

# Integrated Pest Management for Cultural Heritage

Abstracts



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*Integrated Pest Management for Cultural Heritage – Abstracts*

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Day 1 – Tuesday

Theme:  
Communicating IPM

*David Pinniger, DBP Entomology*

## IPM – International Pest Management

My first encounter with pests in museums was when we found carpet beetle larvae eating the quagga at Tring Museum in 1976. Since then I have been fortunate to work in many museums, galleries, libraries, archives and historic houses in the UK. I have learnt many things, the most important being to recognise that each building is unique and will have pests and problems which may be specific to that site. However, it is also clear that there are many common issues which are shared by most collections and buildings which has led to the development of the key IPM guidelines of monitoring, housekeeping, environment and targeted treatment. Workshops which I have run in the UK have led to contacts in other countries and eventually to consultancy, workshops and conferences overseas.

I have been fortunate to work in a number of European countries and also in Canada, USA, South Africa, Japan, Singapore, Qatar, Australia and Brazil. Exchanging ideas with other people working with pests in these countries has proven crucial to the development of international IPM, leading to conferences in London, Vienna, Paris and now Stockholm. We know that climates and pests may be very different, but we can learn from each other from our success and mistakes. Accurate identification of pest species and an understanding of their behaviour and biology is essential to avoid inappropriate action and treatment. Recent developments have made it far easier to communicate with each other and there are valuable sources of accurate information on websites such as, [Whatseatingyourcollection.com](http://Whatseatingyourcollection.com) and [MuseumPests.net](http://MuseumPests.net). It is even more important that we continue to share our experiences with the challenges we now face from reduced budgets, political instability and climate change.

*Fabiana Portoni, Adrian Doyle & Julianne Phippard, The British Museum*

## Are we really integrating pest management: Reducing pest risk at a large national museum

Integrated Pest Management (IPM) is widely accepted as a crucial aspect of collections care. The British Museum aims to protect its vast collection from pest damage with a holistic approach to IPM. The museum has a clear policy, strategy, set of procedures and an outreach and training programme designed to incorporate pest management into every aspect of museum life. However, due to the complexity of its estate and organisational structure, and with increasing demands to use its collections, it can be challenging to ensure that measures to reduce the risk of pests are truly integrated into all activities and initiatives.

The British Museum's pest management plans are successfully integrated into activities such as large collections moves and creating new permanent storage. In these projects, IPM awareness has been an essential element of the programmes, with dedicated members of staff and evidence based learning. It is more difficult to ensure the same methodological approach with some other activities, such as loans, acquisitions, events and refurbishment projects. With pressing deadlines and changing team members, it can be challenging to adhere to our standard procedures. However, the effects of an infestation on mixed collections can be far-reaching and difficult to control. To those with collection care experience, the impact this might have on the preservation of the collection seems obvious, but conveying these potentially devastating effects to members of staff at all levels and with different backgrounds is imperative.

For this paper the authors have reviewed the effectiveness of the museum's pest management policies and procedures, and identified a number of obstacles to incorporating an IPM approach into all museum activities. Consistent communication and integrating pest management from the inception of projects has obtained the most positive results so far. Much work has gone into training and awareness and this has helped to improve aspects of planning. The aim is to enable a thorough understanding of the importance of a successful IPM programme and reaffirm the responsibility of all museum staff



for the long-term preservation of the collection. This paper hopes to share the lessons learned for the benefit of other organisations with similar challenges.

*Mel Houston, National Trust for Scotland*

## Train-the-trainer: Newhailes, a moth case history

The National Trust for Scotland's (NTS) Integrated Pest Management (IPM) programme relies on the NTS conservators training property staff to carry out IPM duties: pest trapping, identification, record keeping and limited treatments. Competing priorities and changes to the role of NTS conservators mean there is less time to train individual staff members. At the same time emphasis is placed on all staff and volunteers delivering high standards of collection care, including IPM to give visitors a day they'll remember. In order to provide training of a high conservation standard and focused on ensuring a high quality visitor experience the NTS is trialling a train-the-trainer approach to staff training; subject-matter experts (conservators) share expertise with a group of 'trained' trainers and this group uses the information to instruct another small group.

A pilot to test this approach was identified during a pest management project at a Trust property in 2018. A small group of trainers, with NTS conservators present, were trained using an external consultancy to deliver specific areas of collections care training for a group of non-specialist volunteers; emphasis was on training trainers to become skilled in effective speaking, targeting key collections care information in accessible forms for a wide learning audience and designing modular workshops that could be repeated by any of the trainers. Critically the conservators were trained in evaluating the effectiveness of the training and incorporating constructive criticism into the training process.

The pilot also focused on how to use IPM as part of the storytelling brief; to identify the IPM stories conservators wish to bring out but have had no time to develop. The story of conservation is one of the most under-utilised narratives and is currently done piecemeal. The training methodology was targeted to identify good collections care stories to tell and the appropriate method of delivery; including developing relationships with the Communications Department to issue

clear accurate information for press releases. This paper looks at the steps involved in implementing the pilot train-the-trainer approach to IPM in the National Trust for Scotland (NTS), identifying issues highlighted in the trial, assessing the efficacy of the programme for future collections care training and evaluating whether the investment to engage an external training company is worthwhile and if it delivers benefits that would not otherwise be achieved.

*Brenna Campbell, Princeton University Library*

## Building a Team: Establishing and leveraging a Preservation Liaison system at Princeton University Library

The Princeton University Library (PUL) Preservation Office serves a library system of over 11 million volumes, held in 12 buildings around campus. With a small staff of one Preservation Librarian and the support of a Conservation Unit of four, successful preservation practice is highly dependent upon engaging staff throughout the library system. These staff members provide on-the-ground knowledge of current conditions in their branches and departments and, with training, are able to respond appropriately to preservation concerns as they arise. They also spread awareness of preservation issues and good collections care practices among their colleagues.

