



Controlling Rodents in Forest Service Facilities

Reports from the Field
Kathleen Snodgrass, Project Leader

Keeping rodents out of buildings has always been a challenge. Recognition of the danger of contracting hantavirus pulmonary syndrome from rodent droppings has increased the importance of keeping Forest Service structures as free of rodents as possible.

Hantavirus pulmonary syndrome is a viral disease transmitted to humans primarily when they inhale airborne dust from dried rodent droppings that contain hantavirus. Rodent urine and saliva can also be sources of infection.

Hantavirus pulmonary syndrome was first recognized as a serious human health risk in the Southwest about a decade ago. Now it is found throughout the United States. This spring, a Glacier National Park deputy superintendent died of the disease in Montana. Through June 2002, more than one in three persons diagnosed with hantavirus pulmonary syndrome died from the disease.

Three Key Steps

Three important steps should be taken to protect Forest Service employees and the public from health dangers posed by rodents:

- Keep rodents out.
- Control rodents that get in.
- Inspect and sanitize facilities.

Keep Rodents Out—Keeping rodents out is the most effective prevention strategy. For mice (figure 1), eliminate all openings larger than ¼ inch into structures. Rodents also enter structures through open windows and doors, through air vents, and along plumbing and utility lines. Repair windows and doors that do not shut securely.



Figure 1—The deer mouse is the host for the hantavirus that is the primary cause of hantavirus pulmonary syndrome in the United States. On average, about 10 percent of deer mice are infected with hantavirus.—Photo by Kristi DuBois.

Control Rodents That Get In—New electronic devices that claim to keep rodents away show promise, but are not proven to be universally effective. Scent-based repellents such as mothballs or fabric softener sheets are also unproven, but may be effective.



Traps and baits can be used to kill rodents. Traps will capture many of the rodents that have entered a structure, but will not stop others from entering.

Poisoning rodents is not always a prudent choice, especially where the poison or poisoned rodents may be consumed by pets or other animals. Consider each situation when deciding whether live traps or toxic traps or baits would work best. Domestic cats can help control rodents, but present their own problems.

Inspect and Sanitize Facilities—In the fall, rodents seek out any structure that will protect them from wind, rain, and cold. While hantavirus presents a year-round hazard, employees responsible for opening and cleaning seasonal structures face an increased risk of exposure to dust from rodent droppings.

Before entering seasonal structures, workers should inspect the area behind and around the structures for rodent activity. This inspection may help to identify possible points of entry and to determine how many rodents live around the structure.

Look for rodent droppings, tracks, gnaw marks (figure 2),

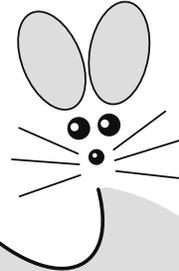


Figure 2—These marks indicate a mouse has been chewing.—Ronald F. Billings (USDA Forest Service) photo. Courtesy of Forestry Images (<http://www.forestryimages.org>).

burrows, runways, grease marks, urine stains, and live or dead rodents. You may be able to hear rodents gnawing or you may smell their droppings.

Trim grass and remove weeds, rubbish, and woodpiles close to structures so rodents don't have places to live nearby. Store food and supplies securely to keep rodents out. Practice good housekeeping.

Safety Precautions



for working around areas that might be contaminated with hantavirus are available from the National Park

Service at: http://www.nps.gov/public_health/zed/hanta/hanta.htm or from the Centers for Disease Control and Prevention at: <http://www.cdc.gov/ncidod/diseases/hanta/hps/>.

A sample job hazard analysis for work in areas where hantavirus is suspected is available at: <http://www.fs.fed.us/r1/people/jha/osh-h/hantavirus%20work%20r1.rtf>.

Reports from the Field

The following comments are a compilation of lightly edited reports from employees responsible for Forest Service facilities.

Keep Rodents Out—I have seen some reduction in the presence of rodents when certain procedures are followed around the structures. Keep woodpiles neat and stacked on top of pallets. Eliminate clutter around the house. Placing gravel around the perimeter of the building can also help. I recommend the National Park Service manual (see *References*).

It is time consuming to plug all holes in and around a building that are $\frac{1}{4}$ inch and larger in any direction, but it seems to help. And after the first go around, the activities become

annual maintenance. From what I've read and heard, steel wool and hardware cloth are two of the best items for sealing holes. Mice will not chew through these. When closing off a basement or attic vent, I put the insect screen on the opening frame and then cover it with the hardware cloth so that the cloth is on the exterior surface.

If you have a question about plugging holes, let me emphasize that every hole 1/4 inch or larger in any direction has to be addressed. Also remember that steel wool is nasty to work with. Wear gloves, a dust mask, and eye protection.

