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The Life and Times of *Tineola bisselliella* in the Collection Store

- Jill Kerr: Natural Science Conservator, Ulster Museum, Belfast

Summary

In the summer of 1999 a 'sticky' trap with a pheromone lure for *Tineola bisselliella* (Hummell, 1823) (webbing clothes moth), located in the taxidermy collection, was found to contain seven moths. This was the first indication of an infestation, which had become established throughout the store. A non-chemical solution for the treatment of the space and specimens based on cleaning and freezing, proved successful, except for one area where a small number of moths were still being trapped. Here, it was discovered that cardboard boxes containing bags of 'unclean' bones showed signs of an extensive, active infestation. The most alarming revelation was that some of the larvae had managed to eat their way out of the polythene bags in which the bones were stored.

Introduction

Pest species, which attack museum specimens, include some species of insects, rodents and birds. They can cause irreparable damage to, and staining of, specimens. An Integrated Pest Management programme is essential for the long-term preservation of museum collections. This offers a holistic approach to the problem of pests by establishing procedures for prevention, monitoring and treatment. Documented here, is the infestation of *Tineola bisselliella* in the Collection Store at the Ulster Museum and the roll of IPM in the discovery and management of the problem.

An IPM programme began at the Ulster Museum in 1997 and the main collection store (Figure 1) was included in the pilot survey. It is the largest store in the museum (780 m^2) and contains a wide range of specimens from various disciplines including zoology, botany, ethnography, archaeology, geology and local history. These specimens, many of which are organic and vulnerable to pest attack, are housed in a variety of cabinets, drawers and racks or on open shelving.

During the five years since monitoring began, the IPM programme has steadily evolved. The monitoring programme now includes the whole museum and a quarantine facility has been set up adjacent to the main collection store. A monthly cleaning regime has been successfully established for this store. The dissemination of information on our IPM programme has stimulated interest and raised awareness amongst curatorial and gallery staff.

To monitor for pests, 'sticky' traps were used in many areas and traps with pheromone lures for *Tineola bisselliella* and *Anobium punctatum* (Degeer, 1774) positioned near collections particularly vulnerable to attack by these species (Figure 1). Since 2002 the lures for *Anobium punctatum* have no longer been available. The traps were inspected monthly and annual reports produced with any findings and recommendations.

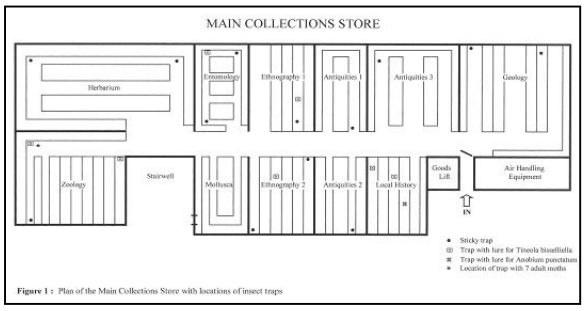
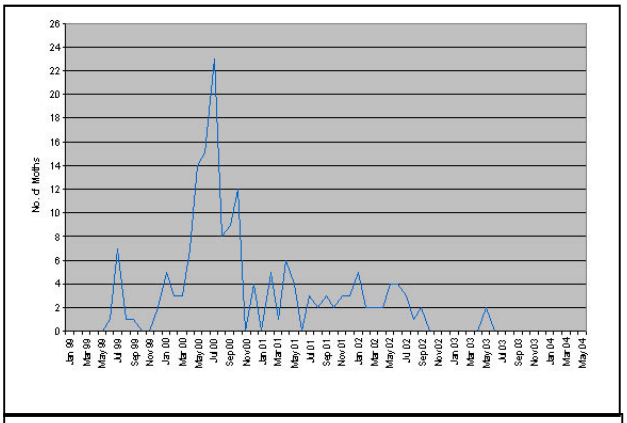


Figure 1 : Plan of the Main Collections Store with locations of insect traps

It was during the third year of monitoring that significant numbers of *Tineola bisselliella* started to appear in the traps in the zoology bay (Figures 1 & 2) and the ensuing infestation put the newly established IPM to the test.

Tineola bisselliella

Tineola bisselliella is a small (5-7mm long), fawn-coloured moth from the family Tineidae. It is known to eat a range of materials, most commonly natural fibres such as wool (preferably soiled), fur, feathers, bird and mammal skins (Pinniger & Winsor, 1998). They can also damage synthetic materials and have the capacity to digest keratin in bone (Florian, 1997). They are not attracted to light and tend to scuttle around in dark areas, only flying when it is warm enough. The larva spins a silk tube, which contains frass and material from the damaged object. One generation usually takes about a year but there can be more if conditions are favourable (Carter & Walker, 1999; Pinniger, 2001). The collection store, which is air-conditioned, typically to a range of 18-23°C and 50-55% RH provides an ideal environment as they breed in temperatures between 20-33°C and an optimum RH of 70%.

