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Controlling Vertebrate Pests in Museums

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Controlling Vertebrate Pests in Museums

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Abstract

When vertebrate animals, particularly rodents, gain access to museum collections, they can soil or destroy artifacts. Prompt identification of the pest and the use of suitable methods to control it are essential. In most cases, nonchemical methods can be used to control vertebrate pests in museums; chemical methods are also discussed.

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Cover

Photograph shows an open loading-bay door allowing rodents to enter at will. Exclusion, in this case by having a tight-fitting door, is the single most important factor in vertebrate pest control. The mousetrap provides a secondary line of defence.

Acknowledgement

Photo by Carl Bigras, CCI. Permission by Woodstream, and EKCO Group company, Lititz, PA, USA.

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1. Introduction

Vertebrate animals, such as rats, mice, squirrels, raccoons, porcupines, bats, and birds, can pose a threat to museum collections, particularly for museums in rural locations where collections are stored and exhibited in wooden out-buildings. Vertebrate pests can damage artifacts by eating them, shredding them to obtain nesting material, or staining them with wastes. In addition, vertebrate nesting sites containing hair, feathers, or dead animals attract insects, such as clothes moths and dermestid beetles, that will spread to artifacts in museum collections.

Correct identification of the pest causing the problem in a museum is essential for choosing an effective solution. Use field guides such as those listed in the Bibliography to aid in this identification.

Effective pest control programs emphasize preventive measures. The first and best defence against vertebrate pests is to exclude them from the building. Until exclusion methods are in place or if exclusion proves impossible, continuous trapping may be necessary. After trapping has been effectively carried out, museums should continue to maintain exclusion techniques to prevent more pests from entering the building.

Resort to chemical control methods only when trapping methods have failed. Contact poisons, poison baiting, and fumigation result in animals dying in inaccessible locations where their corpses will putrefy and attract insect pests. Poisons will not prevent recurrence of the pest problem unless exclusion methods are thoroughly carried out.

Because many recommended pesticides are, to varying degrees, toxic to man and to wild and domestic animals, caution must be exercised in their use, and the manufacturers' directions must be closely followed. The use of many pest control chemicals is restricted, and the service of a professional pest control firm is required for their application.

This bulletin emphasizes the most common vertebrate pests encountered in Canadian museums: rodent (rats, mice, and squirrels), bird (pigeon, starling, and sparrow), and bat pests. The guidelines for dealing with these pests may be applicable to other species. Before dealing with an unfamiliar animal, check provincial regulations on its status. Many fur-bearing mammals are protected, but, as a rule, most protected animals can be trapped or destroyed if they are a persistent threat to property.

2. Exclusion

Most authorities stress that prevention by exclusion is the most effective long-term solution to a vertebrate pest problem. The following precautions will discourage entry of rodents and other small mammals into a museum.

a) Keep food out of the museum or, at least, in sealed metal containers. Keep garbage in covered cans stored outside in an enclosed area away from the building. Practise good housekeeping methods in cafeterias and lunch rooms. Clean spills immediately and thoroughly.

b) Eliminate sources of drinking water by repairing leaky pipes and taps, and by covering open drains with heavy screens using 6 mm (1/4") galvanized wire mesh (16 to 19 gauge). Prevent the formation of condensation on cold pipes by installing pipe insulation.

c) Ensure that doors and windows are tight-fitting and latched. Secure all vents and louvres, and cover openings with 6 mm galvanized wire mesh. Ensure that attic vents are screened. Use sheet metal or concrete to block off all small openings to the outside, particularly in the foundation and ground floor of a building. Exclusion methods must not interfere with normal ventilation of buildings. Inadequately ventilated buildings can accumulate moisture, leading to fungal problems.

d) Keep storage areas uncluttered and orderly, and inspect them frequently. Shelving and cabinets should be mounted a minimum of 10 cm off the floor to allow for thorough cleaning and inspection and to discourage pests from residing there.

3. Rodents - Rodentia

Rats and mice are potentially damaging pests to museum collections in both urban and rural settings. These animals may also carry diseases that can infect man through bites or by contact with hair, excreta, or parasites, such as fleas, lice, and mites. Mice often enter buildings in autumn to overwinter, and constitute a common rodent problem.

