Preventive Conservation and Pesticide Use: Investigating Potentially Contaminated Ornithology and Mammalogy Collections in Zimbabwe's Museums.

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Abstract

The preservation of natural history specimens has been heavily reliant on pesticide use. However, the treatment history of artefacts against pest attack has in general been poorly documented and much research in the global north has focussed on the use of pesticides and their potential negative health effects with repeated exposure. Research emanating from the global north has shown that some of the specimens collected in the 18th - 20th centuries were treated with hazardous insecticides such as arsenic and mercuric chloride. Such antiquated practices of pest management have since been largely abandoned in the global north in favour of integrated pest management practices. Many museums across Africa still rely heavily on chemical pest control. Natural history specimens at the Zimbabwe Museum of Human Sciences in Harare, for example exhibit unknown powders and residues, as well as naphthalene 'mothballs' on artefacts on open display, as well as in storage cabinets. This is likewise the case at the Natural History Museum of Zimbabwe in Bulawayo, which is one of the biggest museums with natural history collections in Africa. Its collections were obtained from across the globe including from the United States, Mexico, Britain, Denmark, India, China, Afghanistan, Kenya, South Africa, Botswana and Zimbabwe, and some date back from 19th Century up to the present time. Institutions such as the Smithsonian, and British Museum amongst others formerly owned some of these collections at a time when it was commonplace to use pesticides. As the collection in Bulawayo is the largest of its kind on the continent, it has invaluable potential for education as part of the school curriculum, as well as documenting historical and modern patterns of biodiversity. The repeated exposure to potentially hazardous residues on specimens could negatively impact on the use of these collections, as well as the health of its users, and the present research thus aims to identify if any potentially harmful contaminants are present on specimens through the use of XRF testing [1] at the Natural History Museum of Zimbabwe in Bulawayo. This research is the first of its kind for Zimbabwe, where the history of pesticide use is poorly documented, and if the presence of such hazardous substances are indeed identified, this research could provide impetus for improved curatorial practices in line with international best practice.

Keywords

Natural History Specimens, Taxidermy, Handheld XRF, Chemical Contamination, Safety Protocols.

Introduction

This research is being conducted to determine pesticide contaminants on selected natural history specimens in Zimbabwe's national museums. Zimbabwe has many natural history specimens which include mammals, birds, fish, reptiles, amphibians and invertebrates. The Natural History Museum of Zimbabwe has over 100 000 specimens collected from Southern Africa, making it the eighth largest in the world. It has the largest bird skins collection in Africa and the fourth biggest in the world after those at the British Museum, the Museum of Central Africa in Belgium and the American Museum of Natural History. The bird collection comprises about 100 000 study skins, 2 000 skeletons, 8 000 egg clutches, nests, an anatomical c-ollection as well as 40 specimen types. The specimens were collected from the 18th Century up to recent times, and they were acquired from Zimbabwe and across the globe including countries such as United States, Mexico, Britain, Denmark, India, China, Afghanistan, Botswana, Mozambique, Zambia, Tanzania, Kenya, Ethiopia (Natural History Museum of Zimbabwe n.d).

Widespread use of Pesticides on Natural History Specimens in Zimbabwe's museums

There is overreliance on pesticides for pest control across all national museums in Zimbabwe. Some of the pesticides that have been used or are currently in use include Naphthalene, Vapona®, Diaz®, Pyrethrin, Thymol and Gastoxin® (Chiwara 2018). Most national museums in Zimbabwe outsource pest control to private companies, and in most cases the pesticides used are sparsely documented. Inadequate documentation of pesticide treatment of museum artefacts is a global issue and thus it is not clearly known what pesticides was applied, how it was applied and when it was applied (Shugar and Sirois 2012; Pool et al 2005; Nason 2001; Purewall 2001)

Condition Assessments

Over 300 Ornithology and Mammalogy specimens have been assessed. Most of the specimens were in a good state of preservation, with a few showing signs of deterioration. Some collections had visible signs of contamination with some white powder on feathers and skins of the specimens as well as storage cabinets (See Figures 1-3). Naphthalene has also been discovered in storage cabinets (See Figure 4). There was heavy foul smell in storage indicating widespread use of pesticides for pest control.

