Canadian Conservation Institute
Institut canadien de conservation

CCI Notes 3/1

Preventing Infestations: Control Strategies and Detection Methods

Introduction

Many materials housed in museums are susceptible to deterioration by insects, fungi, and rodents. While a few insects found among many artifacts may not incite great concern, certain conditions allow pests to progress from grazing and perforation to complete destruction of artifacts.

Controlling Agents of Deterioration

Detection is an integral part of the ideal approach to controlling agents of deterioration, which involves five stages: Avoid, Block, Detect, Respond, and Recover/Treat.

Avoid: Reduce the attractants that invited the infestation or the increase in pest numbers. For example: improve sanitation; organize or discard clutter.

Block: Reduce further problems by isolating the artifact, case, or room. For example: bag objects or use tape to seal leaky cabinet doors. Screen off ventilator outlets. Control the flow of objects in and out of the area. Inspect surrounding areas to determine the extent of the infestation and to locate its source.

Detect: Take measures to determine if there are pests present (for example, collect specimens). Inspect the object or set it over white paper to reveal frass dropping from active infestation. Use spatulas, forceps, and an aspirator to remove insects, cast skins, and frass without damaging the artifact. Place live specimens in a vial with 70% ethanol or 40% isopropanol to keep them from shrivelling. Label the vial with the location at which the specimen was found, and the date and artifact on which it was discovered. Describe damage to the objects. Identify the organism. Obtain information on its life cycle and on possible control methods. Develop contacts with university or government entomologists to assist in identification.

Respond: If there is an infestation, apply appropriate control methods to the collection and the collection area, i.e., increased sanitation, cleaning of artifacts, low or high temperature exposure, controlled atmosphere fumigation, or pesticide application. Assess control measures by continuing detection practices.

Recover/Treat: Clean affected artifacts to prevent false alarms on later inspections. Perform necessary consolidatory and restorative measures.

Avoiding and Blocking Sources of Infestation

Insects, rodents, and fungi are not easily avoided, although eliminating

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attractants through good site sanitation contributes a great deal toward reducing the threat. Pests can enter buildings by boring holes or through existing ones. They can also be carried in by staff and enter on objects on loan, on equipment or merchandise. Good building design and maintenance reduce the former, while quarantine, inspection, and treatment of artifacts (by exposure to low temperature or to controlled atmosphere fumigation) reduce the latter.

Pests enter a museum through open windows, air vents, sewers, and through poorly sealed windows, doors, and walls. Deterioration of the building allows water to penetrate the structure, causing dampness, fungal decay of wood and paint, and subsequent attack by insects.

Accumulated dirt, dust, and hair from careless housekeeping; foodstuffs introduced to storage or exhibit areas; and animal nests and corpses in eaves, attics, and walls all provide ideal breeding and survival conditions for insects and rodents. Many insect problems are traced back to the of these common sources of food. Training in efficient housekeeping practices and timely maintenance of the museum building contribute greatly to preventing infestations.

New acquisitions, incoming loans, and objects returned to the collection after loan to another institution sometimes carry pests. Packaging materials such as corrugated cardboard or felt are also potential harbourages of infestation. Isolate all materials and artifacts entering a collection, inspect them thoroughly, and treat suspect material to kill insect pests before integrating them with existing collections.

The greater the number of protective layers around an object (building, room, case, box, vial), the safer the contents are from infestation during transport or storage. Sealed containers also prevent rapid spread of infestations.

Near the levels of human comfort, elevated temperature and relative humidity can also encourage infestation. Cooler temperatures and, in certain cases, lower relative humidity will usually slow an infestation.

Detecting Souces of Infestation

Regardless of building condition, sanitation, and procedures, a detection program is advisable. This is especially true around high traffic and temporary storage areas where pests are most likely to infiltrate when the "avoid" and "block" stages fail.

Detection is the third stage of this process. Early detection allows one to assess the risk to the collection and to take remedial action based on the other stages of control. If an infestation is not detected early and confronted immediately, it can cause irreparable damage to the collection and may require laborious and extensive measures to halt and recover from the damage.

