

# Illustrated Guide to House Mouse Exclusion and Monitoring



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***All images are donated by Thomas A. Parker, PhD. except where noted.***

# House Mouse: *Mus musculus*

## OUTLINE

- Quick facts
- Guidelines for exclusion
- Guidelines for monitoring
- Tips for identification
- Exclusion tactics: exteriors
- Exclusion tactics : interiors
- Baiting and trapping
- Conclusions



# House Mouse: *Mus musculus*

## QUICK FACTS

- In one year, a house mouse can have five-to-ten litters, with five-to-six babies (“pups”) in each litter: approx. 60 mouse pups per year
- A house mouse is ready to procreate at six weeks old
- A house mouse’s gestation period is about three weeks
- Average life expectancy is six months to two years
- Mice don’t need standing water to survive, the water content of their food suffices
- To survive and thrive, the house mouse needs only food, a safe space, and nesting material
- The house mouse is a thigmotropic creature: it loves to be touched on all sides
- Because the house mouse is thigmotropic, it will seek small, tight, cozy spaces when traveling and making a home



House mouse nest in an old box



# House Mouse: *Mus musculus*

## GENERAL GUIDELINES FOR EXCLUSION



Copper wool gauze



Strategic trap set near door gap

- Mice can flatten out to get through holes/gaps as little as ¼ inch in size
- To plug gaps/holes, use firestop material in conjunction with copper wool (steel wool will rust/fail, so use copper!)
- To plug larger openings, use galvanized hardware cloth and flashing
- Do NOT use foams (expanding or otherwise) to plug gaps/holes: rodents will chew through it and/or use it for nesting material
- Where exclusion isn't possible, place traps near points of entry (eg: can't use door sweeps? Set glue traps on either side of the door)



# House Mouse: *Mus musculus*

## GENERAL GUIDELINES FOR MONITORING

- Establish and follow an inspection and monitoring schedule
- Check traps monthly (or quarterly at a minimum)
- Track/chart/graph monitoring data
- Look for mouse trails: discoloration/staining that looks like grime along baseboards, wire chases, or near rodent entry points
- Rodent urine will fluoresce in UV light: blue-white to yellow-white depending on how fresh it is (keep in mind, though: many things fluoresce)
- Mice urinate in one spot while rats urinate as they walk
- Watch for droppings (oblong pellets with one pointed end and a smooth surface) in suspect locations:
  - Under sinks
  - Near pipe/wire chases
  - In dark, cozy corners



Staining from mice on electrical wiring



House mouse droppings



# House Mouse: *Mus musculus*

## IDENTIFYING MOUSE DROPPINGS

House mouse droppings can be confused with those of the American cockroach- even by professional pest managers. Tips to differentiate:

- *Mouse droppings*: an oblong pellet with one (sometimes both) ends pointed or pinched, and a smooth surface
- *American cockroach droppings*: an oblong pellet with blunt ends and long ridges running down the surface
- *Rat droppings*: smooth, ends are not pinched
- Mouse, rat, and roach droppings are usually black, but may be colored based on what they have eaten (eg: pale after eating banana peels, green after eating bait, any color after eating carpet)



Images from: NY State IPM



House mouse



American cockroach



Rat



# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS

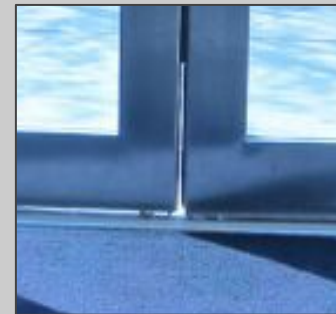
- Survey exteriors carefully to identify potential entry points for mice
- Any hole or gap larger than  $\frac{1}{4}$  inch (in other words, any space into which or under which you could poke a pencil) is an easy in for a mouse
- While mice use existing small openings to gain access, rats chew to get in



# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS *DOORS*

- Rodents can enter through gaps below a door or around the edges of doors that are out of alignment (eg: bay doors/double doors that do not meet tightly at the center)
- Gaps between doors and jambs can be closed by resquaring doors so that they close tightly
- Gaps under doors can be closed by installing astragals/molding and/or door sweeps (such as those manufactured by Xcluder™)
- Use automatic door closers to prevent doors being routinely left open/providing easy entrance for mice



