

Know Your Bugs!

Introduction

The safest and most effective way to deal with insects in collections is the use of Integrated Pest Management (IPM). IPM is a holistic approach to pest management that includes monitoring, housekeeping, and the identification of pests. It is the safest manner of pest control because it avoids the use of chemical pesticides that may cause damage to collection material and create health risks, while also focusing on prevention rather than remediation.

Proper monitoring and identification of pests in and around collection areas is the first crucial step in solving the problems that these invaders can cause. Exact identification provides important information about food sources, preferred environmental and shelter conditions, and life cycles.

This guide provides a list of common North American pests that can cause problems in collections and information about their food sources and life cycles. Knowing what food pests eat helps identify collection items most at risk; knowing how and where pests reproduce aids in reducing, and possibly eliminating, the breeding areas. This guide is not comprehensive and does not include vertebrates such as birds, bats, and rodents. For more detailed information, including additional pest images, refer to the resources at the end of the document.

Pest Roundup

Moths

WEBBING CLOTHES MOTH (*Tineola bisselliella*) Webbing clothes moths are the most common species of clothes moths. Adults are tan in color with a satiny sheen, measuring approximately 6-11 mm in length. While adults do not feed on collections, larvae feed on textiles and create feeding tubes spun from webbing and frass.

- *Collections at Risk:* Larvae feed on proteinaceous materials including wool, silk, feathers, fur, and other animal fibers. Infestations can occur in carpets, wool and silk textiles and blends, upholstery, and other collections with natural animal hair components. Webbing clothes moths prefer the dark, so rolled rugs and folded textiles in storage are at elevated risk of damage.
- *Life Cycle:* Female adult moths lay 40-50 small, white eggs at a time. The eggs typically hatch within 4-10 days in warm temperatures, but this can take longer in cooler temperatures. The larval stage, where webbing clothes moths are most damaging, can vary from one month to



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several years, depending on the temperature and the availability of a good food source. Adult moths live for about one month.

- *Trap Use and Placement:* Blunder traps are best placed on the floor or in closets and in rooms where textiles are stored. Hanging traps with specific sex pheromone lures for this species is a good option for monitoring.

CASEMAKING CLOTHES MOTH (*Tinea pellionella*) Casemaking clothes moths get their name from the silken case that larvae carry around with them until they pupate. Adults are brown with three dark spots on each wing. Larvae have a brownish head and a case that is similar in color to the food source. Adults do not feed on collections.

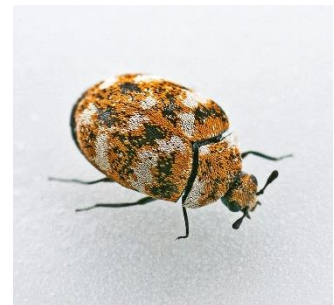


Credit: Patrick Clement; [CC BY 2.0](https://creativecommons.org/licenses/by/2.0/)

- *Collections at Risk:* Larvae feed on proteinaceous materials including wool, mohair, feathers, fur, and other collections with animal hair components. Like webbing clothes moths, casemaking clothes moths prefer the dark, so textiles with crevasses are at elevated risk of damage.
- *Life Cycle:* Female adult moths lay around 40 eggs on potential food sources. The eggs hatch in approximately 4-7 days, with the larval stage lasting up to 90 days. Adults live only 4-6 days. There are typically 3-4 generations per year.
- *Trap Use and Placement:* Blunder traps are best placed on the floor or in closets and in rooms where textiles are stored. Hanging traps with specific sex pheromone lures for this species is a good option for monitoring.

Dermeid Beetles

VARIED CARPET BEETLE (*Anthrenus verbasci*) Carpet beetles get their name from the textiles that they often feed on. Varied beetles are among the most common carpet beetles found in collections. Adults have an irregular pattern of white, brown, and dark yellow scales. The first sign of an infestation is the presence of adult beetles on windowsills. Larvae can be tracked by their shed skins and fecal pellets about the size of a grain of salt.



Credit: AIC1; [CC BY 2.0](https://creativecommons.org/licenses/by/2.0/)

- *Collections at Risk:* Larvae feed on dead animals and animal products, including the wool and silk often found in carpets and textile collections, as well as skins, furs, leather, feathers, and horns. They will also feed on cotton fabrics if they are soiled with organic material. Adult beetles feed on pollen and nectar. They seek sunlight and are commonly found on a variety of pollen-heavy outdoor plants; they can be brought into collections on cut flowers.
- *Life Cycle:* The females lay approximately 40 eggs near a food source. The eggs hatch in around 20 days, but the larval stage can last anywhere from 3-36 months. The pupa stage typically lasts 1-3 weeks.

