

## EMERGENCY MANAGEMENT

# 3.10 Integrated Preventive Pest Management

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### INTRODUCTION

As caretakers of valuable artifacts, artworks, photographs, manuscripts, and other important materials, professionals in cultural heritage organizations should be aware that the presence of pests in collections can seriously damage these materials. The condition of the building “envelope” directly affects its structural integrity, the degree to which pests can infiltrate it, and the overall condition of the collections housed within.

The term **Integrated Pest Management (IPM)** refers to pest control and prevention programs that rely on several simultaneous approaches to obtain the desired result. In the past, discussions of Integrated Pest Management for libraries and archives have often focused on the disinfection of known pest problems in collections.

However, it is much more important, difficult, and time-consuming for staff to *prevent* pest infestation in buildings and collections. The term **Integrated Preventive Pest Management (IPPM)** better reflects this understanding.

Eliminating existing infestations in collections is relatively easy, although many methods can be harmful to collections. A number of treatment approaches have been used, including chemical methods, such as pesticide applications and toxic gas fumigations; and non-chemical treatments, such as freezing or heating the materials, the use of micro-waves, gamma radiation, modified atmospheres, and anoxic fumigation. No one wants a collection to be consumed by an insect or rodent. It is equally important to prevent the chewing, residue deposition, defecation, and urination that may result from a variety of pests inhabiting collection areas. This leaflet will present the concepts of IPPM as well as how to safely respond when infestations do occur.

In dealing with destructive pests, one should consider various issues that might contribute to pest infestation:

- routes of pest entry into the building
- construction anomalies of the building itself
- exhibit design and construction

- kinds of pests that might threaten specific collections
- types and numbers of pests found around or near the exterior of the building

Also, consider policies and procedures that might unwittingly introduce pests: storage practices and equipment, maintenance, and housekeeping practices.

In many ways, cultural heritage collections resemble an agricultural setting, where huge quantities of foodstuffs are stored for long periods of time. Starches, cellulose, and proteins found in collections provide food for various types of pests. Pest damage to collections is primarily caused by termites, bookworms, cockroaches, silverfish, booklice, carpet beetles, clothes moths, rodents, birds, and mold.

The first step is to determine what types of pests are coming into the building and damaging collections, and then determine how to keep them from gaining access to these susceptible materials. Solving existing problems and preventing new ones involves the education and cooperation of the entire staff.

The major objectives of any collections-based IPPM program should be:

1. Create an IPPM committee to oversee all IPPM activities.
2. Repair or modify the building envelope to discourage infiltration by pests, to maintain a moderate climate, and to prevent water and high relative humidity problems that may encourage pests.
3. Devise and institute a thorough housekeeping program in storage, exhibit, work, and public areas.
4. Ensure preventive pest measures are in place during major renovation or construction projects.
5. Maintain a comprehensive pest-monitoring program.
6. Provide training for staff to ensure that they understand the importance of the program and can assist in its implementation.

### THE BUILDING EXTERIOR

#### **Occasional Invaders**

The starting point of any IPPM program is to determine which pests are a threat to the building and its collections. Libraries and archives experience pest pressures from the exterior, which may or may not have an effect on the collections. Many insects, termed occasional invaders, simply walk or fly into the building. Occasional invaders include millipedes, sow bugs, earwigs, flies,

wasps, bees, ground beetles, and night-flying moths. While none of these insects is a direct threat to collections, carcasses of large-bodied insects may act as a food source for carpet beetle larvae and mice. Carpet beetle adults seek out protein-based materials on which to lay eggs. The larvae of these beetles may then devour materials on display or in storage. Dead insects are a major source of protein for mice.

Some valuable manuscripts or books are housed in protective boxes lined with wool felt and carpet beetle larvae will consume this type of material. Other food items favored by carpet beetle larvae are animal-based materials, such as wool, feathers, hair, felt, porcupine quills, whale baleen, wool-based embroidery, tapestries, insect and mouse carcasses, and wool felt exhibit case linings. Leather is generally not attacked and silk is not a food source for carpet beetles. Vegetable-based materials, such as linen, burlap, and cotton, are not attacked. However, sizing in paper and cloth may provide a source of food.