Examples of gaps under/between doors

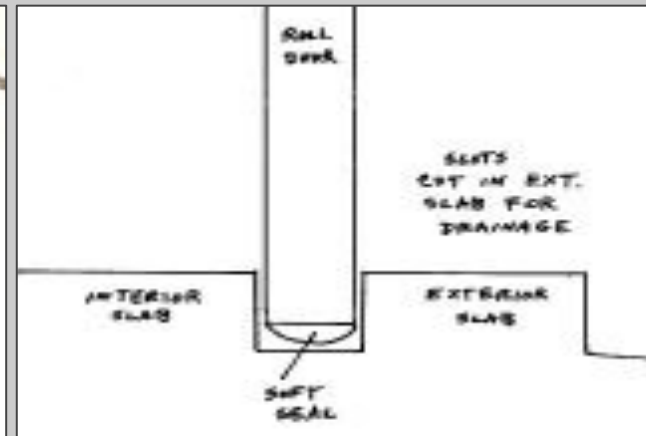




# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS ***GARAGE DOORS***

- Gaps may be present at corners where a garage doors meet the ground
- If the door closure system can be adjusted so that the door lowers into into a gasketed recess, rodents will be blocked from entry
- Weatherseal products (like those by Sealeze™) can be used for sealing gaps around garage doors
- Gaps can also be closed using materials such as Stuf-Fit™ copper wool gauze, which comes as a woven flattened tube in rolls and can be cut with regular scissors



Examples of gaps under garage doors and a schematic for closing the gap



# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS *WEEP HOLES*



Examples of weep holes: first 3 images are open and the last is closed with an exclusion cover

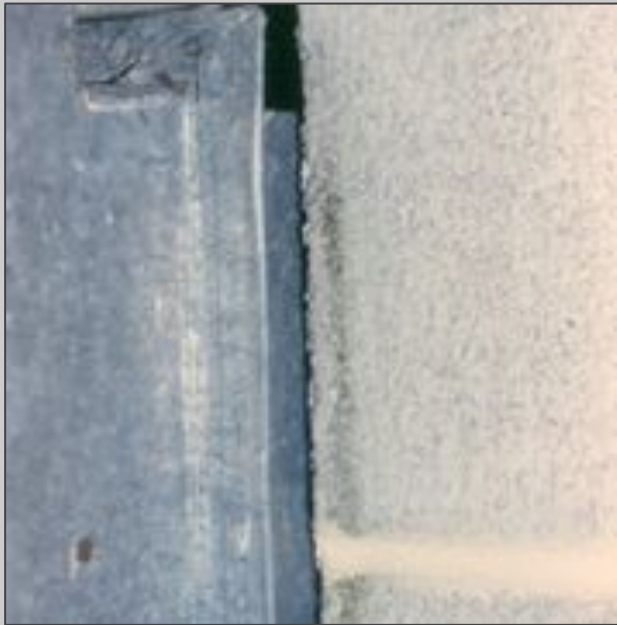
- Mice can enter weep holes (gaps between bricks and cinder blocks that allow condensation to escape from the interstitial space between the exterior masonry and interior wall) within a foot of the ground
- Additional gaps may be present in masonry where mortar has been lost, or in the first row of shingles at the junction between the wooden part of the building and the foundation
- Weep hole covers, like those produced by Tamlyn,™ pressure-fit into the holes to allow drainage, but prevent rodent entry
- Weep holes and gaps can also be closed using copper wool gauze, which can be stuffed tightly into place using a putty knife or similar tool



# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS *VENT/PIPE GAPS*

- Vents and gaps around pipes that come into the building can be stuffed with copper wool gauze, or screened with 1/4 inch hardware cloth.