Official Preservation Liaisons are designated within each branch and major collecting unit of PUL, as well as key departments such as Circulation, Inventory Management, and Facilities. These liaisons meet regularly as a group and are trained in a variety of preservation topics, including emergency response, environmental monitoring, and IPM. They serve as local experts within their units, providing real-time feedback to the Preservation Librarian about conditions within their collections. Along with the Preservation Librarian, the liaisons form the PUL Preservation Team. In this way, the Preservation Office is able to expand its footprint to cover all areas of the library system in spite of a very limited staff.

PUL's integrated pest management program includes the full Preservation Team, as well as staff and institutional partners from the shared high-density storage facility located on campus, the Research Collections and Preservation Consortium (ReCAP). The program

seeks to minimize the use of pesticides by taking a systematic, preventive approach to pest management including staff education, monitoring, environmental control, housekeeping, and facilities management. In the coming months, the Preservation Team will be working with the PUL Communications Office to develop and share training modules to lead staff through a preservation self-study program. These online modules will be supplemented by a calendar of in-person trainings and will be integrated into the onboarding process for new staff. By weaving preservation awareness into the role of each staff member, PUL is building a holistic culture of responsible collections stewardship.

This paper will cover the steps taken to establish the PUL Preservation Team, including gaining support from Library leadership, identifying liaisons, providing training, and setting goals, as well as tips for success and a discussion of lessons learned along the way.

*Matthew A. Mickletz, Winterthur Museum & Rachael Perkins Arenstein, A.M. Art Conservation, LLC*

## Social Butterflies: Social media as a tool for promoting IPM education

The Pew Research Center documents that between 2005 and 2015 social media participation rates for adults in the U.S. rose from seven percent to 65 percent. Now, in 2018, it seems that participating on at least one social media platform is imperative in world-wide networking, audience building and asserting relevance in society. This explosive rise mirrors a shift in the view of social media from a form of entertainment to a means of connecting personally and professionally. In 2016 the Integrated Pest Management Working Group (IPM-Working Group), an ad hoc group of museum professionals which has been working for over a decade on promoting IPM for cultural heritage, took the plunge, re-branding our Facebook page, launching a Twitter account and creating videos for a new YouTube Channel focused on driving traffic to our website [www.Museum-Pests.net](http://www.Museum-Pests.net).

Insect and rodent pests leave tactile, if unwelcome, evidence of their activities in our institutions, a scattering of frass, a hole in a textile, a stain on a book page. It is information with no need for translation into other languages. Photographic evidence of insect infestations

and resulting damage evoke fascination and horror in equal measure. It can thus prove challenging to translate this information into something more palatable that will promote the cause of IPM rather than repel viewers. Via short, concise tidbits of information utilizing links, photos, and hashtags, many times with a humorous slant, viewers are directed into our world of IPM. The audience is encouraged to let their guard down and participate in combating an ugly reality within our institutions.

This paper will examine the IPM-Working Group's efforts on social media and whether the use of these platforms translates into increased awareness of IPM goals and traffic to our website and listserv which provide access to professional resources.

*Jane Henderson, National Museum of Wales; Christian Baars, Cardiff University & Sally Hopkins, Gwent Archives*

## Standardizing and communicating IPM data

The practice of integrated pest management is well defined, and a common approach is spreading internationally following the production of protocols and standards that describe good practice. One essential element of IPM is the collection of data. This paper explores the potentials and limitations of data collection and presentation as commonly practiced within IPM, in particular the potential for confirmation bias in data collection following patterns of placement of insect pest monitors where problems are already identified. The paper examines the outcomes being sought from using IPM and asks whether the data collection and presentation currently offered are a good fit. Many IPM research questions identify dynamic challenges, such as the migration of a new pest through a country, or the spread of an established pest within a collection but common practice in data representation is less well suited to dynamic change. The paper proposes that a greater focus on the needs of the audience and the goal of data presentation is necessary to generate an effective range of approaches for peers, technical experts, colleagues and decision makers.

Improved communication of IPM data can enable more support and resourcing for its practice and is therefore an essential feature of an effective IPM strategy. This paper identifies that there is a weakness in how pest data are analysed, interpreted and represented in

many heritage contexts. The weakness applies both to the accuracy of the data and the efficacy of its communication. Effective IPM requires that actions are taken, decisions are made, budgets released or practice changed. To achieve this more work is required on the consistent and influential representation of pest data. At present, much of pest data representation is static, standard and dull. To better represent and communicate IPM data, the rationale for its collection must be considered, the basis of its collection standardised and the target for communication considered. Data collection intended to affect change must be informed by the change that is sought. Data collection that serves only to fulfil the goal of collecting data will have limited interest for anyone but the data collector. In identifying the person, group or institution that the IPM manager aims to communicate with, it is important to consider their needs, pre-existing knowledge, engagement in the topic, IPM's place in the receiver's priorities and the time and space in which they will consider the message.

Standardisation improves shared data resources, but this is only meaningful if that standardisation is based around a well-considered model. There is a need for a measurement of pest occurrence within a heritage institution that is neutral to the density of pest monitors and room size and that provides a stable index against which change can be measured. This paper recommends a fundamental change to the way that IPM data is collected and shared, using standardisation of data collection and a consideration of user needs in presenting the findings. This leads to the proposal for a consistent reporting unit for pest density: the pest occurrence index (Baars and Henderson 2019).

*Christian Baars, Cardiff University & Jane Henderson, National Museum Wales*

## Novel ways of communicating museum pest monitoring data: practical implementation

The introduction of Integrated Pest Management (IPM) at National Museum Cardiff (NMC) in 2014 resulted in immediate successes, demonstrated by a reduction in the numbers of pests in collections areas during the first two years of the IPM programme. More recently, attention has shifted towards achieving the same results in

non-collections areas, which was expected to be more challenging. In a bid to improve communication of data relating to the conservation of cultural heritage collections, and to assist the behavioural changes required to achieve this, new ways of communication were developed at NMC in partnership with Cardiff University. This required the development of a measure of pest activity that allows comparison of areas with different uses across a large and complex building: the Pest Occurrence Index (POI) integrates pest counts as well as the numbers of monitors deployed and the size of rooms monitored, decreasing unintentional bias introduced by previously used analytical techniques.