Prevention of occasional invaders (as well as all pests) should be aimed at making the building envelope as tight as possible. The most common routes of entry are via doors used by staff and garage doors. Seldom-used fire escape doors can also allow such entry. Weather-stripping and brush sweepers should be installed on all doors to prevent entry of pests. Pipe penetrations through the exterior envelope of the building should be sealed with caulking or copper wool gauze. Exterior lighting affixed to a building should be high-pressure, sodium vapor type fixtures, which give off small amounts of ultra-violet light and thus attract fewer night-flying and crawling insects.

### ***Birds***

Pigeons, starlings, and sparrows are the most common birds that nest and roost on buildings. Dead birds, feathers, and other nest detritus may act as a food source for carpet beetle and webbing clothes moth infestations. Every effort should be made to eliminate nesting of birds. Mechanical measures are most often used to deter bird roosting and nesting. A professional firm specializing in bird control may have to be consulted in order to bird-proof a building.

### ***Mice***

Mice living around a structure often probe the exterior at night, seeking a way to enter a building. Contrary to popular belief, mice do not gnaw their way into a building: they utilize openings in the building envelope. Mouse populations often build up during the warmer months of the year and invade buildings in the fall. Sealing the building exterior is critical to exclusion.

### ***Termites***

Subterranean and/or drywood termites may occasionally be encountered in a building. This type of problem should be left to a professional firm specializing in control and prevention of termites. In selecting such a firm, the primary question to ask the representative is whether the technicians of the firm are certified by their state for wood-destroying insects. Most states

have such a certification program, which requires the individual to study and pass tests dealing with the proper use of pesticides and knowledge of specific pests. A firm that makes the effort to certify all of its technicians can usually be relied upon for quality termite control treatments.

## **THE BUILDING INTERIOR**

### ***Cockroaches***

There are two types of cockroaches that may become a problem in a library or similar institution. Two large cockroaches, the American and Oriental cockroaches, can damage library materials by feeding on them directly. Most commonly, American cockroaches graze on book covers, photographs, and paper-based materials. They often congregate in daylight hours in quiet, dark places in the structure where they emit a brown fluid, called attar, onto the surfaces of materials. Attar has an aggregation pheromone in it, which attracts other cockroaches to their resting place. They are nocturnal and roam widely throughout the facility looking for food sources and opportunities for mating. They often enter buildings via the sewer system and screening floor drains will prevent this immigration. On occasion, egg cases of this cockroach may unwittingly be brought into a building via cardboard boxes onto which the egg cases have been glued by the female. A thorough glue-board monitoring program will alert staff to the presence of these cockroaches. Granular baits may also be used for these large cockroaches. (Types of traps are defined later in this leaflet.)

A smaller cockroach, the German cockroach, is usually associated with food handling kitchens and catering situations, vending areas, and bathrooms. It prefers to rest in cracks and crannies. This cockroach is usually found near a water source and therefore is not normally a threat to collections. It can easily be controlled utilizing gel baits specifically designed for this species.

### ***Silverfish***

Silverfish can also pose a problem to the building and collections. Silverfish are nocturnal, wingless insects that hide in cracks and crevices during the day and come out at night to feed on finished paper, sizing, glue, and wallpaper. Their name derives from their silvery scales and they prefer materials high in starch content. Silverfish are normally found in cool, moist areas of a building. A cousin of the silverfish, the firebrat, is usually found in very hot areas of a building, such as a boiler room, and is not a pest of collections. Silverfish have rather weak mouthparts and feed on materials by rasping the surface. The damage appears to be lace-like, irregular patches on the surface, only occasionally rasping their way all the way through the material, leaving holes behind. Their feeding may include the sizing of silk or starched cloth. A glue-board program will often provide an effective means of control.

### ***Psocids or Booklice***

Booklice are tiny, wingless insects, which may occasionally be seen scurrying across the page of a book. These insects do not damage collections and are usually an indication of high humidity conditions. They feed on microscopic mold. Improving environmental controls may help in heavy infestations. A glue-board program will usually suffice to limit populations.

### ***Bookworms***

Active infestations of bookworms in collections are quite rare in the United States. Bookworms are actually the larvae of certain kinds of beetles that have the ability to damage bound materials. The larvae of these beetles often feed on the glue of the binding and covers, leaving behind tunnels or galleries as they feed. Upon completion of its life cycle, the adult beetle chews its way out of the book, leaving behind a small, round hole. Active infestations will always be associated with piles of colored frass (excrement). The color of the frass is usually the color of the cover of the book. Old, dark exit holes without frass are an indication of an infestation that occurred long ago and is not currently active. The most common bookworm in the United States is the cigarette beetle. In Europe and the Middle East, the bookworm may actually be the furniture beetle. Infestations in the U.S. are unwittingly brought into a cultural heritage organization via incoming loans or acquisitions. Inspection of incoming materials is important for finding and preventing infestations.

