# Integrated Pest Management 101

## THE WHAT-TO'S AND HOW-TO'S

*ONG FANG ZHENG, CONSERVATOR*

*4 MAY 2021*

*ANRI: HARI KEARSIPAN KE-50*

# CONTENT

1. What is Integrated Pest Management (IPM)?
2. What are pests?
3. What to look out for?
4. How to deal with a pest infestation
5. How to maintain a successful IPM
6. How to make decisions

# 1. What is Integrated Pest Management?

# CONSERVATION

**INTERVENTIVE/REMEDIAL CONSERVATION**

Surface cleaning
Tear repairs & in-fills
Adhesive tape removal
Washing & deacidification
Lining, flattening
Board reattachment
Rebinding
Etc.

**PREVENTIVE CONSERVATION**

Housing & storage
Handling & transportation
Environmental monitoring
**Integrated pest management**
Disaster planning management
Security & access
Exhibition support (framing, mounting)
Etc.

**INFORMATIVE CONSERVATION**

Research & analysis
Training/CPD
Advocacy / Education

# INTEGRATED PEST MANAGEMENT (IPM)

PURPOSE

- IPM is part of a preventive care effort done to minimize or slow down rate of deterioration, and to prevent damages to collections due to museum pests. [AIC Wiki]

INVOLVES

- 3 main components: **Prevention** + **Monitoring** + **Treatment**
- Conservators, archivists, registrars, movers, property maintenance staff

# 2. What are pests?

# COMMON PESTS

- Mice
- Cockroaches
- Sliverfish
- Booklice
- Termites
- Lizards
- Rats
- Ants
- Beetles
- Moths
- Bookworms
- Borers
- Bats
- Bees
- Gnats
- Firebrats
- Centipedes
- Millipedes
- Birds
- Houseflies
- Spiders
- Weevils
- Fruit flies
- Grasshoppers
- Praying mantis
- Crickets
- Cicadas
- Bedbugs

# MUSEUM PESTS

- Mice
- Cockroaches
- Sliverfish
- Booklice
- Termites
- Lizards
- Rats
- Ants
- Beetles
- Moths
- Bookworms
- Borers
- Bats
- Bees
- Gnats
- Firebrats
- Centipedes
- Millipedes
- Birds
- Houseflies
- Spiders
- Weevils
- Fruit flies
- Grasshoppers
- Praying mantis
- Crickets
- Cicadas
- Bedbugs

