Chapter 5: Biological Infestations

CHAPTER 5: BIOLOGICAL INFESTATIONS

A. Overview

1. *What information will I find in this chapter?*

This chapter contains information on:

- pests that can damage museum collections
- setting up an Integrated Pest Management (IPM) plan for museum collections

2. *Who should read this chapter?*

You should read this chapter if you are responsible for museum collections. You can use this chapter to develop a museum Integrated Pest Management Program yourself or to evaluate the need for IPM in your museum management strategy. IPM is an ecosystem approach to the control of pests. IPM uses a variety of techniques to prevent and solve pest problems so that pesticides are used only as a tool when other techniques will not work. Pesticides are any chemicals with an EPA registration number used to control pests of any type.

3. *What is a museum pest?*

A pest is an organism that jeopardizes museum resources. Dermestid beetles in a woolen rug are pests. Dermestid beetles in an animal carcass in the field are not.

B. Active Infestations

1. *What do I do if I find live pests in the museum?*

Follow these steps to stop an infestation and prevent it from recurring.

- Don't panic. If you rush to kill the pests you may cause more harm to the artifact (and to yourself) than if you leave the pests alone for a short time. Be thoughtful about each step you take. Remove pests safely and set up a program to keep the infestation from recurring.
- If an infestation is found on objects, isolate them immediately. Put the infested objects in a sealed plastic bag. Don't carry infested material through the collection without isolating it. You can drop eggs or larvae that can spread the infestation.
- Identify the pests. You may find that insects you see are not museum pests. More information on pests and identification is included in Section C.
- Determine the extent of the infestation. Start at the site where the first infested object was found and inspect the collections/areas in ever widening circles. Isolate infested materials as they are found and document the findings.
- Determine the source of the infestation. If the problem is gaps in the building structure, collaborate with appropriate staff and make repairs to the building. If infested materials were brought into the collection,

evaluate and modify the policies and procedures that allowed this to happen. See Section E for more information on keeping pests out of museum collections.

- Develop a treatment strategy. Include the following steps:
  - Identify and document the pest and its development stage.
  - Identify the materials in the infested object.
- Based on these findings, answer the following questions:
  - Can you simply remove the pest?
  - Are eggs present?
  - What is the least damaging approach to treatment?
- There are a number of options for treatment described below. Only after you've considered all options should you treat the object.
- After treatment, clean the artifacts to remove dead pests and waste. Dead pests, larval skins, and nests can all attract new pests.
- Document the treatment. More information on documentation is included in section F.

2. *How do I stop an infestation?*

Use these methods to stop an infestation in objects:

- ***Identification:*** Identify the insect to be sure that it is a museum pest and will cause damage to museum objects. Section C has information on how to have pests identified.
- ***Cleaning:*** If an infestation is limited to a single object and has not progressed too far, careful vacuuming may remove the problem. Before cleaning, you should be sure the structure of the object can withstand the stress of vacuuming. Cleaning will probably not remove all eggs (some can be microscopic). Remove the vacuum bag from the building immediately so it doesn't become a source of new infestations. After cleaning, place the object in a plastic bag and isolate it from the rest of the collection. Determine the life cycle of the pest and monitor the object until you are sure no more insects will hatch.
- ***Freezing:*** Freezing has become the method of choice for treating most active infestations of individual objects and collections. See *Conserve O Gram* 3/6, An Insect Pest Control Procedure: The Freezing Process. Be aware that a few types of materials—lacquer, bone, painted surfaces, and some woods—can be significantly damaged by freezing. Organic and inorganic portions of composite objects will react differently and cracking may result. If you have a question about the safety of freezing an object, contact your Support Office (SO) curator or a conservator.

- ***Anoxic Environments:*** Replacing the air with a gas (nitrogen, argon, carbon dioxide) in a closed space can also kill insects and their eggs. A wide variety of techniques are used, some by museums, others by professional pest control companies. These techniques require special equipment and experience. For more information on anoxic environments and their use in pest control see *Conserve O Gram* 3/8, Managing Insect Pests: Alternatives to Pesticides, and the references listed at the end of this chapter.

- ***Conventional Chemical Fumigation:*** Fumigation is only appropriate if you cannot treat individual objects. It may be appropriate to fumigate a museum space. Vikane (sulfuryl fluoride) is now the only product available; all others have been banned. It is a restricted use pesticide that requires park and regional IPM approval before applications. Work with park and regional IPM coordinators to develop your IPM plan and make decisions about pesticide use.

