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**Using parasitoid wasps in Integrated Pest Management in museums against
biscuit beetle (*Stegobium paniceum*) and webbing clothes moth
(*Tineola bisselliella*)**

Abstract - Biscuit beetle (*Stegobium paniceum*) and webbing clothes moth (*Tineola bisselliella*) cause much damage to museum objects. Some objects and materials are very attractive to these two pest species and objects are often re-infested after treatment. For some years parasitoid wasps have been used in biological pest control to treat and reduce infestations of stored product pests in food processing facilities. Their application in museums is still new and in a research stage. Results from five different museums in Germany and Austria and their application are presented. *Lariophagus distinguendus* wasps were released against *Stegobium paniceum* in the municipal library Augsburg Stadarchiv (Germany), the Ethnological Museum in Berlin (Germany) and the Picture Gallery in the Kunsthistorisches Museum in Vienna (Austria). *Trichogramma evanescens* were released against *Tineola bisselliella* in the Technisches Museum in Vienna (Austria) and in the Deutsches Museum Verkehrszentrum in Munich (Germany). Results show that for active biscuit beetle infestations good results can be expected using the *Lariophagus distinguendus* in museums. Active clothes moth infestations are harder to treat but with a very regular and long-term exposure to the wasps, the clothes moth population can be reduced over the years. We see the application of parasitoid wasps as part of an Integrated Pest Management concept that should be used besides regular insect monitoring and other preventive measures. Difficulties, limitations and research needs in the application of parasitoid wasps in museums are discussed.

Key words: biological pest control, pest infestation, library, ethnological museum, pictures, historic vehicles, *Lariophagus distinguendus*, *Trichogramma evanescens*.

INTRODUCTION

An important part of Integrated Pest Management (IPM) in museums is the prevention of an insect attack. Different measures like sealing the building, regulating the climate, quarantine for all incoming objects, good cleaning and house keeping, training museum staff and monitoring all help to prevent an infestation (see for example Brokerhof, 2007; Kingsley *et al.*, 2001; Pinniger, 2004; 2008; Pinniger & Winsor, 2004; Querner & Morelli, 2010a,b) and are all part of an IPM concept and of preventive conservation. If an infestation is still found in the collection, different treatment meth-

ods like anoxia (nitrogen, argon or carbon dioxide), heating or freezing are applied in museums to kill the insects in all stages. Pesticides chemicals are normally not applied in museums anymore.

In recent years parasitoid wasps have been used in biological pest control to reduce infestations in food storage and processing facilities. Different parasitoid species are now commercially available and can be used against different moths and beetles. The results from different experiments of food selection, breeding parasitoids and releasing them against different stored product pests show good results. Publications are partly in German, see for example Schöller (1998a, b; 2010), Schöller & Flinn (2000), Schöller & Prozell (2003; 2006), Schöller *et al.* (1997; 2006), Hassan (1993) and Prozell *et al.* (1995). Their application in the food storage industry increases steadily in Europe (Zimmermann, 2004). As the same pests, such as biscuit beetles, tobacco beetles or webbing clothes moths, are also museum pests, parasitoids could also be used here. As yet few publications describe their use specifically in museums and libraries (but see Biebl 2009, Schöller 2010, Wilamowski *et al.*, 2008).

The use of different species of parasitoids like *Trichogramma evanescens* Westwood, 1833, *T. piceum* Dyurich, 1987 or *T. brassicae* Bezdenko, 1968 against *Tineola bisselliella* was described and discussed by Adler & Wudtke (1998), Biebl (2009), Plarre (2002), Plarre & Balnuweit (2002) Plarre *et al.* (1999; 2000), Wudtke (2002), Zimmermann (2005; 2004) and Zimmermann *et al.* (2003). *Lariophagus distinguendus* wasps were used against *Stegobium paniceum* in a historic library in Halle / Saale (Germany), where besides the book covers also the wheat straw insulation under the floorboards was infested (Schöller, 2010). Three other beetles regularly occurring in museums are also parasitized by *Lariophagus distinguendus*. These are the tobacco beetle *Lasioderma serricornis* (Fabricius, 1792) (see Steidle *et al.*, 2006), the hump beetle *Gibbium psyllodes* (Czenpinski, 1778) and the golden spider beetle *Niptus hololeucus* (Faldermann, 1836), described in Kassel (2008). Paul *et al.* (2007) discuss different parasitoid species used against common furniture beetles *Anobium punctatum* (DeGeer, 1774) but they seem much harder to treat using wasps. Wilamowski *et al.* (2008) present results from an infested library in Israel where *Lariophagus distinguendus* were successfully used against *Anobium punctatum*, but Steidle *et al.* (2007) found *L. distinguendus* unsuitable against the common furniture beetle.

We tested the application of two parasitoid wasp species against *Stegobium paniceum* and *Tineola bisselliella* in five different museums. Both pests cause much damage to museum objects. Some materials and objects are very attractive to these two species and are often re-infested after treatment. Both have a world-wide distribution and are very common in cities, where they also occur in private homes or are pests on stored products.

MATERIALS, METHODS AND RESULTS

Parasitoid wasps were released in five separate collections in Germany and Austria with an active biscuit beetle (*Stegobium paniceum*) or webbing clothes moth (*Tineola*

bisselliella) infestation. The release of the wasps was part of an IPM program in the museums to reduce or eradicate the pests. All parasitoid wasps were ordered from the company Biologische Beratung Ltd. (BIP) in Berlin.