This index provides data that are comparable across rooms of different sizes, different collections, different areas of use within a building and even across buildings and institutions. Calculation of POI requires that a small amount of contextual information such as type of collection affected, room size, and number of pest monitors deployed are reported during pest monitoring to enable meaningful data interpretation. Collecting data on pest occurrences is a time-consuming task which needs to be justified to museum management, and if pest monitoring data are collected, they ought to be analysed appropriately to be of any valid use. POI can be used as a real and objective measure of the success of pest management efforts, and visualisations based on POI may be used to engage staff in new ways. There is no one-size-fits-all solution for this type of communication; instead, reports with specific messages need to be tailored to defined target audiences. Trials at National Museum Cardiff indicated that the introduction of novel and comprehensive forms of graphical data interpretation, based on the newly developed POI and with messages targeted at specific recipients at National Museum Cardiff, resulted in increased staff buy-in and willingness to assist with pest management and a demonstrable decrease in pest occurrences in some areas of the museum.

*Tom Strang, Canadian Conservation Institute*

## An Elephant walks into a Room – Population models to teach IPM

This paper discusses population modelling of pests as a teaching simulation to explore the topics of chance of discovery and rate of

harm. The models presented use literature values and sensible estimates for factors to project a future. The models train one's imagination and reinforces why collection of information is fundamental to IPM while examining challenges for its interpretation. While necessarily simplified models, they do cover core concepts of applied IPM in buildings, and they can be fun for participant class demonstration. In the course of teaching IPM it is important to discuss why trapping and inspection results, collection vulnerability and loss are all driven by the underlying action of the pest population growth. Students and administrators both need introduction to how pest populations can grow: to reinforce the need for treatment, and sustain IPM capacity in a museum despite reductions in staff activity.

*Lisa Nilsen, Ingela Chef Holmberg & Carola Häggström, Swedish National Heritage Board*

## We have an IPM standard – now what?

In 2016, a new European standard, EN 16970 Integrated Pest Management of Cultural Heritage was adopted. It is a managerial standard, stating what is essential in a museum, an archive or similar institutions, in order to keep pests, including mould, to a minimum.

The Swedish National Heritage Board (SNHB) has, since the start of the standardisation within CEN/TC 346 Conservation of Cultural Heritage in 2004, been engaged in contributing expertise to the different working groups. When standards started to be published, the SNHB felt the need to also promote these standards: if experts from all over Europe are creating them, they need to be used.

Since 2014, several actions have been taken in order to make the standards better known: translation to Swedish, brochures and leaflets, and SNHB staff promoting them at conferences and seminars. Perhaps the single most important action is that they have, during a three-year period, become free of charge to members of the public, with financial support from the SNHB.

The message of the IPM standard is very much in line with what PRE-MAL, the Swedish national IPM-group that is hosted by the SNHB, wants to spread to cultural heritage institutions. As part of a drive to promote the standard, it is currently being translated into Swedish. Short online IPM instructions are also being produced, with a focus of reaching smaller institutions, such as volunteer driven outdoor museums, churches, etc.



In the standard, the importance of the IPM coordinator is highlighted. As this is not a common job assignment in Swedish cultural heritage institutions, the SNHB decided to give two IPM coordinator training courses. The response has been great and the courses will take place in October 2018. The training courses will be based on the standard, and include ordinary IPM features such as identification of pests, but also encourage participants to involve their co-workers, and give advice on how to inform management on IPM issues. The course will also involve information on health hazards.

Another field, in line with IPM, is the effort from SNHB to spread more information on toxic substances traditionally used to eradicate insects, such as arsenic and DDT. An e-learning course was launched last year, which is focussed very broadly regarding the end-users: from museum managers and curators to cleaners and janitors. E-learning is a new field for the SNHB, and we are currently evaluating the format: if e-learning is a success, it could be another way to reach out in this very online-friendly country.

If you, as a reader of this article, are interested in joining the five-year revision of the standard, contact your national standardisation body.

*Amber Xavier-Rowe & Paul Lankester, English Heritage; David Pinner, DBP Entomology; Dee Lauder, English Heritage*

## Webbing clothes moth *Tineola bisselliella* and the risk to historic collections in England

Webbing clothes moth *Tineola bisselliella* catch data from English Heritage and other United Kingdom museums as well as from the general public following the Operation Clothes Moth campaign, are analysed. It is confirmed that *T. bisselliella* numbers have significantly risen to a level that represents the highest insect pest risk to collections housed in historic buildings in the UK. A review of the established annual total measurement and a new average per trap metric is undertaken. Total annual catch combined with insect pest management expertise remains essential for judging the risk posed by webbing clothes moth and other insect pests. *Monopis crocipitella* the pale back clothes moth is also highlighted as a possible future new pest species for historic house collections.



Diana Davis, National Museum of the Royal Navy

## Bringing IPM to historic ships in the UK

The National Museum of the Royal Navy (NMRN) has the largest collection of historic ships in the UK, located across five different sites within the museum group. These include *HMS Victory*, *HMS Warrior*, *HMS Trincomalee* and *HMS Caroline*, ships of differing periods and materials of construction. Until recently, there has been no consistent means of identifying and controlling museum pests within these historic structures. Introducing IPM practises to the ships will be discussed along with the challenges faced.

The main challenges centre around dealing with inherited pest infestations that include well-established wood-borers such as death watch beetle (*Xestobium rufovillosum*) on *HMS Victory*. This presents a significant threat to a high-profile item of national heritage, and has generated some pilot studies into the relationship between the wood-borers and fungal species on board the ship, as well as ways to quantify the damage from the beetles that are non-invasive.

Another challenge is found in communicating the importance of IPM to all staff and teams across a multi-site museum. A shared workshop space and pressures of time and resources within the busy museum sites often mean that proper quarantine measures have not been observed. Controlling the movement of objects and pests between sites is further hampered by a lack of quarantine facilities at many sites.