Examples of vent and pipe holes/gaps



# House Mouse: *Mus musculus*

## EXCLUSION: EXTERIORS *PREVENTION*



- Locate trash collection as far from the building as possible
- Enclose trash collection operations to the greatest extent possible
- Consider rodents in your landscaping choices (eg: avoid planting seedy grasses that will attract/feed rodent populations)
- Store landscaping/gardening supplies (seeds, bulbs, and other organic gardening supplies) in tightly sealed containers

Examples of food sources



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS

- Survey interiors carefully to identify potential entry points/habitats for mice
- Any hole or gap larger than  $\frac{1}{4}$  inch (in other words, any space into which or under which you could poke a pencil) is an easy in for a mouse
- Especially important to monitor kitchens and food storage areas



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS

### ***BASEMENTS/CRAWL SPACES 1 of 2***



- Do your best to close off, seal, or fill these areas:
  - Window wells, where old conduits may have left holes
  - Outside cellar entrances and bulkhead doors that don't close tightly
  - Old, cut off pipes with open ends
  - Dumb waiters
  - Old elevators
  - Coal chutes
  - Fireplaces
  - Laundry chutes
  - Perforations where pipes/cables/gas and electrical lines go through walls and flooring



Examples of holes in foundations

# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS

### ***BASEMENTS/CRAWL SPACES 2 of 2***



- Traps are better for basements and crawl spaces. The spaces are often wet and damp and glue boards will be less effective
  - Dirty/dusty mouse feet do not stick firmly to glue boards
- Materials that can be used to close off holes include:
  - sand
  - copper wool gauze
  - firestop
- Glue boards may require coverage to prevent kicking and/or dust accumulation
  - Covers can be purchased or made (eg: tubular bridges made of PVC pipes sectioned longitudinally to place over traps)



Copper wool, glue trap, snap trap

# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *KITCHENS 1 of 2*



- Invariably mice will end up in a kitchen, pantry, or food storage area
- How do you trap a kitchen?
  - Remove bottom drawer of stove, set trap and use yardstick to push to back of drawer with string attached to retrieve. Return drawer.
  - Mice forage under the stove and burners
- Very important to monitor where there are lots of pipes and vents associated with hoods
  - These are often located above drop ceilings
  - Mice often travel from drop ceilings to the floorline via electrical lines and vertical pipes associated with kitchen equipment
  - Water pipes are usually situated horizontally. Mice use pipe openings in walls to gain access to voids in walls in order to nest.
  - Check for wall and floor perforations.



Evidence of pantry mice



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *KITCHENS 2 of 2*



Mice in the pantry

- Refrigeration equipment compressors either built in or freestanding, are good hiding places
  - They produce heat, and this attracts mice
- Mice can ride in on food/produce deliveries, as in a crate of lettuce, getting in and out through aeration holes



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *ATTICS 1 of 2*



Evidence of mice in the attic insulation and floorboards

- Attics are frequently used for long-term storage, but can be inconvenient to access for inspection and exclusion.
- Often technicians do not check attics and ceiling areas.
- In the absence of a sturdy floor, one may need to lay down plywood in order to lay traps above insulation and facilitate access for regular inspection and exclusion.
- Attics tend to be warm and they often contain insulation materials. These conditions provide an attractive environment for mice to nest.
- Stains on ceilings are often mistaken for leaks, when in fact they are mouse urine.
  - Water leaks usually result concentric tide lines.
  - Mice like to urinate in corners, and use same spot over and over again, creating more irregular stains.



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *ATTICS 2 of 2*

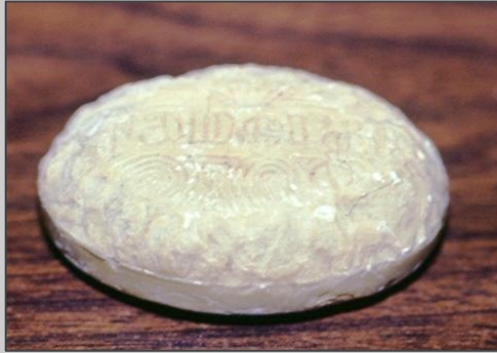
- Mice access attics through numerous conduits associated with infrastructure:
  - Water pipes
  - Vents for toilets and showers
  - Electrical conduits
  - HVAC systems
- Roof damage or broken windows offer points of entry from the outdoors.
- Mice can travel along tree branches near the roof.
- If you must store vulnerable materials in an attic, use heavy plastic totes as a deterrent as you look for a safer long-term storage solution.



Evidence of mice in the attic around cable chases, floorboards, and pipes

# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS **BATHROOMS**



Evidence of mine in the bathroom eating soap/nesting in paper products

- Multi-toilet bathrooms in museums and institutions have large plumbing chases for pipes.
  - The chase provides a quiet space for nesting near food and water.
  - Chases should be inspected during pest monitoring.
- Metal escutcheon plates over wall penetrations around pipes prevent rodents from entering.
  - Adhesives may fail in higher temps and allow mice to move the escutcheon.
  - Install an excluder like copper mesh, then cover.
- Mice will feed on bar soap if given an opportunity.
- Toilet paper is an attractive nesting material.
- Install door sweeps on the doors.