Signs of insect activity include the presence of insects, dead or alive, at various stages of its development; insect parts, wings, casings, etc.; and damaged areas on the building or artifact, loss of hair and fibres, chewed feathers and quills, perforated skins, grazed nap on fabrics, or holes in surfaces of wood.

Wood borer larvae are rarely seen on wooden objects, but their frass and exit holes are noticeable. Cast skins of moulting larvae are common indications of dermestid attack. Dead adult clothes moths, webbing, cocoons, and faecal pellets are often evident around a moth infestation. Insect eggs are hard to see with the naked eye.

Insect frass can sometimes be confused with eggs. Frass is usually larger in size than individual eggs and is present in greater quantity. Frass often matches the object in colour and appears in the form of chips, fine powder, or pellets. Eggs are deposited singly, in small groups, or in orderly clusters. Insects usually deposit eggs in sheltered spots such as crevices or in protective egg cases.

The presence of rodents is indicated by faecal pellets, urine stains, gnawed material, greasy rub marks, nesting activity, and corpses.

Organizing for Easy Detection

Keep the exterior walls of the building free from plantings to reduce pest habitat and allow easy inspection of the building fabric. These sanitary perimeters also allow quick visual detection of intruders. Commercial establishments will often fill perimeter trenches with landscape cloth and pea gravel to prevent plant growth and to reduce rodent burrowing.

Creating sanitary perimeters on floors through organized layout of shelving and cabinets is essential to decreasing the labour of inspections and increasing the success of detection. Many pests will follow along the joint between walls and floors, making this a prime site for traps and detection. The clear lines of sight along walls also allow perimeter intrusion alarms to be installed and provide ease of access during emergencies.

Quarantine

To detect infestation, quarantine and carefully examine all artifacts and materials that will enter a museum storage or display area.

The ideal inspection room is located at a distance from the collection storage and display areas yet near the shipping and receiving dock. The inspection room should be well sealed, have an independent or screened ventilation system, be adequately lit for seeing fine detail, and contain a white examining table and adequate storage furniture. Minimize clutter and ensure that the room is cleaned periodically to prevent it from becoming a source of infestation.

If the infestation status of an artifact or cabinet is in doubt, it can be

contained by sealing it in heavy polyethylene (6 mil[1], 150 microns). Many insects are capable of chewing through polyethylene as larvae or as adults; however, artifacts are usually more attractive, and the insects are less inclined to preferentially eat the plastic. Perforation of plastic bag enclosures usually occurs on the bottom or at the seams where the insect can get a purchase, so these are prime sites for visual inspection.

If a large piece (a heavy piece of machinery for example) will be tarpaulined on an earth or concrete floor, ensure that it is placed on a groundsheet of 150 microns (6 mil) polyethylene. The groundsheet will prevent high humidity from forming under the tarp and will reduce the risk from mould.

Place all smaller articles that are suspect on white tissue, and bag them in clear polyethylene sheeting or seal them in polyethylene or polypropylene containers. Leave these objects sealed for one to two months at room temperature, and occasionally examine them for insect activity. If they remain free from infestation, integrate them into the collection at this point. If the object was humid before being bagged (i.e. acclimated to less than 65% relative humidity) and was not subjected to a temperature differential across the container, objects sealed in bags will not suffer from fungal damage.

Examining Objects

Thoroughly examine *wooden objects*. Pull out all removable parts such as drawers and leaves. Examine joints, knot holes, hinges, the bottom of legs, reverse sides, and hidden areas. Many wood borers will gain access to wooden objects through end grain or through cracks and joints. The emerging adults often avoid painted and varnished surfaces, choosing to emerge through the raw back faces of wood.

Frass that is packed in holes may be loosened by handling, but may also indicate that there are or were active insects in galleries within the piece. Old frass oxidizes with time to become darker or grey, but the best sign of active infestation is frass that continues to pile up beneath holes in an object untouched for several days. In areas where fallen dust would be dispersed by foot traffic or routine cleaning, tape[2] polyethylene swatches over suspected active holes of wood borers to collect ejected frass. However, do this only if the surface will allow the tape to be removed without damage, and be sure to remove the tape within two weeks of application.