# IDENTIFYING PESTS

## MICE & RATS

# IDENTIFYING PESTS

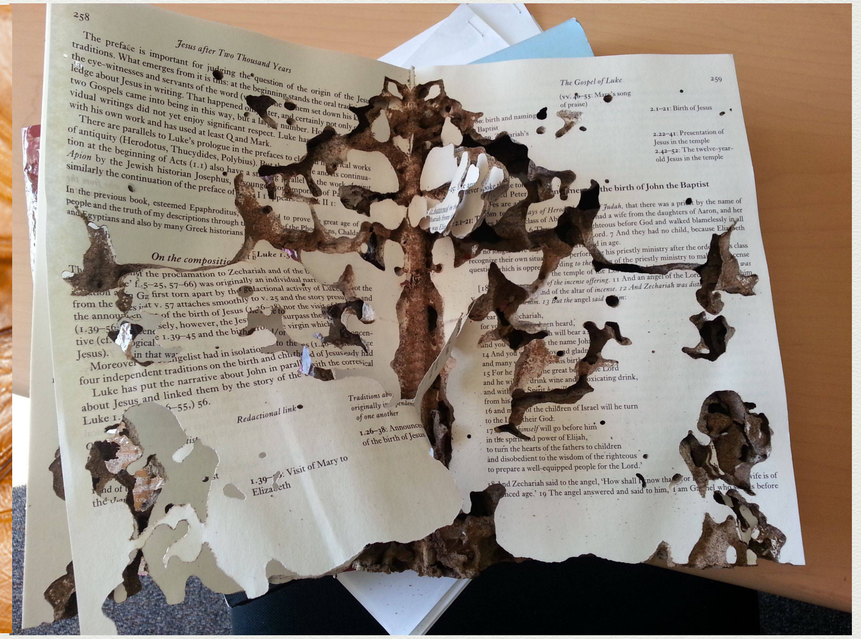
## SILVERFISH & FIREBRATS

# IDENTIFYING PESTS

## BOOKLICE

# IDENTIFYING PESTS

## TERMITES

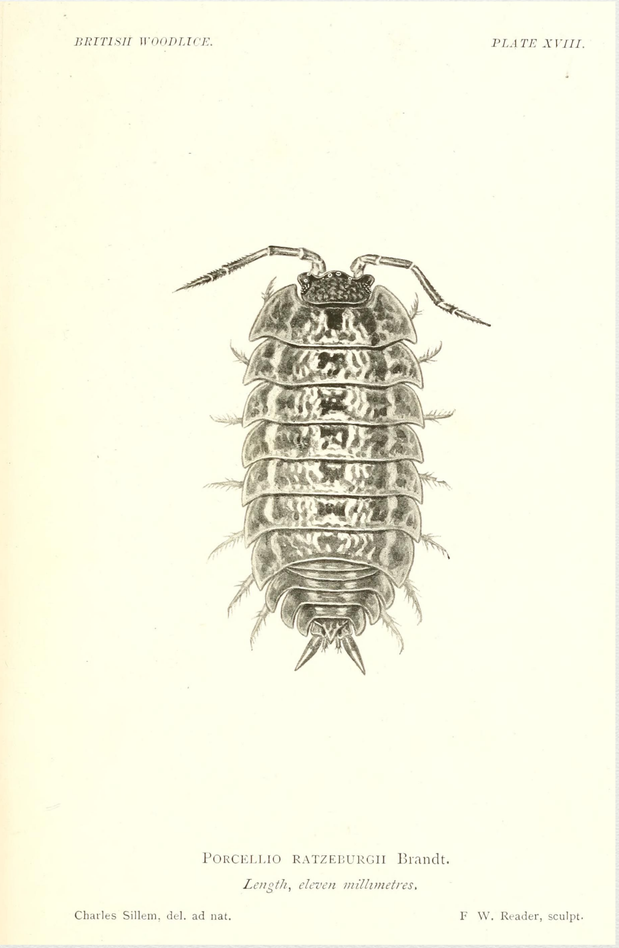


# IDENTIFYING PESTS

GNATS

# IDENTIFYING PESTS

WOOD LOUSE



# IDENTIFYING PESTS

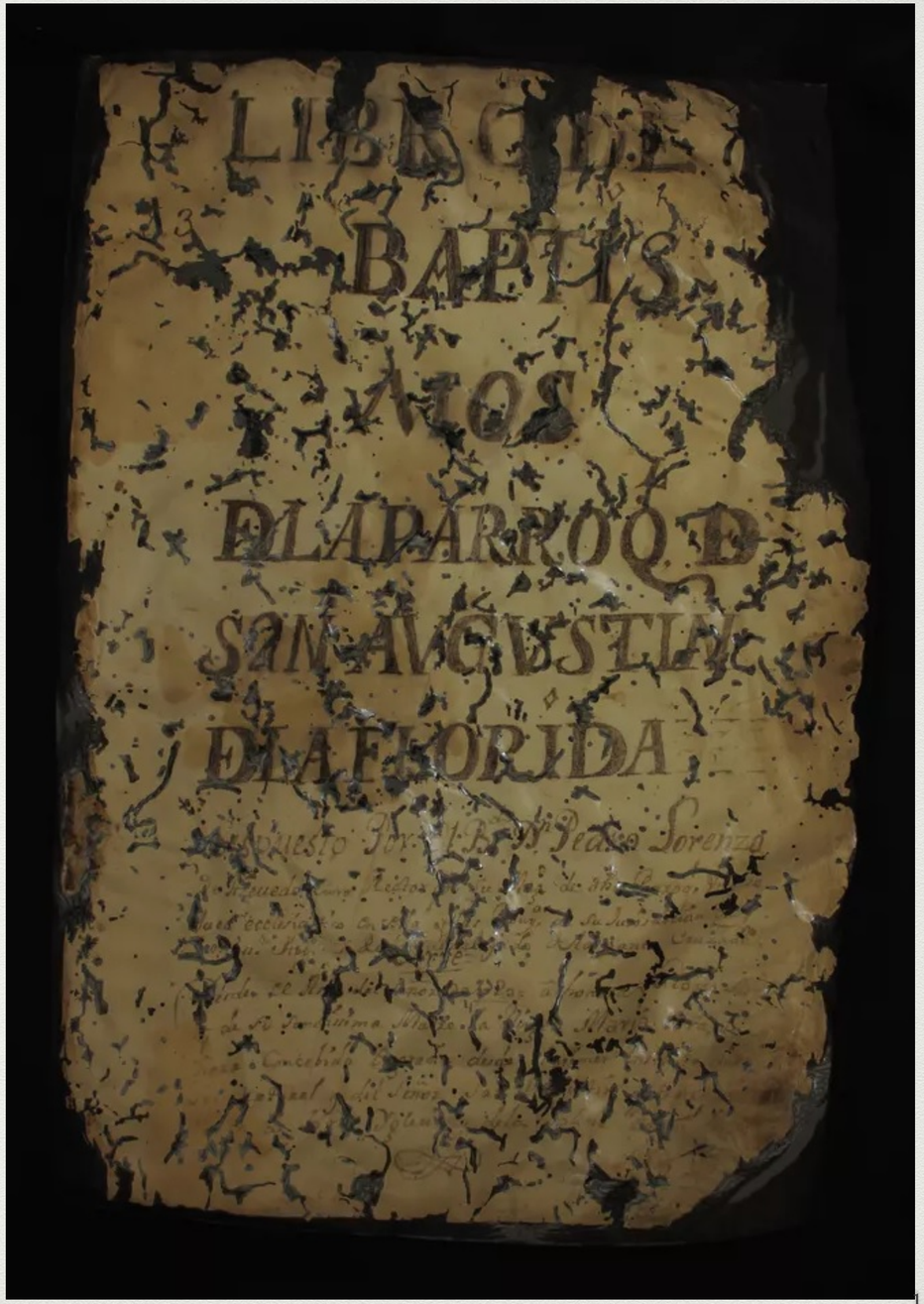
MOTHS

# IDENTIFYING PESTS

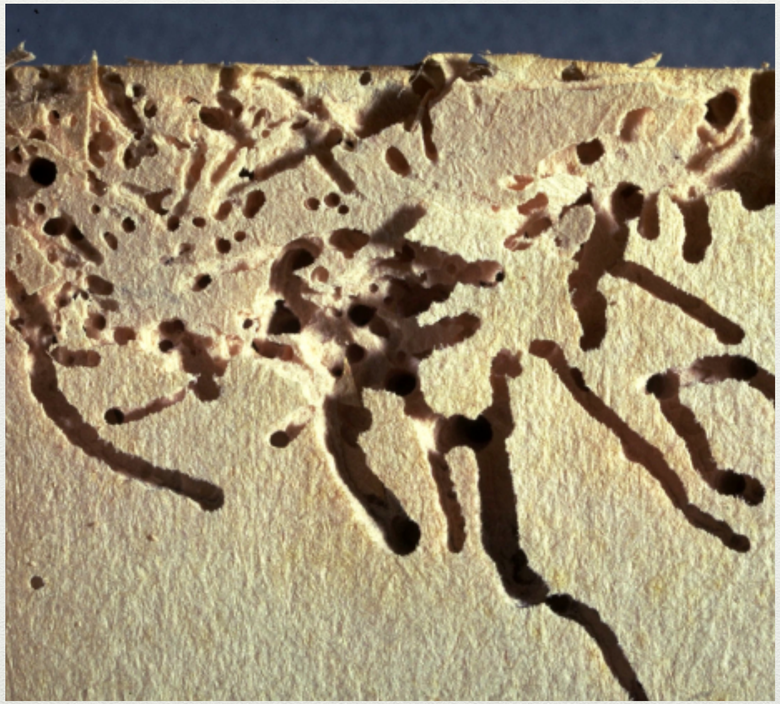
## BEETLES

# 3. What to look out for?


IN THE JUSTICE'S COURT
STATE OF IDAHO
JUSTICE OF THE PEACE


LIBRO DE
BAPTIS
MOS
DE LA PARROQVIA
DE SAN AVGVSTIN
DE LA FLORIDA


402
403
Of the Bishops Jurisdiction
Capital Cities



# LOOK OUT FOR

INCOMING COLLECTIONS

- Signs of pest damage: losses, holes, frass, etc.
- Pests (dead or alive)
- Mould

COLLECTION STORAGE AREAS

- Potential entries: gaps in door frames, windows, piping, etc.
- Potential habitats: dark and moisture areas with stagnant air

# LOOK OUT FOR

BUILDING EXTERIOR