The buildings that we applied these procedures to have fewer rodents. Previously rodents had homesteaded half of the buildings.—*Teresa Reed, Facilities Engineer, Cibola National Forest*

It's a lot of work, but seal up the holes (figure 3). That doesn't mean foaming openings. Mice chew right through it. Mix steel wool and cement together and force it around and in openings. It's the only thing I've used that works. It's better to do it when you're constructing the building, but it works at any time.—*Ron McLain, Cleveland National Forest*



Figure 3—Mice can squeeze in any holes larger than 1/4-inch diameter. This deer mouse made a nest inside a bluebird house.—*Photo by Kristi DuBois.*

We recommend using 1/4-inch metal hardware cloth in barns and storage areas. When applied to the doors, feed bins, and even the lower walls, this effectively reduces the area in which the mice have the opportunity to chew into the building. We have a few barns that have had hardware cloth since the 1940s and they have not had any problems, unlike other buildings on the same site that are overrun with mice.

In buildings habitable by people, the same principle applies. Check the building thoroughly inside and out for any points of access and block them off. If the mice cannot get in, then the problem is partly solved. This also helps reduce any chances that a predator might have access to poisoned rodents. This is the reason you only use poison inside buildings.

—*Marie Willis, Engineer in Training, Boise National Forest*

When closing a facility for the season:

- Keep all cabinet doors open. Mice like dark enclosed areas.
- Besides removing foodstuffs, also remove all paper goods such as toilet paper and paper towels (that may become nesting material).
- Mice like to make nests in kitchen stoves. Disconnect the stove and move it to the center of the room. Take 12-inch aluminum flashing (it comes in rolls) and lay it on end around the cook stove, cut to length and then rivet the ends together so that the flashing completely encircles the stove. Mice cannot climb over the slippery flashing and nest in the stove.
- Mice also like to nest in the exhaust ports and the burner area of water heaters. Seal off the vent port and burner area with aluminum tape. Be sure to place a huge note on the heater notifying the next person to light the heater to remove the tape from the burner and exhaust before lighting the heater.
- Don't forget hantavirus precautions when opening up any building.
- Remove mattresses for the winter. I hope this helps!—*Bill Aron, Tahoe National Forest*

I have a cabin in the backcountry of northern Wisconsin, near the Upper Peninsula of Michigan, adjacent to a wilderness area. It is “mouse proof.”

Yes, it can be done. It takes meticulous attention to detail in design and construction, but if you don’t give mice a way, they won’t get in.

Our piece of the woods is overrun with mice, but we have none. I have built other cabins and had the same success. On one cabin that had a problem, we discovered one small hole had been cut during construction and not properly sealed. Once we had that fixed, that cabin too was mouse proof.

On another cabin, we found that a flying squirrel had made his way in through a water heater vent pipe. This is a problem in winter when the pilot is off. In that case, a cover for the off-season was the answer.

Good luck! These critters are annoying and can do a lot of damage.—David Dercks, Regional Architect, Eastern Region

A rodent specialist at the Interagency Facilities Conference in San Diego said that rodents can get through openings larger than 1/4-inch, so he recommended a wire mesh with 1/4-inch or smaller openings to keep them out. He said all other solutions are temporary and that the electronic devices have never been tested scientifically and have had questionable success.—Marcus Anderson, Station Engineer, Pacific Northwest Research Station

It depends on the type of building and the type of occupancy. A lot of our buildings can’t be rodent proofed. You’re wasting taxpayer money if you try.

You cannot rodent proof a barn or the combination shop and barn that the Forest Service is famous for. We have a historical shop and barn that they want us to keep mouse proof. This is impossible.

What works for buildings that are occupied by people is sealing up the exterior envelope of the building and using self-closing doors and screen doors. It takes a lot of inspection and modification to make it work. Hire a facility person or contractor that cares about his or her workmanship.—Dennis

Stuhr, Facility Engineer, Prescott National Forest

In the Eastern Region I’ve seen several rodent nests in well houses. There’s no food to attract the mice, but it is a relatively warm and sheltered location, so they nest there. Last year I was a contracting officer’s representative for the construction of a new supervisor’s office at Midewin National Tallgrass Prairie in Illinois. We had some mice move into the building and nest between the walls while construction was still in progress. There was no heat or food to attract the mice, just shelter.—Nick Vrevich, Capital Investment

Coordinator, Eastern Region

Control Rodents That Get In—A rodent specialist at the Interagency Facilities Conference in San Diego said the only sure way of solving the rodent problem is keeping them out. He said that all other solutions are only temporary and that the electronic devices have never been tested scientifically and have had questionable success.—Marcus Anderson, Engineer,

Pacific Northwest Research Station

This is so unbelievable, I hesitate to pass it on. But I have had it proven to me that this technique works. Use Bounce fabric softener sheets.