This paper is intended to discuss the problems and successes that have been experienced in introducing IPM to an unusual museum environment, where the historic ships are *de facto* gallery spaces that the visitors may walk through.

At the time of writing we have just had confirmation that an unusual silverfish discovered in the *HMS Victory* timber store is *Ctenolepisma lineata*, which is the first known report of this species in the British Isles. Collaborating with other institutions and specialists, including the Museum of London, we are looking into the implications for museums and collections care in the UK, in the light of this new potential risk. This find has highlighted the importance of accurate species identification in IPM practises and the vital need for quarantine facilities.

*Robert Child, Historyonics*

## Pesticides and their Heritage

Biocides in various forms have been used for the control of biological pests for thousands of years. Since the Industrial Revolution, with the advent of scientific developments, insecticides have become more sophisticated and effective. Their use in agriculture had the drawback that mammalian toxicity of some chemicals limited their use, but this restriction was not applied when used for treatment of cultural material. Highly toxic compounds such as mercuric chloride and arsenic have been used since the early 18<sup>th</sup> Century. Later formulations such as dichlorodiphenyltrichloroethane (DDT) were considered to be safer but were then found to have severe environmental repercussions.

Early commercial pesticides were expected to be long lasting and be effective for extended periods of time. Unfortunately many of them were, and we are left with their heritage in the form of pesticide residues. Historic buildings and collections were routinely treated against insect pests such as wood borers and textile pests and the chemicals used can still be detected.

This paper aims to identify the major pesticides used in the last two centuries on historic and artistic materials, how their presence can be detected and analysed and what risk assessments should be carried out for their use and exhibition. It will also consider methods of decontamination of pesticide residues. It should be remembered that many hundreds of biocides have been used historically and their detection is difficult.

Finally, the paper will review the effect of recent EU legislation (Biocides Regulations 528/2012), which restricts the movement of treated objects between countries for commercial purposes. This may affect sales, loans and donations of affected objects.

*Georgia Miller, Auckland War Memorial Museum*

## Socializing Integrated Pest Management

Integrated Pest Management (IPM) requires a museum-wide approach to be successful, effective tools for communication can prevent or reduce most pest problems. Empowering all staff to identify as stewards in the care of collections is challenging but can be achieved

with a variety of communication techniques that are accessible and insightful. Methods for socializing IPM at Auckland War Memorial Museum take the form of visually stimulating signage, engaging presentations, digital platforms and interactive educational tools. Varied strategies for spreading awareness have become increasingly necessary while the museum is undergoing major building transformations and since encountering an infestation of *Reesa vespulae*. By reconsidering traditional methods for communicating IPM and utilizing new and innovative techniques, staff interest and involvement has increased with a rise in the number of pest sightings being reported and pest considerations from non-collections staff. Soft skills such as positivity, creativity and good communication play a proven and integral role in the success of any IPM plan.





## Day 2 – Wednesday

Theme:  
IPM in the era of globalisation



Johan Mattsson & Kolbjørn Mohn Jenssen, Mycoteam AS

## Handling the increasing problem with grey silverfish (*Ctenolepisma longicaudata*) in archives

Grey silverfish (*Ctenolepisma longicaudata*) has become a major problem in Norway over a few years, both in homes and commercial buildings, e.g. shops, offices, museums and archives. Surveillance of various museums and archive institutions has shown that most of the insects are found in rooms for reception of materials and adjoining rooms such as offices, toilets and public areas. Only a limited number of the grey silverfish have been found in the archives and magazines themselves. To avoid grey silverfish being established in the buildings in general and especially in areas where they can cause critical damage in stored materials, it is important to maintain regular monitoring and specific assessment of the conditions. The main source of the insects into the buildings is through transport of goods, both the materials delivered for storage and other products, such as packaging, copy paper and other everyday office and canteen products. For this reason, handling incoming materials is central to reducing the risk of contamination. However, if the species have managed to establish a reproducing population in the building, the integrated pest management (IPM) must combine systematic monitoring, knowledge of the requirements for microclimatic conditions and the building physics in the actual building to reduce and in best case eradicate the attack. This study presents the results from examination/monitoring in seven archives as well as practical observations in other Norwegian locations.

Abby Moore, Rachel Chapman, Kate Perks, Frances Cooper & Letitia Steer, Museum of London

## *Ctenolepisma longicaudata* (grey silverfish): occurrence and behaviour in UK heritage organisations

At the 3<sup>rd</sup> International IPM Conference in Museums, Archives, Libraries and Historic Buildings, *Ctenolepisma longicaudata* (grey sil-

verfish) were reported from a UK heritage organisation, the Museum of London (MOL), for the first time. Silverfish data collected as part of MOL's ongoing IPM programme (from 2013–18) is presented, as well as data from three other UK heritage organisations also reporting *C. longicaudata* in their buildings. Grey silverfish are currently being reported from organisations based in urban locations, and it is observed that they are able to thrive in environments optimised for the long term storage of collections. Grey silverfish are also capable of establishing large and widespread populations in buildings containing significant food sources, making containment and remediation challenging, and emphasising the importance of effective building maintenance programmes and quarantine procedures.

*Julia Sybalsky, American Museum of Natural History; Robert Corrigan, RMC Pest Management Consulting; Robert Hanson, Lisa Elkin & Michael Freshour, American Museum of Natural History*

## Remote Sensor Technology for Rodent Surveillance in Museums: Trial Program at the American Museum of Natural History

As all those involved in collection care know, mice and rats pose significant threats to artifacts and biological specimens in museums. Remote rodent monitoring technology (RRMT) developed in the last 15 years provides early detection of rodent pests and many associated advantages for museum integrated pest management (IPM) programs. These products are now available from numerous manufacturers, including large scientific corporations as well as smaller entrepreneurs.

The American Museum of Natural History (AMNH) in New York City is among the first museums to evaluate this new technology in a large, structurally complex, functionally diverse institution. Outcomes of the AMNH trials provide insights into key criteria for assessing these systems and demonstrate the role of early detection alerts in better protecting museum artifacts from pest attacks. We observed increases in efficiency of routine trapping, opportunities for strategically investigating known or suspected activity, and a shift toward more environmentally sensitive trapping methods.