- Potential entries: gaps in door frames, windows, piping, etc.
- Fruit trees, shrubs, flowering plants, etc.

# 4. How to deal with a pest infestation

# INCOMING COLLECTIONS

| | |
|---|---|
| **INSPECTION** | Look out for signs of pest damage or infestation |
| **ISOLATION** | Keep away from the rest of the collections |
| **OBSERVATION** | Isolate and observe over time if pest presence suspected |
| **TREATMENT** | Eradicate pests in the collection before storage |

# TREATMENT

Anoxic treatment (active)

Anoxic treatment (passive)

Carbon dioxide ‘fumigation’

Freezing

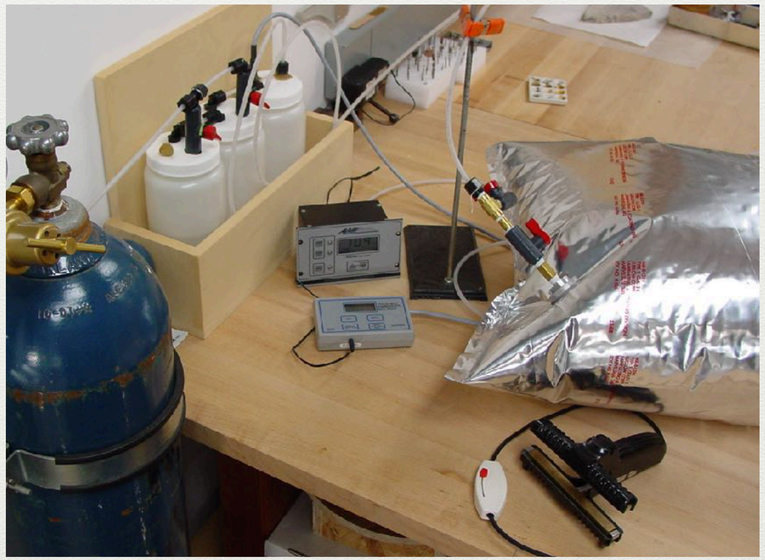
Heating

Biological methods

# ANOXIC TREATMENT

ACTIVE

- Anoxic chamber for 14 days at <0.3% oxygen at 30°C
- Not recommended to perform at below 20°C, and/or above 60% RH
- Every 5°C decrease and exposure time doubles



# ANOXIC TREATMENT

## PASSIVE

- Using oxygen scavengers (eg. Mitsubishi Ageless®) in a microclimate
- Requires many additional materials (MarvelSeal® 360, heat sealer, etc.)