If an active infestation of bookworms is discovered, the materials can be frozen and the infestation effectively eliminated. If an infestation is found in established collections, consultation with a professional may be required. In addition, a pheromone trapping program may be necessary for monitoring existing collections and pinpointing continuing infestation.

### ***Clothes Moths***

Clothes moths, along with carpet beetles, are generally referred to as fabric pests. Two types of clothes moths, the webbing clothes moth and the case-making clothes moth, are typically found infesting protein-based materials. It is rare to encounter a clothes moth infestation in a library or archives, simply because such institutions do not normally store or exhibit materials susceptible to clothes moth attack. The most common clothes moth found in buildings in the U.S. is the webbing clothes moth. The larvae of this moth feed on wool, feathers, fur, felt, taxidermy mounts, and other animal-based products. The adults do not have functional mouthparts and therefore do not damage materials. If a small, active infestation of webbing clothes moths is discovered, freezing the materials is usually the first choice for disinfestation. Control and prevention of large infestations should be left in the hands of a qualified entomological consultant.

### ***Mice***

Mice on the interior of a building may damage materials by chewing them for nesting material or defecating and urinating

on them. The most common mouse found in buildings is the house mouse. This mouse is nocturnal, highly territorial, and very curious—it will inspect anything new in its territory. Because of this tendency, snap traps and/or glue-boards can be used to trap mice.

Rodent bait should not be used in a cultural heritage organization. Rodent bait will generate carpet beetles in the bait itself. The bait may act as a food source for other insects, including large cockroaches, and the toxicant in the bait will not kill insects. If a mouse dies from the effects of the rodent bait, when the carcass mummifies it may become a food source for carpet beetles and/or clothes moths. As such, mice should be trapped and removed from the building, not poisoned.

### ***Bedbugs***

Bedbugs are increasingly a concern for collecting institutions, not because of the damage they do to the materials, but because they are a parasitic insect that feeds on blood and reproduces rapidly. Bedbug infestations can have an impact on human health, resulting in skin rashes and allergic reactions, not to mention the psychological effects the infestation can have on staff and patrons.

If an active infestation of bedbugs is discovered in collection materials, the materials can be frozen and the infestation effectively eliminated. Modified atmosphere treatments, especially those based on nitrogen, are also very effective for bedbugs. If an infestation has been established in the building, consultation with a professional will be required.

## **OVERALL IPPM STRATEGIES**

To ensure an effective program, an IPPM committee should be created to oversee all IPPM activities within the organization. These activities include the overall strategies, chemical treatments, and non-chemical treatments described below. Members of all departments or areas should be included on the IPPM committee, which supervises the collection of pest monitoring data and the implementation of specific control and prevention programs. Members of this team might include administrative staff, archivists, curators, librarians, paraprofessional staff, housekeeping and maintenance staff, and exhibit design staff.

It is best to begin a formal pest management program with an initial survey of the building and all collection storage areas. Have there been any pest problems in the past? If so, what type of pest was involved and what materials were affected? What was done to solve the problem? Once the committee understands the types of pests that might enter the building and possibly damage collection materials, the next step is to set up an IPPM program to address the identified needs.

### ***The Building Exterior***

Make the structure uninviting for roosting and nesting of birds, rodents, cockroaches, and other vermin, and make the structure

as tight as possible to prevent infiltration by insects, rodents, and birds. Seal windows and doors tightly—weather-stripping may be necessary. Do not regularly prop open doors. Seal openings around pipes and cracks in the walls or foundation. Screen vents to keep out birds and rodents. Design and install exterior lighting so that it will not be attractive to night-flying insects. Repair, modify, and install guttering on the structure to prevent damage from rot and insects caused by water problems, and to lessen the humidity of the interior, ambient air. Maintain a planting-free zone of about 12 inches around buildings to discourage insects from entering. In addition, plantings should be properly cared for and not over watered. The area around foundations should be graveled and graded away from a building to avoid basement flooding.

In the event that a pest infiltration does occur, it may also be necessary to modify existing elements of the building to prevent pest infestation from spreading throughout the facility

### **The Building Interior**

#### **CLIMATE**

Climate should be moderate, and conditions should be cool and dry; specifics depend on the needs of different materials. For pest control, temperature should be 68°F or lower, and relative humidity should be kept below a maximum of 70%; however, maintaining climate conditions recommended for the preservation of books and paper will help to control insect populations. For more information on climate, consult the NEDCC Leaflet 2.1 *Temperature, Relative Humidity, Light, and Air Quality: Basic Guidelines for Preservation*.

