INSECT TRAPPING IN MUSEUMS AND HISTORIC HOUSES

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Abstract—Pest control treatments in museums, galleries and historic collections have traditionally been reactive, in response to damage or insect pests being found. Where control treatments or prophylactic measures are taken the pesticides, adjuvants and carriers can themselves be damaging to historic materials. As a result of recent legislation and a greater appreciation of the deteriorative propensities of pesticide formulations, insect trapping is becoming a favoured means of early warning and monitoring of insect pest infestations.

This paper outlines the choice of trap types and lures effective against museum pests, and gives guide-lines through two case studies on effective monitoring programmes.

INTRODUCTION

When insects are detected by visual inspection in museums or historic houses, infestation levels may already have reached damaging proportions (Florian, 1987). The use of traps may occasionally control isolated small outbreaks and give early warning of the presence of insect pests hazardous to the collections.

Insect traps are normally a combination of two components—a lure or attractant and a killing and retention system. Attractants include:

- Food baits—which may be solid as in cockroach baits, or solutions in water
- Pheremones—sexual and aggregation types
- Light—usually of short wavelengths below 400nm
- Coloured surfaces—yellow

Insects attracted to the traps are killed and/or retained until they can be disposed of. Typical systems used are:

- Electrocution by a high voltage grid
- Drowning in the attractant solution or water
- Fumigation with a vapour-phase insecticide such as dichlorvos
- Exhaustion of the insect in a closed container such as a funnel trap from which it cannot escape
- Adhesion to a sticky surface, as with 'fly-paper' and sticky traps.

Most types of insect traps are not suitable for use in museums owing to their propensity to damage historic materials. Electrocutor types generate ozone and as with other light traps usually emit ultra-violet and low wavelength radiation (Zaitseva, 1991) both of which are highly damaging to delicate materials particularly textiles and works of art on paper. Dichlorvos vapour can cause corrosion of metals (Child, 1989) and liquids may be accidentally spilt. Systems that collect large numbers of insects can themselves attract other more harmful insect pests. Thus electrocutor type traps can attract and kill large numbers of flies on which the carpet beetles (Anthrenus spp and Attagenus spp) have been known to feed and thrive on the tastily grilled carcases.

Sticky Traps

The use of sticky traps for early warning or monitoring infestations of insects originated with the ancient Greeks who used bowls filled with goat grease for fleas and bed-bugs (Beavis, 1988). More recently, the value of glue covered sticky traps has been clearly demonstrated in food storage and

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public health for the detection of beetles, moths and cockroaches and the use of these traps has allowed targeting of cleaning and pest control applications which has been instrumental in raising standards (Pinniger, 1988). Most of the principles which apply to the use of traps in public health and food storage can also be applied to the problems associated with the care of museum collections. Cardboard sticky traps such as the Detector which were originally designed for trapping cockroaches have been used successfully for the detection of clothes moths (*Tineola bisselliella*), carpet beetles (*Anthrenus spp*) biscuit beetles (*Stegobium paniceum*) and booklice (*Liposcelis bostrychophila*) in museum stores in the U.K. (Pinniger, 1991). Detection of insects to provide early warning of insect presence and monitoring of infestation levels by use of sticky traps has been a crucial component of the pest management programme implemented by a major museum in London (Hillyer and Blyth 1992). In this museum the traps were used successfully for the detection of adults and larvae of the Guernsey carpet beetle (*Anthrenus sarnicus*) and the brown carpet beetle (*Attagenus smirnovi*). Incorporation of attractant lures based on sex or aggregation pheromones can result in dramatic increases in catch of adults of some food storage insect pests, such as the rust-red flour beetle (*Tribolium castaneum*) and the larger grain borer (*Prostephanus truncatus*) (Dendy *et al,* 1989).

Certain insect species are pests of the museum environment as well as the food storage industry and this has resulted in the commercial production of specific traps and lures for the food industry which can also be used in museums. The Fuji Trap 87 contains a lure for the biscuit beetle (*Stegobium paniceum*) and the Serricotrap contains food and pheromone lures for the cigarette beetle (*Lasioderma serricorne*) (Gilberg 1991). Because it is a much more specialised area, there has been less commercial development of the pheromones of pests such as carpet beetles which are specific to museums and houses. Although some sex pheromone components have been identified, such as undecenoic acid, the sex pheromone of the varied carpet beetle (*Anthrenus verbasci*) (Kuwahara and Nakamura, 1985) and decyl butyrate, a sex pheromone of the Guernsey carpet beetle *Anthrenus sarnicus* (Chambers *et al* 1993), the cost and difficulties in synthesizing synthetic pheromones together with the relatively small commercial market make it less likely that they will be available as sex attractant lures to supplement traps in the near future.

Traps have been generally less successful for wood borers, such as the common furniture beetle (*Anobium punctatum*). The larvae complete their development entirely within wood and completely hidden from view by anything but x-rays and, in addition, the adults have one very short mating and dispersal flight period each year. The sex pheromone of *A. punctatum* has been identified (White and Birch, 1987) and it may be that effective flight traps with attractant lures could be developed for this species. The death watch beetle (*Xestobium rufovillosum*) adults can emerge from infested timbers and wander widely over the wood surface or fall from roof beams to be found at floor level. Owing to their predominantly non flying habit, adults are frequently found on sticky traps.

