larger, rat-size fecal pellets were found near the kitchen corner next to the furnace cabinet. Although sanitation in this trailer left a lot to be desired, there is resident can do to lessen rodent problems inside the trailer until major repairs are completed.

DEFICIENCIES

EXTERIOR

- A large portion of the trailer skirt is missing from this trailer. 'The bottom covering of this trailer is relatively intact and seems to only broken on the south east corner and where pipes penetrate the floor. It may be possible to repair the bottom covering and screen pipe penetrations rather than installing a completely new skirt. If the decision is to install a new skirt, install 'L' wire, hardware cloth at the base of the skirt all around the trailer.

- Repair windows that do not close and which have openings filled with wadded up plastic bags.

- Remove all vegetation at the rear of the trailer out 3 to feet from the trailer.

- Install supporting wooden framework for the hot water heater cabinet and a cabinet door. Carefully inspect the existing cabinet and replace rotten floor and open pipe and electrical line chases and wall separating the cabinet from the kitchen sink.

INTERIOR

- Remove copper mesh pushed into crack (West side) of the living room floor and repair and reseal the floor.

- Close the opening around the clothing washer bib and caulk pipe chases at floor level.

- Re-caulk/seal the bathtub; various cracks are nearly large enough to allow mice to enter.

- Caulk the pipe chases under the bathroom sink at the toilet.

- No rodent activity was seen inside the furnace inspection door but seal the bottom and upper louvers with hardware cloth.

- Caulk the pipe chase for the copper water inlet line located in the cupboard to the right of the kitchen stove.
-
- Replace the wall under the kitchen sink which separates the kitchen from the hot water heater cabinet; seal all pipe and chases.

TRAILER # 2

I was not able to speak with the resident of this trailer but a male resident from nearby Trailer # 3 told me that the woman living in # 2 has had considerable rodent problems she has not been able to control and, lately, found large, 'rat-like' animal feces in the kitchen. I thought I would try to speak with the resident of # 2 to provide a few pointers on both sanitation and rodent control or at least leave a note; however, our inspection of the trailer showed there is nothing the resident can do to control rodents until major repairs are completed on the trailer.

DEFICIENCIES

EXTERIOR

- Install a furring strip under the drip flashing.
- Install an 'L' wire, hardware cloth barrier at base of skirting.
- Caulk up the small holes around the trailer tongue.
- Caulk the gas line inlet chase.
- Repair loose trailer skirting panel on west side.
- Install new floor in hot water heater cabinet and seal all holes and pipe/electrical chases in interior walls and ceiling.
- **INTERIOR**
-
- Insert compressed metal wire (lathe metal or copper mesh) in and then caulk. over the open rodent hole in the bottom of the door facing.
- The kitchen stove contains rodent nests; remove and clean stove. We found rat-sized feces under the top and around the base of the kitchen stove; a medium-sized onion had been gnawed on and moved from one side of the room (where the resident stores onions on the floor) to the other side of the room near the stove.
- Caulk the kitchen pipe chases under the sink.

- There are abundant rodent feces in the floor heater vent. This allows rodent-contaminated dusts to be blown out with warm air. Clean the vents and check the heater ducts and bottom of the furnace under trailer for possible rodent entry.

- Seal up the large holes around the circuit breaker box and caulk electrical line chases at the floor level.

- Remove rusted steel wool and re-caulk bathroom pipe chases under sink and at toilet.

- Seal up the large hole around the clothing washer bibs and caulk pipe chases at floor level.

- Caulk the floor level holes in the east corner of the middle bedroom. Screen around the furnace, the base of the furnace, interior louvers, and around the furnace chimney pipe chase with **3** inch hardware cloth.

Appendix C

AHANTA KIT@

This kit was compiled and submitted in 1994 by Elaine Harmon and the staff of Fort Davis, National Historic Park. This kit was developed because mice were found in the building. FODA=s museum tech checks 38 traps every morning. This routine normally takes approximately 40 minutes.

The kit contains: a bucket or pail

One pint of alcohol to saturate trap/carcass (FODA uses alcohol instead of bleach as bleach may discolor the floor) A pint **2** is used per dead mouse.

Paper towel roll

Trash picker upper

Respirator mask with HEPA filter

Plastic bags (disposed in dumpster according to local county procedures, as burning is not permitted, and FODA=s county does not treat carcass as a biohazard)

Contact Elaine Harmon, (915) 426-3225, for further details on the kit.