3.1 Species

Brown Rat *Rattus norvegicus*
[Norway, Common, Sewer, Wharf or House Rat].
Total length: 30 to 45 cm.
Weight: 200 to 550 grams.
Colour: Brown or reddish-grey with a lighter grey belly.
Nose: Blunt.
Ears: Short and thick.
Tail: Shorter than head and body; lighter underside; rough and thick.
Reproduction: Sexually mature in 8 to 12 weeks; average 24 young per year.
Females have 12 mammae.
Food: Omnivorous.
Droppings: Capsule-shaped; average 20 mm long; 40 to 125 passed daily.
Range: Most of Canada except Alberta.

Habitat: Individuals range over half a kilometre outdoors, and often along established runs indoors; burrow approximately one metre underground or inhabit lower levels of buildings; good climbers and swimmers, and can jump heights to 80 cm and gaps to 1.5 m.

Black Rat *Rattus rattus*
[Roof or Ship Rat].
Total length: 42 cm.
Weight: Up to 300 grams.
Colour: Black or brownish-grey with a lighter belly.
Nose: Pointed.
Ears: Thin and large.
Tail: Slender, longer than head and body.
Reproduction: Sexually mature in 12 to 16 weeks; capable of a litter every 3.5 to 4 weeks; fewer young per year than *R. norvegicus*.
Females have 10 mammae.
Food: Omnivorous.
Droppings: Tear-drop shaped; average 12 mm long.
Range: West coast of Canada.
Habitat: Individuals usually range within 100 metres; prefer upper levels of buildings; good climbers and swimmers, and can jump 1.5 m.

House Mouse *Mus musculus*.
Total length: 17.5 cm (body, 8.5 cm; tail, 9 cm).
Weight: Up to 25 grams.
Colour: Brownish-grey with grey belly.
Nose: Pointed.
Ears: Large.
Tail: Longer than body; dark in colour.
Reproduction: Sexually mature in 5 to 12 weeks; capable of a litter every 3.5 to 4 weeks, and up to 60 young per year.
Food: Omnivorous but prefer cereals.
Droppings: 6 mm long; narrow.
Range: Canada.
Habitat: Individuals usually range less than 12 metres from nest; can pass through 10 mm (3/8") hole; enter buildings in fall for shelter during winter; inhabit enclosed spaces such as wall cavities; burrow 20 cm deep; excellent climbers, good swimmers, and can jump 30 cm.

3.2 Identifying a Rodent Problem

The following signs, often evident before rodents are ever seen, will alert museum staff that rodents are present.

a) Tooth marks from gnawing; wood chips near baseboards or cabinets; or irregular losses, tears, or soiling of fabrics. Rodents engage in gnawing to wear down their constantly growing incisor teeth, to gain access to food, and to make nests. Most soft materials, including aluminium, asphalt, and lime mortar, are susceptible to rodent gnawing.

b) Faecal droppings. Droppings are produced in large numbers and will dry in one or two days. Rat droppings often contain hair. Because of the possibility of disease, do not handle rodent droppings directly; wear gloves or use a dustpan.

c) Urine deposited as small dribbles or as a line of droplets. Dried rat urine stains may not be visible to the naked eye, but will fluoresce blue-white under ultraviolet illumination. Avoid contact with urine. Use a germicidal janitorial detergent to clean rodent urine off surfaces.

d) Greasy smudges on walls, beams, and pipes deposited from dirty and oily rodent fur. These marks are only visible in high traffic areas called runs.

e) Nests made from shredded material, such as paper or textiles. Nests will usually be found in dark, dry, sheltered, and undisturbed areas, and are usually well concealed.

f) Tracks of paw prints on dusty surfaces. Apply a non-toxic tracking powder, such as talc (not flour), along walls or suspected runs, and observe for several days to confirm the presence of rodents. Inspect the tracking powder with a raking light to enhance the visibility of the tracks. The front paws of rodents leave tracks showing four toes, the rear paw tracks are elongated and have five toes, and the tails leave short lines as marks.

g) Burrows in the earth around buildings, or holes in the building foundations of 10 cm (4") in diameter that were made or enlarged by rodents. Rat nesting and access burrows are usually less than 1.2 m (4') deep. Fill in burrow entrances and check for excavation on the following day to determine if they are in use.

h) Sounds of gnawing, squeaking, or scampering in walls. Sounds will be heard mainly at night unless the rodent colony is overpopulated.

i) Odour. Rats have little odour unless the population is large or well established. Mice can often be detected by their musky odour.

j) Live or dead rodents seen in the building. Do not handle live or dead rodents with bare hands; see precautions described below.