  – Use of any pesticide requires at least regional approval.

  – Check with a SO curator or a conservator to be sure that the pesticide you choose will not harm collections.

C. Identification of Museum Pests

1. *What are museum pests?*

Museum pests are biological agents that can cause damage to museum collections. Insects, mold, mice, rats, birds, and bats are all museum pests. The damage pests do comes from feeding or nesting behavior or by attracting other types of pests. Pests that regularly damage museum collections can be roughly grouped as:

- fabric pests
- wood pests
- stored product pests
- moisture pests
- general pests

Identifying an insect and its life stage is critical in determining what is happening in the areas being monitored. This chapter gives only brief descriptions of some types of pests. Many other pests may be found. You should familiarize yourself with other resources. Refer to the NPS Integrated Pest Management Information Manual and other references at the end of the chapter. Good illustrations to help you identify pests can be found in the references by Zycherman and Schrock (1988) and Mallis (1982). To get help in identifying unknown pests, contact park and regional IPM coordinators, SO curators, or NPS Cooperative Park Study Units. You can also get assistance from entomologists in the cooperative

Extension Service, U.S. Forest Service, state departments of food and agriculture, and at local universities and natural history museums. See Figure 5.1 for a sample pest identification request letter.

You should also start your own reference collection of pests to compare to when identifying new pests that you trap. These insects can be stored on small squares cut from insect sticky traps (discussed below) and placed in small plastic boxes. You can also use small vials or boxes to store pests you find or trap using other methods.

2. *What are fabric pests?*

Fabric pests are protein eaters. The two main groups are carpet beetles (of the family Dermestidae) or clothes moths (of the family Tineidae). The larvae of these types of insects feed on animal products used in museum collections, such as wool, fur, feathers, and horns.

Carpet beetles are also commonly known as dermestids. Carpet beetle larvae cause damage by feeding on a wide variety of materials including fur, feathers, wool and silk cloth, wool felt, hair, study skins, and trophy mounts. They may not be seen because they hide from light, burrowing deep into artifacts. The larvae shed their skins as they grow and these skins are one of the signs of infestation to watch for. The adults are attracted to light and come out of hiding to mate. They may collect along windowsills. There are many species of carpet beetles, but the four described below are commonly found in museums. These beetles can be easily mistaken for other types of beetles that do not damage museum collections. Be sure to carefully identify the beetle before taking action.

- **Black carpet beetle** (*Attagenus unicolor*) is the most abundant and destructive of the carpet beetles. The adult is 1/8"- 3/16" long, a solid dark brown or dull black color, and more elongated than carpet beetles described below. The larva is less than 1/4" long and carrot-shaped. It is covered with golden brown hairs and has a characteristic "tail" of long hairs at the rear end.

- **Varied carpet beetle** (*Anthrenus verbasci*) is primarily a scavenger. It is common in the nests of birds, on dead animals, and in insect collections. It can damage woolens, carpets, wall hangings, hides, horns, and bone artifacts. Small populations often go unnoticed behind furniture or along baseboards, feeding on accumulated lint, hair, food crumbs, dead insects, and other organic debris. The adult is about 1/8" long, oval to round, blackish with splotches of white, yellow, and black on its back. The larva is 4-5 mm long, teardrop-shaped, and covered with rows of light brown hairs.

- **Common carpet beetle** (*Anthrenus scrophulariae*) attacks carpets, woolens, and animal products such as feathers, furs, leather, silks, mounted museum specimens, and pressed plants. The adult is about 1/8" long and black with white scales and a band of orange scales down the middle of its back. The larva is reddish-brown and covered with brown or black hairs. Larvae are active and move rapidly.

- **Furniture carpet beetle** (*Anthrenus flavipes*) attacks upholstery

(particularly old horsehair-stuffed furniture) and items made from wool, fur, feathers, silk, horns, and tortoise shell. The adult is about 1/8" long and is rounded and blackish with variable mottling of yellow and white scales on the back and yellow scales on the legs. The larva is difficult to distinguish from the common carpet beetle.