# CARBON DIOXIDE ‘FUMIGATION’

- 60–70% carbon dioxide
- 4–5 weeks at 20°C, <65% RH
- May cause dizziness with high concentration (leak)

# EXTREME TEMPERATURES

FREEZING

- Vacuum pack (preferably double, and with interleaves)
- -30°C for 5–7 days, or -18°C for 14 days
- Let materials acclimatise min. 24 hours before opening

HEATING

- 50°C for min. 1 hour, up to 1–2 days due to object density (↓°C = ↑time)
- As much as possible, maintain 40–60% RH

# BIOLOGICAL METHODS

PREDATOR & PREY

- Using the natural predator of your target insect pest

PHEROMONES & GROWTH REGULATORS

- Pheromones placed in pest traps to attract pests (not recommended)
- Growth regulators are hormones that inhibit the growth of insect larva to adults

# COMPARISON

| | ANOXIA (ACTIVE) | ANOXIA (PASSIVE) | $CO_2$ 'FUMIGATION' | FREEZING | HEATING |
|---|---|---|---|---|---|
| **MATERIALS** | Anoxic chamber, oxygen-free nitrogen gas | MarvelSeal® 360, Ageless® Z/RP-K, Ageless® Eye, nitrogen tank, heat sealer | MarvelSeal® 360, $CO_2$ tank, $O_2$ analyser, digital hygrometer, heat sealer | Industrial freezer, freezer truck | Industrial oven |
| **SPACE** | Large, fixed | Little, portable | Large, portable | Medium, fixed/portable | Small, fixed/portable |
| **DURATION** | 14 days | 3 weeks | 4–5 weeks | 5–14 days | 1–2 days |
| **DIFFICULTY** | Low–Medium | Medium–High | Medium | Easy | Easy |
| **PROS** | Large volume, consistent, safe | Little monitoring required | Large volume, safe, little monitoring | Relatively quick | Quick |
| **CONS** | High initial cost | Tricky calculation, small volume | Slow, gas tank dangerous | sensitive materials, electricity bill | sensitive materials, electricity bill |
| **COST** | Low | Medium | Medium | Low | Low |

# 5. How to maintain a successful IPM

# PEST TRAPS

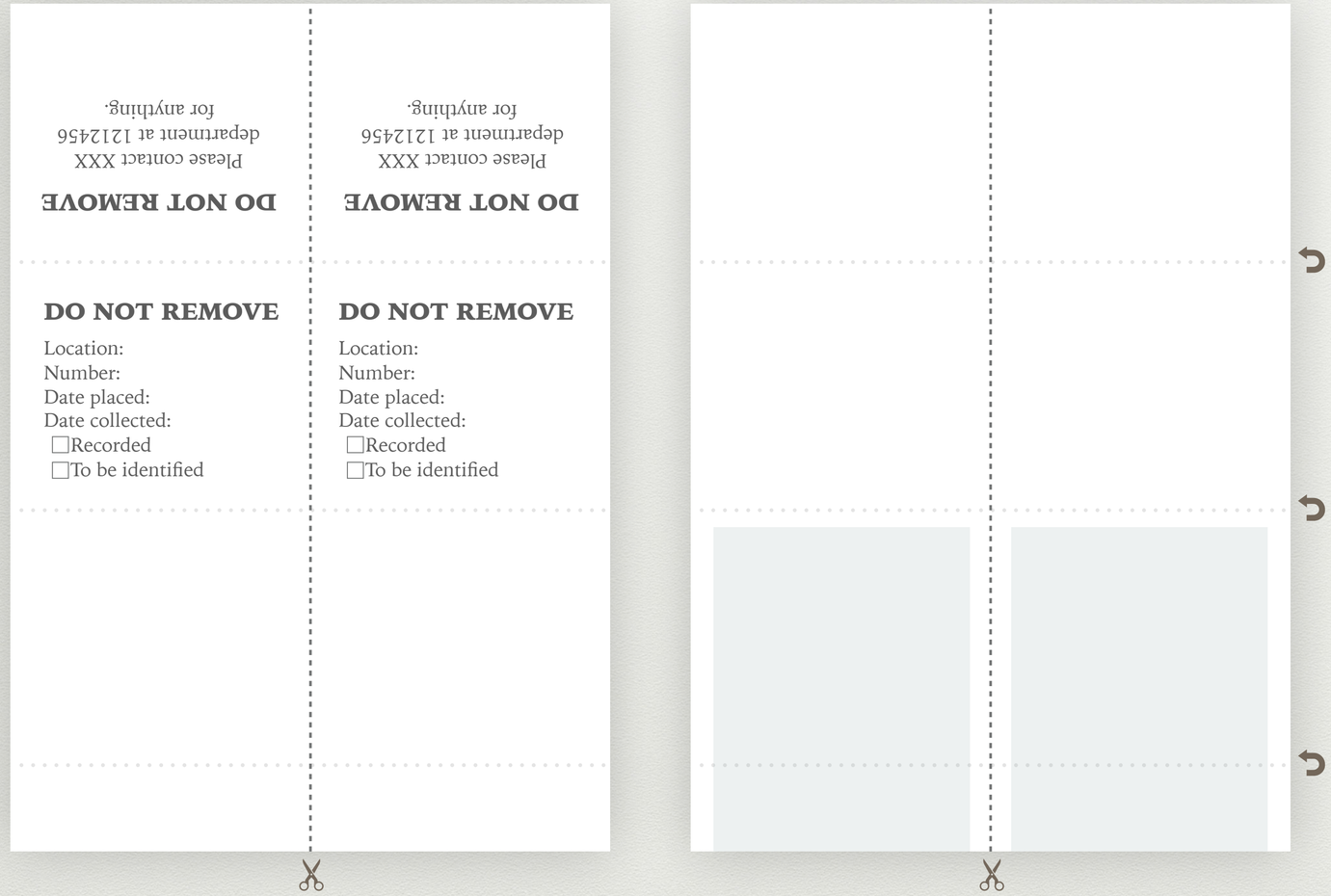
- Buy ready-made ones or DIY
- Always label!
- Check periodically and replace
- Identify pests if possible