3.3 Nonchemical Methods of Control

Exclusion

Exclusion is the best way to prevent rodent pest problems. The following techniques should help to keep rodents from entering a museum.

a) If rodents are gnawing at wooden doors or window frames, apply sheet-metal cladding as a deterrent.

b) Cut back any overhanging branches to beyond 3 metres from the building. Remove vines that rodents could use to climb to openings on upper levels.

c) Place large sheet-metal cones (30 to 45 cm in length and in diameter) on exterior pipes and poles at a height of 2.5 metres to prevent rodents from jumping past the cones and climbing up to points of access. Fasten 18" squares of sheet metal over small pipes and wires that run up walls from ground level or are attached to the building from hydro poles or outbuildings. Caulk gaps between sheet-metal guards and wires to prevent mice from crawling through.

d) Dig up, disturb, or remove nesting sites, burrows, and hiding places. Undergrowth and debris provide protective cover for rodents; eliminate it from around museum buildings.

Ultrasonic repellent devices have not been proven conclusively to be effective at repelling rodent pests despite the fact that rodents do hear and vocalize in the ultrasound frequency range.

Trapping

Trapping can effectively eliminate a rodent problem when combined with exclusion. Unlike baiting, trapping usually prevents the rodent from dying in an inaccessible place where it will eventually produce a foul odour and attract undesirable insect pests.

The common and effective snap trap (also called the guillotine, spring, or break-back trap) is available from grocery or hardware stores. Choose a size appropriate to either rats or mice.

Traps must be positioned out of reach of the public, especially children. Place traps near holes or runways, against wall, or at sites of previous damage. To prevent them from being dragged away by a trapped rodent, secure traps to a beam, pipe, or wall with wire or chain. Keep a floor-plan record of trap locations to prevent misplacing or accidentally tripping them.

Check traps daily.

Since rats tend to be wary of changes in their environment, it is advisable to put the traps out several days before setting or baiting them. Soiled traps can still be effective, but traps that rodents appear to be ignoring should be cleaned or replaced.

Exercise care when setting traps; some can break a person's finger if accidentally tripped.

Effective baits for rats include bacon, raw or cooked meat, fish, fresh bread, peanut butter, and oatmeal. Good baits for mice are fruit, cake, peanut butter, seeds, sugar candy, gum drops, and oatmeal. To prepare oatmeal baits, soak the oatmeal in water to soften it, and then mix with peanut butter.

Place just enough bait on the trap to cover the trip mechanism. Soft baits can be wrapped in cheesecloth and tied to the trigger. Tying solid bait to the trigger with string or fine wire increases the chances of success. Too much of any bait will permit the rodent to feed without setting off the trap.

In well-defined runways where rodents pass frequently, traps can be used without bait. Expand the trigger by attaching a square of heavy cardboard or sheet metal. Ensure that the rodent will be hit by the sprung wire when the trigger is stepped upon.

Another kind of trap that can be effective in runways is the glue board trap, which catches the rodent by means of an adhesive. These traps will not work in wet or dirty areas. Choose glue boards appropriate to the size of the rodent. Check the traps daily, and kill trapped rodents quickly. Many consider glue boards to be inhumane; the animal is captured by the feet, is distressed, and must be quickly dispatched by a solid blow to the head. Ensure that you do not contravene local waste disposal regulations when discarding corpses of pest animals. Contact your local Humane Society for advice and help in disposing of live-captured animals and of animal corpses.

For protection against rodent-borne parasites and disease, wear rubber gloves or use long tongs to remove dead rodents from traps. Seal corpses in plastic garbage bags for disposal.

If gloves are not available, place plastic bags over your hands, release the rodent from the trap, and slip the two bags, one after the other, over the rodent. Seal the outer bag and dispose of the remains.

3.4 Chemical Methods of Control

Chemical methods for killing rodents include poisoned baits, contact poisons, and fumigants. There are two forms of rodenticide used in bait: anticoagulant and acute. With all forms of chemical control, it is probable that the animal will die in an inaccessible place, posing a second threat to collections by becoming a source of damaging insect pests.

Anticoagulants

Anticoagulants prevent blood from clotting. Rodents die from haemorrhaging after eating treated bait or after ingesting the poison during grooming. One feeding is rarely lethal, but since there is no violent reaction after feeding,

bait-shyness usually does not develop. Anticoagulant rodenticides can contain warfarin, diphacinone, chlorophacinone, coumafuryl, pindone, sulfaquinoxaline, or ergocalciferol. Single-dose anticoagulants contain bradifacoum or bromadiolone, and are much more toxic than the multiple-dose forms.