Clothes moths are small, silvery-beige moths with a wingspan of less than 1/2". They have narrow wings fringed with long hairs. Small grain- and flour-infesting moths are often confused with clothes moths, however, clothes moths have different flying habits. They avoid light and are rarely seen flying. They prefer dark corners, closets, and storage areas, and usually remain out of sight.

The primary food of clothes moth larvae is soiled woolens, but they also feed on silk, felt, fur, feathers, and hairs. In museums they often damage woolen clothes (particularly old military uniforms), feather hats, dolls and toys, bristle brushes, weavings, and wall hangings.

- The **webbing clothes moth** (*Tineola bisselliella*) and the **casemaking clothes moth** (*Tinea pellionella*) are the two most common clothes moths found in museums. The larvae are small white caterpillars with brown heads. They feed on the surface of the material infested. The webbing clothes moth produces feeding tunnels of silk and patches of silken webbing on the fabric's surface. The casemaking clothes moth is rarely seen since it constructs a cylindrical case of fabric that it carries around to hide and feed in. The color of the larval case will match the material on which it's feeding. Using this clue can help you locate infested materials.

3. *What are wood pests?*

Materials made of wood are susceptible to attack by a number of wood-infesting pests. The culprits in museums are usually woodboring beetles or drywood termites. Both can severely damage valuable artifacts while remaining invisible to the untrained eye.

Woodboring beetles are a group of beetles in the insect families Anobiidae (anobiid, furniture, and deathwatch beetles), Lyctidae (true powderpost beetles), and Bostrichidae (false powderpost beetles). The term "powderpost" comes from the fact that the larvae of these beetles feed on wood and, given enough time, can reduce it to a mass of fine powder.

Woodboring beetles spend months or years inside the wood in the larval stage. Their presence is only apparent when they emerge from the wood as adults, leaving pin hole openings, often called "shot holes," behind and piles of powdery frass (digested wood that looks somewhat like sawdust) below. Shot holes normally range in diameter from 1/32" to 1/8", depending on the species of beetle. If wood conditions are right, female beetles may lay their eggs and reinfest the wood, continuing the cycle for generations. Heavily infested wood becomes riddled with holes and tunnels packed with a dusty frass. Powderpost beetles can attack both hardwood and softwood, although lyctids only infest hardwoods.

Items in museums that can be infested by woodboring beetles include wooden artifacts, frames, furniture, tool handles, gunstocks, books, toys,

bamboo, flooring, and structural timbers.

Drywood termites, unlike their cousins the subterranean termites, establish colonies in dry, sound wood with low levels of moisture, and they do not require contact with the soil. They are primarily found in the coastal southern states, California, and Hawaii, but they are easily transported to northern states in lumber, furniture, and wooden artifacts. Drywood termites attack wooden items of all kinds. The termites feed across the grain of the wood, excavating chambers connected by small tunnels. The galleries feel sandpaper-smooth. Dry, six-sided fecal pellets are found in piles where they have been kicked out of the chambers. The pellets may also be found in spider webs or in the galleries themselves.

A swarming flight of winged reproductive termites can occur anytime from spring to fall. Most drywood termites swarm at night, often flying to lights.

4. *What are stored product pests?*

Many museums include items made in part of seeds, nuts, grains, spices, dried fruits and vegetables, and other foods. A long list of pests, traditionally called "stored product pests" or "pantry pests," can infest items containing these foods. Probably the most common of such pests in museums are the cigarette beetle and the drugstore beetle.

Cigarette beetle (*Lasioderma serricorne*) is named for the fact that it is a pest of stored tobacco, but is also a serious pest of flax, spices, crude drugs, seeds, and, most importantly for museums, books and dried plants. This beetle has been called the "herbarium beetle" because of the damage it can cause to dried herbarium specimens. It has also been found infesting rodent bait.

The adult beetle is light brown, 1/8" long, and the head is bent downward so that the beetle has a distinctive "hump-backed" look. It is a good flier. The small larva is grub-shaped and whitish, with long hairs that make it appear "fuzzy." It has yellow-brown markings on the head.

Drugstore beetle (*Stegobium paniceum*) feeds on a wide variety of foods and spices (particularly paprika or red pepper). It is also a serious pest of books and manuscripts, has been reported "feeding on a mummy," and has been known to chew through tin foil and lead sheeting.

The adult beetle is very similar to the cigarette beetle. With careful examination through a magnifying lens, the three-segmented antennal club may distinguish the drugstore beetle. The larva, too, is similar, but does not appear as "fuzzy."

