Insect Pests of Archives and Libraries

An entomologist's perspective on bookworms

Dr. Gregory Setliff
Entomologist
Department of Biology
setliff@kutztown.edu
610-683-4316

http://www.lyonsvalleytermite.net

Lehigh Valley Pennsylvania Library Association Spring Conference, 19 May 2016

Sharing Their World

Insects are the world’s most successful organisms:

- species diversity
- ecological role
- reproductive capacity
- longevity
- habitat manipulation & dominance

They are our #1 competitors for resources

The pests of today’s libraries and archives are the same species that attacked stored food, clothing, and trash pits in early human settlements more than 300,000 years ago.

Weevil: Eupholus loriae
Nuisance Pests & Non-Injurious Invaders (*not all bad....*)

Many insects and related critters will enter a building by accident or in search of food and shelter.

Most are harmless and some are even beneficial:

- most ants
- flies
- most moths
- most spiders
- daddy longlegs
- most beetles
- earwigs
- stink bugs
- millipedes
- house centipedes
- sowbugs & pillbugs
- bees & wasps
- many, many others!

Figures:
A. Earwig: *Forficula auricularia*
B. Asian Lady Beetle: *Harmonia axyridis*
C. House Centipede: *Scutigera coleoptrata*
D. Cellar Spider: *Pholcusph*

All images: https://bugguide.net
Bedbugs – A Re-emerging Problem

Blood-sucking ectoparasites invading homes all over the US.

- pesticide resistant
- easily spread/transported
- eggs and immatures hard to detect

Brought into libraries on patron’s personal items and in returned materials.

- irrational fear of libraries
- 120 – 140° F heat treatment or freezing materials for 4 days can stress library materials

For more information:
http://www2.epa.gov/bedbugs
Insects in the Stacks – *two groups*

1. Pests that consume and digest paper, leather, vellum, hair, cloth, wood, glue, etc.
   - cellulose and starch (plant sugars)
   - collagen & keratin (animal protein)

2. Pests that damage paper indirectly
   - mold feeders
   - borers making pupal galleries
   - general household or urban pests
     - stains from feces or other effluence

---

*Wood-boring beetle galleries*

A natural habitat
Recognizing a Pest Problem

If damage is discovered and no insect can be found, examine the area carefully. Look for:

- frass – small piles of fine, dry, powdery insect excrement. Note color & consistency
- exuviae – shed skins of insect larvae that have pupated. Keep for identification

Try to determine the source and extent of the infestation. Note:

- what materials were damaged (leather bindings, paper, paste behind end sheets, bookshelves!?!)
- location & shape of damage (tunnels from cover to cover, exit holes in spine, damage only on margins of pages)

Silverfish and Firebrats

Thysanura

Description: 10–20 mm long; wingless, flat bodied; fragile; with three tail-like appendages on last abdominal segment; scaly covering

Feeds on: starch and animal based glues and cellulose and sizing

Indication: lace-like feeding damage along edges of pages or grazing damage on the surface of paper; rarely attack interior of books.
**Silverfish and Firebrats**

*Thysanura*

**Treatment:** Hard to eradicate.

**Prevention:** remove attractive food sources; check cardboard boxes; reduce or eliminate water sources

**Notes:** fast running nocturnal insects; silverfish prefer damp, cool, dark areas, firebrats prefer warmer areas

---

**Termites or White Ants**

*Blattodea: Isoptera*

**Description:** small, soft bodied, ant-like insects; usually cream colored; workers wingless

**Feeds on:** all materials containing cellulose (paper, wood, bindings)

**Indication:** Usually large, sprawling galleries connected by tunnels; may include wooden shelves and multiple books; frass specks glued to walls of galleries; termites usually found in galleries
### Termites or White Ants

**Blattodea:**

**Isoptera**

*Termite galleries. Note trails of brown frass.*

**Treatment:** prevention! Infestations usually require multiple pesticide applications by a licensed exterminator

**Notes:** Damage to all paper-based materials can be catastrophic; usually indicates a building wide problem!

---

### Booklice

**Psocodea: Liposcelididae**

- **Description:** tiny (1–2 mm), brown or clear insects; roughly triangular head; wingless.
- **Feeds on:** mold & starch based glues
- **Indication:** Adults crawling on paper
- **Treatment:** Reduce relative humidity to below 50% for 6+ days. Remove water sources.
- **Notes:** Very common on books. Not a true louse (don’t bite). Damage is insignificant except in extreme cases; good early warning of humidity and mold problems
**Bookworms**

Coleoptera: Anobiidae

**Description:** small (~2 mm) reddish to brown beetles; head not visible from above; larvae tiny, cream-colored, and C-shaped

**Feeds on:** starchy glue

**Indication:** small, circular exit holes in spine, tunnels under bindings; dry, powdery frass. Tunnels in text can run all the way through a book.

---

**Bookworms**

Coleoptera: Anobiidae

**Treatment:** freezing infected items multiple times to kill eggs; PDB (moth ice) fumigant for books or sealed cabinets. Moth balls preventative but will not eradicate infestations.