# DIY PEST TRAPS

FRONT

BACK

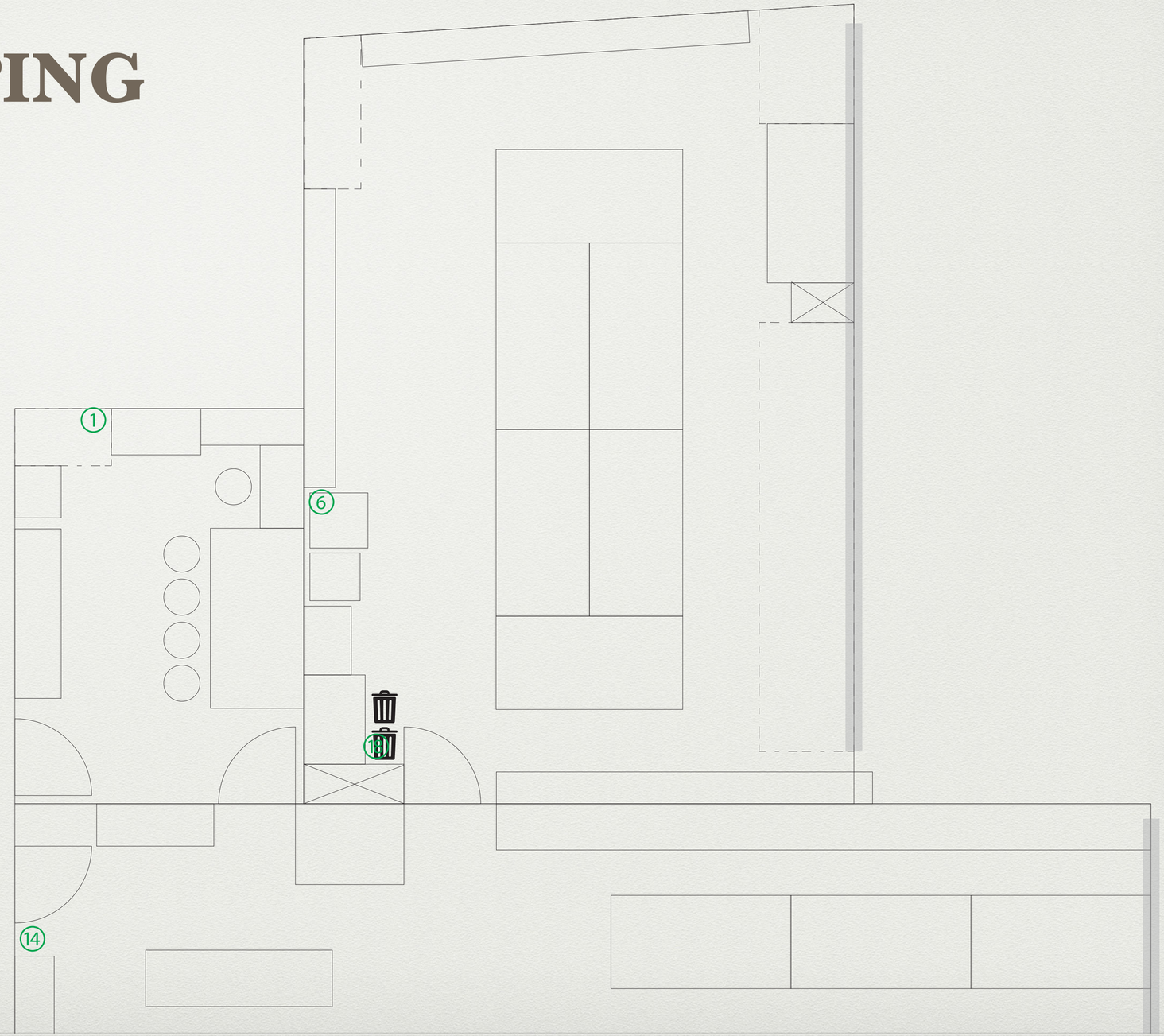



- Each A4 gives you 2 traps
- 250–400gsm art card
- *Very sticky* double-sided tape