- *Trap Use and Placement:* Blunder traps are best placed on the floor in rooms with vulnerable collections and in areas with a porous building envelope.

BLACK CARPET BEETLE (*Attegenus unicolor*) Black carpet beetles can also be damaging to collections, particularly in the spring and summer months. Adult black carpet beetles are 3-5 mm in length and are dark brown/black. Larvae are brown and carrot shaped, with a tuft of hair on one end. Like varied carpet beetles, the first sign of an infestation may be the observation of adults on or near windowsills.



Credit: Ryan Hodnett; [CC BY-SA 4.0](#)

- *Collections at Risk:* Larvae feed on dead animals and animal products, including the wool and silk often found in carpets and textile collections, as well as skins, furs, leather, feathers, and horns. They will also feed on cotton fabrics if they are soiled with organic material. Adult beetles feed on pollen and nectar. They seek sunlight and are commonly found on a variety of pollen-heavy outdoor plants; they can be brought into collections on cut flowers.
- *Life Cycle:* Females lay approximately 50 eggs near possible food sources that hatch in 6-10 days. The larval stage can vary in length from 9 months to 2 years. Adults live around 40 days.
- *Trap Use and Placement:* Blunder traps are best placed on the floor in rooms with vulnerable collections and in areas with a porous building envelope.

WAREHOUSE BEETLE (*Trogoderma variabile*) Warehouse beetles get their name from the dried grains and animal feeds they often feed on. Adults are black or brownish black with three reddish-brown, golden, or gray irregular lines across the body. Larvae are yellow white in color and look hairy.



Credit: CSIRO; [CC BY 3.0](#)

- *Collections at Risk:* Warehouse beetles are largely a threat to dried grains and other dried food products. In collections, they can feed animal specimens and dried plants, so natural history collections are at risk of infestation.
- *Life Cycle:* A female can lay more than 90 eggs in a food source, and the entire lifecycle can take place over the course of a month in warm and relatively dry conditions. Larvae are very tolerant of low humidity environments, and so anoxic treatment may not be an effective form of eradication.
- *Trap Use and Placement:* Pheromone traps can be hung along a wall, placed on shelves, or within drawers where plant and animal specimens are stored.

LARDER BEETLE (*Dermestes Lardarius*) Larder beetles get their name from their attraction to dried, cured meats. Black larder beetles are sometimes used to clean animal carcasses as a part of the skeleton preparation for zoological specimens and are sometimes referred to as “museum volunteers”. Adults are 7-9 mm in length. They are black with a lighter band across the center that has three dark spots. Larvae are up to 14 mm long and are brown with hair.



Credit: gailhampshire; [CC BY 2.0](#)

- *Collections at Risk:* Collections utilizing larder beetles for specimen preparation must be careful to contain populations. Larder beetles prefer high-protein food sources like dried meats, skins, furs, feathers, and hair. They can also feed on wool that is stained with blood or sweat.
- *Life Cycle:* Adult female larder beetles lay hundreds of eggs on a food source. Eggs hatch in about 2 weeks. The larval stage lasts between 15-80 days, including several molting stages, which result in shed skins that can be a sign of infestation. Black larder beetle adults live 2-3 months.
- *Trap Use and Placement:* Blunder traps can be used near food sources, and areas should be regularly inspected.

Anobiid Beetles

CIGARETTE/TOBACCO BEETLE (*Lasioderma serricorne*) The cigarette/tobacco beetle gets its name from the stored tobacco that it often feeds on. These beetles can cause damage to collections in both their larval and adult stages. Adults are 2-3mm and brown in color with small hairs overall. Larvae are white and covered in long hairs.



Credit: CSIRO; [CC BY 3.0](#)

- *Collections at Risk:* Dried food products are most at risk to infestation by these insects, though they can also feed on dried plant material and book bindings.
- *Life Cycle:* Females lay around 100 eggs near food sources. Eggs hatch in 6-10 days. The larval period lasts 5-10 weeks, and the pupal period lasts two to three weeks. Adults usually live up to a month.
- *Trap Use and Placement:* Blunder traps can be used near food sources, and areas should be regularly inspected. Food products should always be kept in sealed containers.