Servicewide IPM Program, NPS

APPENDIX D

SOURCES OF RODENT CONTROL SUPPLIES AND EQUIPMENT

The following list of rodent control equipment and chemical suppliers is not meant to completely cover the entire field and is offered as an assistance in finding specific products. Space limitations do not permit including every possible vendor. Undoubtedly, the list omits those products or companies not coming to our attention. Products or companies listed here are not endorsed or recommended by the United States Government or G&L Consultants. No discrimination is intended against products or companies not listed. Additional listings and classified by subject can be found in: Scott E. Hygnstrom, Robert M. Timm, and Gary E. Larson, 1994; Prevention and Control of Wildlife Damage, Coop. Exten. Div., Inst. Agric. and Nat. Res., University of Nebraska, Lincoln NE.

ALPHABETIZED LISTING

Advantage Products, P.O. Box 307, 2343 Commerce Blvd., Mound MN 55364; 800/257-3464. Rodent bait stations.

Agricultural Warehouse, Box 237, Ennis TX 75210; 214/875-0090. Deodorizers.

Allen Special Products, Box 605, Montgomeryville PA 18936; 800/848-6805. Manufacturer of "Stuff-It", a copper, non-rusting, material to exclude pests.

Animal Damage Control (magazine), ADC, P.O. Box 224, Greenville PA 16125, 412/588-3492; References and information.

Animal Management Inc., 720 Eppley Rd., Mechanicsburg PA 17055-9786; 717/790-9346, 800/745-8173. Deodorizers.

AO Safety; distributor: Public Health Equipment & Supply, P.O. Box 10458, San Antonio TX 78210, 800/284-0106, 800/444-4774. Respirators, personal protective safety equipment.

Atlantic Paste and Glue Co., 4-53rd St., Brooklyn NY 11232; 718/492-3648. Catchmaster rodent sticky traps.

Ben Meadows Co., PO Box 80549, Atlanta, Georgia 30366; 800/547-8813. Weed flamers.

Bramton Co., Dallas TX 214/438-0397. Outright Skunk Odor Eliminator (enzyme from Bacillus subtilis that breaks down sulfide bonds in skunk scent)

Brody Enterprises, 9 Arlington Place, Fair Lawn, New Jersey 07410; 1-800/GLU-TRAP; rodent snap/live traps, glue boards, other products.

Burlington Scientific Corp., 222 Sherwood Ave., Farmingdale NY 11735; 51/6/694-9000. Ro-Pel (benzyldiethyl methyl ammonium saccharide) general gustatory repellent to prevent gnawing by rodents.

Cabot Safety Corp., Safety Div. of American Optical; 1/800/444-4774. HEPA filters and respirators.

Chim-a-lator, 8824 Wentworth Ave. S., Minneapolis MN 55420; 612/884-7274. Chimney covers.

Clean & Fresh, 6619 13th Ave, Brooklyn NY 11219; 800/373-7487. Odor neutralizers, degreasers, and cleaning supplies.

Consep, Inc., 213 SW Columbia St., Bend OR 97702; 800/367-8727. Yellow jacket and wasp traps, fly traps, clothing moth traps, teflon (fluon) barrier paint, covered rodent traps, etc..

Critter Control Inc., 640 Starkweather, Plymouth MI 48170, 313/453-6300. Rodent and animal traps and control supplies.

DAP Inc., USG Corporation, PO Box 277, Dayton OH 45401. Asphalt caulking.

Direct Safety Co., P.O. Box 50050, Phoenix AZ 85076-0050 (7815 South 46th St., Phoenix AZ 85044); 800/528-7405. Respirators (UVEX), other safety equipment.

Elco Mfg. Co., 111 3rd St., Pittsburgh, PA 15215; 412/782-1850. Moisture meters, blacklights, decontaminants, bait stations/trays, disinfectants, glueboards, tracking powder stations, automatic/live traps, other products.

Epoleon Corp., 3858 CarsonSt., Suite 212, Torrance CA 90503; 213/316-4242. Deodorizers.

Follansbee Steel, PO Box 610, Follansbee WV 26037; 304/527-1260. Tyrne metal.

Forestry Suppliers, Inc. 205 West Rankin Street, PO Box 8397, Jackson, MS 39204-0397; 800/647-5368. Weed flamers; live/multiple capture/snap traps; monitoring equipment, other products.

Fox Valley Marking Systems, Inc., 172 S. Northwest Hwy, Cary, IL 60013; 800/323-4770. Metal traps.

Fritsche, Dodge & Olcott Inc, 76 Ninth Ave., New York, NY 10011. Neutroleum alpha, odor eliminator.