5. *What are moisture pests?*

Not only is moisture a threat to museum specimens on its own, it may attract a number of moisture-loving pests that can do additional damage. Molds can be a big problem in damp conditions and can attract insects in the order Psocoptera that feed on those molds.

Molds are fungi that can cause damage or disintegration of organic matter. Basically plants without roots, stems, leaves, or chlorophyll, molds occur nearly everywhere. When moisture and other environmental conditions

are right, molds can appear and cause significant damage to wood, textiles, books, fabrics, insect specimens, and many other items in a collection. Their growth can be rapid under the right conditions.

It is important to realize that fungal spores, basically the "seeds" of the fungus, are practically everywhere. Whether molds attack suitable hosts in a museum depends almost exclusively on one factor—moisture. When moisture becomes a problem, molds will likely become a problem too.

For this reason museum objects should not be stored in humidity above 65%. Be aware, however, that some molds can grow at a lower humidity. **Psocids** are commonly called booklice, but they are not related to parasites such as head lice or body lice. They are referred to as booklice because they often infest damp, moldy books. They feed on the mold growing on paper and the starchy glue in the binding. Psocids also infest such items as dried plants in herbaria, insect collections, manuscripts, cardboard boxes, and furniture stuffed with flax, hemp, jute, or Spanish moss.

Psocids do not themselves cause damage. They become pests simply by their presence. However, their presence also indicates a moisture problem and the likely presence of damaging molds. They are tiny insects, less than 1/8" long, and range in color from clear to light gray or light brown. Most indoor psocids are wingless, looking a bit like a tiny termite.

6. *What are general pests (perimeter invaders)?*

Any household pest may become a pest in a museum. Many kinds of pests can get into a building that has not been well sealed. Cockroaches, crickets, silverfish, ants, millipedes, and other common pests can invade and infest a museum as well as a house or other structure. Mice, rats, birds and bats can also infest museum collections and buildings. They can cause direct damage to collections through nesting and feeding behavior. Their nests will also attract many other kinds of insects that can then move into the collections.

German cockroaches (*Blatella germanica)* are omnivorous. They are familiar as they are the most common cockroach found in the United States. They feed on leather, paper, glues, animal skins, and hair. Damage to objects is caused by chewing. They are especially attracted to objects stained with sweat. They can also stain objects by depositing various bodily fluids.

House crickets (*Acheta domesticus)* commonly come into buildings at the onset of cold weather. Like german cockroaches they are omnivorous and will eat protein and cellulosic materials. These include textiles (wool, silk, linen, cotton), leather, and animal skins and fur. They are especially attracted to stains.

Silverfish (*Lepisma saccharina*) and firebrats (*Thermobia domestica*) will eat fabrics, paper and sizing, and glue and paste in book bindings. They are omnivorous, so will eat protein materials as well as cellulose. They are especially damaging in dark, damp storage areas. They have a distinct carrot shaped body, short legs, long slender antennae, and three tail-like appendages.

D. Integrated Pest Management (IPM)

1. *What is Integrated Pest Management?*

Integrated Pest Management (IPM) is a decision-making process that helps you determine if, when, and where you need pest suppression. It helps you develop a strategy to keep pests from attacking collections. IPM uses a variety of techniques to prevent and solve pest problems using pesticides only as a last resort. It depends on knowledge of a pest's habits, ecology and the environment in which it thrives and survives. IPM is also site-specific and adaptable to any museum. It provides a structure in which to make responsible decisions about treating pests. Museum IPM has two goals:

- protect the museum and its collections from pests
- reduce the amount of pesticides used in collections

2. *Why should I use IPM?*

Pesticides can be health hazards for staff. Exposure to pesticides used incorrectly can cause acute symptoms such as nausea, vomiting, and breathing difficulty. Exposure can also cause chronic effects such as seizures, skin and eye irritation, and memory defects. Many pesticides are carcinogens or suspected carcinogens and human teratogens. For your own safety, as well as that of your offspring, visitors, and researchers, pesticide use should be carefully considered and only applied following label directions.

In 1980, a Presidential memorandum directed all federal agencies to adopt IPM in management policies. This memorandum and excerpts from Department of the Interior (DOI) and NPS policies on IPM are included in Appendix A. NPS-77, *Natural Resources Management Guideline*, provides guidance on pesticide use in the National Park Service.