DRUGSTORE/BISCUIT BEETLE (*Stegobium paniceum*) Drugstore/biscuit beetles are closely related to cigarette/tobacco beetles and get their name from the pharmaceuticals and breads that they feed on. Adults are 2-3 mm in size and brown in color. Larvae are white with brown heads.



Credit: Siga; [CC BY-SA 3.0](#)

- *Collections at Risk:* While their main food source is dried food and plant materials, drugstore beetles have an extremely varied

diet that can include spices, cosmetics, and prescription drugs. They have also been known to attack books, animal mounts, human remains, and bore through thin metals to get to food sources.

- *Life Cycle:* As with the cigarette beetle, the life cycle of the drugstore beetle is tied to the environment, and can produce several generations per year in favorable climates. Females lay approximately 100 eggs near food sources. Eggs hatch in 6-10 days. The larval period lasts 5-10 weeks, and the pupal period lasts 2-3 weeks. Adults usually live up to a month.
- *Trap Use and Placement:* Blunder traps can be used near food sources, and areas should be regularly inspected. Food products should always be kept in sealed containers.

Woodborer Beetles

FURNITURE BEETLE (*Anobium punctatum*) Furniture beetles are powderpost beetles that get their name from the seasoned hardwoods and softwoods that they consume in the larval stage. Adults are 2-9 mm long and are brown/black. Larvae have a white body with a brown head and are 2-5 mm long. Furniture beetles leave distinct holes in the wood they eat, and their frass pours out of the exit holes if the object is moved.



Credit: Udo Schmidt; [CC BY-SA 2.0](#)

- *Collections at Risk:* Furniture beetles eat older seasoned hardwood and softwood. The sapwood of pine and poplar are particularly vulnerable. Collections of furniture and wooden artifacts are vulnerable in addition to lumber and flooring.
- *Life Cycle:* Females lay eggs in cracks or inside previous emergence holes in the wood. Eggs hatch in 4-5 weeks. Larvae tunnel into the wood and then pupate below the wood's surface. Adults exit the wood and reproduce. The larval stage can last over one year.
- *Trap Use and Placement:* Furniture beetles are often detected by the presence of their frass. Active infestations are indicated by fresh frass (which is lighter in color and fluffier than old frass). Blunder traps can be used around food sources for monitoring.

Psocoptera

BOOKLOUSE/ PSOCID (*Liposcelis spp*) Booklice get their name from their affinity for damp books. Adults are soft-bodied and less than 4 mm long with long antennae. Nymphs look similar but are smaller and paler. Booklice need high humidity to survive, so collections in damp areas or in buildings without humidity control are at higher risk of infestation.



Credit: Andreas Eichler; [CC BY-SA 4.0](#)

- *Collections at Risk:* Booklice feed on microscopic mold and fungi found on paper, wheat starch paste, and food products.
- *Life Cycle:* Females lay eggs in warm, humid areas. Eggs hatch in about 3 weeks, and nymphs shed their skins various times during development. The

lifecycle of booklice is extremely moisture dependent. Their lifespan ranges from 24-110 days.

- *Trap Use and Placement:* Blunder traps can be used around food sources for monitoring. Booklice are very small, so identification may require magnification. Booklice generally cannot survive at a relative humidity below 50%, so environmental maintenance is a good mitigation strategy.

Zygentoma

SILVERFISH (*Lepisma saccharina*) and **FIREBRATS** (*Thermobia domestica*) Silverfish get their name from their silvery color and fish-like movement. Adults have a flattened, carrot-shaped body covered in scales and can grow to approximately 12.5 mm in length. Nymphs are smaller, but similar in appearance to adults. Firebrats get their name from their preference for high temperatures. Firebrats are similar in shape to silverfish but have scale covered bodies. Nymphs are smaller, but similar in appearance to adults.



Silverfish

Credit: Christian Fischer; [CC BY-SA 3.0](#)



Firebrat

Credit: Ryan Hodnett; [CC BY-SA 4.0](#)

- *Food:* Silverfish and Firebrats like starch and items containing starch, such as wallpaper, wallpaper adhesive, and glazed paper. They can also feed on book bindings, textiles, and other adhesives.
- *Life Cycle:* Adult female silverfish lay between 50-60 eggs per year that hatch within 2-8 weeks. The nymph period lasts around 12 months, and the total lifespan can range from 5-7 years. The lifespan of female firebrats is between 3-5 years, over the course of which they may lay up to 6,000 eggs. Incubation is 12-13 days, and nymphs can reach maturity in 2-4 months, which means there can be several generations in one year if the environmental conditions are favorable.
- *Trap Use and Placement:* Blunder traps can be used around food sources for monitoring. Both silverfish and firebrats require warm, damp environments to survive, so maintaining a cool and relatively dry environment can help prevent infestations.