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *OFFICE SPACES 1 of 2*



- Rodents can get into voids and interstices behind and inside cabinets, drawers, and counters.
- Electrical runways in the base of hollow cubicle walls provide runways for mice to hide or travel.
- Inspect where you can, place traps, and close gaps.
- Close any wall perforations behind cabinets.
- Remove shelves and drawers to access voids underneath.
- Clean and place traps as necessary. These areas collect debris that can sustain mice.

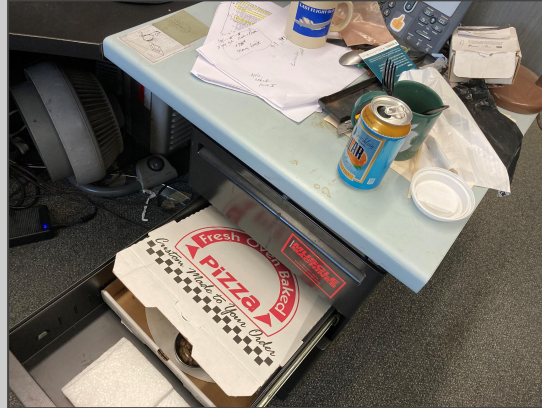


Evidence of mice in the office; holes and urine staining on floors, a cable chase that acts as a mouse passageway, and paper in an unused drawer serving as nesting material



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *OFFICE SPACES 2 of 2*



Evidence of mice in the office: urine staining on ceiling tiles, food waste hoarded in an office, and a mouse chewed food container

- When cleaning floors, be sure to move tables and clean underneath.
- Food consumed in offices attracts mice. Empty food waste daily. Keep trash cans clean and use liners and cans that close for food waste.
- Hoarding and clutter will attract mice and serve as attractants (i.e. nesting materials, food, harborage, etc.) and thwart mitigation efforts.
- Copier alcoves can be warm and inviting.
- Acoustic tile is often used in office spaces and can hide points of entry, conduits, food and nesting materials and harborage.
- Mice can enter office spaces through sunken electrical outlets in the floor.



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *EXHIBITIONS*



Rat chew marks on a leather saddle.  
(F. Ritchie, NPS)

- Display cases with openings/holes/open grates on top (for ventilation, for air circulation fans, for security monitoring devices, resulting from clumsy construction, etc.) provide entrance points into casework for rodents.
- Display cases should either be easily accessible underneath for cleaning, or form a tight seal with the floor below (caulked seams or a single piece/unified baseboard to floor transition) to avoid creating dusty shelters/harborage for rodents.
- Open dioramas present pest problems. Certain materials that might be found in an open diorama (e.g: wool batting, corn, etc.) provide food and nesting materials for rodents and should be replaced with faux versions made of materials not of interest to rodents. Corn inside a display for a natural history museum. Mice like the germ and not the whole corn (just the pointy end).



Mouse nest on a stagecoach seat, on open display. (C. Sullivan, NPS)



# House Mouse: *Mus musculus*

## EXCLUSION: INTERIORS *EXHIBITIONS*

- Void spaces below floors in exhibit areas can accumulate dust, dirt, and other debris left by visitors. These dark, hidden areas are attractive to mice and other insects for potential food sources, nesting, harborage, etc.
- Electrical outlets below display cases can provide warmth and a potential void space
- Storage areas for exhibit furniture/equipment are also seldom accessed and can hold dust/debris
- Proper housekeeping is essential to minimize accumulations and void spaces should be cleaned regularly

