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Insect pest management programmes and results from their application in two large museum collections in Berlin and Vienna

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ABSTRACT

Since the 1980s the concept of Integrated Pest Management (IPM) has been applied in museums, historic houses and archives to reduce the application of pesticides and damage to historic objects. Insect pests such as the webbing clothes moth (*Tineola bisselliella*), drugstore beetle (*Stegobium paniceum*), different *Attagenus* and *Anthrenus* species or the common furniture beetle (*Anobium punctatum*) have been known as museum pests for a long time, having caused major damage to the collections of natural or cultural history. The monitoring (regular inspection) with sticky blunder and pheromone traps plays a major role in IPM to detect an infestation and to locate damaged objects. The results of a monitoring in 2010 in ten museums in Berlin of the Stiftung Preußischer Kulturbesitz and the Museum of Ethnology, Vienna, the Austrian Theatre Museum and six collections of the Museum of Fine Arts, Vienna, are presented. The most common pests found in both cities were webbing clothes moths (*T. bisselliella*), the drugstore beetle (*S. paniceum*), the varied carpet beetle (*Anthrenus* (*Nathrenus*) *verbasci*) and silverfish (*Lepisma saccharina*). The khapra beetle (*Trogoderma angustum*) and the brown carpet beetle (*Attagenus smirnovi*), both common pests in homes and museums in Berlin, were not yet found in Vienna. *A. smirnovi* may be replaced in Vienna by the ecologically similar species, the black carpet beetle (*Attagenus unicolor*). Four wood destroying pests were found in the study, *Nicobium castaneum* in Berlin and the common furniture beetle (*A. punctatum*), *Hexarthrum exiguum* and the powderpost beetle (*Lyctus brunneus*) in Vienna. The distribution of these species, other insect pests and the success of the IPM programs are discussed.

1. Introduction

The concept of Integrated Pest Management (IPM) was developed in the 1950s in the food industry and since the 1980s has been successfully applied in museums (see for example Story, 1986; Linnie, 1987; Albert and Albert, 1988). Strategies to be used by museums and IPM concepts were described by Jessup (1998), Kingsley et al. (2001), Boylan (2004); Pinninger and Winsor (2004), Strang and Kigawa (2006); Querner and Morelli (2010a, 2010b) and Querner and Simon (2011). The most comprehensive papers on IPM in museums were described by Kingsley et al. (2001), Pinniger (2004, 2008); Brokerhof et al. (2007a, 2007b), and Winsor et al. (2011). Today, IPM is an important part of preventive conservation focussing on the prevention of pest infestations and the reduction of pesticide application. This is achieved by sealing the building against pests, adapting the (micro-) climate, maintaining high hygienic standards, quarantining new and incoming objects and monitoring pest infestations with traps. Only when necessary are non-harmful methods used to treat infested objects (see for example Linnie, 1996; Åkerlund et al., 1998; Jessup, 1998; Strang, 1999; Kingsley et al., 2001). Today, after prohibition of the use of methyl bromide and hydrogen cyanide, very few museums in Europe regularly use pesticides against insect pests. Treatment methods were changed to chemically free methods like heating, freezing or anoxic treatments, mainly with nitrogen or CO_2 (see for example Gilberg, 1989, 1991; Gilberg and Roach, 1991; Strang, 1992; Selwitz and Maekawa, 1998; Maekawa and Elert, 2003; Pinniger, 2003). Chemicals are only used in emergencies or when no other method can be applied such as, for example, when only a few days

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remain before the opening of an exhibition with infested objects. Insect pest monitoring is an important part in IPM to detect pests, to provide for the correct identification of species involved and to locate the infested objects or problems associated with the building (Child and Pinniger, 1993; Cox et al., 1996; Ackery et al., 1999; Pinniger et al., 2004; Child, 2011). All these aspects require consideration by one centralized person in charge of the IPM project for the coordination of data collection, treatments and the setting of priorities for further actions.

Pests like the webbing clothes moth *Tineola bisselliella* (Hummel, 1823), less frequently the case-bearing clothes moth *Tinea pellionella* Linnaeus, 1758, the drugstore beetle *Stegobium paniceum* (Linnaeus, 1761), the common furniture beetle *Anobium punctatum* (De Geer, 1774), different carpet beetles (*Attagenus* sp. and *Anthrenus* sp.), silverfish *Lepisma saccharina* Linnaeus, 1758, but also mice or pigeons, regularly cause problems in European museums.

Most museums in Germany, Austria and Switzerland disclaim today the use of pesticides and have started implementing an IPM program, or at least parts of it. But most European museums have yet to put a long term monitoring protocol in place and IPM is not jet standard for all large collections (for Germany and Austria cases see Reichmuth et al., 1991, 1994; Unger et al., 1996; Wudtke, 1996, 2002, 2003; Brand and Wudtke, 1997; Pinniger, 1998; Ranacher, 1998; Wieβmann, 1998; Unger, 2002; Noldt and Michels, 2007; Querner and Morelli, 2010a,b). In Hilbert's book (2002) on museum conservation and safety, a German standard textbook for museums, IPM as a concept or monitoring tool is not presented in sufficient detail.