Most insect traps used in museums are based on the familiar sticky cockroach trap (Detector, Roach Hotel, Hoy-Hoy etc) where the sticky surface forms the base of an open-ended box. In this construction the sticky surface does not get accidentally attached to objects, visitors or staff and is protected from dust and debris which would reduce its efficacy. Small triangular prism shaped traps typically with a base size of 2.5 x 3.0 cms are now manufactured by a number of companies using a synthetic sticky material of inert polybutenes.

The shape and size of sticky traps may be critical in their effectiveness in catching a wide range of insects. Comparison of two traps of similar size but different internal heights used to monitor an infestation of *Tineola bisselliella* indicated that the greater internal height was more effective in catching the adult moths. The effect of different colours or patterns on the trap exteriors is not known.

AgriSense Window traps made from Corex - a corrugated plastic with a central sticky well, have been found useful in catching larval forms of some pest insects but the corrugations are too small to allow adult moths and some adult beetles to enter. Owing to their 'see-through' window over the sticky well, the Window traps are valuable in show-cases etc where any catch can be seen without opening the case or disturbing the trap.

The critical factor in effective monitoring programmes using sticky traps appears not to be the trap type or design but in the correct location of the trap. Insect traps in museums, galleries and historic houses tend to be positioned to catch crawling insects. Traps for flying insects are not popular owing to their visual obtrusiveness and exposed sticky surfaces and because many museum insect pests have short-lived flying adults in their life cycle.

English Heritage Museum Store: Insect Monitoring Programme

A large modern warehouse building used by English Heritage as a temporary store was thoroughly cleaned and treated with permethrin smokes/generators and a permethrin-based residual insecticide at the wall/floor interfaces, before any objects were brought in. All incoming material—the total contents of a large mansion, was where necessary treated against insect infestations. Delicate textiles—curtains, carpets etc—were treated by deep freezing while larger bulkier items such as upholstered chairs, mattresses etc were fumigated with methyl bromide. All objects were thoroughly surface cleaned before entering the store.

Insect traps of the Detector and Window type were placed in a grid pattern on the floor around the walls of the store and the storage racks at about 5m intervals. Catches were noted weekly from April to July and monthly thereafter. The trapping programme was designed to assess the efficiency of the treatments by freezing and fumigation and to determine whether the store was insect-proof.

The results of one year's trapping indicated that the pest control treatments were generally effective. Adult *Tineola bisselliella* were found in two areas and the trapping grid was tightened to a 1m grid to confirm that some objects were still infested. These objects were re-treated by re-freezing and no further problem has since occurred.

Insect traps placed near loading doors and fire doors caught a large number of insects. A floor plan of the store was used to plot the build-up of insects on the traps using a series of clear plastic overlays. The insects caught included garden pests as well as museum pests (typically *Anthrenus* spp and *Tinea* sp and *Tineola* sp). Better sealing of the doors, removal of overhanging trees and bushes and switching off 24-hour security lights situated by doors has completely eliminated incoming insects and the store is now substantially insect-free.

The National Trust: Gawthorpe Hall

In April 1991 a woollen carpet temporarily stored in the Gallery of the Dining Room of Gawthorpe Hall caused a massive infestation of common clothes moth (*Tineola bisselliella*) throughout the building. As the Hall houses a large and valuable textile and costume collection, immediate action was considered to prevent any damage spreading. Three options were considered: total fumigation of the building, fumigation of the contents and spraying a residual insecticide in the building interior. Finally it was decided that as environmental conditions in the Hall were unfavourable to *Tineola sp* development with low relative humidities (typically 50% RH) and low temperatures (typically less than 15°C) the outbreak might be short lived.

An intensive cleaning campaign was instituted by the house staff, and an insect monitoring programme started in March 1992. A hundred Detector insect traps were placed throughout the building with typically five traps per room. Every fireplace was monitored with a trap, with others being placed in unobtrusive areas of the room close to skirting under furniture. Some traps were placed on window-sills.

Regular monitoring over the following ten months indicated that although the outbreak from the carpet was dying out, with numbers of moths trapped in the Dining Room dropping over the months, a more general insect infestation was present. The Detector traps caught significantly greater numbers of *Tineola sp* in the firegrates than elsewhere in the house. The chimneys in Gawthorpe Hall are not used and are in many instances blocked with birds' nests and other debris. It is hoped that cleaning and capping the chimneys will help prevent any further infestation.

A large number of garden insects were trapped near doors and some windows indicating access during the open season of the Hall when doors are open for visitors and windows opened for ventilation. The Australian spider beetle (*Ptinus tectus*) was detected sporadically throughout the house often near house plants, possibly drawn by the presence of free water. *Ptinus tectus* adults were trapped in large numbers in the loft areas as were huge quantities of house flies. It is possible that the spider beetle is thriving on the dead fly bodies.

A combination of intensive cleaning, better sealing of doors and windows, cleaning and sealing of chimneys is being carried out and the expected improvements in pest control continuously monitored over subsequent years.

Pest insects trapped by Detector traps at Gawthorpe Hall:

Tineola bisselliella	adult
Endrosis sarcitrella	adult
Attagenus sp	adult and larvae
Attegenus sp	larvae
Anthrenus sp	larvae
Lepisma saccharina	adult

Pest insects trapped by Window traps:

Lepisma saccharina	adult
Ptinus tectus	adult

CONCLUSION

The efficacy of non-baited sticky insect traps in catching a wide range of insect pests of museum material is now well documented. Continuing trials in museums, galleries and historic houses indicate that the use of insect trapping programmes is an invaluable adjunct to other collections care activities and can provide valuable early warning of the onset of pest infestations before object damage becomes evident.

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