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Thirty Years of Pest Control in Museums: Policy & Practice

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ABSTRACT

The Smithsonian's Museum Conservation Institute (MCI) has contributed to a targeted approach to Integrated Pest Management. This paper will review changes in museum practices that have taken place during the past thirty years: from the closure of ethylene oxide (EtO) facilities in major libraries and museums, the introduction of museum specific approaches and courses, the advent of preventive cultural changes, the tightening of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Occupational Safety and Health Administration (OSHA) workplace rules, the withdrawals of numerous pesticides and mothproofing agents, the advent of public outreach and inquiry, the development of intramural groups, the adoption of climate sensitive patterns and practice, to the formal licensing of conservators and collection management staff, and in-house museum based research on the effects of pesticides, the creation of standards for testing, and the mitigation of museum pesticides. The paper will focus on the effect of FIFRA on the development of museum working standards and research initiatives as safety issues, on the gradual recognition of the need for a scientific understanding of the biology, the materials, and the regulations to control and prevent insect infestations in museums. In doing so, the distance from economic entomology and general urban entomology will be underscored.

Keywords: FIFRA, fumigation, laws, IPM, pesticides, safety, object safety, toxicity

INTRODUCTION

During the last thirty years, the recognition of biodeterioration in the preservation of museum objects and the potential effects of pesticides on museum staff has gained prominence. At the same time, laws and regulations have also altered the landscape of pest control activities inside museums. The Smithsonian Institution with its 19 museums and 147+ million artifacts and works of art, is a federal trust facility open to the public, largely based in Washington, D.C. As such, it has weathered changes in policies and practices, even as the various museums and departments maintain individual procedures and protocols.

The Museum Conservation Institute, previously known as the Conservation Analytical Laboratory and then the Smithsonian Center for Materials Research & Education, is the central laboratory for research on art work and artifacts. It has been buffeted by the changes in federal and state laws and has also participated in advancing some of the alterations in museum policy, programs, and practices [1-7, 18, 20, 24, 29, 38, 39, 44, 46].

Although the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) had been enacted in 1947, its primary purposes were to provide farmers with sufficient information (“labeling”) about the pesticide products to use them safely and to establish performance standards—efficacy—for the pest(s) the pesticide was meant to kill. With the establishment of the Environmental Protection Agency (EPA) in 1970, this agency took over the administration of FIFRA from the Department of Agriculture. An update of the law in 1972 specifically mandated that the EPA consider the environmental impact as well as the regulation, sale, and use of pesticides. Under the authorization of the EPA, individual States enact regulations and enforce compliance of FIFRA, including the licensing and regulation of pest control operators (PCO’s), inspections of their operations, storage, and record keeping. Both in 1972 and again in amendments in 1978, 1988, and 1996 Congress has amended FIFRA to strengthen the registration and re-registration of pesticides. The 1996 Food Quality Protection Act, in particular, is important to museum and archives because it established special dosage and exposure for infants and children, when it established a ‘single health based standard for all foods’ and required a rolling periodic review and registration of all pesticides [4,5,12-13,15-16,19, 30-35, 37-39, 46-47].

This “registration” process differentiates the pesticide manufacturers from the requirements of the chemical industry needed to sell a small quantity of solvent. A generalized table lists several of the categorical differences. A fiduciary role is mandated by law for the manufacturer of a ‘restricted use’ pesticide; the manufacturer is required to specify the limits or boundaries of usage, is required to generate data and literature [12, 30, 31, 34, 37]. The pesticide applicator is required to hold, use, store, document, and dispose of residual pesticide in a specific manner (see Table 1). Thus, the period between 1980 and 1990 brought the greatest changes to fumigation practices and to pesticide use in museums as these regulations filtered down to museums and archives.

Table 1. A comparison of a restricted use Pesticide label with a MSDS (Material Safety Data Sheet) for a solvent used in Conservation [12, 21, 30, 31, 37, 41, 47].