Adam Osgood, *Historic New England*; Patrick Kelley, *Insects Limited*; Eric Breitung, *Metropolitan Museum of Art* & Megan Creamer, *Andrew W. Mellon Fellow in Conservation, Historic New England*

## Long Lasting Insecticidal Netting as a Potential Form of Museum Pest Control: Effectiveness and Safety of Alphacypermethrin Impregnated Polyethylene Mosquito Netting for Pest Management of Clothes Moths (*Tineidae*) and Carpet Beetles (*Dermestidae*)

Long Lasting Insecticidal Netting (LLIN) has been used successfully as a barrier against pest migration in museum and art storage settings (Nicosia *et al.*, 2016, p. 46). This interdisciplinary research project aimed to further characterize the efficacy, safety, and feasibility of using alphacypermethrin LLIN in a museum IPM program. Laboratory testing was completed on webbing clothes moths (*Tineola bisselliella*) and cabinet beetles (*Trogoderma inclusum*). LLIN proved to be lethal to adult and larval stages of these museum pests on wool encased with LLIN and on wool interleaved with LLIN. Materials analysis of three brands of LLIN was completed through Oddy testing and gas-chromatography-mass spectroscopy (GCMS). Results suggested the netting may be safely used in proximity to museum collections on a temporary basis. Field studies were performed to evaluate the use of LLIN in the practical settings of a collections storage facility and at a historic house museum site. The field studies showed an interruption of the movement of adult webbing clothes moths and carpet beetle larvae after deployment of LLIN in areas of documented infestation.

*Caroline Laffont & Simona Drago, National Library of France*

## Management of an infestation at the National Library of France: the role of the IPM team

In October 2017, a *Lyctus* infestation was discovered in framed photographs made in the framing workshop of National Library of France. The alert was given and the infestation management process began immediately, under the supervision of the conservation department through its Integrated Pest Management (IPM) coordinator. The main goal of the IPM team was to evaluate the risk of the infestation spreading and to develop an appropriate remedial and preventive action plan. Meetings were organized to reassure the collections managers and curators of the low risk of spreading and to present them the action plans. The main challenge was coordinating the communication between all the stakeholders and determining the decision-making process in order to implement curative actions. This infestation was an opportunity to implement preventive procedures and actions previously not considered necessary, such as the reinforcement of insect trapping; the increase of training sessions; and the reorganization of spaces including fitting out a new quarantine area.

*Stephan Biebl, Ingenieurbüro für Holzschutz*

## Practical emergency plans in the case of pest infestations in museums

This paper reports on sudden pest infestations in museum exhibitions and storage facilities, which may happen without warning. These infestations may be caused by a lack of lending routines, lack of quarantine or infested transport boxes and wrapping material.

Practical experience from a consulting expert in museums helps to show solutions with different methods such as protecting storage rooms with tapes, using traps and quarantine. A description of methodology will be given along with recommendations based on personal experience to help avoid mistakes and failures by implementing IPM.



*Bartłomiej Pankowski, Jarosław Pawłowicz & Maria Dutkowska,  
SET Bartłomiej Pankowski*

## Neuronic™ system – a professional tool to identify and classify insect species

Monitoring traps in cultural heritage organisations has become crucial for risk assessment, and the necessity to identify the monitored insects has become a new challenge. This task is sometimes difficult for staff and the very activity of identification may be tedious and time-consuming. If external pest companies are contracted, logistics may be cumbersome as well. Hence, a wish to automate the processes has occurred. The newly developed Neuronic® app provides this possibility. Not only does the identification process become automated, but analysed data are digitized as well. Thus, the data can be archived and constitute a valuable resource for further investigations.

*Gabriele Sauseng, Ecodogs Austria & Pascal Querner, University  
of Natural Resources and Life Sciences, University of Applied Arts  
Vienna*

## Sniffing dogs in the detection of biscuit beetle (*Stegobium paniceum*) infestations in historic libraries

Using sniffer dogs to detect the Asian longhorn beetle (*Anoplophora glabripennis*), an introduced quarantine pest from Asia, is already widely used in Europe. Infested wood packaging materials are investigated by sniffer dogs to prevent the spread of invasive pest beetles. The infested wood is mainly used for the transportation of stones imported from China and outbreaks have occurred in many European countries (e.g. Austria, Germany, Switzerland, Italy and more). We started testing the capability of sniffing dogs to detect active biscuit beetle (*Stegobium paniceum*) infestations in historic libraries and museums in Austria. These libraries, often found in monasteries, hold thousands of books being stored in a single large room. Locating individual infested books is very time consuming, expensive and can often end without the source being found. A well-

trained dog should be able to detect an infestation in a room, locate actively infested books and also be able to locate potential sources of beetles in the building. We trained a 2 year-old beagle dog with original biscuit beetle frass from historic books, living adult beetles and larvae. In three locations (two libraries and one storage depository of a museum), the capacity of the dog to locate infested material was tested. Results are compared with other methods of monitoring like the use of sticky blunder traps, pheromone and UV light traps as part of an IPM program.

*Kilian Anheuser, Musée d'Ethnographie de Genève*

## Anoxic treatment or freezing? Consider your options

In objects conservation there are four generally accepted preventive or curative treatments for suspected insect infestations: deep freezing, anoxic treatment in a large air-tight chamber usually using nitrogen, anoxic treatment in small oxygen-barrier film bags with oxygen absorbers placed inside, and heating to *c.* 50–55 °C with strict humidity control. Each of these techniques has its specific advantages and drawbacks.

An experimental study of relative humidity (RH) fluctuations is presented for the two types of anoxic treatment and for deep freezing.

Anoxic treatment in a nitrogen chamber requires some considerable investment into infrastructure and takes several weeks per treatment cycle but carries the lowest risk of damage to the object through RH and temperature variations. It is suitable for treating large objects such as furniture or large carpets.

