Journal of Biological Curation

Title: Physical methods of pest control

Author(s): Stansfield, G.

Source: Stansfield, G. (1989). Physical methods of pest control. *Journal of Biological Curation*, *Volume 1 Number 1*, 1 - 4.

URL: http://www.natsca.org/article/1030

Physical methods of pest control

G.Stansfield

Department of Museum Studies, 105 Princess Road East, Leicester. LE1 7LG

The ideal method of pest control is one which is lethal to all species of pests at all stages of their life cycles but which does not affect the material being treated or the personnel undertaking the treatment in any way.

In the absence of an ideal solution, museums have relied upon a combination of methods including 'poisoning' specimens during preparation, the use of chemical deterrents and the isolation of material in drawers and boxes. The growing concern about the health hazards associated with chemical insecticides and deterrents and the effects of such chemicals on the objects themselves has intensified research into non-chemical methods. This paper reviews the current state of the art of physical methods of pest control.

It is a facet of human nature that we prefer sophisticated high technology solutions to simple, unsophisticated routine solutions. It has to be said, however, that the museum which has established good housekeeping practices will have done much to control insect pests. In this context, good housekeeping means careful inspection of incoming material to detect possible infestation; the isolation of any suspect material pending treatment; procedures to ensure that pests are not introduced into the museum with foodstuffs, display materials and packaging; the design of individual storage units (boxes, trays, cupboards, etc.) to ensure that any infestation is isolated; the frequent inspection of collections in store and on display with the use of traps where appropriate; the elimination of sources of infestation (bird nests etc.) from the building and possible routes of entry (windows, ducting etc.); efficient cleaning; and procedures for the effective treatment (and recording of such treatment) of any infestation which occurs.

The main purpose of this paper is to review current methods of pest control by temperature, relative humidity and by exposure to various kinds of radiation.

High temperatures

There is no doubt that at sufficiently high temperatures, all insects can be killed at all stages of their life cycles. However, control by heat has little application to pest control in museums because of the damage which the high temperatures cause to the museum objects themselves and to the containers in which they are housed. Having said this, I am aware of one museum which still places complete drawers of insects in an oven at relatively low temperatures, as a method of pest control.

Low temperatures

Freezing would appear to be one of the most promising methods of pest control available to natural history curators. It has been used for herbarium material at the

Swedish Museum of Natural History, Stockholm (quoted in Crissafulli, 1980) at the Royal Botanic Garden at Kew (Anon, 1980 and Hall, 1981), and at the British Columbia Provincial Museum (Ward, 1976); and for mammal material (Williams, Genoways and Schlitler, 1985). Although some doubt has been expressed at the claim that the treatment can be 100% effective for all pest species at all stages of the life cycle,it would appear that the treatment can be very effective if carried out rigorously. It is recommended that material being treated should be held at -18 degrees Centigrade for a period of 48 hours although Florian (1986) quotes correspondence with Billings at the Slough Laboratory of the Ministry of Agriculture and Fisheries in which he cites experiments which showed that some species of pests were killed effectively in much shorter periods.

Some precautions need to be taken. If large and bulky parcels of herbarium specimens are treated, it may take a long time for the temperature to fall to the required level (in one instance at Kew it took 17 hours). If this is likely to be a problem a thermocouple can be inserted into the middle of the bundle to monitor the temperature. It is probably better to keep bundles small to allow for air circulation within the freezer

There is also evidence to show that some species of insects can acclimatize to low temperatures in certain conditions. The answer would seem to be to ensure that the rate of cooling is rapid enough to prevent this from happening. There is also evidence to show that a slow rate of thawing is most effective.

It is recommended that material is packed in airtight, clear polythene film before treatment. Condensation should not occur inside the bag if it contains absorbent material but silica gel can be used if condensation is likely to occur. After freezing, material should be left inside the polythene wrapping until it has reached room temperature and there is no condensed water on the outside of the bag.

Freezing can affect the germination rates and viability of seeds in herbarium specimens and if this is a factor, advice should be sought from the Royal Botanic Garden. It is unlikely that freezing will adversely affect other types of natural history museum objects unless adhesives have been used.

Freeze drying

Although it is likely that freeze drying may be more effective than simply freezing, the difficulty in obtaining freeze drying equipment with a large enough chamber makes its use for this purpose impractical.