G.G. Bean, Brunswick ME; 207/729-3708. Skunk Kleen, water based deodoroizer.

Glendale Protective Technologies Inc., Woodbury NY. Respirators, filters, HEPA filters.

Guardian Trap Co, PO Box 1935, San Leandro CA 94577, 415/357-0900. Gopher traps.

Havahart Traps, Woodstream Corp. Front and Locust Streets, Lititz, PA 17543, 717/626-2125. Live traps.

HY-C Co., 2107 North 14th St., St. Louis MO 63106; 314/241-1214. Chimney covers.

IDENTIFICATION SOURCES: call/write to inquire about services or other sources of identification.

Arizona Dept of Health Services, Disease Control, 3008 N. 3rd Ave., Room 201, Phoenix AZ 85012. Pests of public health concern.

A & L Mid West Laboratories, Inc., 13611 B Street, Omaha, NE 68144; 402/334-7770; Complete chemical/analytical lab services.

Combined Scientific Supplies, P.O. Box 1446, Fort Davis, Texas 79734; 915/426-3851

Consulting Diagnostic Service, 992 Santa Barbara Rd., Berkeley, CA 94707; 415/642-4950 (days), 415/524-9476 (evenings).

Duke University Medical Center, Micology Center, Div. Infectious Diseases and International Health, Duke Univ., Durham NC 27710; 919/684-3717. Histoplalsmosis in guano/feces.

Fumigation Service and Supply, 10540 Jessup Blvd., PO Box 40641, Indianapolis IN 46280-1451; 317/846-5444.

New Mexico State University, Las Cruces, New Mexico, Department Entomology; Cooperative Extension Service; New Mexico Pest Survey and Detection Program.

Raltech Scientific Services, Inc., P.O. Box 7545, Madison, WI 53707; 608/241-4471.

University of Arizona, Cooperative Extension, 2400 S. Milton, Flagstaff AZ 860001, 602/774-1868

Improvements, 4944 Commerce Parkway, Cleveland OH 44128; 800/642-2112. HEPA vacuum bags, door sweeps, weather stripping, caulking tips, epoxy kits, vertical-rising dryer vent cover, under appliance vacuum tip and brush.

Industrial Safety Co., 1390 Neubrecht Rd., Lima OH 45801; 800/537-9721. Respirators and replacement cartridges, safety supplies.

Intruder Traps, P.O. Box 136, Rice Lake WI 54868; 800/553-5129. Easy-set plastic rat and mouse traps.

Isothermics, PO Box 18703, Anaheim CA 92817; 714/778-1396. Heat treatments for termite and pest infestations.

J. Norris Corp, 25 W. Merrick Rd, Freeport NY 11520. Dazie Disk skunk odor remover.

J.T. Eaton and Company, 1393 East Highland Rd., Twinsburg OH 44087; 800/321-3421. Traps, rodenticides, bait boxes.

K Fence Systems, Rt. 1 Box 195, Zumbro Falls MN 55991; 507/753-2943.

Kness Manufacturing, Hwy. 5 South, P.O. Box 70, Albia IO 52531-0070; 800/247-5062. Snap/multiple-capture rodent traps; supplies.

Lab Safety Supply, P.O. Box 1368, Janesville, WI 54547-1368; 800/356-0783. HEPA filters, respirators, vacuum cleaners, disposable coveralls.

Live Trap Manufacturing Co., P.O. Box 411, Pioche NV 89043; 702/962-5402. No Spray Skunk Live Trap, with enclosed area where skunk can hide.

Lowry Products and Services Inc., Box 531966, Grand Prairie TX 75053; 214/647-8727. Deodorizers.

R.C.F. Developments Inc., 2509 Browncroft Blvd, Rochester NY 14625. Skunk-Off odor eliminator.

M & M Fur Co., Box 15, Bridgewater SD 57319-0015; 605/729-2535. Animal lures and urine, traps, trapping supplies.

Macklanburg-Duncan Co., 800/654-8454. Major manufacturer of weather stripping devices with designs shown in their catalog.

McClintock Metal Fabricators, Haul-All Equipment Systems, Woodland California 95695; 800/350-3588. Hid-A-Bag, a tightly closing garbage can for vertebrate pests.

Meyer Brand Trapline Products, Box 153, Garrison, Iowa 52229; live traps.

Miracle Marketing Manufacturing Corp., P.O. Box 520125, Salt Lake City UT 84152; 800/634-6102. Li'l Hummer HEPA filter vacuum.

