

Preservation of Herbarium Specimens

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THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS
COOK COLLEGE

An Herbarium

- Pressed and mounted plants
- Seeds
- Wood sections
- Pollen
- Microscope slides
- Frozen DNA extractions
- Fluid-preserved flowers or fruits
- 300 million specimens preserved for research in herbaria



Alnus maritima from The Academy of Natural Sciences of Philadelphia (PH)

Herbaria cont.

- Built up by active collecting, exchange and incorporation of private collections,
- Associated with universities, museums or botanical gardens
- Today around 4,000 herbaria in over 165 countries



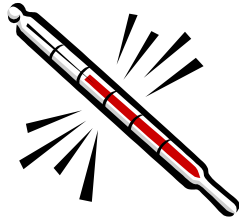
Mobile herbarium compactors at PH

Use of Collections

- Regional Floras
- Indispensable basis for research in taxonomy and systematics
- Evolution
- Ecology (distribution, invasive species)
- Vouchers (bioprospecting, DNA analysis)
- Novel research (using new technologies, e.g. climate analysis)

Preservation Issues

Environmental Conditions



- Heat
- Moisture



Biological Pests



- Insects



- Mold and Mildew



Acid Free or Neutral pH Materials

- Important for long term preservation
- Herbarium paper
- Glue
- Packets
- Labels
- Linen strips or tape

The cigarette beetle (*Lasioderma serricorne*)

- Also known as the herbarium beetle
- Will eat most dried plant materials (especially flowers, fruits, starchy roots)
- Damage is done by both adult and larvae life stages
- Adult beetles can live from 3 to 4 weeks
- Females lay up to 100 eggs
- The eggs hatch in 6 to 10 days
- The larvae feed for 5 to 10 weeks then pupate within protected cells they excavate. (dependant on temperature)
- Pupation lasts 2 to 3 weeks



- small 2 to 3 mm oval
- Oval & stout
- reddish-brown beetle.
- humped-back appearance.
- smooth elytra

The cigarette beetle (*Lasioderma serricorne*)

- The generation time from egg to reproducing adult is about 2 to 3 months.
- In warm climates, there can be 5 to 6 generations per year.



Cigarette Beetles Have Favorite Groups

BEETLES LIKE:

- Asterids (composites, mints)
- Rosids (roses, legumes)
- Large flowered monocots (lilies, arums)



BEETLES GENERALLY DO NOT LIKE:

- Mosses
- Ferns
- Conifers
- Grasses



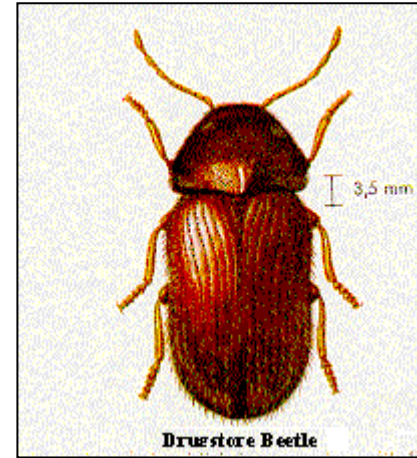
The drugstore beetle (*Stegobium paniceum*)

Similar in appearance to the cigarette beetle

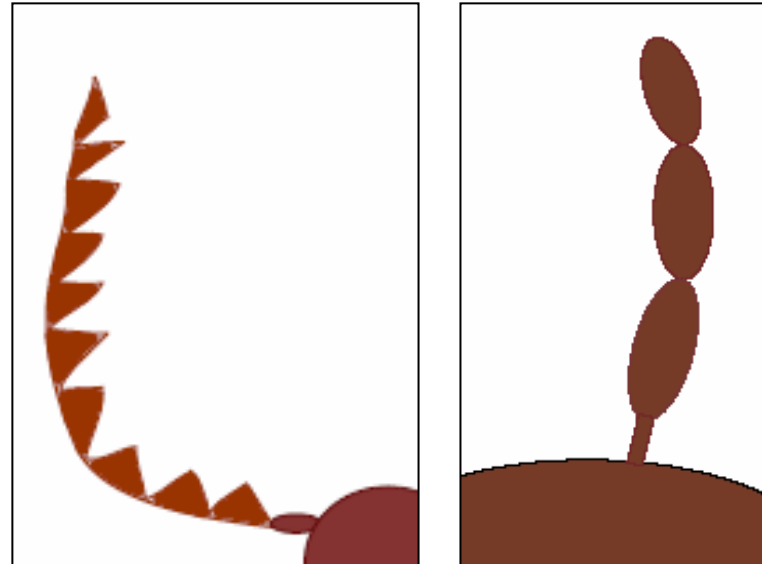
Two characters can be used to tell the difference between them.