**Notes:** tunnels into text of books for pupation; adults chew their way out, making circular exit holds. Many deathwatch beetles are found in dry wood borers (tables, chairs, shelves, paneling) and may not be in materials.
**Larder Beetle**  
*Coleoptera: Dermestidae*

**Description:** elongate, brown and black beetle; 7–9mm long; larvae hairy  

**Feeds on:** larvae attack animal products, mostly leather bindings; when fully fed they bore into the text to pupate  

**Indication:** look for fine, powdery, dry frass and noticeably hairy exuvia; also look for adults at windows  

**Treatment:** Freezing multiple times  

**Notes:** prefers cured meats & cheeses

---

**Carpet Beetles**  
*Coleoptera: Dermestidae*

**Description:** Small (3–5 mm), oval beetles, usually dark colored with lighter patterns; larvae hairy  

**Feeds on:** Variety of animal and plant products (dead insects, wool, plant fiber)  

**Indication:** Same as previous species  

**Treatment:** freezing infected items multiple times to kill eggs; PDB (moth ice) for books or sealed cabinets; hot soapy water  

**Notes:** difficult to eradicate; re-emergence!
Cockroaches
Blattaria

Description: Large (up to 45 mm long), flat insects, with or without wings, reddish-brown to black, long antennae and spiny legs

Feeds on: damage leather and parchment bindings, binding paste or pasted labels, and cloth bindings

Indication: large frass pellets (1mm+), brown stains from sex pheremones, and hard sack-like ootheca (harden egg cases); adults

Treatment: Improve sanitation; remove potential food & water sources (check kitchens and restrooms). Roach baits work for heavy infestations if used properly (never use foggers or dusts!)

Notes: Most roaches prefer to run rather than fly; they like the dark. Species of concern include: The American, German, Brown-banded, & Oriental cockroaches
Pest Management Methods

Deep-Freezing

• Considered the safest method of control for materials and user community
• Wrap in plastic to reduce condensation
• **Rule of thumb:** freeze to center of object within 4 hours at a temperature of -20°C (-4°F) for at least 72 hours (96 hr. for bedbugs); then thaw over 24 hours
• Repeated cycles of freezing and thawing are usually necessary (**many insects are freeze tolerant**)
• Consult a professional conservator for advice on what materials not to freeze!

Pest Management Methods

Chemical  

Insecticides are generally discouraged
  • disfigure materials
  • pose health risks

Nearly all pesticides that are toxic to insects are toxic to humans (**choose pyrethrins over organophosphates**)

Not effective on the insect eggs (resurgence)

Insect specific pheromone baits provide a relatively non-toxic chemical alternative

Used as part of an **Integrated Management Strategy** based on knowledge of insect’s biology
Pest Management Methods

Replaced Atmosphere

Nitrogen, methyl bromide, sulfuryl fluoride, and CO₂ have been used to replace O₂ – effective for some but not all pests and may damage materials.

Noble Gasses: odorless, colorless gases, with very low chemical reactivity and no residual concerns.

Argon is considered to be one of the best noble gasses for conservation:
- inexpensive and available
- non-toxic and non-damaging for materials
- removing moisture and oxidative atmospheric gasses
- kills pests
- no residual protection

Figures. The U.S. National Archives maintains the Declaration of Independence and the Constitution in argon-filled cases to prevent oxidation and pests.

Pest Management Methods

Gamma Irradiation

Gamma Irradiation approved for food and cosmetics to kill microbes, fungi, and insects.

Products are non-toxic after treatment (no residual radioactivity).

At high levels of ionizing radiation, cellulose is irreversibly damaged (effects are additive).

Anthrax scare in Washington D.C., 2001 and irradiated mail:
- letters browned and brittle
- CD-R melted to case

Used mostly in emergency recovery situations (e.g. following flood damage) at lower radiation levels.
Integrated Pest Management

*Building level focus on prevention, monitoring, & non-chemical treatment*

- Keep the collection clean, cool, and dry to deter the growth of mold. Relative humidity <50% discourages mold & pests.
- Get to know the Facilities dept. and your HVAC system!
- Remove bird and wasp nests outside (even ones that have been sprayed with pesticides).
- Remove dead wood (including tree stumps) and standing water up to 50 feet from the building whenever possible.
- Maintain weather striping on doors and windows and seal any cracks and fittings for utility pipes, cords, and ducts.

*Have a written management plan!*

---

Integrated Pest Management

*Building level focus on prevention, monitoring, & non-chemical treatment*

- How to deal with incoming collections?
- How to survey and eliminate possible route of entry?
- How will you quarantine suspect materials and treated infested materials?
- When is it safe to return infested materials to circulation?
- Housekeeping policies?
- What are your action thresholds? Usually 1–2 insects is cause for further investigation not extermination!
- How will you monitoring for pests? Use sticky traps!
Why Use Sticky Traps?

- Catch pests before they are found visually
- Catch a wide range of pest species
- Catch adults and larvae
- Set in hard to reach areas
- Trapped insects can be identified
- Trapped insects can be counted
- Clues to the history and point of origin of an infestation
- Evidence that a treatment worked (or not)

References and Suggested Reading

Book:

Online Resources:
Northeast Document Conservation Center, excellent preservation leaflet on IPM strategies
https://www.nedcc.org/free-resources/preservation-leaflets/3-emergency-management/3.10-integrated-pest-management

Cornell Library Preservation and Conservation Tutorial
http://www.library.cornell.edu/preservation/librarypreservation/mee/management/pestcontrol.html

Bookworms: The Most Common Insect Pests of Paper in Archives, Libraries, and Museums
http://mrichardsonjr.net/insects/pests.htm

Approaches to Insect Problems in Paper and Books (deep-freezing protocol and materials not to freeze)
http://www.hrc.utexas.edu/conservation/resources/insects/

The Yale Non-toxic Method of Eradicating Book-eating Insects by Deep-freezing by Kenneth Nesheim

Types of pesticides US EPA website
http://www.epa.gov/pesticides/about/types.htm

Penn State Extension Service Insect Fact Sheets
http://ento.psu.edu/extension/factsheets


All images not cited in this presentation are courtesy of Wikimedia.