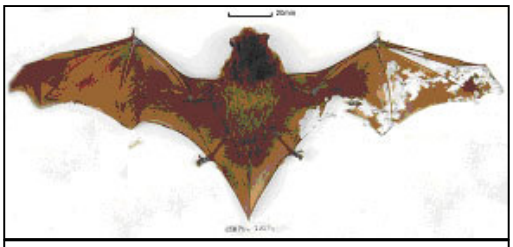


Moth catches in Collection Store

***Tineola bisselliella* in the Collection Store**

In the first two years of monitoring, the numbers trapped indicated a low level of activity, four adults between May 1997 - April 1998 and two in the subsequent year. These had been found in the zoology, ethnography and local history costume bays (Figure 1). In July 1999 a trap with a pheromone lure was inspected and seven adult moths identified. The trap was situated in the zoology bay amongst the taxidermy collection (Figure 1).

In the following months, the number of moths trapped and the sightings of adults increased dramatically. Vulnerable parts of the collection (taxidermy, ethnography and costume) were inspected. Relatively few objects appeared infested but those that were, showed quite severe damage (Figure 3). A number of options to treat the specimens and the space were considered. It was decided that the most practical and effective way to treat the specimens was by freezing (Strang, 1992). If carried out correctly this would be guaranteed to kill all the life stages of the moths and would have minimal effects on those objects in the collection identified for treatment (Strang, 1996). The specimens found to have an active infestation were treated immediately and those vulnerable to attack were bagged in preparation for freezing. Although progress was slow due to the freezer capacity, bagging of specimens protected them from infestation and contained those already infested.



Bat with damage from *Tineola bisselliella*

A few taxidermy specimens, which showed signs of insect activity but were too large to fit in the freezer, were treated with Dichlorvos (Vapona ™). It came as an impregnated strip, which slowly released a vapour, lethal to insects at the correct concentration. Its main use was where a contact insecticide was not appropriate and had the added advantage of remaining effective for up to six months. However, this product was not suitable for all types of specimens as it can fade some dyes and corrode metal (Dawson & Strang, 1992). This insecticide has now been withdrawn for all use in the UK because of health and safety concerns.

Pest control companies were consulted about an approach to the treatment of the storage space and furniture. Various factors had to be considered such as the residual effects of the treatment, health and safety and disruption to staff and visitors. A series of pyrethrin-based spray treatments was suggested for the treatment of the building fabric and methyl bromide fumigation for the furniture. A survey of the store revealed that there was a lot of unnecessary non-collection material cluttering up the floor space, creating potential food/harbourage sites of pests and restricting access for cleaning. It was decided to make significant improvements to the housekeeping regime and to consider the chemical solution only if these steps did not prove effective in reducing moth numbers.

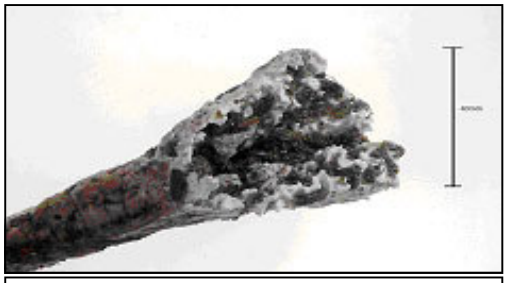
During the bagging process, extra pheromone and blunder traps were placed in areas containing specimens vulnerable to attack to help locate the source of any activity as soon as possible. Steps were taken to improve cleaning in the store and a programme started to remove non-collection material in order to facilitate cleaning. Storage furniture was cleaned thoroughly whenever specimens were removed for freezing.

***Tineola bisselliella* in the Osteological Collection**

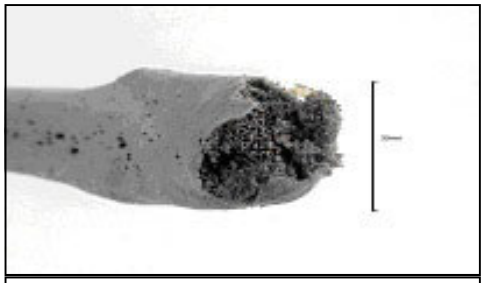
In May 2002 the bagging of taxidermy, ethnography (organic specimens) and local history costumes was completed and the number of moths trapped reduced to an average of 2-3 per month (Figure 2). These were mostly confined to one particular area in the taxidermy collection. This was perplexing because all the taxidermy specimens had been bagged thereby eliminating possible food sources. It was decided to continue with the removal of the non-collection material in an attempt to clear this area and find any sources of infestation. It was then that a box of bones was discovered which showed signs of an established infestation of *Tineola bisselliella*. An inspection of this and the surrounding boxes revealed a number of seal skulls and dolphin bones which had not been completely de-fleshed during preparation and which showed signs of activity. Inside the boxes, the bones were stored in unsealed polythene bags. A new programme of inspection and bagging began in an attempt to eradicate what was hoped to be the last source of moth activity.