#### **WATER SOURCES**

Pipes in collections areas and other sources of water such as restrooms, kitchens, or climate-control equipment should be inspected routinely to guard against water leakage. Wrap sweating pipes with insulating tape. Close off unused drains or drainpipe openings. Roofs and basements should be inspected periodically to ensure that there is no standing water or flooding. Where and when problems recur, frequent inspections should be implemented.

#### **FOOD SOURCES**

Limit the number of live plants and cut flowers in the building. If this is impossible, plants should be well cared for and kept to a minimum; flowering plants should certainly be avoided. Avoid over watering and watch plants carefully for signs of infestation or disease.

Food consumption should be confined to a staff lounge or, if food is allowed throughout the building, garbage should be emptied daily. If functions including refreshments are held in other spaces, seal all leftovers tightly or ensure that they are removed by the caterers. Vacuuming and kitchen cleanup should be performed immediately. Store all food in tightly sealed glass or metal containers or in the refrigerator, and

provide a plastic garbage can with a tight-fitting lid for food waste. Trash should be removed from the building daily.

#### **HOUSEKEEPING**

Devise and institute a thorough housekeeping program, emphasizing routine vacuuming of susceptible exhibits, storage areas, public areas, and other rooms. In addition, collection storage areas (and other areas) should be cleaned thoroughly at least every six months. All areas should be checked for signs of pests at least once a month. Look for stains and signs of insect grazing (small holes in paper, or areas of loss on the surface of paper or bindings). Check windowsills, under bookcases and radiators, on and behind shelves, and inside boxes and drawers for signs of insect activity. Look for small piles of dust, insect bodies, frass (insect droppings), egg cases, and live insects; clean up any insect debris immediately.

#### **INCOMING COLLECTIONS**

It is particularly important to develop strict procedures for dealing with newly acquired collections, as collections often will have been previously stored in attics or basements hospitable to pests.

Examine incoming material immediately to see if there is evidence of infestation. Work over a clean surface covered with blotter or other light paper. Remove all objects from storage or shipping enclosures and look at the binding, pages, and hollow (if any) in books. Examine frame backings and mats, wrappings, and other accompanying materials. Look for live creatures, insect droppings, larvae, or insect bodies.

Transfer materials to clean archival boxes until you can process them. If possible, isolate re-housed, incoming materials in a space away from other collections until processing. Space that will provide preservation conditions is cool, dry, clean, and outfitted with shelving to discourage mold and insects. (Shelving allows air circulation and keeps items off of the floor.) Throw the old boxes away unless they are archival quality and you are absolutely certain they are clean.

The clean archival boxes can be used repeatedly for this temporary holding use as long as the contents and boxes continue free of evidence of insects. Ideally, of course, incoming material should be processed and re-housed in its permanent enclosures promptly. Realistically, processing may be delayed, and the interior of boxes should be inspected routinely at least every few weeks. A tent or motel-type sticky trap can be placed on a sidewall inside each box to improve monitoring. If there is evidence of insects, talk to a preservation professional for detailed advice before proceeding. Materials can be vacuumed thoroughly (assuming the objects are not deteriorated or fragile) through a nylon or other soft screen, using a high-filtration vacuum. Discard both filter and disposable bag outside of the building or in a sealed container that is provided for food wastes and is emptied daily.

## **Monitoring**

Once the building envelope has been sealed, effective pest monitoring on the interior requires the routine use of a trapping program. Install non-chemical traps for rodents and insects on the interior, in case pests slip past the exterior defenses. The most common method is to employ the use of **sticky traps**, also called **blunder traps** or **glue-boards**, which are available from a variety of commercial manufacturers. Cardboard glue-boards, which sit flat on the floor, should be used. Tray-type glue-boards should not be used, because insects will simply travel around the glue-board and not be caught in it. In undisturbed areas, the traps can be laid flat on the floor in quiet areas and corners of rooms and closets. In public areas, folded, tent-like traps can be used. The direction of travel can be ascertained by noting where an insect is caught on the trap.