Cockroaches

GERMAN COCKROACH (*Blattella germanica*) Though German cockroaches likely originated in Borneo, they were named by a Swedish entomologist in the 18th century. The German cockroach is 13-16 mm in length and brown in color. There are two prominent black stripes running down the broad shield behind the head. Nymphs appear similar but smaller; nymphs do not show the stripes on the shield. German cockroaches are very similar in appearance to Asian cockroaches, but they are much more commonly found indoors.



Credit: Clemson University; [CC BY 3.0 us](#)

- *Collections at Risk:* German cockroaches will eat almost anything including proteinaceous, starchy, sugary, and fatty food sources. German cockroaches are a risk to all organic collections, particularly those stored in warm and humid spaces.
- *Life Cycle:* German cockroaches reproduce faster than any other residential cockroach. They grow from egg to sexually mature adult in 50-60 days in ideal conditions. Adults live 100-200 days.
- *Trap Use and Placement:* Blunder traps should be placed in or next to areas where cockroaches are likely to be encountered, such as the kitchen and bathroom. The traps work best when placed along the edges of the floor and in corners. They also should be placed in the cabinet under the sink as cockroaches can be attracted to water sources.

AMERICAN COCKROACH (*Periplaneta americana*) American cockroaches are the largest species of common cockroach. Adults are 34-53 mm long and are reddish brown in color with a pale brown to yellowish band around the edge of the shield behind the head. Nymphs do not have wings.



Credit: Gary Alpert; [CC BY 2.5](#)

- *Collections at Risk:* American cockroaches will eat almost anything including proteinaceous, starchy, sugary, and fatty food sources. American cockroaches are a risk to all collections, particularly those stored in warm and humid spaces.
- *Life Cycle:* the life cycle for an American cockroach from egg to sexually mature adult is about 600 days, and then adults can live up to 400 days after reaching maturity. These stages are temperature and humidity dependent. Females will produce between 90-200 young in their lifetime.
- *Trap Use and Placement:* Blunder traps should be placed in or next to areas where cockroaches are likely to be encountered, such as the kitchen and bathroom. The traps work best when placed along the edges of the floor and in corners. They also should be placed in the cabinet under the sink as cockroaches can be attracted to water sources.

Web Resources and Key Readings

General

<https://www.canada.ca/en/conservation-institute/services/agents-deterioration/pests.html>

“AIC Conservation Wiki,” Integrated Pest Management. https://www.conservation-wiki.com/wiki/Integrated_Pest_Management

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BS EN 16790:2016. *Integrated Pest Management (IPM) for Protection of Cultural Heritage*. London: British Standards Institution.

Deacy-Quinn C., 2020. *FUNDamentals of Museum IPM*. Spurlock Museum, College of Liberal Arts and Sciences, Illinois. <https://www.spurlock.illinois.edu/blog/p/emfundamentals-of-museum/327>

Pinniger D., 2015. *Integrated Pest Management in Cultural Heritage*. London: Archetype Publications Ltd.

Strang, Thomas, Jeremy Jacobs, and Rika Kigawa, “Integrated Pest Management for Museum Collections,” in Elkin, Lisa and Christopher Norris, eds. *Preventive Conservation: Collection Storage*. New York:

Society for the Preservation of Natural History Collections, 2019.

Identification

<https://museumpests.net/>

<https://www.insectslimited.com/museum>

Communication

Baars C., Henderson J., 2019. *Novel Ways of communicating museums pest monitoring data: practical implementation*.

Handerson J., Baars C., Hopkins S., 2019. *Standardizing and Communicating IPM data*.
Mallis, A. 1997. *Handbook of Pest Control*. Mallis Handbook and Technical Training Company.

Further Reading

Nilsen, Lisa, and Maria Rossipal. 2019. Integrated Pest Management (IPM) for Cultural Heritage Proceedings from the 4th International Conference in Stockholm, Sweden, 21-23 May 2019. <https://www.diva-portal.org/smash/get/diva2:1389000/FULLTEXT01.pdf>.