After the bones had been frozen, they were cleaned of any moth debris, which included frass, larval tubes, larvae and adults. Examination of the bones during cleaning revealed a number of interesting features:

- The extensive nature of the colonisation by the moths in this environment (Figure 4).



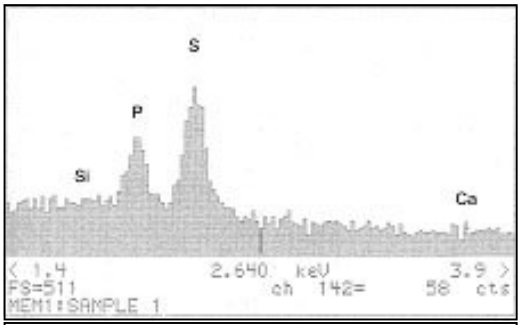
Frass from *Tineola bisselliella*



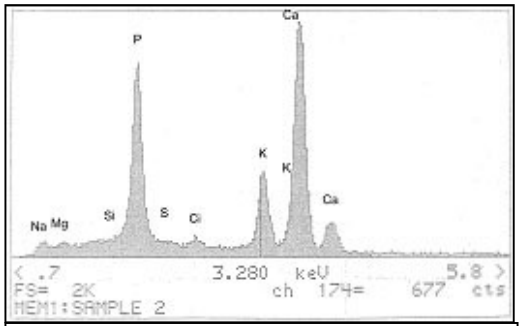
Pale 'bone' coloured frass

Appearance and analysis of some of the frass indicates that the larvae had digested bone as well as flesh. Most of the frass is a dark 'flesh' colour but in a few cases it appears to be a pale 'bone' colour

To discover if the moths had digested bone, two samples of frass were compared using X-ray microanaly sis. Figure 6 was produced from a sample of dark frass and Figure 7 from a sample taken from the bone shown in Figure 5. Several areas of each sample were analysed. The pale frass shows distinct peaks for calcium, potassium and magnesium, all elements common in bone. By comparison, the dark frass shows no peaks for these elements.



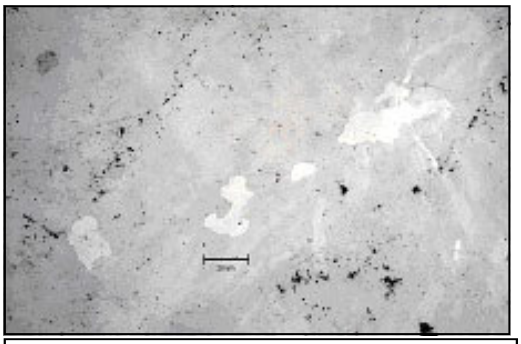
X-ray microanalysis of dark frass



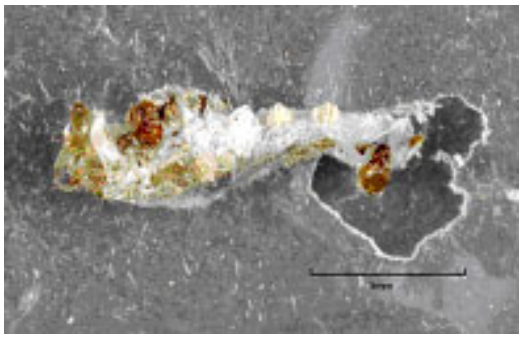
X-ray microanalysis of pale frass

Some of the larval tubes appear to made from dead adult moth wings and frass, and several of the polythene bags showed signs that they had been eaten through from the in side by larvae.

Larval tube made from *Tineola bisselliella* wings and frass



Hole in polythene bag eaten by *Tineola bisselliella*



Larval tube attached to hole in polythene bag

Conclusion

Since this incident, the number of moths caught have been significantly reduced (Figure 2). The freezing programme is making slow but steady progress and vulnerable specimens remain bagged. Keeping the specimens in bags has created problems with access and the co-operation of curatorial staff has played an essential part in controlling the spread of this pest. The objects can only be removed from their bags after freezing and when no moths have been trapped over a period of several months. It was decided that the improvement in housekeeping had proved effective in reducing moth numbers and a chemical treatment was not required for the space or furniture.

Hopefully, this experience has taught us several valuable lessons, which will lessen the risk of future infestations:

- A quarantine procedure is essential to prevent the entry of pests.
- A good housekeeping regime can reduce the likelihood of an infestation developing.
- A trapping programme is essential to identify pest outbreaks and sources.
- Pests can be very resourceful in their quest for survival.
- In order to manage a pest population it is essential to understand their habits.
- Pest management is the responsibility of all staff.

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