Anoxic treatment in bags with oxygen absorbers requires little capital investment but is limited to smaller objects.

Freezing to -25 to -35 °C has become popular as a rapid, inexpensive and convenient technique. The treatment only takes a few days and a suitably large freezer is affordable also to institutions on small budgets. However, RH fluctuations during treatment are significant. When the object is cooled to sub-zero temperatures, RH drops to very low levels as water is removed from the system by being frozen out. At the end of the treatment there is a risk of condensation on the cold object as the temperature of the environment increases. For polymers (glues, varnishes, natural resins, binding media) cooling below

the glass transition temperature creates a risk of brittleness and associated damage.

The effect of placing bags of silica gel (Prosorb™) with the objects to mitigate RH fluctuations was also investigated.

The paper concludes with recommendations for best practice in choosing the most appropriate technique for a given situation. All techniques have their rightful place in conservation but should have different areas of application.

*Maruchi Yoshida, kurecon Kulturgutrettungscontainer*

## Killing me softly... – Adaptive freezing as object-friendly and efficient pest control method

Freeze treatment is a pest control method accepted and applied by museums and archives. This paper describes a technical approach to apply the freezing treatment in a multipliable and scalable manner in order to support especially small and middle sized museums and archives to prevent and control pest infestation. ISO-standardized, air-conditioned containers are equipped with supplementary technology in order to control the re-humidification in regard to the dew point line of the object surfaces. Pre-tests are run in a climate chamber to assess the technical feasibility of available measurement, control and regulation technologies to precisely control the humidification in the freezing and thawing process. The first test series are run with paper material and grey silverfish (*Gtenolepisma longicaudata*). The focus is set on a fast treatment cycle with regard to the “highest” lethal temperature of the grey silverfish and to the avoidance of condensation on the object surface. Further tests are provisioned to achieve that plastic packaging can be dispensed with in future applications. Reference projects are started to create services which helps affected institutions to adapt their IPM-system to specific conservational needs, their individual economic requirements and general ecological principles.

*Katarina Havermark, Moderna Museet*

## The challenge of combining contemporary art and IPM at Moderna Museet, Stockholm

Contemporary art can present considerable challenges regarding integrated pest management, (IPM). The collection of Moderna Museet is relatively new and the museum building is only a few decades old. The very nature of a modern and contemporary art museum involves exhibiting and collecting high-risk objects. Already in the re-inaugural exhibition at Moderna museet in 1998, the Conservation Department encountered many challenges, followed by more in the coming years. Through increased awareness and shared responsibility, the IPM routines at Moderna Museet have gradually evolved and expanded during the period the museum has been operating in a new building.

*Bill Landsberger, Rathgen-Forschungslabor, Staatliche Museen zu Berlin - Preußischer Kulturbesitz; Harro Frauendorf & Cornel Adler, Julius-Kühn-Institut, Bundesforschungsinstitut für Kulturpflanzen Berlin; Rudy Plarre, Bundesanstalt für Materialforschung und -prüfung Berlin*

## Capability and Limitation of Anoxic Treatments in Museum Collections Protection

Without precaution, insects may cause serious damage to museum collections. Quarantine of potentially infested objects can be logistically challenging. Anoxia under controlled nitrogen atmosphere is a most gentle but also time-consuming method to eradicate insect pests in all kinds of different materials. Treatment results are usually affected by duration, temperature, humidity and residual oxygen content.

During a two-year research project, 34 relevant pest insect species of all developmental stages were tested in different materials (wood, paper, wool) to monitor treatment success and to determine optimum treatment parameters. Duration of treatment ranged from one to three weeks at temperatures of 20–27 °C. As expected, results

showed significant differences in mortality among tested species. Highest tolerance of hypoxic conditions was found in elder larvae of *Hylotrupes bajulus*. Although this species is an unlikely museum pest, it may serve as an overall most tolerant reference. Anobiids and other wood boring beetles are more often an issue related to cultural heritage. A combination of three weeks exposure time at maximum 0.5 % residual oxygen and 24 °C, alternatively 1 % residual oxygen and 27 °C are recommended for infested artefacts. Imbedding materials in general had no influence on mortality. This study was funded by Deutsche Bundesstiftung Umwelt (DBU).

*Christian Baars, National Museum Cardiff; Pascal Querner, University of Natural Resources and Life Sciences, University of Applied Arts Vienna & Charlotta Bylund Melin, Nationalmuseum*

## European restriction of using nitrogen in anoxic pest treatments – open discussion

### Basis for discussion

Nitrogen gas has been an important tool for the treatment of insect infestations in cultural heritage objects for many decades. At present, no satisfactory, safe and cost-effective alternatives to nitrogen treatment are available for objects made from materials that cannot be committed to freezing or heat treatments. Nevertheless, the use of nitrogen gas as an anoxic pest treatment of cultural heritage objects has been restricted in European Union member states since September 2017. This is the result of the introduction of 'Regulation (EU) No 528/2012 of The European Parliament and of The Council of 22 May 2012 concerning the making available on the market and use of biocidal products' (the so-called "Biocides Directive"), where nitrogen is now included as an Annex I biocidal active substance. There is some debate over whether, in addition to bottled gas, nitrogen produced in nitrogen generators is equally covered by the Biocide Directive. Controversially, nitrogen is currently used legally for food storage and treatment, where its use is sanctioned by different EU regulations. In addition to such inconsistencies, different EU member sta-

tes have interpreted the Biocides Directive in different ways, resulting in the institutions of at least two member states being allowed by their national authorities to continue to use nitrogen gas for pest treatment purposes, whereas in other countries national authorities have been more restrictive. Hence, amid the considerable confusion caused by the Directive, there is concern that one result of the implementation of the Biocides Directive may be the damage and even irretrievable loss of some cultural heritage items. In recent months, the confusion caused by the Directive and the concern for cultural heritage at risk from pest damage has created considerable debate at regional, national and international levels across the EU. This discussion aims to share the latest information on this debate, and to provide some indication of how the heritage sector may contribute to a derogation of nitrogen from the Directive for the purpose of protection of cultural heritage. Depending on the outcome of the discussion there may be an opportunity to support, either as individual conference delegates or as representatives of home institutions, the recent ICOM/ICOMOS statement calling to repeal the classification of nitrogen as a biocidal active substance for cultural heritage preservation applications, or a similar statement, with the aim of using the expert voices of the conference delegates to highlight the importance of nitrogen treatment as part of successful IPM.