# RAT/MOUSE TRAPS

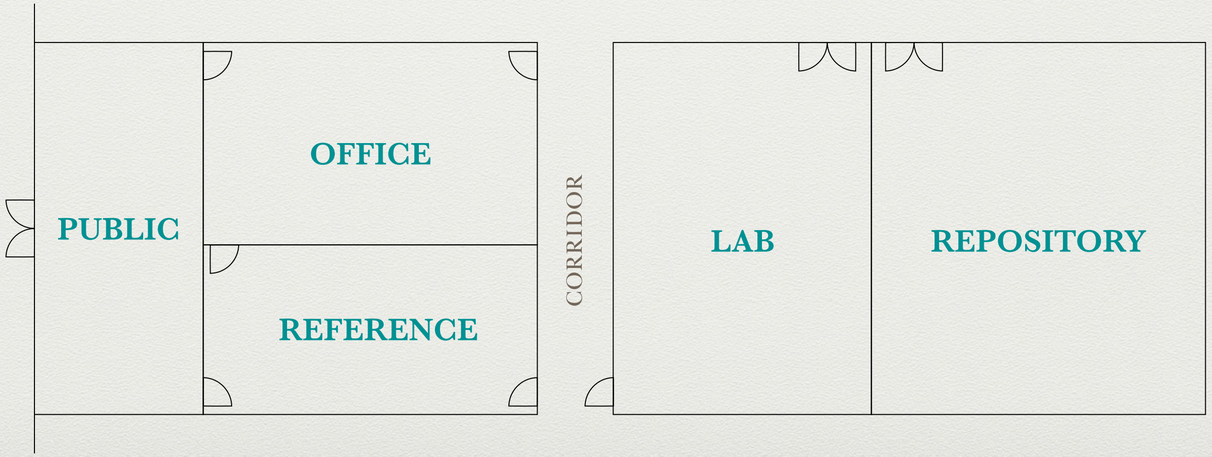
- Catch them alive
- Do not use food or live baits
- Do not use rat poison
- Identify reason and point of entry


# PEST TRAP MAPPING



# FLOOR PLAN

- Space segregation between:
  - Public (fully accessible by public)
  - Office (closed to public, food & drink allowed)
  - Research/Reference (restricted access, no food & drink)
  - Repositories (restricted access, security, no food & drink)



# BUILDING MAINTENANCE

- Environmental monitoring and housekeeping
- No large gaps at doorways
- No flowering trees or shrubs near the building
- Keeping a gap between building and plants
- Keeping trash bins some distance away from the building

# 6. How to make decisions

# CONSIDERATIONS

- Size of (incoming/affected) collections
- Type of materials in the collections
- Severity of pest infestation
- Estimated frequency
- Time
- Resources

# RESOURCES

- AIC Wiki: Integrated pest management (IPM) https://www.conservation-wiki.com/wiki/Integrated_pest_management_(IPM)
- Connecting to Collections Care: https://www.connectingtocollections.org
- Global Conservation Forum (ConsDistList): https://community.culturalheritage.org/communities/community-home?CommunityKey=ea3d002c-9fc3-4446-b7d2-c308f5faed13
- MP-WG: Museum Pests https://museumpests.net
- National Park Service: Museum Handbook, Part I: Chapter 5: Biological Infestations https://www.nps.gov/museum/publications/MHI/CHAP5.pdf
- NEDCC: 3.10 Integrated Pest Management https://www.nedcc.org/free-resources/preservation-leaflets/3.-emergency-management/3.10-integrated-pest-management

# IMAGE CREDITS

(as presented on 4 May 2021)

- 3: https://i.gifer.com/ZJt4.gif
- 7: https://www.fg-a.com/insects/animated-fly-1.gif
- 8: https://static.wixstatic.com/media/5922a2_8daa0edcad56426fbdcca402c7c0022d~mv2.gif
- 9: https://monophy.com/media/tSti2Eqe5j1Di/monophy.gif
- 10: https://www.animatedimages.org/data/media/323/animated-insect-image-0142.gif
- 11: https://img.17qq.com/images/hjiofppfhhz.jpeg, https://www.pngkit.com/png/detail/69-695954_mouse-transparent-black-transparent-background-rat-png.png, https://www.bl.uk/britishlibrary/~/media/bl/global/about%20us/around%20the%20building/pests%20mouse%20damage%20copyright%20dbp%20entomology.jpg
- 12: https://upload.wikimedia.org/wikipedia/commons/thumb/8/84/LepismaSaccharina.jpg/1600px-LepismaSaccharina.jpg, https://images.saferbrand.com/is/image/woodstream/sb-lc-insect-header-silverfish?qlt=75, https://brookerpestcontrol.com/wp-content/uploads/2013/07/silverfish-three.jpg, https://www.perthpest.com.au/wp-content/uploads/2015/11/Silverfish-1.jpg
- 13: https://bugspray.com/wp-content/uploads/2012/01/booklice3.jpg, https://owlpestcontrol.ie/wp-content/uploads/2019/09/owl-pest-control-booklice.jpg, https://upload.wikimedia.org/wikipedia/commons/thumb/c/ce/Book_louse_03.JPG/1599px-Book_louse_03.JPG
- 14: https://fijisun.com.fj/wp-content/uploads/2016/08/Asian_Subterranean_Termites-750x403.jpg, https://www.vippestcontrol.com.au/wp-content/uploads/2019/06/termite-control-melbourne.jpg, https://apps.lucidcentral.org/ppp_v9/images/entities/asian_subterranean_termite_384/1920large.jpg, https://www.insectekpest.com/wp-content/uploads/2020/04/INSECTEK-WEB-SERVICES-TERMITES.jpg, https://nilepost.co.ug/wp-content/uploads/2019/10/Termites-eat.jpg, https://ucanr.edu/blogs/slomggarden/blogfiles/51445.jpg, https://www.cleggs.com/wp-content/uploads/2019/08/drywood-termite.png, https://nilepost.co.ug/wp-content/uploads/2019/10/Termites-eat.jpg
- 15: https://upload.wikimedia.org/wikipedia/commons/c/c4/Sciaridae_%28Sciaridae%29_%28Unidentified_Dark-winged_fungus_gnat%29_-_%28imago%29%2C_Arnhem%2C_the_Netherlands.jpg, https://bringmethenews.com/.image/ar_1:1%2Cc_fill%2Ccs_srgb%2Cfl_progressive%2Cq_auto:good%2Cw_1200/MTY0NjEyMzgzOTY3MjkwOTMx/gnat.jpg, https://images.saferbrand.com/is/image/woodstream/sb-lc-insect-header-fungus%20-gnat?qlt=75, https://www.gardeningknowhow.com/wp-content/uploads/2010/09/fungus-gnat1.jpg
- 16; https://res.cloudinary.com/dk-find-out/image/upload/q_80,w_1920,f_auto/MA_00892035_obfp0o.jpg, https://blogs.bl.uk/.a/6a00d8341c464853ef0192aca77da5970d-pi, https://i.pinimg.com/originals/d3/87/8f/d3878f0e8688f8e4c389e0cc9261616d.jpg
- 17; Indian Meal Moth.png, webbing-clothes-moth-insects-limited.png, webbing-clothes-moth.png, https://upload.wikimedia.org/wikipedia/commons/7/79/Tineola_bisselliella_E-MK-17521a.jpg, webbing-clothes-moth-on-sweater.png
- 18: https://www.perthpest.com.au/wp-content/uploads/2015/11/Carpet-Beetle-2.jpg, https://www.permachink.com/images/stories/blog/beetle1.jpg, https://cdn.branchcms.com/VO0gdXagzR-1209/images/wood-destroying-identification.jpg, https://cdn.rentokil.com/content/local/gb-pc/images/desktop/main_woodworm_beetle.jpg, http://ecoworldtermite.com/uploads/3/4/4/5/34457076/9839158_orig.jpg, https://upload.wikimedia.org/wikipedia/commons/a/af/Drugstore_beetle_02.jpg, https://www.johnson-group.tw/wp-content/uploads/2018/05/overview-woodbeetle.jpg, https://www.permachink.com/images/stories/blog/beetle2.png, https://calvalleytermite.com/files/shutterstock/2020/04/shutterstock_85988293_1586971747_i10365784867.jpg?w=1440&h=1080&a=t
- 19; https://static.wixstatic.com/media/5922a2_3837495b5f174990be9729e68e188d6b~mv2.gif