Requirements	Restricted Use Pesticide	Small quantity chemical (ex. acetone)
Ingredients, Purity, Quality, CAS #	√, √, √,√	√, √, √,√
MSDS/SDS: handling, exposure, Personal protective equipment	√, √, √	√, √, √
Health Hazard: Toxicity class, LD ₅₀	√	possibly
Storage Regulation: Security Container	√ √	
Uses Permitted: Substrates Allowable Target Insect(s) When (timing before harvest) Conditions for use (°C, RH) Concentration permitted Duration	√ √ √ √ √ √ √	

Environmental Guidelines	√	
Placarding, Notification	√	possibly
Dept. of Transportation rules	√	
Mishandling:		
Civil liability	√	possibly
Loss of Access, Loss of Livelihood	√	
Criminal liability	√	
Record keeping of use, quantity required	√	
Academic studies		
Bionics, dosage, efficacy, safety	√-all	√-safety
Manufacturer's research		
Dosage, Logistics, Efficacy, safety	√-all	√-safety

DECADE OF THE 1980'S

Treatment strategies from broad-based biostats in storage units to single dose fumigation had paralleled the growth of climate controlled museum environments. Pest management inside museums was largely practiced by in-house technicians on a routine basis. The use of the fumigant ethylene oxide (EtO) became widespread. Ethylene oxide kills all stages of an insect and sterilizes mold as well. Policies were casual, and procedures, somewhat haphazard, as seen in Table 2 taken from a 1980 pesticide survey of zoos and science museums [7, 6]. While ethylene oxide was used by only 5% of responding institutions, another survey of 75 large (university) libraries and archives showed 36% (27) were using ethylene oxide and 16% (12) more had fumigation chambers not yet in use [2, 5, 8, 19, 32].

Table 2. From a 1980 museum survey: The Percentage of Responding Institutions taking precautions when dealing with pesticides [5, 8]

<i>Safety precautions taken</i>		<i>No precautions taken</i>		(%)
Minimize exposure periods	49	No perceived hazard	25	
Gloves worn	21	Too time-consuming	10	
Gas mask worn	12	Not specified	4	
Other	13			
<i>Ventilation</i>		<i>Air quality monitoring</i>		
Considered adequate	63	Human senses	84	
Considered inadequate	37	Gas detection	5	
		None	11	

The required re-registration of pesticides in 1980 ended the production of some products and led to the reclassification of others. Manufacturers had products they could not or would not support; museums were caught with equipment they could not legally operate. [19, 32, 34, 38] By 1983, fumigation was suspended in the majority of US libraries and museums: their fumigation chambers were not compliant with the new standards and would cost too much to retrofit [5, 15, 19]. Fumigants like ethylene oxide,

methyl bromide, and sulfuryl fluoride were severely restricted; others like Dowfume 75 (ethylene dichloride in carbon tetrachloride) were no longer manufactured. In the face of the new federal mandates, many pesticides and mothproofing agents were also dropped from production [2, 16, 35, 48]. This was the beginning of the end for a great deal of “off-label” and casual use in museums, libraries, archives, and zoos [4, 8, 30, 32, 38-40].

While the Smithsonian Institution had already purchased and installed a fumigation chamber and smaller vacuum fumigation unit in a purpose limited space at the Museum Support Center (MSC) for the Conservation Analytical Laboratory (CAL) to operate, it also contracted Keith Story from Harvard to write a book geared to insect control in museums, incorporating Integrated Pest Management (IPM) strategies. The book, *Approaches to Pest Management in Museums*, was published in 1984. CAL began to offer one-day courses on pest management, given by Keith Story, in 1985. Professionally, three CAL staff members, including the deputy director, qualified as licensed pest control operators (PCO's) [4, 11, 38, 39, 46].

DECADE OF THE 1990'S

IPM stressed the use of non-chemical means as a primary defense against insect damage. With broad spectrum insecticides like organophosphates, carbamates, and cyclodienes being canceled, scientists and collection managers had to consider new strategies [1, 10]. During the 1990's these strategies included the introduction of alternative inert gas disinfestation like nitrogen (N₂), carbon dioxide (CO₂), and Argon (Ar) and the approval of sulfuryl fluoride (Vikane) for chamber fumigation. Bionics—the study of an insect life cycle and preferences—produced new product and protocol avenues: baits, insect pheromones, growth regulators, and microbial predators [1, 10, 22, 23, 26-28, 42, 43].