I was in private practice for many years in northern Idaho. The Palouse is a major grain-growing area, and mice are an extreme problem in the winter. After harvest and fall tilling they come in from the grain fields and invade any kind of shelter they can find. They even get into cars and live under the dash where they chew up the wiring and shred the firewall insulation.

I worked for several small water and sewer districts. Mice that got into the pump and equipment houses were a real problem.

One of the districts got a new maintenance person who told us the problem could be fixed by putting Bounce original scent dryer sheets in the buildings. Only original scent works. The maintenance person tore a box of dry sheets off the roll and wadded them up on the floor of each pump house. Within a couple of weeks, all evidence of infestation was gone. Apparently there’s something in the smell of the sheets that the mice can’t stand.



I told one of my surveyors about the dryer sheets. He had a bad problem with mice in his Subaru. He put the dryer sheets on the floor and under the dash. The problem disappeared immediately. Our forest archeologist tried dryer sheets in her garage with success.—*David G. Plummer, Facilities Engineer, Dixie National Forest*

We all have this problem. I am going to give more serious consideration to cats! We also throw a lot of old-fashioned mothballs around in the crawl spaces and attics.—*Linda Sue Torgerson, Northern Zone Engineering Program Manager, Arapaho-Roosevelt National Forest*

Folks in this part of the country have spoken well of the electronic devices. They cost around \$15. Not a bad price to try them out. If the electricity to the cabin is off and on depending on the weather patterns, you couldn't expect coverage all the time.—*Terresa Reed, Facilities Engineer, Cibola National Forest*

Our experience with electronic pest devices has been remarkably successful for all our buildings that have power. Each device has a square foot recommendation that it is supposed to cover. I err on the side of "more must be better." In a janitor closet, that is 4- by 8-foot, we would have at least one unit plugged in. In a 12- by 12-foot room, we might plug in two or three devices, on opposite walls if possible.

We tried these devices last winter and found very limited rodent activity. Normally we would have had entire rodent villages.

The one strange thing about these units is that if we do find a mouse, it will be dead. Could the electronic noise from several of these units in a small area actually be enough to kill a mouse? We couldn't find any other contributing factor, but failed to do an autopsy.

For the most part, we have them plugged in year round. From a personal perspective, you must know that I have a sort of phobia about mice. I hate them with a passion!

At home I have a metal pole shed where I have plugged these units in throughout the building.

Inside the building is a 12- by 18-foot insulated workshop where the mice were particularly bad. I have 3 or 4 units inside this room.

I haven't noticed anything myself or heard anything odd, but when my dog comes into the building he won't stay long and tends to shake his head as if he has an ear infection. I do believe he hears the units and feels discomfort from them.

I also have two units plugged into my attached garage. My indoor cats and dog spend a lot of time hanging out there. It's sort of their play area when the overhead door is shut. I haven't noticed any of my pets acting weird or uncomfortable in the garage because of these units. None of this is scientific. These comments just reflect my experience and observations.

These devices usually cost \$15 to \$30 apiece. Sam's Club sells packs of five units for \$20. This adds to my willingness to plug them in all over.—*Dawn M. Meier, Chequamegon-Nicolet National Forest*

I have successfully used live traps for rodents. Peanut butter is an effective bait. Make sure the trap is designed for the size of the rodent that's causing the problem. A trap that is too large or too small won't work. Live traps left unattended become lethal traps.—*Kathy Snodgrass, former Facilities Engineer, Nez Perce National Forest*

I am writing a generic Rodent Reduction Plan for the Boise National Forest. We have an epidemic at some of our backcountry sites. If you are having a major rodent problem, then the natural predators are:

- Not able to get to the mice.
- Not able to eat enough of the mice.
- Excluded from the area because of human habitation.

In the plan we specify rodent exclusion techniques and prescribe a rotation of different rodent poisons every couple

of months. These poisons are available at your local feed store and therefore acceptable for use. The poisons should only be used *inside* the buildings.

Our local pest control department told us that without rotating the poisons, the rodents will actually become more resistant to a single type of poison such as D-Con. This will cause ‘super mice’ that will need much more poison in their system to kill them. This increases the risk to predators.

Of course, cleanliness and proper storage of food are mandatory for rodent reduction. At the end of the season, mattress pads can become a favorite place for rodents to move in for the winter. A rodent-proof storage box for mattresses or removal of mattresses for the winter would be a good way to deal with this problem.