3. *What types of damage can pesticides do to museum objects?*

Pesticides can cause the following damage:

- metal corrosion, including iron, brass, and other light color metals
- deterioration of proteins, such as fur, feathers, leather, wool, horsehair
- deterioration of paper
- shrinking, stiffening, or softening of plastics
- color change in dyes and pigments
- staining from surface and vapor contact

Museums have routinely used pesticides in collections for years. Many of these materials leave residues on museum artifacts. Search collection documentation for records of previous pesticide use. Be aware, however, that users often did not record pesticide use. Be sure to take precautions when handling the objects. See *Conserve O Grams* 2/2-4 for information on the health and safety risks associated with some pesticides residues that are found on museum objects.

Many different types of pesticides have been used in museum collections. **None**

of these pesticides are now recommended for use. Pesticides that have been commonly used in museums include:

- arsenic (see *Conserve O Gram* 2/3*)*
- mercuric chloride
- thymol
- DDT
- ethylene oxide (see *Conserve O Gram* 2/2)
- dichlorvos (Vapona, DDVP) (see *Conserve O Gram* 2/4)
- naphthalene
- paradichlorobenzene (PDB)

4. *What are the components of an IPM Program?*

Each of these components is on-going and the whole process is cyclical in nature. To carry out an effective IPM program you should:

- ***Build consensus*** by working with other staff in the park. IPM requires coordinated strategies to be effective.
- ***Identify*** pests that can cause damage to your collections.
- ***Review NPS policy*** to understand how IPM works and your responsibilities when using chemical treatments.
- ***Establish priorities*** to focus on tasks in an organized fashion. For example, set up a monitoring program in areas of the collection that contain sensitive botanical specimens first.
- ***Establish action thresholds***. How many insects in a collection are too many?
- ***Monitor*** pests and environmental factors.
- ***Implement non-chemical management***. Modify pest habitats, use good housekeeping, and use non-chemical treatments such as freezing and anoxic environments.

  If needed, review and obtain approval for an appropriate chemical pesticide. Treatments should only be done when pests have been found and identified. You must get approval from the regional IPM coordinator to use any pesticide in your park.
- ***Evaluate*** results to be sure your strategies are working.
- ***Document*** monitoring and treatments.

E. Monitoring

1. *Why should I monitor for pests and monitor the environment?*

Monitoring for pests and monitoring the environment provide you with different kinds of information.

Pest monitoring tells you . . .	***Environmental monitoring tells you . . .***
Baseline information on the insects in your collection	Baseline information on your museum environment
How pests got into the museum	If conditions will support pest activity
Where pests are in the museum	If your actions are changing the environment
How many pests there are in the museum	
If your control strategies are working	

Taken together, these two types of monitoring can help you determine strategies to eliminate future access and survival of pests in the collection. Monitoring can also help you evaluate the effectiveness of any treatment action you take. You can get more information on environmental monitoring in Chapter 4. It also provides information about environments that might help support an infestation.

2. *How do I know where to monitor?*

When developing a monitoring strategy, think about the resource that you are trying to protect and the kinds of pests that will cause damage to the resource. For example, will you expect mostly protein eaters because of lots of wool textiles? Are the collections in a historic, poorly sealed building with a damp basement?

Think through what kind of pests will be attracted to your collections. Also think about the kind of pests that will be supported in the environment in your building. Then aim your monitoring strategy to find out if those kinds of pests are present. Work with your park and regional IPM coordinators to develop a thoughtful strategy to identify pests for the collections in your park.

3. *What does pest damage look like?*

Different pests cause different types of damage. Evidence of pests includes:

- holes
- chewing marks
- hair loss
- webbing
- cast skins

- "grazed" surfaces
- frass (insect waste, which is usually a soft powdery material)
- fecal pellets

4. *How do I monitor for pests?*

Monitoring relies on a variety of techniques.

- ***Routine inspection of objects:*** Visually inspect the collection to look for cast larval skins, holes in textiles, piles of frass, cut hairs around and below artifacts. Do spot checks at least every six months; check more vulnerable objects like biological specimens and ethnographic objects more often.
- ***Routine inspection of the building:*** You must also routinely inspect the building to look for signs of insects that may get into your collections. Check windowsills and door jams especially carefully.
- ***Trapping:*** Identify pests moving into and throughout the building. Using traps allows you to "zero in" on problem areas where pests may be getting into a building, or where you have infested collections.
- ***Documentation:*** Document your inspection and trapping program carefully so that you have a record of problems that can be evaluated over time.