Figure 1. White Pesticide Residues on Specimens and Storage Cabinets

Figure 2. White Pesticide Residues on Specimens and Storage Cabinets

Figure 3. White Pesticide Residues on Specimens

Figure 4. Naphthalene placed in Storage Cabinets of Specimens

Analysis of Specimens

Testing of specimens using Handheld X-ray Fluorescence spectrometry is underway at the Natural History Museum of Zimbabwe to determine heavy element pesticide residues (As, Hg, Pb, Cd) that have contaminated the specimens. Three hundred specimens are targeted for analysis. Observations of white powder on specimens and storage cabinets is indicative of pesticide contamination. XRF analysis is helping to determine some of these pesticide contaminants on the specimens. Initial analysis has shown that some specimens are contaminated with arsenic, mercury and lead (See Figure 5). The hides had the least inorganic contamination, with mostly lead containing material and fair amounts of arsenic, whereas ornithology specimens were heavily contaminated with arsenic and mercury. Hides were tanned locally, and ornithology had some of the oldest specimens collected from around the globe An additional 30 samples were taken for Chromatography analyses to determine organic pesticides which cannot be detected by XRF.

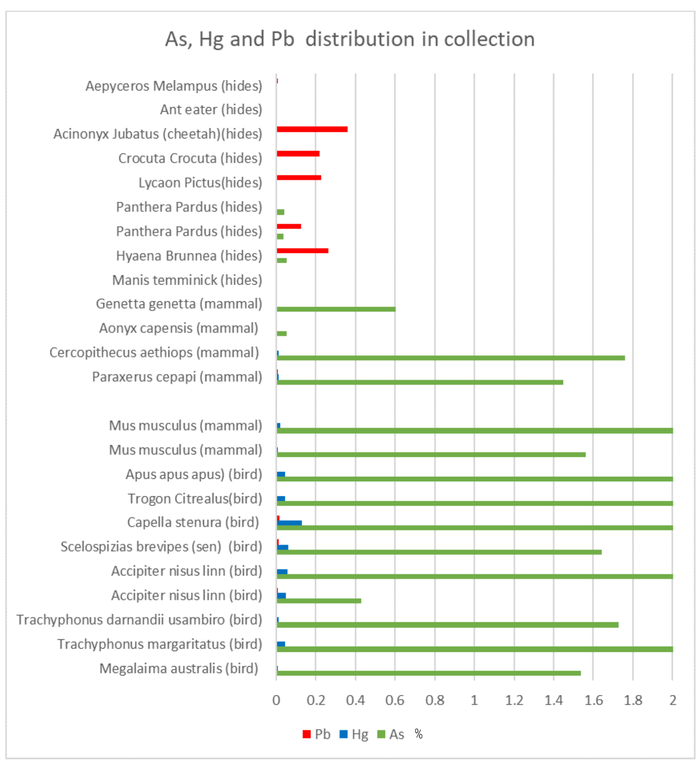

Figure 5. Selected XRF Data on Inorganic Pesticides Found on Specimens at the Natural History Museum of Zimbabwe

Conclusion

The identification of white powder on specimens and foul smell in storage areas in the museums is a warning for possible harmful pesticide contaminants that may affect the health of museum staff, researchers and visitors who use these specimens. Research has shown that human exposure to some pesticides such as arsenic, mercuric chloride and naphthalene among others can lead to serious health problems such as cancer, anemia and lung, kidney and heart failures amongst others (Pool et al. 2005; Davies et al. 2001; Hawks 2001; Nason 2001). Research has also shown that some pesticides react with museum collections leading to their deterioration (Kigawa et al 2011; Austin et al 2005; Odegaard and Sadongei 2001; Goldberg 1996; Dawson 1992) In light of this, we are working towards ensuring that the museums quarantine contaminated artefacts by creating separate storage space to prevent cross contamination. We are creating labels that warn staff, researchers and visitors to the museum about contaminated collections in the museum's storage and exhibition areas. We are encouraging the museums to acquire protective equipment for use when handling contaminated specimens and working in contaminated environments. This includes nitrile gloves, goggles, respiratory masks and dust coats. We also are encouraging the museum to limit its over reliance on pesticides for pest control and adopt affordable indigenous methods for pest control such as the use of tobacco leaves, cinnamon and chili. These indigenous methods are healthy to museum staff, researchers and visitors and for the conservation of collections. The discovery of harmful pesticide contaminants on museum collections is not only unique to Zimbabwe. This is a widespread problem across most museums in Africa. A concerted effort must be made to avail funding for analysis of collections and to rectify the matter for the safety of museum personnel and visitors.

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