

Chantry Library Bibliographies:

No 6: Integrated Pest Management by Amy Crossman and David Pinniger



Left: Female *Anthrenus*, carpet beetle producing a pheromone attractant to attract males (Reference: Child and Pinniger, 1994)

Centre: Stored Australian parrot specimen seriously damaged by *Lasioderma serricorne* (Reference: Doyle et. al. 2007)

Right: Tom Strang demonstrating that heating with controlled humidity has no effect on a sensitive wood object (Reference: Strang, 2001)

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Amy Crossman possesses an MSc in Collections Care from Cardiff University, 2009 and a BA (Hons) Conservation and Restoration from University of Lincoln, 2004. She has 15 years' experience working as a conservator for various national and international organisations. A consultant conservator since 2018 in collections care specialising in integrated pest management, Amy has long-term involvement in the delivery and development of the British Council's International Museum Academy Myanmar programme, designing and delivering a national conservation training framework, specifically implementing and progressing Integrated Pest Management countrywide; details can be found at <https://www.britishcouncil.org.mm/programmes/arts/international-museum-academy-myanmar>. Amy is Trustee for the International Association for the Study of Arabia and steering group member for Pest Odyssey UK. She speaks the Arabic language and has translated and proofread integrated pest management and conservation terminology from English into Arabic.

David Pinniger is an entomologist who formerly worked as a research scientist for the Ministry of Agriculture, Fisheries and Food (MAFF) Pest Infestation Control Laboratory (later Central Science Laboratory) in Slough. For the last 25 years he has been an independent consultant providing specialist advice and training on pests in museums, archives and historic houses. He is the pest management strategy adviser for English Heritage and advises many of the major national museums and galleries and historic houses in the UK. David has also worked with overseas museums and delivered lectures and training workshops in many countries. He is the author of over 60 papers and publications, including the books *Integrated Pest Management in Cultural Heritage* and *Pests in Houses Great and Small*.

Amy and David have collaborated on an ongoing project to create a searchable IPM literature database detailing a wide range of IPM-related references. The database can be accessed via <http://www.whatseatingyourcollection.com/reference.php> and many of the sources it contains can be consulted in the Chantry Library. In 2019 David donated part of his working IPM collection to the Chantry Library.

Introduction

The application of Integrated Pest Management (IPM) transcends museum disciplines, collections and material types. Whilst aspects of IPM have been carried out in various forms for hundreds of years in the West, with its roots in a domestic setting, it is not until the relatively recent past that it has been recognised as a discipline within its own right. Some early IPM research was not always published in museum journals but in publications in other fields, such as stored product protection, and is therefore difficult to track down. This is reflected in recent conservation literature, which is beginning to generate its own specialist body of sources. The advent of the internet has resulted in the development of online resources and identification tools. To guide the reader, this selected bibliography has been arranged chronologically within themes, allowing for progression within topics to be easily identified and traced. It is interesting to note that some of the most useful papers on practical IPM are case studies published in conference proceedings rather than in peer-reviewed journals. The key to IPM for conservators is understanding the biology and behaviour of insect pests and their response to our actions.

Books

Ward, R. Philip. *Getting the Bugs Out, Museum Methods Manual No. 4*. Victoria: British Columbia Provincial Museum, 1976.

Whilst this is the earliest publication relating to IPM within a museum context, it does not recognise the holistic nature of the process, focusing on the treatments used to disinfect materials. Some of these treatments are no longer acceptable but at the time of writing were deemed appropriate and relevant. The booklet contains many interesting facts and observations which are still applicable to IPM workers today. It draws on knowledge and research from a diverse range of disparate fields, from the military to the stored food product industry, as sources of information.

Zycherman, L.A. and J.R. Schrock, eds. *A Guide to Museum Pest Control*. Washington DC: AIC/Association of Systematics Collections, 1988.

The first and seminal publication on IPM in museums, but with the emphasis heavily in favour of pesticide usage. Each chapter is a contribution by an individual specialist and as such each stands as a discrete chapter rather than a joined-up, cohesive single-authored approach. Dawson's chapter 'The Effects of Insecticides on Museum Artifacts and Materials' is the first key reference to consider the deleterious effects of pesticides on museum objects.