Anticoagulants are available as baits, powders, and liquid concentrates. Some anticoagulants are available to the public through hardware stores and feed stores, while others are restricted to use only by licensed pest control operators. As rodent populations are developing a resistance to anticoagulants, the effectiveness of this type of rodenticide is being reduced.

Because anticoagulants are toxic, baited objects must be kept out of the reach of children, cats, dogs, and wildlife. When using anticoagulants in public spaces, clear, multilingual, and symbolically labelled bait stations that physically prevent contact with non-target animals are a necessity.

Secondary poisoning can occur if animals, such as dogs, eat poisoned rodents. Anticoagulants must be handled carefully. Should they be ingested accidentally, the antidote (vitamin K) should be administered by a physician or veterinarian.

Single-dose Rodenticides

Acute or single-dose rodenticides do not require repeated feedings on the bait and are very toxic to domestic animals, wildlife, and humans. Strychnine, phosphorous paste, zinc phosphide, and sodium fluoroacetate (Compound 1080, which is not registered in Canada) are such rodenticides. Some acute rodenticides, for example Compound 1080, have no antidote. Most fast-acting rodenticides are available only to licensed pest control operators.

Agriculture Canada can provide information on toxicology, first aid, and accepted registered use of pest control products in Canada (see Appendix for Sources of Information).

Fumigants

Controlling a vertebrate pest by fumigation should rarely, if ever, be resorted to and then only when all other methods of control have failed. Fumigating vertebrates will leave corpses in inaccessible locations. These bodies become breeding grounds for very damaging insect pests. Fumigants also have potentially deleterious effects on collections, so their use in a museum should not be considered without a careful assessment of the risks. Additional information about fumigants can be found in *Technical Bulletin* 15, "Dealing with the Insect Problem in Museums: Chemical Control", Meehan (1984), and Zycherman and Schrock (1988).

Rodents trapped in their burrows or inhabiting air-tight buildings can be exterminated with fumigants such as methyl bromide, chloropicrin, or calcium cyanide. These chemicals are very toxic and are for use only by registered pest control operators.

Carbon dioxide fumigation is used to dispose of live-trapped pests, such as rats or mice, that are not being released. Use dry ice as a source of carbon dioxide. A recommended volume of dry ice is one kilogram per 2.5 cubic metres with exposure ranging from 3 to 24 hours. Concentrations of 23% CO_2 for two hours or of 15% CO_2 for 24 hours will kill mice (Meehan 1984). Dry ice is extremely cold and can quickly freeze unprotected skin, so wear good-quality winter gloves or use ice tongs to handle it. Put dry ice in a garbage can or similar container, place the trapped animal in the can, and close the lid. Carbon dioxide is heavier than air, so it will displace oxygen in the container and eventually kill the animal by suffocation. Carbon dioxide is recommended by humane societies to kill pest animals. Veterinarians and humane societies will also advise on humane methods of dispatching and disposing of animals.

3.5 Other Rodents

The killing of fur-bearing and game species is controlled through provincial ministries of natural resources. Usually if an animal is destroying property, it can be killed without requiring a permit or incurring a penalty. Contact your local ministry for more information.

Tree Squirrels *Sciuridae*

Tree squirrels are tree-nesting rodents that occasionally cause gnawing damage to buildings, or nest in attic spaces with similar consequences to those related to harbouring rats or mice. The most common squirrel to inhabit buildings is the Eastern Grey Squirrel *Scurius carolinensis*.

Exclusion techniques discussed for rats and mice should be practised to control tree squirrels.

Use live traps to trap squirrels. Live traps are usually metal or wooden boxes with spring doors. Bait the trigger with peanut butter, large seeds, fruit, or shelled nuts. Check live traps frequently since small mammals can die from stress when caught in live traps. The captured squirrel can be carefully released outdoors a minimum of 15 km from the museum site to prevent its return. Squirrel young are dependent on their parents between April and September; trap outside of these months if possible.

Local humane societies can provide further information on live trapping. Leghold/steel traps are inhumane and should never be used.