Records of trap placements in the building should be kept, along with details of what has been trapped. Initially the recording of trap catches should be kept weekly. Eventually they can be recorded on a monthly basis. Traps should be replaced if they are no longer sticky or if large insects or mice are trapped. If outdoor insects are being trapped, this should alert staff to the fact that a door or window is allowing ingress. If collection pests are being trapped, a more intensive trapping program should be instituted in the immediate area in order to pinpoint the source of the infestation. The insects being trapped can be sent to a local agricultural extension agent for identification. Proper identification is necessary to determine if the trapped insects are a direct threat to collections. Several of the resources listed at the end of this leaflet can be used for identification of insect pests affecting collections.

The basic procedure for monitoring using traps is as follows:

1. Identify all doors, windows, water and heat sources, and furniture on a building floor plan.
2. Identify likely insect routes, and mark trap locations on a floor plan.
3. Number and date the traps.
4. Place the traps in the area to be monitored, as indicated on the floor plan.
5. Inspect and collect the traps regularly.
6. Refine trap placement and inspection as necessary, according to the evidence collected.

All staff members should be educated as to the importance of the IPPM program and be encouraged to submit samples of insects found throughout the facility to the IPPM committee. In time, with the glue-board monitoring program and insect submissions, the committee will become familiar with the types of pests encountered in the building and the dynamics of the populations. Effective, permanent corrective actions can then be taken to prevent pests from entering the structure and infesting the building and collections.

## **TREATMENT METHODS: CHEMICAL TREATMENTS**

### ***Conventional Pest Control***

An Integrated Preventive Pest Management program will rarely require the use of conventional pesticide applications in a cultural heritage organization. If a professional pest control firm is under contract to an institution, the technician will commonly spray pesticides around the perimeter of various rooms. This approach may be effective for only two types of heavy infestations: silverfish and booklice. Normally infestations of these two types of insects do not require repeated pesticide applications. In a heavy infestation, an initial application of a micro-encapsulated insecticide will suffice, followed by the established monitoring program. Fogging of pesticides should never be used in a collections institution. Instead, the pest control technician should focus on the food handling and vending areas, utilizing bait applications rather than spraying. The remainder of the facility can normally be kept relatively pest free through the IPPM monitoring program and thorough cleaning and vacuuming by the housekeeping staff.

### ***Toxic Fumigants***

In the past, some of the most toxic gases in the world have been used to fumigate cultural heritage materials. Fumigants as methyl bromide, ethylene oxide, and Vikane have been used for disinfestation of infested materials. Today, there is never any reason for the cultural heritage community to utilize such dangerous chemicals to rid a collection of insect pests. Non-chemical methods can be employed when an infestation of collections is discovered.

In addition, routine fumigation of incoming materials is unwarranted and dangerous. Not only is there a possibility the materials themselves will be adversely affected, but also the off-gassing of the fumigant is a direct threat to the health of staff and the building environment.

## **TREATMENT METHODS: NON-CHEMICAL TREATMENTS**

### ***Freezing***

Most paper-based materials can be frozen to effectively eliminate all stages of the insect's life. Studies have shown that freezing materials does not adversely affect them, with some exceptions. An excellent reference is the pioneer work on freezing written by Mary-Lou E. Florian and subsequent work by Thomas J. K. Strang. Very delicate or friable materials, or those made of mixed materials, generally should not be frozen. In practice, materials that one might hesitate to freeze would be objects with inlays and wooden composites. A conservator with extensive experience in freezing all manner of materials and objects should be consulted before proceeding.

Commonly, a household or commercial freezer is used for this process. The materials are placed in a sealed, polyethylene bag and held at room temperature. They are then quickly placed in the freezer. Care must be given not to pack the freezer tightly. The freezer should be capable of reaching 0°C (32°F) within 4

hours, and continue to plummet to -20°F. Most chest-type, household freezers qualify for these parameters. The materials are held in the freezer for a period of 72 hours and then removed. They should be allowed to warm to room temperature (while still in the bag), and then removed from the bag, cleaned, and labeled in some manner with information concerning the process and the reasons for freezing the materials. It is good practice to include this information in official collection records as well. For the types of insects typically encountered in collections materials, a single progression through the above process is usually sufficient.

In situations where a large incoming shipment of collection materials has been inspected and found to have an infestation (such as bookworms), the entire shipment may have to be quarantined, boxed, palletized, shrink-wrapped, and sent off to a commercial warehouse for frozen foods or a commercial freezing operation. A commercial freezing operation usually maintains a constant temperature of 0°F. The materials will have to be exposed for one week because the temperature never reaches the required -20°F. If the freezing unit is a vacuum freeze dryer, 72-hours will be sufficient for effective disinfestation. However, freezing imparts no residual benefits to the materials; they will still be vulnerable to subsequent attack.