Pinniger, D.B., *Integrated Pest Management for Cultural Heritage*. London: Archetype, 2015.

This book based on the author's earlier *Pest Management in Museum Archives and Historic Houses* (Archetype, 2001) offers a holistic, systematic, practical approach to formulating and implementing an IPM strategy for cultural heritage application. It considers all aspects of IPM including processes and procedures required to implement an effective IPM strategy. It includes full-colour photographs of the principal museum insect pests, serving as an effective and comprehensive identification tool.

Articles

Stansfield, G., 'Pest Control: A Collection Management Problem', *Museums Journal* 85/2 (1985) 97-99.

This article sets out to emphasise the lack of information available on current and historic pest control practices in the UK and in doing so suggests that pest control in museums is a global problem which

should involve a multi-disciplinary response. The interest in this article is that it is the first reference to distinguish between pre and post treatments, and consequently, it serves to highlight the various approaches taken by virtue of the level of vulnerability of different collection materials to insect attack. Basic principles are put forward that can be adopted by all museum workers across all museums and disciplines to counter the unknown use of historic pesticides.

Rossol, M. and W.C. Jessup, 'No Magic Bullets: Safe and Ethical Pest Management Strategies', *International Journal of Museum Management and Curatorship* 15/2 (1996) 145-168.

This article offers the very first direct reference to the phrase 'Integrated Pest Management' as a holistic and preventive approach to pest management in museums. It advocates a fully co-ordinated approach to IPM as the way forward, to eliminate reliance on the use of hazardous pesticides. In order to better understand the unquantified hazards faced, the authors argue IPM workers should have a good working knowledge of the main chemical classes of pesticides used in the past, but it also states it is impossible to provide an exhaustive list of possible treatments and chemical combinations which may lead to further adverse interactions. It points to the constraints of working in a museum environment, where lack of consistent recordkeeping and limited resources make it impossible to undertake exhaustive analysis, and by moving to a holistic approach, less toxic and more narrowly species-specific treatments can be sought. It cites many salient issues which are still relevant, referencing possible effects of pesticides on the research value of DNA of treated specimens.

Nesheim, K., 'The Yale Non-Toxic Method of Eradicating Book-Eating Insects by Deep-Freezing', *Restaurator* 6 (1984) 147-164.

This is the first case study of the real-life application of freezing to an infested library collection, offering a pragmatic and practical approach to using the freezing process as a safe alternative method to disinfest an operational library facility. Whilst it primarily focusses on assessing the efficacy of freezing on collection materials and insect pests, it recognises the need for additional preventive measures to be introduced to limit the spread of infestation from its source. It also points to the need for thorough documentation and development of freezing processes and procedures as key to maximising efficacy of treatment to minimise library disruption. Libraries were among the first disciplines to embrace IPM principles by recognising that their collections were vulnerable to pest attack.

Florian, M-L.E., 'The Freezing Process - Effects on Insects and Artifact Materials', *Leather Conservation News* 3/1 (1986) 1-13.

This is an important paper being one of the first to examine in detail the use of low-temperature treatments as an alternative to pesticides in the museum context. There is a comprehensive review of previous literature on insect responses to freezing and an assessment of the possible effects of freezing on the condition of a range of museum-collection types. A number of key points are made in this paper relating to the practicalities of freezing and the balance of risk. Firstly, the necessity of bagging to create a stable environment surrounding an object to protect it from loss of moisture during the freezing process and from condensation after the treatment. Secondly, that objects other than textiles may need additional buffering materials placed in the bag to maintain stability. Subsequent research, however, has shown that some of the observations on freezing resistance are not of practical relevance in the context of heritage treatments. More importantly, it has been shown that

longer single-exposure times are needed at -20°C to ensure that all stages of the pest are killed. This paper is an important contribution to IPM literature but more recent guidelines for freezing exposure times, such as in Pinniger's *Integrated Pest Management for Cultural Heritage*, should be used in practise.