# IMAGE CREDITS

(as presented on 4 May 2021)

- 20: https://www.perthpest.com.au/wp-content/uploads/2015/11/Silverfish-2-1024x1024.jpg, https://2.bp.blogspot.com/-BvGpZQC_6Gc/VyKIceMQSKI/AAAAAAAAHSw/EB0HWJDuupkNDUAllFsW9lrE9RplkklLgCLcB/s640/presweek2.JPG, https://pbs.twimg.com/media/Ce53zjkXIAEUdJi?format=jpg&name=small, https://blogs.bl.uk/.a/6a00d8341c464853ef01901ee8243a970b-580wi, https://www.pbs.org/newshour/nation/i-dig-through-archives-to-unearth-hidden-stories-from-african-american-history
- https://d3i6fh83elv35t.cloudfront.net/static/2018/12/con_photo3.jpg
- 21: https://www.frontiersin.org/files/special%20topics/16226/thumb_400.jpg, http://cdn.shopify.com/s/files/1/1472/3568/products/Fresh_Sawdust_9cdcbbf1-3d38-4abd-80fc-25f8ea45bf94_grande.jpeg?v=1592953289
- 22: https://i.pinimg.com/originals/36/dc/47/36dc479b454578408d96c4a6c7ce1a98.png, https://i.pinimg.com/originals/8b/fd/9f/8bfd9f0e387df7e04beed842ecfe20c6.png
- 23: https://www.pngitem.com/pimgs/m/61-618574_ftestickers-ant-animals-ants-freetoedit-transparent-background-ants.png, https://i.pinimg.com/originals/9b/ec/54/9bec54ee4731bda3cddab032c7c87dfd.gif, https://thumbs.gfycat.com/AnyOddballDavidstiger-size_restricted.gif
- 24: https://cdn.edu.buncee.com/assets/7f8c9ccd83765d5a2e4336b676ef594d/animation-science-magnifyglass.gif?timestamp=1546895230, https://static.wixstatic.com/media/ff7cb3_5be2d8288f2a4b87bc984a23f3779115~mv2.gif
- 26: , http://expm.com.pt/wp-content/uploads/2019/10/expm6-1.png, John Burke, https://cdn.shopify.com/s/files/1/0277/4060/2473/products/Untitled-1_a4a81d4b-b3b4-49ab-85c9-e411f6947c66_700x700.png?v=1579711398
- 27: Fang Zheng
- 28: https://www.historicnewengland.org/wp-content/uploads/2017/01/Bubble.jpg
- 29: https://lh3.googleusercontent.com/proxy/rMDECpK21n9abhrorFvpiLF9zwEpvbVzEOKDkvUOk3p1f_coqMXpEcJhYuzdTIcwwf-osmVrKyE1lPcWpZLp4FQk, https://acegif.com/wp-content/gifs/fire-77.gif
- 32; http://cdn130.picsart.com/303749730139201.gif?to=min&r=1024
- 33: https://images.squarespace-cdn.com/content/5f85d31d86a30c227b913863/1609342730433-MFNLWYMBN9ZM4YBYFOQH/Museum+Trapper+Monitor+Thumbnail.jpg?content-type=image%2Fjpeg, https://www.preservationequipment.com/imagecache/13c448f2-621e-4ddd-a382-a61f009c954a/Insect-Monitor-Trap_1000x750.jpg, https://pbs.twimg.com/media/D5VaSeXWAAAXA8P.jpg, https://i1.wp.com/blog.dma.org/wp-content/uploads/2020/05/traps-1.jpg?fit=500%2C667&ssl=1
- 35: https://images-na.ssl-images-amazon.com/images/I/71XjoOmCAyL.jpg, https://images-na.ssl-images-amazon.com/images/I/71w73OhgLDL._AC_SL1500_.jpg, John Burke
- 36: Chien Hua, Fang Zheng
- 38: https://p.kindpng.com/picc/s/130-1307115_garbage-clipart-wastebin-recycle-trash-bin-png-transparent.png, https://www.pngkit.com/png/full/772-7726482_trash-can-with-transparent-background-waste-management-october.png