Woodchucks *Marmota monax* [Groundhogs]

Woodchucks can be nuisances at historic sites, primarily in cultivated fields and gardens. To reduce depredation of gardens, provide areas of alfalfa or clover in fallow fields.

Porcupines *Erethizon dorsatum*

Porcupines may cause damage to structures. To reduce this damage, cover gnawed areas with sheet metal or use special paint containing bitter substances to prevent animal browsing. Providing a salt lick may prevent gnawing damage to structures, but may also attract animals to the locality.

Beavers *Castor canadensis*

Beavers become pests on historic properties when they cut down trees thereby flooding fields or woodlands. Loss of trees can be prevented by wrapping trunks with chain-link fencing. Particularly troublesome beaver colonies can be live-trapped and relocated. Consult local wildlife authorities for advice and help. Beavers are protected under the Fish and Game Act as fur-bearing animals.

4. Bats - Chiroptera

Bats are nocturnal predators that eat half their weight in insects each night. When bats roost or hibernate within walls and attics, the staining from their urine or faeces can present significant problems of sanitation, insect infestation, and aesthetics. The physical presence of bats is often unnerving for staff and members of the public; in fact, there is little cause for alarm.

Bats do pose a potential public health risk because they can transmit rabies and because their faeces can be a source of bedbugs *Cimex hemipterus* and fungal spores causing histoplasmosis, a severe respiratory ailment. Although these health hazards are not currently considered to be a problem in Canadian bat populations, caution should be exercised when working to control bats or when removing their faeces.

4.1 Species

Of the nineteen species of bats in Canada, only three species habitually roost in buildings:

Little Brown Bat *Myotis lucifugus*
Wing span: 22-27 cm.
Range: Across Canada.

Big Brown Bat *Eptesicus fuscus*
Wing span: 32-39 cm.
Range: Southern British Columbia to northern Alberta; mid-Saskatchewan; southern edges of eastern provinces.

Yuma Bat *Myotis yumanensis*
Smaller than *M. lucifugus*.
Range: Southwestern British Columbia.

Others

Five other species are occasionally found in Canadian buildings: Western Big-eared Bat *Plecotus townsendii*; Northern Long-eared Bat *Myotis septentrionalis*; California Bat *Myotis californicus*; Eastern Small-footed Bat *Myotis leibii*; and Long-eared Bat *Myotis evotis*.

The Little Brown Bat *M. lucifugus* and the Big Brown Bat *E. fuscus* are the species that commonly come in contact with man since they most frequently inhabit buildings.

It can be relatively difficult to determine bat species, so obtain the assistance of an expert or consult the reference on bats by van Zyll de Jong (see Bibliography). Identifying the species can help in determining breeding and hibernation periods, and guiding humane use of exclusion techniques. However, as identification frequently requires capture of the animal, the following control guidelines can be adopted with all species, thus preventing unnecessary handling.

4.2 Identifying a Bat Problem

The following are signs of a bat problem:

a) Evening sighting of bats flying out of their roosts.

b) Stains from greasy fur left when bats move through holes in walls, louvres, shingles, etc.

c) Urine stains or faeces, which sometimes produce a pungent odour, below roosting sites. Bat droppings are approximately the size of mouse droppings (1/4"), but, unlike rodent droppings, powder easily when crushed dry. When bat droppings are examined under a hand lens or a dissecting microscope, the major component is insect parts.

d) Noises (scratching, squeaking, rustling) heard when bats are disturbed, raising young, or at the beginning or end of evening flights.

4.3 Nonchemical Methods of Control

Exclusion

Exclusion is the only effective means of dealing with bats. They only use existing holes and do not chew entrances into buildings. If carried out thoroughly, and at the right time of year, exclusion techniques avoid destroying the bats.

To avoid trapping young bats in their roosts, exclusion methods should not be carried out in Canada between early June and early August. The months of April, October, and November are the best times to seal holes used by bats (van Zyll de Jong, p. 46).

Several evenings of observation may be required to determine entry points of resident bats. Examine the building for openings as narrow as 5 mm in places such as chimneys, louvres, vents, cornices, warped siding, eaves, rafters, and hollow walls. Bats prefer warm, dry, and dark areas for roosting.

Stop up entry points between November and the end of March, when bats may have migrated to hibernation sites. Since some bats hibernate where they roost, a careful check should be made before closing entry points. Alternatively, closing entry points is best done when bats are away from the roost, such as during their evening flight, which usually begins around dusk and concludes just before dawn. Usually the roost is vacated within an hour of the first bat leaving. Several evenings may be required to close all entries.