Strang, T.J.K., 'A Review of Published Temperatures for the Control of Insect Pests in Museums', *Collection Forum* 8/2 (1992) 41-67.

The first in-depth study investigating the potential of thermal methods of pest disinfestation as a safe and ethical alternative to the use of previously identified harmful pesticides. In considering heat and freezing to determine lethal mortality thresholds for known museum insect pests, Strang concludes heat is a more efficacious method of disinfestation. This research is based on a thorough literature review of published thresholds from entomological data from many fields including food storage. It points to the many complexities of dealing with thermal treatment for cultural heritage purposes, including the lack of reliable data available and the lack of reported failures which prevent a 'complete' picture being built up. The paper shaped the direction of subsequent research in the field, and acts as a method of defining the use of thermal treatment methods.

Rust, M.K., Daniel, V., Druzik, J.R. and F.D. Preusser, 'The Feasibility of Using Modified Atmospheres to Control Insect Pests in Museums', *Restaurator* 17/1 (1996) 43-60.

This is the first article to evaluate the use of low oxygen atmospheres using nitrogen application to vulnerable collections as an alternative treatment to thermal methods. Using an experimental approach, the mortality of 10 known museum insect pests to anoxia in conditions replicating real museum objects, it was determined that it is possible to maintain low oxygen atmospheres of <0.1% oxygen to achieve complete kill of all life stages of the pests. It moved the profession closer to developing treatment methodologies suitable for direct application by the conservation profession, and it removed the implied, negative nature of some literature with regard to anoxia.

Strang, T.J.K., 'Principles of Heat Disinfestation', *Integrated Pest Management for Collections: Proceedings of 2001: A Pest Odyssey*. London: James & James (2001) 114-129.

Building on Strang's 1992 paper, this puts forward the scientific basis for the application of heat for disinfestation. His persuasive argument is a cohesive, evidence-based reasoning of the fundamental concepts of heat disinfestation, examining the effect of heat on both organism and object. It also demonstrates the importance of moisture stability and control to prevent damage to objects during the heating and cooling procedure. The crucial notion of relative risk is introduced as a method of assessing the risk of damage through heat treatment and shortening an object's useful lifetime by an infinitesimal amount against its destruction through lack of action, which is often poorly understood. It brings into focus the benefits of using heat, particularly considering operational restrictions organisations may face. The context in which heat treatment is framed, within the wider conservation profession, appeals to the conservator's ethical framework and values, which should compel us to consider changing our attitudes towards heat application for IPM purposes.

Kigawa, R. and T.J.K. Strang, 'Effects of Fumigants and Non-Chemical Treatments on DNA Molecules and Proteins: Case Studies on Natural History Specimens and Proteinaceous Components of Museum Objects', *Integrated Pest Management for Collections: Proceedings of 2011: A Pest Odyssey, 10 Years Later*. Swindon: English Heritage (2011) 115-122.

In-depth study considering the impact of thermal treatment methods on specimen DNA and amplification of DNA fragments by polymerase chain reaction (PCR), in light of previously identified damage from fumigant gas applications. It was concluded that thermal methods of treatment are the way forward as a least harmful approach, but that more research is required to determine the implications of repeated thermal application on specimen DNA and subsequent PCR analysis. It makes practical recommendations for the storage of specimens to reduce the impact of thermal treatments, which fall in accordance with conservation good practice guidance.

Child, R.E. and D.B. Pinniger, 'Insect Trapping in Museums and Historic Houses', *Preventive Conservation Practice, Theory and Research: Preprints of the Contributions to the Ottawa Congress Sept 1994*. London: IIC (1994) 129-131.

One of the few articles dedicated to the trapping process and the first to describe the systematic approach to trapping in museums and historic houses as a basis for practical IPM. It contextualises the trapping process and its practicality and significance within a wider preventive conservation strategy. Whilst this article mainly examines the types of traps, including those with pheromone attractants, which are safe for use within collection areas, it also briefly touches on the complexities of trap data interpretation.