Inside the Smithsonian, a group of conservators and collection managers responsible for pest control in their units founded a forum to exchange methods and ideas (Pizzazz group). Different museums and different collection units had divergent strategies in order to meet their collections' requirements: freezing for botany and anthropology, carbon dioxide fumigation for vertebrate zoology, argon anoxic disinfestation for fine art, and microbial predators for the live botanical studies. The past history of pesticide use at the National Museum of Natural History's (NMNH) anthropology department was published, as a monitoring study of the odd beetle there [17, 18, 22, 36, 45]. Later, the National Museum of the American Indian contracted to have a similar past history of pesticide use in the Heye Foundation collection completed for internal reference. Talks on insect bionomics (study of organisms and their relationships to the environment) were given to NMNH “MOVE” technicians who transferred collections from NMNH to MSC so that they were made aware of protocols for the health of the collection as well as for their own health. At MCI, the association of climate zones to species of museum pests was reviewed, citing temperate vs. tropical zones [28].

IN THE 2000'S

In the first decade of the second millennium, the role of biodeterioration in damage to fine art was established [25]. The ramifications of older practices were made clearer with new technologies [24, 29, 44]. At MCI, the portable XRF was re-characterized to identify the presence of heavy metal poisons—principally arsenic (As) and mercury chloride (Hg) [44]. The means to mitigate such residual pesticides was pursued at MCI in conjunction with the NMAI [29]. Down the hallway at the Laboratories of Analytical Biology, the cellulolytic bacteria inside the gut of termites were characterized [9]. Such

biological studies may help propel pest management forward in future decades. Other studies at MCI continue the review of Prussian Blue, an inorganic pigment and dye that loses color with anoxia (and high light levels). MCI also successfully carried out an anoxic treatment with argon on a major costume collection for the upcoming National Museum of African American History and Culture in two 11.5 x 11.5 x 8 foot (1058 cubic feet) plastic chambers [6]. As a result of subsequent work on this collection, which retains its susceptibility to insect attack, MCI promulgated a pest management policy and monitoring program within its footprint at MSC. It also has supported a specific textile protocol for the textile conservation laboratory. These efforts have increased awareness by all MCI staff and interns to conditions that can reduce insect activity within our collections. It has also benefited the office of facilities management by identifying the locations of anomalous pests (gnats, wasps) that may indicate building envelope issues that may need repair.

2010 TO PRESENT

Another problem encountered with Smithsonian collections has been organic residual fumes of paradichlorobenzene (PDB) and of naphthalene; some staff have proven to be more sensitive to these fumes than the threshold limiting value (TLV) or the perceptible odor minimum would indicate [20]. MCI continues to support the dissemination of the latest pest management information for museums. *Pesticide Mitigation in Museum Collections* is sold out but available free, on line [24]. MCI has trained several conservators in anoxic protocols and encouraged them to get PCO licenses. At the present time, one staff conservator is licensed as are two research associates.

SUMMARY

- Over the last thirty years, the Smithsonian Institution had supported a variety of pest management methods for a variety of reasons, within the guidelines of federal regulations. Across the museums a variety of suitable treatments have been developed.
- MCI supports BCIN, the Bibliographic Conservation Information Network database, where 1162 references on fumigation studies, 695 on pesticides, 1,077 on insecticides, and 3,119 on insects can be found [43]. Several hundred articles were collected over the years by MCI (and predecessor namesakes CAL and SCMRE) staff, who have also contributed their own research articles to those numbers.
- Smithsonian policies encourage collaboration across museums to understand bionomics and the specific requirements of federal agencies and preservation needs of particular collections.

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The administration of FIFRA, including licensing & courses:

In Maryland: <http://www.md.state.md.us>

In Virginia: <http://www.vdacs.virginia.gov/pesticides/categories.html>

In Washington, D.C.: <http://ddoe.dc.gov/service/pesticides>

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