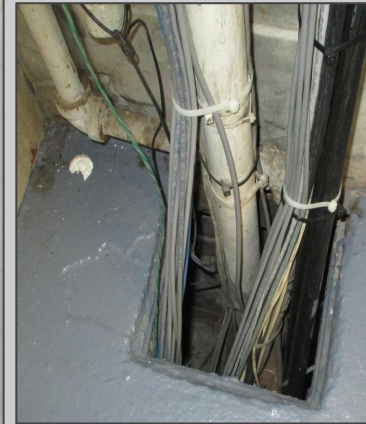
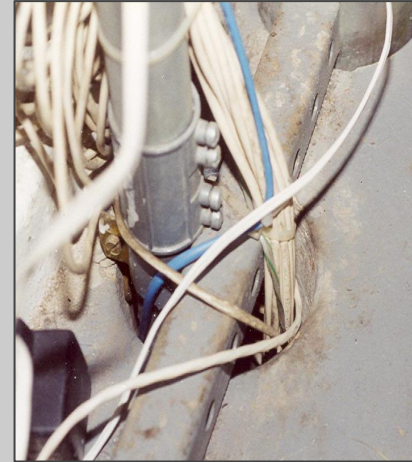




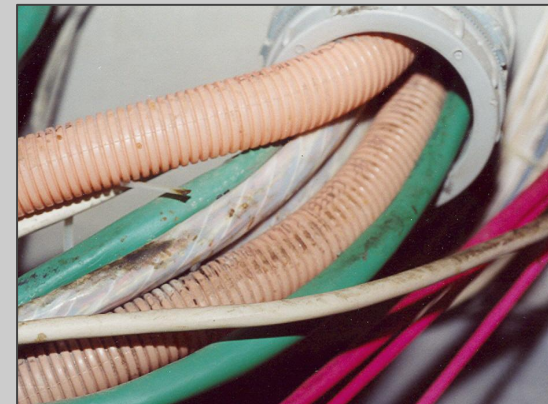
# House Mouse: *Mus musculus*

## EXCLUSION: INTERIOR *HEAT/ELECTRIC/FLOORS*

- Things to Consider
  - Gap between baseboard and flooring needs to be closed.
  - Electrical races/chases under wooden floors are also mouse highways. Mice can die inside and carcasses become infested.
  - Elevated floors in computer rooms are popular with mice. They're dark, warm, with lots of wiring/holes. Rodents chew wires and can start a fire this way.
  - Mice will travel from floor to floor using:
    - Pipes for radiators and steam heat systems
    - HVAC
    - perimeter baseboard heat
    - Retrofit sprinkler systems



Holes for wires and pipes, mouse staining on corrugated plastic pipes, and a chewed electrical cord



# House Mouse: *Mus musculus*

## TRAPPING & BAITING

- **Equipment Options**
- **Placement**
- **Strategies**
- **Exterior Baiting**
- **Interior Baiting**



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: *EQUIPMENT*

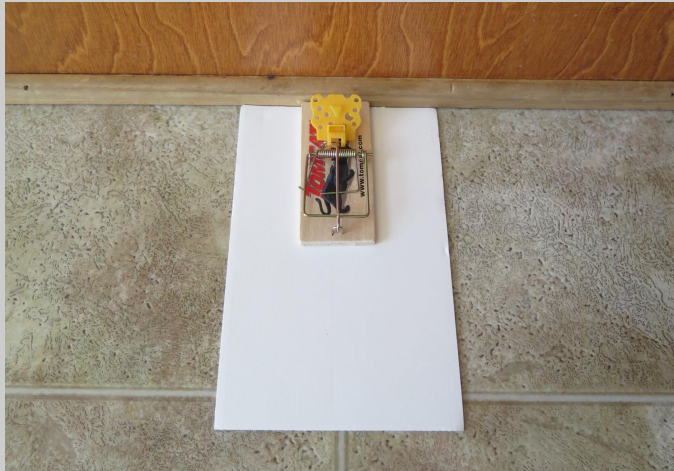


- Standard snap trap
- Expanded trigger trap
- Mini t-rex
- Multi-catch trap (ex. Tin Cat)
- Glue boards
- Remote sensor monitors/traps
- Electronic traps (ex. RADAR)
- Exterior bait stations



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: **SNAPS TRAPS**



Snap traps

- Snap Traps should be placed perpendicular to the wall with the trigger against the wall or parallel to the wall, preferably with two traps back to back with the triggers facing outward (see double trapping for more information)
- Expanded trigger traps are snap traps with a larger trigger area and are the preferred type of snap traps. They will give you 17% more catches.
- Reuse traps if possible, but use gloves.
- Place traps in quiet corners in order to catch them when they are slowing down a bit rather than in middle of their run or along walls.
- Gluing snap traps on a board can be helpful for placement and removal once the trap is sprung