## Day 3 – Thursday

Theme:  
IPM in a changing climate



*Gustaf Leijonhufvud & Tor Broström, Department of Art History,  
Uppsala University*

## A call for systematic monitoring: exploring the link between monitoring and management of cultural heritage in times of climate change

Climate change will give a warmer and more humid climate in Scandinavia, which will increase the risk of bio-deterioration of cultural heritage. Given the limited understanding of future risks, there is a need to adopt management strategies that are robust, adaptive, and that facilitate organizational learning. We therefore suggest that safeguarding cultural heritage from climate change impacts will require management practices that use feedback from long-term, systematic monitoring. In this paper we argue for the need of such monitoring, as well as discuss its conceptual foundations. Collected data can be used as feedback at different levels: to improve the scientific models of the system, to give early warning signs that require immediate management action and to improve long-term decision-making. Monitoring programmes cannot live a life on their own, decoupled from management. We advocate that monitoring and management should be set-up and work in tandem in a framework of adaptive management, where feedback from monitoring provides double-looped organizational learning.

*Tor Broström, Magnus Wessberg & Gustaf Leijonhufvud, Department of Art History, Uppsala University*

## Better safe than sorry? – Climate control for mould prevention

Climate change is expected to result in a warmer and more humid climate in northern Europe. Historic buildings with none or primitive climate control will face higher risk of bio-deterioration – mainly due to mould, rot and insects. The first part of the paper presents a technical cross-comparison of three different strategies for preventing mould growth: conservation heating, dehumidification and

adaptive ventilation. The investigation was carried out during three years at Skokloster, an unheated Baroque castle in Sweden suffering from problems due to high indoor relative humidity. The second part of the paper discusses the importance of understanding the load for measures aiming to reduce relative humidity in relation to the selection of control strategies and safety margins. We have shown how small changes in the safety margin or in future outdoor climate can have major implications on energy use, and illustrated how load duration curves can be a simple yet effective visual aid to support decision-makers in making informed trade-offs between preservation and energy use.

*Rebecka Karlsdotter, Studio Västsvensk Konservering*

## **Ecclesiastical textiles and mould – strategies for prevention**

Textile conservators in Sweden have seen an increasing problem with mould growth on ecclesiastical textiles. This paper will describe how the mould infested ecclesiastical textiles are decontaminated and new outbreaks are prevented at Studio Västsvensk Konservering, a conservation studio in Gothenburg. Mould can be hazardous for the health and can damage ecclesiastical textiles. The Church of Sweden has a long tradition of using liturgical colours on ecclesiastical textiles and therefore our churches house a large number of valuable textiles.

An anonymized church with mould and dampness problems is used to illustrate the process of decontaminating the ecclesiastical textiles. On some of the textiles sticky-tape tests for spores and hyphens were taken and analysed by the Swedish research institute RISE.

The paper also describes that it is impossible to fight mould on ecclesiastical textiles if the climate in the vestry is not controlled, further that good communication with the people involved in the care of the textiles in the church is key to obtain the desired results.

*Yoshihisa Fujii, Kyoto University; Masahiko Harada, Association for the Preservation of the Nikko World Heritage Site Shrines and Temples; Hiroyuki Kitahara, Total System Institute; Yuko Fujiwara, Kyoto University; Rika Kigawa, Kyushu National Museum; Yoshinori Sato, Yukio Komine, Masahide Inuzuka & Tomoko Kotajima, Tokyo National Research Institute for Cultural Properties; Shingo Hidaka, National Museum of Ethnology; Akiko Saito, Natural History Museum and Institute, Chiba; Tadashi Fukoka, The Japanese Association for Conservation of Architectural Monuments*

## Application of humidified warm-air treatment to entire historic wooden buildings at Nikko World Heritage site to control insect attack

To control insect attack, mainly by beetles, in historic wooden buildings in Japan, a humidified heat treatment system for large scale treatment was developed, and it was applied to two wooden Buddhist buildings in Nikko in Japan, in November 2017 and September 2018. The temperature of the airflow was increased from atmospheric up to 60 °C at a rate of 0.3 °C per hour and kept at 60 °C for three days. The humidity of the airflow was controlled so that the moisture content of the wooden parts was kept at initial air-dry level of about 15 percent. In the process of cooling down, another unit was employed for generating cooler and dry airflow to avoid water condensation in the treatment system. It was confirmed that the air in a treatment volume of about 400 m<sup>3</sup> can be controlled successfully by the developed system. The treatment ability was confirmed by the mortality of the test insects at several stages evaluated in a wooden sample. The strain both on the wooden surface and the Japanese lacquer surface finish was also evaluated using strain gages attached to the wooden members and test specimen. The strain was smaller in comparison with results obtained by a long term strain monitoring for the actual wooden members of the buildings in Nikko. No color change on surface finish, crack generation or deformation of the wooden parts was detected as a result of the treatment.

*Johan Mattsson & Ole Martin Stensil, Mycoteam AS*

## House longhorn beetle (*Hylotrupes bajulus*) in historic buildings – the importance of microclimate

The larvae of the house longhorn beetle (*Hylotrupes bajulus*) are dependent on stable temperature and moisture content in the wood to develop successfully over time. Surface temperature monitoring has suggested that even short-term exposure to direct sunlight can be lethal for the larvae. Examination of microclimatic conditions can therefore explain why damage can vary across the exterior of wooden buildings. It has been observed that the level of detail in the data analysis is crucial to understanding the whole picture. Based on this information, possible causes and possible prevention measures to limit house longhorn beetle activity are suggested.