Doyle, A., Pinniger, D.B. and S. Ryder, 'Risk Zones for IPM: From Concept to Implementation', *Collections Forum 22/1-2*, (2007) 23-31.

The first documented case study of the introduction of risk zones as a preventive tool to assess the level of pest risk posed to collections, offering a programme flexible enough to respond to changing demands and new threats. It is the first reference to recognise that individual buildings have their own resident pest populations living on organic matter within voids and other dead spaces in the building rather than in the collections. Identification of high to low risk areas within the building allowed resources and procedures to be prioritised, adapted and targeted as appropriate. Through a cross-disciplinary approach and involvement of staff from different levels within the organisation, it was demonstrated that the process of arriving at risk zoning is as important as the outcome, resulting in buy-in and ownership of the final concept. An ongoing programme of staff awareness training is fundamental to maintaining cooperation and IPM effectiveness.

Kwindt, M. and L. Smyk, 'Building with Pest Management in Mind: A Case Study from the Canadian Museum of Nature, *Integrated Pest Management for Collections: Proceedings of 2011: A Pest Odyssey, 10 Years Later*. Swindon: English Heritage (2011) 46-54.

A case study providing an overview of the effectiveness of preventive conservation principles applied to a new build with a view to reduce the risk of pests entering the building. It demonstrates that while a range of basic through to more advanced IPM features can be effectively incorporated into a new build, it is the human element that requires continual reinforcement through regular training. Many of the features detailed are not IPM-specific, but are a common-sense approach to building design. The authors emphasise that ongoing regular maintenance, inspection and upkeep are essential to underpin the concept, and capital funding needs to be made available to support this work.

Stengaard Hansen, L., et al, 'The Brown Carpet Beetle, *Attagenus smirnovi*: How Will Climate Change Affect its Future Pest Status?', *Integrated Pest Management for Collections: Proceedings of 2011: A Pest Odyssey, 10 Years Later*. Swindon: English Heritage (2011) 55-60.

This article presents the results of a collaborative project analysing the impact of climate change on a relatively recent museum pest species, the brown carpet beetle, *Attagenus smirnovi*, across Scandinavia. It contextualises why IPM is practised in museums, as opposed to other methods. It is the first reference to link climate change to an increase in insect pest damage directly, rather than to changes in insect pest incidence, which is not always an effective damage indicator.

Conference Proceedings

Kingsley, H., Pinniger, D., Xavier-Rowe, A. and P. Winsor, eds. *Integrated Pest Management for Collections: Proceedings of 2001: A Pest Odyssey*. London: James & James (2001).

A joint conference of English Heritage, the Science Museum and the National Preservation Office held at the British Library, London, 1-3 Oct 2001.

Winsor, P., Pinniger, D.B., et al, eds. *Integrated Pest Management for Collections: Proceedings of 2011: A Pest Odyssey, 10 Years Later*. Swindon: English Heritage (2011).

A joint conference with the Collections Care Group in partnership with English Heritage, the British Museum, Natural History Museum, Historic Royal Palaces, Victoria and Albert Museum, Museum of London, Horniman and Tate, held at the British Museum, London, 26-28 Oct 2011.

Querner, P., Pinniger, D.B, and A. Hammer, eds. *Integrated Pest Management (IPM) in Museums, Archives and Historic Houses - Proceedings of the International Conference in Vienna, Austria, 2013*.

An international conference held at the Kunsthistorisches Museum, Vienna, 5-7 Jun 2013, papers available online <https://museumpests.net/conferences/> accessed 16 Feb 2020.

Nilsen, L. and M. Rossipal, eds., *Integrated Pest Management (IPM) for Cultural Heritage: Proceedings from the 4th International Conference in Stockholm, Sweden*.

An international conference held in Stockholm, Sweden, 21-23 May 2019, papers available online, <http://raa.diva-portal.org/smash/record.jsf?pid=diva2%3A1389000&dswid=-4849> accessed 14 Feb 2020.

Online Resources

What's Eating your Collections?

<http://www.whatseatingyourcollection.com/>