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: *DOUBLE SNAP TRAPS*

- Three options for “double trapping” include:
  - Set up a first trap abutting a second trap, with both traps parallel to the wall and with triggers to the outside/away from one another
  - Set up one trap on either side of a corner, each perpendicular to their own wall with triggers towards the wall
  - Set up two traps, both perpendicular to the wall and right next to each other, (double wide-style) with triggers towards the wall
- The so-called “popcorn response” triggered when mice sense an issue with the first trap, will cause them to jump to get out of the way of the first trap, falling into the second trap.
- These tactics work best with snap-traps and expanded trigger traps.



Double Snap  
trap set up

(F. Ritchie, NPS)



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: *PLACEMENT*

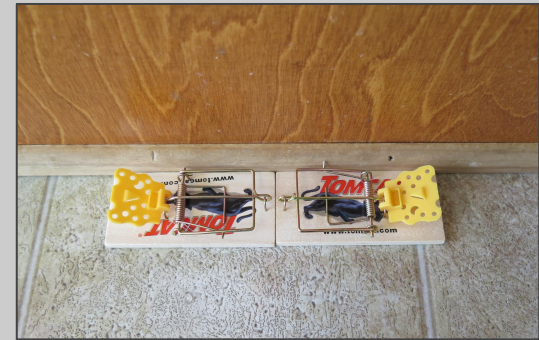
Follow the walls mice run along and find quiet corners to catch them while slowing to round a bend



Single trap with trigger against wall



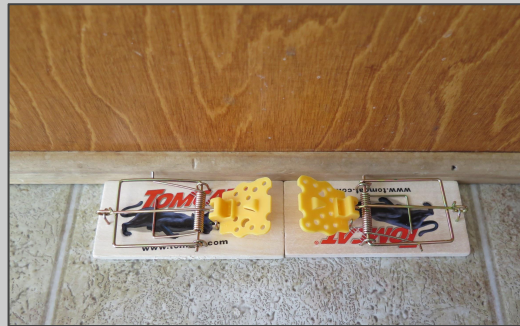
Two traps increases success rate



Double traps parallel to wall with triggers to the outside



Wrong - trigger not against wall



Wrong - double traps with triggers on the inside



Wrong - trap too far from wall

(F. Ritchie, NPS)



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: **GLUE TRAPS**

- While snap traps are preferred, occasionally glue traps are also necessary
- Larger, rat-sized boards with thicker glue layer are best
- Freeze boards first to ease removal of contact paper/release paper
- Low-temp glue boards exist for use in cold (eg: in refrigerators and freezers)
- Flat glue boards are better than trays/mice will run around or bypass trays
- Can be used in combination: Glue boards alone will get about 70%. You need combo to get both. Traps and glue boards on a perimeter, traps in the corners, boards along the runs. You can wrap a glue board around pipes – more for rats than mice, because mice eventually come down to eat
- If glue boards are not allowed in your institution during public hours, place them at closing and retrieve in the morning before opening
- Trap position: place along runs or in areas with smudges



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: **REMOTE MONITOR TRAPS**

- Remote rodent monitoring technology (RRMT) provides early detection of rodents and was invented in 1999 and first patented in 2002.
- Available from numerous manufacturers, including large scientific corporations and smaller entrepreneurs.
- Most remote monitors employ sensors that detect rodent movement, touch, or trap activation. The sensors then transmit alerts to a remote cloud server or designated Smartphone.
- Alert data can be gathered/summarized according to location, facilitating data compilation across rooms, floors, or an entire building.
- Eliminate inefficient routine checks of untriggered rodent traps
- Quickly deploy staff to remove trapped rodent carcasses, thereby reducing risk of secondary insect invaders





# House Mouse: *Mus musculus*

## TRAPPING & BAITING: *NON-LETHAL* OPTIONS

- While “No Kill” traps may initially appear on the surface to be a more humane option, they can often result in a prolonged, painful death when compared to a quick-kill snap trap solution
- Most trapping/monitoring IPM campaigns will not have the resources to be able to check traps in frequent enough intervals
  - Rodents can die within 6-12 hrs of being trapped
- Multi-catch traps can result in stress, fighting, and even cannibalization for the trapped animals
- Dead mice will also attract insects
- Glue traps can have similar issues and therefore should be checked regularly and only used strategically as necessary