It is unlikely we will ever be able to remove all rodents from our backcountry buildings. After all, they are in the woods. But with a little attention to the major preventable problems, we should be able to greatly reduce the impact that our furry little friends have on our time in the woods.—*Marie Willis, Engineer in Training, Boise National Forest*

I have used a battery-powered mouse and rat electrocution trap. It’s clean, quiet, easy to power, and it’s easy to dispose of the dead mice. You just tip them out the trap’s door. There is no poison involved and no mess. I bait the trap with dog food. I’m sure pizza crusts would work fine. I did have

some field rats that proved too big to kill, but the trap did kill others that were so big they filled the trap. These traps work well. I purchased mine at the local feed store.—*Tim Dedrick, Facilities Civil Engineer, Sequoia National Forest*

I have seen a trap that works well, although it isn’t very humane. It’s called a bucket trap. A 5-gallon bucket is filled with about 1½ gallons of water. A pop can is suspended from a stiff clothes hanger wire laid across the top of the bucket. The wire goes through a hole drilled in the center of the pop can’s top and bottom. A dowel or stick is the ramp from the floor to the rim of the bucket. Peanut butter is smeared on the can.

A mouse climbs the stick to the bucket rim, and then goes out on the wire to reach the pop can. When the mouse climbs on the can, the can spins on the wire, dropping the mouse into the water, where it drowns. I have seen six or seven dead mice in a bucket.

We had seasonals living at a work center in a trailer house. This is how they were keeping the rodent population down.—*Dean Lebeda, Laramie District Engineer, Medicine Bow-Routt National Forest*

Take a 5-gallon bucket and fill it half full of water. Lay a wooden dowel across the top of the bucket with a dab of peanut butter on the middle of the dowel. Place a stick against the side of the bucket that mice can climb to reach the dowel. The mice will crawl out on the dowel to get the peanut butter, fall off the dowel as it rolls and drown.

The best thing about this method is that you can flush the bucket's contents down the toilet without having to touch anything. This is the way they deal with mice on many farms around Idaho and Utah.—*Gil M. Levesque, Facilities Design Team, Intermountain Region*

Here's a variation on the bucket trap. It works great if you are overrun with gophers, chipmunks, and other outdoor rodents. Fill a 5-gallon bucket two thirds full of water. Float a layer of sunflower seeds on the top of the water. Make a board ramp to the top of the bucket. The bucket looks like it is full of seeds to the rodent. This one really works.—*David Dercks, Regional Architect, Eastern Region*

Inspect and Sanitize Facilities—We sprayed the infested areas with a mixture of bleach and water and took care of the rodent exclusion techniques first, working from the outside in fresh air. Then we had a hazmat crew clean up the rodent waste from the houses, including waste in the ductwork. After cleaning, they sprayed a virucide.—*Terresa Reed, Facilities Engineer, Cibola National Forest*

The best solution I know is to sterile clean these buildings using Clorox or ammonia. **Don't mix** these chemicals. Focus most of this cleaning in the kitchen. Many areas have good cleaning companies that can do this for \$100 to \$150 per home. These cleaning folks will even move the stove and refrigerator and clean out the nasty things that grow under them. Once you remove the food source, the smell of

ammonia or Clorox will drive away the pests. Ammonia or Clorox also will kill germs.—*Shelly Pacheco, Lincoln National Forest Safety and Occupational Health Officer*

Good house cleaning works. Some crews leave all sorts of stuff behind when they vacate a building. It's real frustrating.—*Dennis Stuhr, Facility Engineer, Prescott National Forest*

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About the Author

Kathleen Snodgrass came to the Missoula Technology and Development Center as a project leader in 2001 from the Nez Perce National Forest. She had been the facilities architect for the Nez Perce National Forest for about 7 years and had worked in facilities, landscape architecture, land

line, and general engineering on the forest for about 10 years before that. Kathleen spent 10 years in highway design and construction with the Idaho Division of Highways after graduating from Washington State University in 1974 with a bachelor's degree in architectural studies.

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Describes techniques employees have used to control rodents in Forest Service facilities. Recognition of the danger of contracting hantavirus pulmonary syndrome has increased the importance of keeping Forest Service structures as free of rodents as possible. Hantavirus pulmonary syndrome is a viral disease transmitted to humans primarily when they inhale

airborne dust from dried rodent droppings that contain hantavirus. Through June 2002, more than one in three persons diagnosed with hantavirus pulmonary syndrome died from the disease. Employees should take three important steps to protect themselves and the public from health dangers posed by rodents: keep rodents out, control rodents that get in, and inspect and sanitize facilities. The tech tip includes reports from a number of Forest Service field employees explaining how they address each step.

Keywords: hantavirus, mice, Muridae, pest control, safety at work, trapping, ultrasonic devices, viral diseases

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