Acoustic detection may be used for some wood borers, but will not be effective during times when larvae are not active. Radiography over several months can detect further excavation by wood borers, but may not be possible on all pieces.

Examine *textiles, clothing*, and *accessories* front and back; inside and out; in pockets, folds, and sleeves; under collars; along seams; under appliqué, bindings, buttons, hems, linings, and padding; and in all hidden areas where insects might live. To inspect skins and furs, look along seams and part the fur with your fingers to inspect the skin. While one may not be able to examine all of a fur or a complicated textile, these inspections often reveal signs of insect attack.

Upholstered furniture and *stuffed animals* often present intractable inspection problems because insects may breed and live in the interior, although active larvae and adults are often seen on the surface. Keratinous stuffing (hair, wool) is more likely to be infested by insects than cellulosic stuffing (cotton, kapok). Exposure to low and high temperature and controlled atmosphere fumigation can kill insects within these objects.

Examine *paper goods* such as cardboard boxes, stacks of paper, and books for cast skins, chewing, and grazing.

Monitoring for Infestation

Use adhesive traps to routinely monitor the collection, display, and support areas of museum facilities. Prime areas for infestations are loading bays, doorways, cafeterias and restaurants, sumps, and mechanical rooms.

Adhesive traps, pheromone traps, light traps, and mechanical rodent traps capture pests and indicate where they are, thus allowing local control measures to be taken. Tracking powders can be useful for detecting rodent habits prior to setting traps.

Adhesive traps used for monitoring insect pests are 6 x 6 cm to 6 x 18 cm and are covered with a cardboard shelter that attracts insects to crawl inside and that protects the adhesive from falling debris. The adhesive on these traps is active for only a couple of months (for a shorter period in dirty environments), so replace adhesive traps regularly, ideally on a monthly inspection and replacement routine. Otherwise, as insects accumulate on old traps, they become bait and ultimately food for damaging dermestid beetles, which multiply and leave the inactive trap to infest nearby areas. However dead insects and fish meal can be used as food attractants for protein-eating insects and may increase success of the traps.

Pheromone traps are designed specifically for one insect species, or for a few closely related species at best. These traps can combine sex attractants and food attractants to detect both male and female adult insects. Males and females in a species may not emerge simultaneously, and detecting the first emergence is advantageous for successful control. Pheromone traps are more expensive than adhesive traps. However, when the pest insect is known to be present, the cost of a commercial pheromone lure is offset by the benefits of earlier detection and control. Pheromone traps are often spaced about 10 metres apart to avoid confusion between the traps, so maximum cost can be

estimated based on covering the floor area with a 10 metre grid of traps, or place a few traps in suspected areas.

Light traps attract many flying adult insects. The light sources are often rich in ultraviolet radiation, so do not place them where they can irradiate artifacts in the collection. Aim light traps in buildings so as to draw insects back towards external doors and away from galleries and storage areas. Not all insects are attracted to light sources. Regular inspection and cleaning of the traps are necessary to prevent secondary infestation by dermestids.

Mechanical traps are useful to detect and control rodent infestations. These include snap traps, live release traps, and wind-up traps that reset after a rodent is caught. Rodents generally frequent the boundaries of buildings and stored material. Place traps along wall-floor junctions rather than in exposed locations.

Avoid using poison bait stations to prevent both secondary infestation by dermestids and an accumulation of rodent corpses in hidden locations. Rodents are also adept at removing many baits from bait traps and at placing them in areas that are not secure but that are accessible to children and pets.

[1] mil: "A unit of length equal to 0.001 inch, often used for specifying diameters of wires and glass fibres." (Whittington, Lloyd R., *Whittington's Dictionary of Plastics*, 2nd edition. Westport, CT: Technomic Publishing Co., Inc., 1978, pp. 201-3).

[2] Low tack vinyl-sign transfer tape.

Suppliers

Traps:
local pest control products suppliers or hardware stores

Ethanol:
laboratory chemical supply - denatured ethanol or some liquor control boards (requires permit)

Isopropanol:
drug stores - rubbing alcohol

Polyethylene sheet:
hardware stores or building supplies stores

Polyethylene and Polyethylene containers:
hardware stores, department stores

Further Reading

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