Moldex-Metric Inc., Safety Products Div., 4671 Leahy St., Culver City CA 90232; 800/421-0668. Disposable fume, dust, mist HEPA respirators, fit testing kits.

Morrison Manufacturing Co., PO Box 52, Highway #175, Morrison IA 50657, 800/648-CAGE, 319/345-6406. Safe-N-Sound Live Traps live traps.

Mustang Mfg. Co., Box 920947, Houston, TX 77292; 713/682-0811. Live traps

Myro, Inc., Milwaukee WI 53233. Caulk finishing tool and plastic caulking tube tips; available in hardware departments of stores like K-Mart.

Neutron Industries, Formula NI-712 Super Concentrated Organic Odor Eliminator; 800/421-8481.

Nilfisk of America, 300 Technology Drive, Malvern PA 19355, 213/647-4620. HEPA filter vacuum cleaners.

On Target Animal Attractants, P.O. Box 5345, Glendale Hts. IL 60139, 708/858 4895. Lures and scents.

Pestgon Products. Snooper 2000 PCO Pest Detector a rake-like device producing heat, vibration, and color; attracts fleas to a disposable sticky trap.

Phillips Petroleum Co., Bartlesville OK 74004. R-55 (tert-butyl selfenyldimethyldithiocarbamate) pocket gopher/burrowing animal repellent; for application to soil and cables; phytotoxic.

Professional Equipment, 130 Dale St., West Babylon NY 11704; 800/334-9291. Full line of test equipment, moisture meters.

Pocatello Supply Depot, USDA-APHIS Animal Damage Control; U.S. Fish and Wildlife Service, 238 E. Dillon St., Pocatello ID 83201; 208/236-6920. Gopher control supplies, deodorants (and netroleum alpha).

P-W Manufacturing, 610 High Stree, Henryetta OK 74437; 918/652-4981. Death-Klutch DK-1 and DK-2 Gopher Getter gopher traps.

Racal Health and Safety, 7305 Exexutive Way, Frederick MD 21701-8368; 301/695-8200, 800/682-9500. Delta 3 HEPA Filter.

R.C. Steele Veterinarian Supplies, 1989 Transit Way, Box 910, Brockport NY 14420-0910. Happy Jack Flea Trap sticky trap with and attached heat source.

Sealeze Corp., 8000 White Pine Rd., Richmond VA 23237; 800/446-7325. Pest Stop, brush-type weatherseals for commercial and residential doors and windows.

Science Products Co. Inc., Chicago IL 60646. Science Rabbit and Deer Repellent (thiram) for deer, meadow mice, rabbits.

Sherman, H.B.; 3731 Peddie Drive, P.O. Box 20267, Tallahassee FL 32303, 904/575-8727. Standard Sherman folding live traps.

Survival Air Systems (SAS) Co., 3401 69th St., Long Beach CA 90805; 800/262-0200. Respirators, personal protective equipment.

Sudbury Laboratory Inc., Box 34820, Phoenix AZ 85067; 602/285-1660. Chaperone Deer and Rabbit Repellent (thiram) rabbit, deer, meadow mice repellent.

Target Specialty Products, Box 1117, Cerritos CA 90702-1117; 213/865-9541, 800/352-3870. Deodorants.

Tomahawk Live Trap Co., PO Box 323, Tomahawk, WI 54487; 715/453-3550; live traps.

Tramex, 1893 Coyote Cir., Golden CO 80403, 303/582-3538. Non-destructive moisture meter.

UVEX Safety, LLC, 10 Thurber Blvd., Smithfield RI 02917; 401/232-1200, 800/343-3411. HEPA-Tech 3010 Filter.

Van Waters and Rogers, 2600 Campus Dr., Box 5932, San Mateo CA 94403, nation-wide number 800/888-4897; Phoenix office: 602/272-3272, Tucson office: 602/747-8717. Chemicals, pest control equipment.

Wildlife Control Technology Inc., 2501 N. Sunnyside Ave. #103, Fresno CA 93727; 209/294-0262, 800/235-0262. Fencing materials, "Bat Kit" and instructions.

Wildlife Management Supplies, Critter Control Inc., 640 Starkweather Rd., Plymouth MI 48170; 800/451-6544. Chimney covers, skunk deodorants.

Woodstream Corp., Lititz PA 17543, 717/626-2125. Victor Gopher Getter and Victor Gopher Trap; Havahart live traps, sticky traps.

ZA Macabee Gopher Trap Co, 110 Loma Alta Ave., Los Gatos CA 95030, 408/354-4158;