### **Modified Atmospheres**

This term refers to fumigation with various inert gases, such as nitrogen, carbon dioxide, argon, or a combination of some of these, for insect control. In order to use these methods, a gas-tight structure, fumigation bubble, or low-permeability plastic bag must be used in order to maintain exact levels of the gases necessary for total insect kill. The air is drawn out of the airtight confinement container. Nitrogen, often in combination with carbon dioxide, is then pumped into the container. Over a period of 3 weeks, the nitrogen/carbon dioxide levels are closely monitored and maintained. After exposure, the materials are aerated before being brought back into the facility. Specialized monitoring and application equipment is necessary for these types of anoxic fumigations. Most libraries and archives are not

equipped to perform these types of procedures and professional assistance will be required.

### **Heating**

All stages of an insect's life can be effectively killed by heating materials to 130°F for a period of 3 hours. In most instances, this type of disinfestation of collections is not recommended for cultural heritage materials. Temperatures necessary for insect eradication accelerate paper aging and oxidation, and materials can become brittle and otherwise damaged. Microwave heating should be entirely avoided. This process is uncontrollable and will result in damage to covers and pages with the possibility of scorching or igniting them.

### **Gamma Radiation**

Gamma radiation is used to sterilize cosmetics, food and agricultural products, medical supplies, and hospital and laboratory equipment. Research has shown that gamma radiation may initiate oxidation and cause scission of cellulose molecules; it has the potential to seriously damage paper-based materials. There is also a cumulative effect from repeated exposures. Given these factors, gamma radiation is not recommended.

### **CONCLUSION**

The many varying threats from pests make it advisable for cultural heritage organizations to develop an Integrated Preventive Pest Management program for their buildings and collections. This effort should be implemented with the full cooperation of staff under the direction of an IPPM committee.

An effective monitoring program will determine what pests are present and how they are entering the facility, and will give insight for the development of a preventive program targeted at selected pest problems. Non-chemical methods of pest prevention can be implemented in-house to effectively and safely prevent infestations. Chemical treatments should be avoided if at all possible. The focus of any IPPM program should be on preventing pest problems before they arise.

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## **RESOURCES**

### **Connecting to Collections Care**

*Identifying Museum Insect Pest Damage and Addressing It with Integrated Pest Management* (webinar)

<https://www.connectingtocollections.org/webinar-pest-management/>

### **Council of Library and Information Resources (CLIR) and Cornell University**

*Library Preservation and Conservation Tutorial: Pest Control*

<https://chinapreservationtutorial.library.cornell.edu/content/pest-control>

### **Mary-Lou Florian**

"Freezing for Museum Insect Pest Eradication"

*Collection Forum*, Spring 1990

[http://www.spnhc.org/media/assets/cofo\\_1990\\_V6N1.pdf](http://www.spnhc.org/media/assets/cofo_1990_V6N1.pdf)

### **Integrated Pest Management Working Group**

Website covering prevention, monitoring, identification, and expert advice.

<http://museumpests.net>

### **National Park Service**

Conserve-O-Grams: Series 3: Agents of Deterioration  
[https://www.nps.gov/museum/publications/conserveogram/cons\\_toc.html#collectionpreservation](https://www.nps.gov/museum/publications/conserveogram/cons_toc.html#collectionpreservation)

NPS Museum Handbook, Part I (2014): Chapter 5, Biological Infestations.  
<https://www.nps.gov/museum/publications/MHI/CHAP5.pdf>

**NEDCC Preservation Leaflets**

2.1 Temperature, Relative Humidity, Light, and Air Quality: Basic Guidelines for Preservation  
<https://www.nedcc.org/free-resources/preservation-leaflets/2.-the-environment/2.1-temperature,-relative-humidity,-light,-and-air-quality-basic-guidelines-for-preservation>

**Thomas J. K. Strang**  
“A Review of Published Temperatures for the Control of Pest Insects in Museums”  
*Collection Forum*, Fall 1992  
[http://www.spnhc.org/media/assets/cofo\\_1992\\_V8N2.pdf](http://www.spnhc.org/media/assets/cofo_1992_V8N2.pdf)

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Cooperative Extension Service  
<https://nifa.usda.gov/cooperative-extension-system>

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