Sheet metal, aluminium flashing, pressboard, plywood, wire screening (less than 5 mm mesh), oakum, weather stripping, caulking compounds (for cracks, etc.), aerosol urethane sealants (used for home insulation), glass fibre insulation, insect netting, and similar products are useful for stopping entry points. Bats do not chew entries to buildings, so soft materials can be used to close holes. Plugging and caulking openings offer the indirect benefit of energy savings, but care must be exercised not to block required ventilation.

In addition to closing entry holes, thoroughly clean the roosting sites to remove faecal matter and the distinctive bat odour that can attract new bats.

Raising light levels in roost sites displaces bats and drastically reduces the size of the roosting population. For this method to be effective, all shadows in the roosting area must be illuminated to prevent the bats from simply moving to non-lighted areas. This technique can be used to eliminate bats while museum staff are in the process of closing entry holes, or if closing the holes must be delayed for any reason. In contrast to exclusion, the increased energy costs, fire hazard, and reduced effectiveness make lighting an undesirable solution.

Ultrasonic and electronic devices are not effective for repelling bats.

Wear protective clothing when doing surveys and renovations; a hard hat, leather work gloves, coveralls, particulate mask, and goggles are recommended. Always wear gloves when handling dead bats. Exercise caution when handling live bats since they will bite and they may be injured by handling.

Wear a disposable mask capable of filtering out particles down to 2 microns in diameter (e.g. 3M Canada 8710 Dust and Mist Respirator) and protective clothing when removing bat or bird faecal matter. Do not wear contaminated garments into households or public areas. Contaminated garments should be removed and bagged until they can be washed. It is also advisable to shower thoroughly after finishing the job. These precautions will reduce potential exposure to lung-infecting spores and other health problems related to faecal material.

After the bats have been excluded, it may be necessary to use a pesticide to eradicate insects that are inevitably associated with the faecal material.

Trapping

Capturing bats with live or snap traps is not recommended.

4.4 Chemical Methods of Control

No chemical product is presently registered for use on bats. Wherever possible, it is desirable to avoid killing bats because they contribute to control of insects. Use of fumigants on bats will lead to their dying in inaccessible places, resulting in problems of odour and the attracting of damaging insects.

5. Birds - Aves

5.1 Species

Correct identification of the bird species posing the problem will help staff in predicting their habits. Museum staff should consult bird identification books or experts, such as university ornithologists or local naturalists. The three most common problem species are the Rock Dove or Domestic Pigeon *Columba livia*, the House Sparrow *Passer domesticus*, and the Starling *Sturnus vulgaris*. Various species of Swallow also nest in buildings.

5.2 Identifying a Bird Problem

Birds can be a nuisance if they roost or nest on ledges and other architectural features, because their faeces not only leave unattractive stains but encourage the growth of micro-organisms that can damage a building's surface. Some birds, such as pigeons, can also carry disease and parasites. Insects, such as clothes moths, carpet beetles, and larder beetles, are attracted to feathers and other debris left in nests, and may enter the museum and cause damage to artifacts.

5.3 Nonchemical Methods of Control

Exclusion

Birds can be deterred from nesting or roosting through a number of simple exclusion techniques.

a) Put wire screening or polypropylene agricultural netting over potential roosting sites.

b) Apply sheet metal (e.g., aluminium flashing) at a 45° angle to window ledges and other roosting sites.

c) Use corrosion-resistant pointed wires or sharp, pointed metal strips to repel birds. These are manufactured commercially and may be obtained through pest control firms. Place wire on roosting sites, such as ledges, where it will not interfere with routine maintenance.

Other methods devised to discourage nesting may prove less effective in the long term. For example, static and moving models or silhouettes of hawks or owls will frighten only until birds become accustomed to them. Devices producing loud noises or distress calls are effective, but are frequently equally disturbing for humans. Sticky substances that repel birds and not trap them can be applied to roosting areas only after the site has been thoroughly cleaned and any porous surfaces have been sealed. A more convenient approach is to use removable painted boards or metal sheathing to hold the repellent. The boards allow convenient periodic removal and reapplication when dirt, dust, and feathers accumulate on the repellent.

It is recommended that bird faecal matter be removed to eliminate a source of insect pests. Use the same safety precautions on birds as those outlined in the section on excluding bats. Note that in Canada, bird guano is considered more hazardous than bat guano as a source of disease and disease-bearing parasites. As with bat guano, it may be necessary to use a pesticide to kill mites and ticks before or after removal.