1) Antennae of the drugstore beetle end in a 3-segmented club, cigarette beetle are serrated

2) Elytra (wing covers) of the drugstore beetle have rows of pits giving them a striated (lined) appearance, cigarette beetle are smooth



www.insectslimited.com

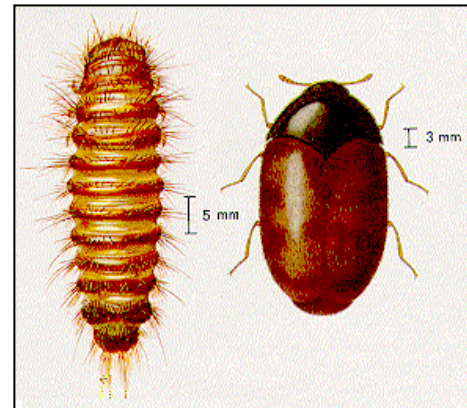
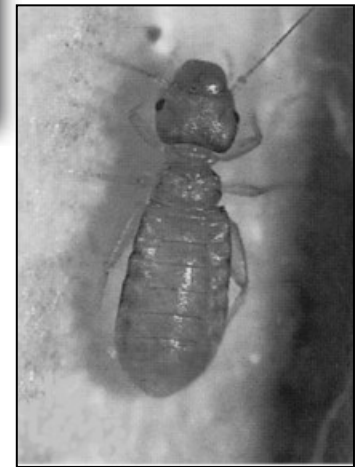
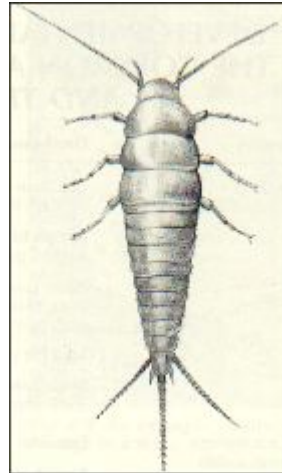


Left – cigarette beetle

Right – drugstore beetle

Other Herbarium Pests

- GERMAN COCKROACH
(*Blattella germanica*)
- INDIAN MEAL MOTH
(*Plodia interpunctella*)
- WAREHOUSE BEETLE
(*Trogoderma spp.*)
- BOOK LOUSE
(*Psocid sp.*)
- SILVERFISH
(*Lepisma saccharina*)



Methods of Insect Prevention

- Sanitation
- After use promptly return specimens to cabinets
- Control incoming specimens
- Monitor regularly
- Keep good records of insect activity

Methods of Insect Control

Poisoning or fumigating the specimens with toxic chemicals to kill or repel the insects

- Mercuric chloride
- Methyl bromide
- Naphthalene
- Sodium arsenate
- **Pyrethrum**



Environmental Control

- Optimal temperature is 20-23° C or lower and humidity at 40-60%.
- Temperature and Humidity Controls Insect reproduction
Stegobium life cycle completed in 6 weeks at 30° C, 1 year at 17.5° C
- Lower humidity protects specimens from fungal growth

Freezing Specimens

- Freezing is employed in libraries, herbaria, and natural history collections
- Repeated exposures to -20°C or lower for two days
- To avoid freeze-resistance, a high cooling rate and multiple exposures to sub-zero temperatures can be utilized



Freezing Specimens

- At -20°C , complete mortality for all life stages of *Stegobium paniceum* L (Gilberg M and Brokerhof)
- Boxed folders of specimens may be insulated against the cold, and thus longer exposure periods may be required

Properly functioning Cabinets

- Closed Cabinets
- Good seals
- Isolates infestation



Herbarium cabinet with closing doors



Disintegrating gasket



- Immediately freeze specimens
- Vacuum infested cabinets

Insect Traps

- Sticky traps
 - Monitor Populations
 - Reduce Populations
 - Pheromones; naturally occurring chemical attractants (serricornin, stegobinone)
 - Good for monitoring
 - Attract only males
 - Tobacco attractants
- Trap Specimens?

Alternative Treatments

Heat Treatment (bad for specimens)

- May damage specimens (DNA and phytochemicals)
- Works best at high humidity (also bad for specimens)

Carbon Dioxide Fumigation

- Must be well sealed
- Need proper concentrations

Alternative Treatments

- Essential Oils

Certain essential oils have been found to deter insect pests and may be used inside of sealed herbarium cabinets for additional protection

- Insect Growth Regulators

products or materials that interrupt or inhibit the life cycle of a pest

IGR's work on a variety of pests

Resources for More Information

- Gunasekaran, N. and S. Rajendran. Toxicity of carbon dioxide to drugstore beetle *Stegobium paniceum* and cigarette beetle ***Lasioderma serricorne***. *Journal of Stored Products Research*. 2005. v. 41, no. 3 .
- Gilberg, M and A. Brokerhof. The Control of Insect Pests in Museum Collections: The Effects of Low temperature on *Stegobium paniceum* L., the Drugstore Beetle. *Journal of the American Institute for Conservation*. 1991, v.30, No. 2, Article 7. pp. 197-201
- <http://www.insectslimited.com/Herbarium%20Pest%20Control.htm>
- <http://www.darwinfoundation.org/terrest/Botany/method.html>
- http://creatures.ifas.ufl.edu/main/search_scientific.htm
- <http://www.ksu.edu/fergusonlab/herbarium/pests.html>