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: ***EXTERIOR BAITING***

- Do NOT use anticoagulant baits where they may cause secondary poisoning in predators who may ingest dead rodents
- Use products without secondary toxicity to raptors, coyotes and other animals, such as baits using vitamin D3 as active ingredient
- Snap traps or glue boards can be included in bait station units if well-monitored



Exterior  
bait trap



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: ***EXTERIOR BAITING***

- Exterior baiting has to be managed by a PMP (Pest Management Professional)
- Monitor/work with your PMP to ensure:
  - Correct baits/traps are used and they are well-located
  - That the PMP regularly maintains the baits/traps
  - That the PMP monitors baits/traps meaningfully
  - That technicians actually unlock, open, and check each box
- Check local ordinances regarding allowable uses of rodenticide baits
- Do not use bait in or near buildings if mice may enter afterwards
- Check outdoor traps quarterly, if not monthly



Exterior bait stations



# House Mouse: *Mus musculus*

## TRAPPING & BAITING: *INTERIOR BAITING*

**NEVER USE RODENT BAIT** inside museums historic houses, libraries, or archives!

- Poisoned rodents often die in hidden voids (behind walls, under floorboards, etc.) leaving carcasses that are difficult to find/remove
- Hidden carcasses attract flies, hide beetles, carpet beetles, clothes moths, and other pests that will attack collections when the carcass is finished
- Many commercial rodent baits come unintentionally pre-tainted with dermestid eggs, which will soon hatch and attack collections



Interior bait stations and Dermestids in a rodent bait tray



# House Mouse: *Mus musculus*

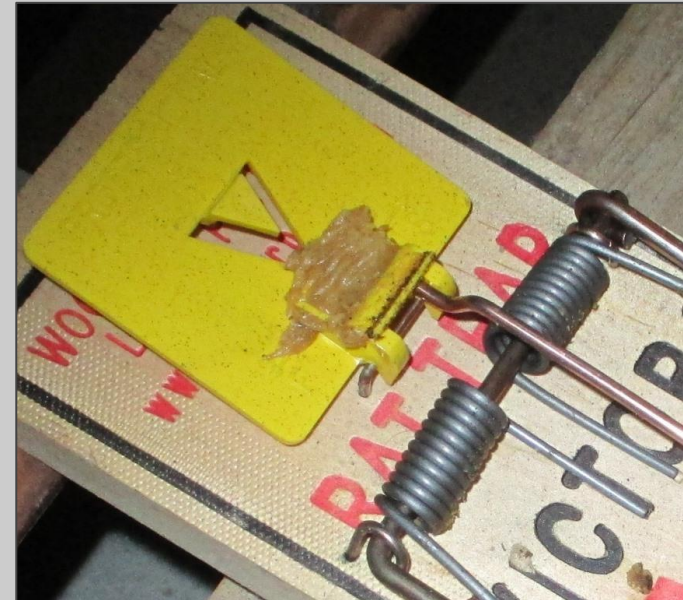
## TRAPPING & BAITING: *INTERIOR BAITING*

Traps should be baited using non-lethal attractants.

Options include:

- Whatever mice are already feeding on
- Cotton balls infused with vanilla
- Nutella (effective, but messy and may attract more mice)
- Tootsie-rolls used with mini T-Rex traps (they will not attract more mice, but these traps are strong so use care setting them)

\*Avoid baiting with peanut butter, as it poses allergy concerns in public spaces and is so effective that it can attract more rodents



Although peanut butter is a common snap trap bait, a vanilla infused cotton ball is a much better option



# House Mouse: *Mus musculus*

## CONCLUSION

- Mice are prolific reproducers and don't need much to survive
- Mice can pass through openings as small as  $\frac{1}{4}$ " wide
- Establish a monitoring schedule and chart resulting data
- Know how to differentiate various types of pest droppings
- Know what to look for when considering exclusion and be as aggressive as possible: use the right materials in the right places
- Eliminate or segregate trash and prevent hoarding/filth
- Check traps frequently
- Snap traps are currently the most effective traps
- If using glue traps, larger models backed with paper are best
- Trap placement/location/orientation is very important
- Any exterior rodent baiting must be managed by a Pest Management Professional
- Never use rodent bait inside