# BIBLIOGRAPHY


- “Closed but Still Caring for Our Collection”, *Dallas Museum of Art Uncrated*, https://blog.dma.org/2020/05/21/closed-but-still-caring-for-our-collection/
- David Pinniger (2006) 'The Use of Oxygen-Free Environments in the Control of Museum Insect Pests’, *Studies in Conservation*, 51:1, 78-79, DOI: 10.1179/sic.2006.51.1.78
- Giuseppe Chidichimo, Francesco Dalena, Antonio Rizza & Amerigo Beneduci (2018) ‘Insect-Infested Wood Remediation by Microwave Heating and Its Effects on Wood Dehydration: A Case Study of Hylotrupes bajulus Larva’, *Studies in Conservation*, 63:2, 97-103, DOI: 10.1080/00393630.2017.1314584
- Kerstin Elert & Shin Maekawa (1997) ‘Rentokil Bubble in nitrogen anoxia treatment of museum pests’, *Studies in Conservation*, 42:4, 247-252, DOI: 10.1179/ sic.1997.42.4.247
- “Identify Your Pest”, *Insects Limited Incorporated*, https://www.insectslimited.com/insects
- “IPM-Working Group Identification Resources”, *MP-WG*, https://museumpests.net/identification/identification-resources/
- Mark Gilberg (1989) 'Inert atmosphere fumigation of museum objects’, *Studies in Conservation*, 34:2, 80-84, DOI: 10.1179/sic.1989.34.2.80
- Naoko Sonoda, Shingo Hidaka & Kaoru Suemori (2016) ‘Common challenges for ethnographic and modern art collections: Pest control for large and complex objects containing new materials’, *Studies in Conservation*, 61:sup2, 329-331, DOI: 10.1080/00393630.2016.1188255
- Naoko Sonoda & Shingo Hidaka (2008) ‘Between Conservation and Access: Implementation of Integrated Pest Management at the National Museum of Ethnology Osaka, Japan’, *Studies in Conservation*, 53:sup1, 88-92, DOI: 10.1179/sic.2008.53.Supplement-1.88
- P.R. Ackery, J.M. Testa, P.D. Ready, A.M. Doyle & D.B. Pinniger (2004) ‘Effects of High Temperature Pest Eradication on DNA in Entomological Collections’, *Studies in Conservation*, 49:1, 35-40, DOI: 10.1179/sic.2004.49.1.35
- Parker, T. A. “Emergency Management - 3.10 Integrated Pest Management”, *NEDCC*, https://www.nedcc.org/free-resources/preservation-leaflets/3.-emergency-management/3.10-integrated-pest-management
- Pascal Querner, Elke Oberthaler & Monika Strolz (2019) ‘Biological Pest Control of a Biscuit Beetle (Stegobium paniceum) Infestation in an Old Masters Paintings Storage Area’, *Studies in Conservation*, 64:7, 373-380, DOI: 10.1080/00393630.2018.1537352
- “Pest Control”, *Cornell University Library*, https://chinapreservationtutorial.library.cornell.edu/content/pest-control
- Stephan Biebl & Pascal Querner (2021) ‘Transportation of Wood Boring Beetles in Wooden Transport Boxes, Wooden Pallets, and Newly Bought Wood in Museums’, *Studies in Conservation*, 66:1, 44-50, DOI: 10.1080/00393630.2020.1756126
- Suzanne Ryder & Armando Mendez (2019) ‘Using Risk Zones in Museums as Part of an IPM Programme: Does it Work?’, *Studies in Conservation*, 64:4, 203-207, DOI: 10.1080/00393630.2018.1530859
- T.K. Strang, J. Mitchell, A. Pearce & C. Pearson (2000) Low Cost Heating Methods for Insect Pest Control’, *Studies in Conservation*, 45:sup2, 27-27, DOI: 10.1179/sic.2000.45.s2.027
- “Wood boring insects and beetles”, *Western Exterminator Company*, https://www.westernexterminator.com/wood-boring-insects/
- “Chapter 5: Biological Infestations”, *National Parks Service*, https://www.nps.gov/museum/publications/MHI/CHAP5.pdf

# Thank you.

*ONG FANG ZHENG, CONSERVATOR*

*4 MAY 2021*