See *Conserve O Gram* 3/7, Monitoring Insect Pests with Sticky Traps, for more information on using a monitoring program.

5. *What kinds of traps should I use?*

There are three main types of insect traps. Use them in combination. Decide which kind of trap is most appropriate for a particular place and for the problem you have.

- **"Sticky traps"** collect bugs on an adhesive base. They are sometimes known as roach motels and come in a box or tent shape. They are available from a wide variety of manufacturers. For general purpose the tent shaped traps are the best. Replace them regularly as the adhesive will dry out and become ineffective. *Conserve O Gram* 3/7 and NPS *Tools of the Trade* have information on sticky traps.
- **Pheromone traps** are usually sticky traps that include a pheromone attractant specific to one species of insect. These are only available for webbing clothes moths, drug store beetles, cigarette beetles, and the German cockroach, but more are being developed. See *Conserve O Gram* 3/7.
- **Light traps** are useful for detecting and controlling flying insects. They emit ultraviolet light (black light) that attracts flying insects, particularly flies and moths. The insects are drawn toward the light and trapped by a glue board or in a bag. Windows also act as passive light traps so windowsills should also be carefully monitored.

6. *How do I establish an*

Step 1. Draw a floor plan of the area you wish to monitor. Indicate the

insect trapping program?

locations of doors, windows, water and heat sources, and drains. Also include furnishings in the room, such as museum exhibit and storage cabinets and cases. Note what types of materials are stored in the cases.

Step 2. Number and date the tops of the traps for quick identification.

Step 3. Place traps throughout the area to be monitored. Keep in mind that pests like dark, warm, damp places. Where possible place the trap against the wall, as pests tend to move along this surface. Critical areas where pests are likely to be found include:

- along the perimeter walls
- in corners
- near doors
- near windows and other light sources
- under furniture
- near water sources
- near drains
- near heat sources
- inside and outside exhibit and storage cabinets

Step 4. Indicate the location of the traps on the floor plan.

Step 5. Inspect the traps on a regular schedule and record:

- the trap number
- the location of the trap
- the date inspected
- the species of insects
- the number of individuals per species found in the trap
- other useful information, including the life stage of the species, unusual conditions, and replacement date for the trap

You may devise your own survey form. See Figure 5.2 for a sample. Many museums document their pests with a simple computer spreadsheet or database program. During the initial phase of the monitoring period—usually the first three to six months—inspect the traps weekly. This will allow you to identify current problems and solve them quickly. Long-term monitoring will catch problems that develop later on and variations you

may see in different seasons of the year.

Refine the trap placement, as trapping becomes routine. Based on the evidence you find in the traps, you may want to move traps or inspect more or less often. However, don't wait too long to inspect traps, as dead insects are a food source that may attract other pests. With careful placement of traps you will be able to identify problem areas precisely.

Replace traps at least every two months, when they become full, or when the adhesive loses its tackiness—whichever comes first.

7. *What actions should I take to keep pests out?*

Cultural controls and mechanical controls are two basic types of actions you can use to prevent insects from getting into and thriving in your collection. Cultural controls are policies and procedures that you can implement. Mechanical controls are techniques to limit pest habitats and close off areas where pests get into the building.

Cultural controls include:

- inspecting any material (new accessions, loans, storage material) before it comes into collections areas
- developing good housekeeping and interior maintenance programs
- restricting food and smoking in the museum
- barring live and dried plants inside and eliminating plants and mulch next to the building
- developing environmental controls for a stable, low humidity
- putting objects into closed storage and exhibit cases whenever possible

Mechanical controls include:

- installing self-closing devices, sweeps and gaskets on exterior doors
- installing screening on floor drains
- removing ivy and plants growing on the structure
- cleaning gutters regularly
- closing windows and installing 20 mesh screening
- eliminating clutter, including cardboard, which is very attractive to insects
- minimizing dust
- using a vacuum cleaner instead of a broom to clean floors and structures

- caulking or otherwise blocking all holes in the building structure
- using sodium vapor lighting, which is less attractive to insects, for exterior fixtures

8. *How do I know when I have a problem and must take some action?*

Set a **threshold**. A threshold is the point at which you will take some action to remove or prevent the pest. Decide how many pests you must see or trap in an area before taking action. The action will usually not be a pesticide treatment. Establishing a regular vacuuming program is also an action.