In the present study we describe and compare the IPM strategies applied in the large collections of the National Museums of Berlin and the Museum of Fine Arts in Vienna Kunsthistorisches Museum Vienna with its integrated institutions of the Museum of Ethnology, the Austrian Theatre Museum. The results from the monitoring in the different museums and collections in the two cities for the year 2010 are presented. The distribution of some of the most common pest species and measures taken against them are discussed.

1.1. National Museums of Berlin

The National Museums of Berlin form part of the Prussian Cultural Heritage Foundation, which was set up in 1957. The Foundation is one of the world's major cultural organizations with the State Museums of Berlin, the State Library, the Secret State Archives, the Ibero-American Institute and the State Institute for Music Research. The 16 museums are devoted to the ancient cultures of the Mediterranean (Egypt, the Near East, Greece, Rome), to all branches of modern art and culture (paintings, sculpture, graphic arts, applied art, photography, film, video), to the great non-European cultures (India, the Islamic world, East Asia), and to the ethnology of all five continents.

Damaging insect pests have repeatedly infested some collections and storage areas of the foundation. In the Ethnological Museum, for example, mainly webbing clothes moths (*T. bisselliella*), biscuit beetles (*S. paniceum*), common furniture beetles (*A. punctatum*) and tobacco beetles (*Lasioderma serricorne* (Fabricius 1792)) have been damaging the collections for many years. In earlier years, the museums had a treatment chamber where lindane (benzene hexachloride) was used for pest control. In 2002 a nitrogen tent (O_2 at 0.8% and 25 °C) and a walk-in freezing chamber were installed in the museum, which is used mainly for objects from the ethnological collection but also by other institutions of the foundation. Until recently few collections had set up a monitoring program (some parts of the Ethnological Museum, the textile collection of the Museum of European Cultures and the Bode Museum).

Because of a large clothes moth outbreak in 2008 and repeated infestations in the museum, a fulltime IPM position for the foundation was allocated to the Rathgen Research Laboratory in 2009. The aim was to implement an IPM concept, start a large scale monitoring program, train museum staff, prepare an insect pest species reference collection, and engage in research and dissemination. We present here the results of the first systematic monitoring program of 2010 in the museums of the foundation.

1.2. The Museum of Fine Art, Vienna (MFA KHM) Kunsthistorisches Museum, Vienna

The MFA KHM Vienna is one of the largest fine arts collections worldwide, comprising not only the MFA, but also the Austrian Theatre Museum the Museum of Ethnology and several other collections (see "Materials/Methods"). All are housed in Vienna and Ambras Castle in Tirol. The Vienna Museum of Fine Arts opened in 1891 and comprises artworks from seven millennia – from Ancient Egypt to the late 18th century. The collections of Renaissance and Baroque art are of particular importance. The museum has a large variety of object types and numerous exhibitions and storage rooms, housed mainly in historic buildings.

Formerly, all kinds of chemicals were applied in the collections against insect pests or fungi such as DDT (dichlorodiphenyltrichloroethane), naphthalene, methyl bromide (bromomethane), lindane (up to 1982), pyrethroid (until 1998) or ethylene oxide. The Museum of Ethnology had its own ethylene oxid fumigation chamber for treating infested objects. Eulan was sprayed on or objects were submerged in it until 1990, Thymol was applied to remove mold or Xylamon was used to combat wood-destroying insects. From 1996 fumigations with nitrogen were tested in the Picture Gallery collection (Ranacher, 1998) and an 80 m^3 walk-in nitrogen chamber was built in 1998. Since then all infected objects from the museum, but also from other museums, institutions and private collections are successfully treated in the chamber in a five-week rhythm (at 0.8% O_2 and 25 °C). Ten years ago the first insect pest monitoring program was introduced in the Museum of Carriages collection and the implementation of an Integrated Pest Management (IPM) concept began. The museum was the first in Vienna to introduce an IPM programme.

By now, most collections have set up insect pest monitoring programs but different pest species still occur from time to time in the collections (see Querner, 2009 for an overview). In 2011 large parts of the museum collection were moved to a new high standard storage site (Querner et al., 2011). To prevent the introduction of pest species to the new site, all relevant collections were monitored in 2010 and the results are presented here.

2. Material/methods

2.1. Monitoring in Berlin

An insect pest monitoring program was introduced in a number of museums: Ethnological Museum (EtM), Museum of European Cultures (MEC), Bode Museum (BM), Museum of Islamic Art (MIA), Egyptian Museum (EM), Kunstbibliothek (Art Library; KB), Museum of Photography (MP), Kupferstichkabinett (Museum of Prints and Drawings; KK), Museum of Music Instruments (MI) and Geheimes Staatsarchiv (Secret State Archives Prussian Cultural Heritage Foundation; GS). Monitoring with sticky (or blunder) traps and pheromone traps (mainly for clothes moths) was started in spring (February or March) 2010 and checked monthly until October. Blunder traps have a sticky base to trap insects and are placed along the walls and in corners where pests are likely to be found. Pheromones traps are designed to attract specific insects. The traps were supplied by PestimoServices and traps were placed in storage areas, libraries and archives (see Table 1 for an overview of the