*Sophie Downes, Paul Lankester, Sarah Lambarth, Caroline Rawson, David Thickett, Amber Xavier-Rowe, English Heritage & David Pinniger, DBP Entomology*

## Beetles Behaving Badly – Control of furniture beetle *Anobium punctatum* outbreak in wooden storage pallets

The emergence of furniture beetle (*Anobium punctatum*) during autumn, from wooden pallets storing collections at two large English Heritage (EH) stores, has raised questions over the effect of equilibrium moisture content on the lifecycle of *A. punctatum*. Results from an analysis of temperature, relative humidity, equilibrium moisture content and *A. punctatum* numbers at both stores are presented. A literature review suggests that *A. punctatum* cannot survive in wood with an equilibrium moisture content below 10 to 12%. Options for control are reviewed. Replacing wooden pallets with plastic over five years emerged as the solution for stone collections in storage areas with no or passive relative humidity control. For robust historic wood based collections an equilibrium moisture content /relative humidity control solution is investigated. The relationship between rela-

tive humidity and equilibrium moisture content isotherms are measured gravimetrically for five pallets. The minimum relative humidity to achieve 12% and 10% equilibrium moisture content is confirmed as 59.8% and 46.3% respectively. Over ten months the equilibrium moisture content of the wooden pallets has been kept below 12% for 98% of the time. Further monitoring is required to confirm the effectiveness of lowering equilibrium moisture content as a control strategy.

*Pascal Querner, University of Natural Resources and Life Sciences,  
University of Applied Arts Vienna*

## Communicating and teaching IPM

This paper reports on different Integrated Pest Management (IPM) courses over the last six years. Courses vary from one to five days and are a combination of practical exercises and theoretical lectures. These courses have been well received, as the training in monitoring, treatment, prevention, identification and documentation can be applied hands on in the home institution. Besides IPM courses, further activities to spread awareness of IPM are regular presentations at national meetings and conferences, publications in the native language and building a network of persons interested in IPM that meet annually in a national IPM working group. The background of the participating museum staff varies greatly between countries and institutions, making it interesting and a learning experience also for the teachers. Experts team up together to teach, making it more diverse and interesting for the participants. Developing guidelines, pest posters and starting a reference collection are new activities that can help an institution to continue working with IPM in the future.

## Posters

**Analysis of ten years data and countermeasures to reduce significant bird strikes on the large glass walls of a museum building by lighting design**

Rika Kigawa, Junko Akiyama, Hiroki Watanabe, Shiho Tomimatsu, Mika Matsuo, Kyushu National Museum & Hirofumi Okido, Hironori Kakimoto, Hiroto Okabe, Kyushu Environment Evaluation Association

**Backpackers and hitchhikers: The increased risk to collections in a global world**

Natalie Newman, Modified Atmospheres

**Biodegradation of traditional Japanese style shake roofs and preservative effect of copper plates on wooden shake**

Yuko Fujiwara, Kyoto University; Yosei Kozuma, Nara National Research Institute for Cultural Properties; Hitomi Nakano, HORIBA, Ltd. & Yoshihisa Fujii, Kyoto University

**Biological control of the webbing clothes moth *Tineola bisselliella* with *Baryscapus tineivorus*: experiences from five years of practical application (Lepidoptera: Tineidae, Hymenoptera: Eulophidae)**

Sabine Prozell, Biologische Beratung GmbH; U. Köhler, Abteilung Restaurierung, FB Präventive Konservierung, Stiftung Preußische Schlösser und Gärten & Matthias Schöller, Biologische Beratung GmbH

**How to repel bees without chemicals**

Joel Voron, Colonial Williamsburg Foundation

**Inside the wood: Biological control of *Anobium punctatum* with *Spathius exarator***

Alexander Kassel, Christine Opitz & Judith Auer, APC AG

**Integrated Pest Management and treatment methods in Austrian Natural History Museums and Collections**

Pascal Querner, University of Natural Resources and Applied Life Sciences, Department of Integrated Biology and Biodiversity Research, Institute of Zoology

**Integrated Pest Management: Informing the decision making process**

Amy Crossman, Collections Care Consultancy & David Pinniger, DBP Entomology

**Lizards in the Library: A case study of an established resident population of Mediterranean house geckos in collection storage areas**

Alan Van Dyke, Harry Ransom Center, The University of Texas at Austin

**Nitrogen as a biocide?**

Sergio Piras, RGI BIOSTERYL TECH Ltd

**Nondestructive evaluation of development, feeding, and oviposition of the bamboo powderpost beetle, *Dinoderus minutus***

Hiroki Watanabe, Kyushu National Museum, Yoshiyuki Yanase & Yoshihisa Fujii, Graduate School of Agriculture, Kyoto University

**Old books infestation by *Gastrallus pubens* Fairmaire (Coleoptera Anobiidae)**

Sara Savoldelli, Costanza Jucker, Serena Malabusini, Matteo Zugno & Daniela Lupi, DeFENS, Università degli Studi di Milano

***Oligomerus ptilinoides*, the discovery of a new Anobid woodborer in the UK**

Samantha Higgs & Rebecca Gilchrist, Historic Royal Palaces

**Practical IPM-work at the conservation studio 2019**

Lotti Benjaminsson, VÄSTARVET, Studio Västsvensk Konservering, Västra Götalandsregionen

**PRE-MAL: Pests, Research, Education – Museums, Libraries and Archives**

Ingela Chef Holmberg & Carola Häggström, PRE-MAL, Swedish National Heritage Board

**Selling IPM – Pest awareness in times of change**

Amy Sampson, The National Archives, Kew

**The early bird catches the worm – participatory methods to implement IPM-strategies within small and middle-sized museums**

Maruchi Yoshida, YCONS yoshida-conservation, Munich & Simon Kirnberger, Municipality of Munich

**What IS eating your collection? Is it eating mine?**

Jane Thompson Webb, Birmingham Museums Trust; David Pinniger, DBP Entomology & Lisa Nilsen, Lisa Nilsen Kulturvård