The threshold is site-specific for each museum. For example, finding one insect near the door may not warrant action, but it does warrant increased vigilance. Finding an insect in a closed cabinet warrants action. You can expect to trap more insects in historic buildings than in new visitor centers. Decide on your thresholds before you start a monitoring program.

See information in Section A of this chapter for dealing with an active infestation.

F. Documenting and Evaluating Your IPM Program

1. *How should I document my IPM program?*

Use the IPM survey forms described in Section D and Figure 5.2 to document the monitoring. You can also develop your own spreadsheet or database. Use environmental monitoring forms in Chapter 4 to document the environmental monitoring that is done.

Document treatments done to objects (fumigation, freezing, cleaning). Record the treatment for each object in ANCS+ in the Preservation supplemental record. You can also file the information in the appropriate accession file or catalog folder, as outlined in the NPS *Museum Handbook*, Part II, Chapters 2 and 3. Be sure to include the brand name of insecticides and fumigants and the chemical name if known.

2. *How do I know if the IPM strategy is effective?*

Regularly evaluate your strategy. Analyze your survey forms. Are you seeing fewer pests in your traps? Have you stopped infestations?

If your strategy is working, all your time will be spent on prevention and maintenance and none on dealing with live pests and infestations in the collections.

3. *Where can I find other information about IPM and museum pests?*

Work with your park IPM coordinator. A regional IPM coordinator reviews applications for pesticide use. The regional IPM coordinator and the SO curator can help you develop IPM plans and strategies when you discover an infestation. The Associate Director, Natural Resources, and regional offices develop training in IPM. Some of the information contained in this chapter came from a National Park Service website *The NPS Integrated Pest Management Manual* <http://www.colostate.edu/Depts/IPM/natparks/natpark.html>. You can find more information there.

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Zycherman, Lynda A., and Richard Schrock, eds. *A Guide to Museum Pest Control*. Washington, D.C.: Association of Systematics Collections, 1988.

H. Web Information

The NPS Integrated Pest Management Manual: <http://www.colostate.edu/Depts/IPM/natparks/natpark.html>

Pest Management: <http://palimpsest.stanford.edu/bytopic/pest>

Radcliffe's IPM World Textbook: <http://ipmworld.umn.edu>

Insects Limited, Inc. homepage: <http://www.insectslimited.com>

[Date]

Dr. Melissa Adams
West Virginia Department of Agriculture
100 1st Street
Charleston, WV 25305-0170

Dear Dr. Adams:

The enclosed insect samples were found during monthly pest monitoring at Chris Doe Homeplace. Will you please identify the insects circled in red in the enclosed sticky traps as specifically as possible? We are particularly interested in potential pests to museum objects. Please return the specimens to me so that I can refer to them in the future.

My address is: Mark Hayden
National Park Service
Chris Doe Homeplace
P.O. Box 50
Ridgely, WV 23456-0050

Thank you very much for your help.

Sincerely,

Mark Hayden
Curator

Figure 5.1. Sample Pest Identification Request Letter

NATIONAL PARK SERVICE
MUSEUM INTEGRATED PEST MANAGEMENT SURVEY FORM

Park: Chris Doe Homeplace

Date Trap Set: Oct. 1, 1998 Date Trap Inspected: Oct. 15, 1998

Structure Housing Museum Collection: Big Run Visitor Center Storage
Exhibit Space?____ Storage Space? X

Name and Title of Inspector: Mark Hayden, Curator

List number of each type of pest.

Trap number:	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**
Location:	ext. door	N. wall	NE corner	SE corner	int. door	floor drain	window
dermestid beetle			1 larva				
cigarette beetle							
drugstore beetle							
powderpost beetle							
clothes moth							
silverfish						3	
cockroach	1						
termite							
spider							1
fly							5
fungal growth							
mouse							
other: cricket	1						
other:							
undetermined							
Total pests:	2	0	1	0	0	3	6

Other unusual observances (e.g., puddles, unusual level of dust, etc.).

Debris on floor around exterior door.

Figure 5.2. Sample Museum Integrated Pest Management Survey Form