Microwave

The treatment of pest infested museum specimens with microwaves has been used experimentally with textiles (Reagan, 1982), and with herbarium material (Hall, 1981 and Florian and Kennes, 1981). The technique is based upon the principle that microwave radiation (recommended dose 2 minutes at 2450 MHz/sec) agitates water and fat molecules in the insects, raising the temperature to the extent that they are killed. It should be noted however, that the objects being treated will also be subjected to a significant rise in temperature and that this will be increased if the objects contain fat or water. Reagan concluded that the deleterious effect on textiles made the treatment unsuitable for all but the most robust specimens. Problems have also occurred when using microwave for the treatment of herbarium specimens. Philbrick (1984) noted the devastating effect of microwaves on the viability of some seeds, and Florian (1981)

records that in some cases it weakened adhesives, and in others it caused pine cones to open and shed seeds. Also, unobserved staples or foil could cause burning of associated materials. It was concluded that the method can not be recommended as a standard treatment to disinfest herbarium specimens.

Gamma radiation

Although widely used commercially, particularly in the food industry, gamma radiation has not been used in museums because of the cost of the equipment and the complex safety precautions necessary. However, Urban and Justa (1986) describe the installation of a gamma radiation unit at the Museum of Central Bohemia in Roztoky in 1980 in which a cobalt source was supplied by the Nuclear Research Institute which happened to be located nearby. The authors state that a dose of 250 to 500 Gy is sufficient to kill wood boring beetles at all stages of their life cycle and that the rays will penetrate to a depth of 1 metre. The radiation chamber measuring 4.5 x 4.5 x 3.6 metres allows large objects to be treated. The authors also claim that no damage is caused to wood, polychrome, oil and tempera paints, surface coatings and glues, straw, textile, leather, parchment or paper.

The possibility of setting up one or two regional centres for gamma radiation appears attractive, but the claims that the objects themselves are not damaged in any way should be treated with some caution. A literature survey reported in *The Abbey Newsletter* on the effects of gamma radiation indicates that there is a weakening of the physical strength in some materials and there is clearly a need for further research.

Butterfield (1987) showed that gamma radiation caused a decrease in the mechanical strength of some papers. A pilot project into the effectiveness of gamma radiation to control mould and insect infestations (reported in *The Abbey Newsletter* April, 1984), carried out at the Alan Mason Chesney Medical Archives at John Hopkins Medical Institution in Baltimore, USA, found that a treatment of 0,45 Megrads for 45 minutes was effective for mould and insect pests (no details of species). The estimated cost was $1.00 per cubic foot.

Summing up

At the present time, the most effective and practical treatment for insect pest control in natural history collections would seem to be freezing. However, developments with gamma radiation need to be followed and more research is needed.

References

Anon. (1980). Disinfestation of dried specimens at Kew. *Taxon*, **29**: 198.

Butterfield, F.J. (1987). The potential long-term effect of gamma radiation on paper. *Studies in Conservation*, **32**: 181-191.

Crissafulli, S. (1980). Herbarium insect control with a freezer. *Brittonia*, **32**: 224.

Florian, Mary-Lou E. (1986). The freezing process - effects on insects and artifact materials. *Leather Conservation News*, **3**: 1-17.

Florian, Mary-Lou E., and Kennes, L.M. (1981). Testing G.E. microwave oven Model Jet 86, frequency 2450 MHz for disinfesting herbarium specimens as a means of insect control. *Memorandum*, British Columbia Provincial Museum.

Hall, D.W., (1981). Microwave: a method to control herbarium insects. *Taxon*, **30**: 818-9.

Philbrick, C.T. (1984). Comments on the use of microwave as a method of herbarium insect control - possible drawbacks. *Taxon*, **33**: 73-4.

Reagan, B.M. (1982). Eradication of insects from wool textiles. *Journal of the American Institute for Conservation*, **21**: 1-34.
Urban, J. and Justa, P. (1986). Conservation by gamma radiation: the Museum of Central Bohemia in Roztoky. *Museum*, **15**: 165-171.
Williams, S.L., Genoways, H.H., and Schlitler, D.A. (1985). Control of insect pests in mammal collections. *Acta Zool Fennica*, **170**: 71-3.
Ward, P.R. (1976). *Getting the bugs out.* Museum Methods Manual No.4. Friends of the Provincial Museum, Victoria B.C.