Trapping

Trapping is not recommended to control birds because it is difficult, temporary, and publicly unpopular. Trapping requires municipal approval, and must be performed by a licensed pest control operator to ensure that non-target species, such as songbirds, racing pigeons, or banded birds, are not destroyed.

5.4 Chemical Methods of Control

The same restrictions cited under trapping apply to control methods that employ contact poisons or chemicals. Both trapping and chemical control should be avoided whenever possible.

For sanitary reasons and to avoid secondary poisoning of other animals, dead birds must be quickly collected and disposed of if poisons are used. Poison baits must be clearly labelled and kept in a secure place out of the reach of children and domestic animals.

6. Cats - *Felis domesticus*

Cats are not recommended for use as pest control operators within museums or historic buildings, although cats are used in historic site barns for pest control. Problems can develop with the interaction of working cats, staff, and visitors. Unless one staff member is designated as the responsible livestock manager, uncoordinated feeding of hungry cats will reduce their effectiveness in killing mice. Unless the cats are neutered, there will be a continuing responsibility for placing or disposing of kittens. While visitors are often attracted to cats, the interaction is not always positive, and some people suffer a strong allergic reaction when in rooms that cats frequent. There is an unwarranted risk of claw damage to artifacts, staining from faeces and urine, accumulation of shed hair, and soil from food.

7. Skunks - *Mephitis mephitis*

Skunks are sometimes encountered residing under verandas, steps, outbuilding floors, etc., where they can use an existing access. Skunks are nocturnal omnivores and are protected under the Fish and Game Act as fur-bearing animals. The presence of skunks is accompanied by the threat of their pungent defence odour. Their wastes and nesting habits cause similar problems by attracting insect pests.

To control skunks, block their entrances with heavy gauge wire mesh, leaving one way out. Hinge an oversized wire mesh door over the remaining entrance so the skunk can leave but cannot return. Repair holes in the structure and fill in any removed earth once the skunk is out.

Provide prompt maintenance and practise good sanitation around buildings and garbage storage sites to reduce their attraction to skunks.

8. Raccoons - *Procyon lotor*

Raccoons are nocturnal omnivores with good climbing abilities, and are skilful in opening containers when searching for food. Garbage should be kept in locked, sealed containers, and preferably stored inside a structure. Raccoons will nest in shelters found in nature or in man-made objects. They rarely nest in buildings, but exclusion techniques may be necessary during breeding season. Raccoons are protected as fur-bearing animals under the Fish and Game Act.

9. Conclusion

The primary method for controlling vertebrate pests in museums is through exclusion. By working toward sealing the museum to pest entry, trapping programs can reduce and eventually eliminate pests within the building. Without exclusion, there is less hope for eliminating the problem.

Materials and Suppliers

Live traps:
local humane societies

Snap traps for rats and mice:
hardware stores, pest control companies

Glue boards:
pest control companies

Bird netting:
agricultural supply firms, pest control companies

Wire mesh / Hardware cloth:
hardware stores

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Appendix

Sources of Information
Questions regarding museum pests and pest control can be directed to the following sources:

Pesticide Call Line
Agriculture Canada
Ottawa ON
Tel.: 1-800-267-6315

Canadian Conservation Institute
Department of Canadian Heritage
1030 Innes Road
Ottawa ON K1A 0M5
Tel: (613) 998-3721
Fax: (613) 998-4721

Communications Québec
Tel: 1-800-363-9883

Ontario Ministry of the Environment
Hazardous Contaminants Branch
135 St. Clair Ave. W.
Suite 100
Toronto ON M4V 1P5

Centre for Pest Management
Department of Biological Sciences
Simon Fraser University
Burnaby BC V5A 1S6
Tel. (604) 291-3701
Fax: (604) 291-3796

Pest Diagnostic and Advisory Clinic
Department of Environmental Biology
University of Guelph
620 Gordon Street
Guelph ON N1G 2W1
Tel: (519) 824-4120 ext. 2700
(15:30 - 16:30 EST)

Provincial Departments of Agriculture or Environment often maintain departments responsible for pesticides and for insect and vertebrate pests.

Biologists at local universities and federal or provincial experimental stations may also be able to provide assistance in the identification and control of vertebrate pests.

Notes