Augsburger Stadtarchiv, Germany

In the large municipal library Augsburger Stadtarchiv an active *Stegobium paniceum* infestation was discovered in 2009. Besides cooling the rooms to slow down their development and treating the books with anoxia (nitrogen), 20 x 30 *Lariophagus distinguendus* wasps were released on two occasions in 2009 (August and September).

Ethnological Museum Berlin, Germany

In two collections (American and African Ethnology) of the Ethnological Museum in Berlin an active *Stegobium paniceum* infestation was discovered during insect monitoring in spring 2010. The monitoring was part of an IPM project (Querner & Simon, submitted) in the foundation "Stiftung Preußischer Kulturbesitz". Different types of objects were infested in various collections such as basketry, voodoo dolls, pumpkin bowls or other objects made of plant material. As the monitoring with pheromone traps for biscuit beetles was not successful (the commercial traps did not capture any beetles, even though live and dead beetles were regularly found on the window sills) and a very large number of objects were possibly infested (over 100,000 objects in total), we decided to release 100 x 30 *Lariophagus distinguendus* wasps on three occasions in 2010 (July, August and September) in the two infested collections (both collections were connected by a large shaft). The wasps were released in the two large storage rooms and 36 individual closets with possibly infested objects. Besides this biological pest control, objects were treated with freezing and nitrogen.

Picture Gallery in the Kunsthistorisches Museum Wien, Austria

The large picture collection of the Kunsthistorisches Museum is stored in different depots. Pictures have been repeatedly infested by biscuit beetles (*Stegobium paniceum*) in the past and many pictures in the collection show historic or recent damage by them. They attack specifically the paintings lined with starch paste linings (also described in France by Fohrer *et al.*, 2006). In 2010 a new outbreak of biscuit beetles was found in two of the large storage rooms during the monitoring. As the whole collection will be moved in 2011 to a new storage site, the pictures were not immediately treated. To reduce the beetle population and the damage to the paintings, we released 12 x 30 *Lariophagus distinguendus* individuals on three occasions in 2010 (April, May, June). The storage rooms were also cleaned and the number of sticky blunder traps increased. In 2011 no live or dead biscuit beetles were found on the objects, monitoring traps or floor of the storage rooms.

Technisches Museum Wien, Austria

One historic automobile in the museum exhibition space and one historic horse carriage in the storage depot of the museum were both heavily infested by webbing clothes

moths for many years. Therefore in 2009 we performed a mass release of *Trichogramma evanescens* in both objects. Four cards with 2,000 wasps each were placed in the car and in the horse carriage every four weeks from May until August. During the whole time the monitoring with pheromone traps was continued to evaluate the effect of the parasitoids. The release of the wasps did not have any effect on the moth catch during the whole active period of the moths.

Deutsches Museum Verkehrszentrum München, Germany

Felt mats in the historic cars in museum exhibition rooms were repeatedly infested with webbing clothes moths in the Deutsches Museum Verkehrszentrum in Munich. *Trichogramma evanescens* were released on a weekly basis in 74 cars and vehicles with a total number of 45,000 individuals per year. With the help of pheromone traps, the moth populations were monitored during the parasitoid release (2007-2009). After the third year of the release a significant decrease of moths was found from an average of 10-15 moths per car down to 2-3 moths per car. In some cars the moths were completely exterminated. Besides the release of the wasps and the monitoring, individual cars were treated with freezing, heat or nitrogen against the infestations.

DISCUSSION

We could show that the use of parasitoid wasps as part of an Integrated Pest Management concept in museums might have a big future. The method is cheap, easy to use and two of the main museum pests can be treated in a very effective way. Especially for objects that cannot be transported to a nitrogen chamber parasitoid wasps can do a good job in reducing the pest population or eradicating them altogether. We see using parasitoids as a part of an overall Integrated Pest Management concept in the museum. Only if other measures are also taken, like sealing the building, regular cleaning and introducing a quarantine, can new infestations in the collection be prevented. The temperature in the collection is an important aspect that has to be considered; parasitoid wasps are only active and able to find the eggs and larvae of the pests with temperatures above 15°C. In the museums mentioned most objects were still treated with nitrogen or freezing to kill the pests but more research could prove the release of parasitoids is also a suitable biological pest management or a preventive management strategy for museums with a regular release of wasps like in the Deutsches Museum Verkehrszentrum in Munich where they are still being released. The lack of effect found in the Technisches Museum in Vienna might be the very small size of *Trichogramma evanescens* wasps and their difficulty in getting to the moth larvae in the horsehair stuffing in the cars or carriages.

Still more research is needed to evaluate the efficiency of parasitoid wasps for their use in museums and to breed and test more parasitoid species for the different pests occurring in museums. Conservators of the collections are often not happy with the idea of releasing a large number of small insects in their storage rooms, so the effect of the parasitoid wasp has to be explained to them, and cleaning the collection after

treatment to eliminate the dead insects (pests and parasitoids) is also important. For the moment, their use is limited to the parasite species commercially available. Future research should focus on common species of museum pests like *Anobium punctatum* or different *Anthrenus*, *Attagenus* or *Dermestes* species, as they cause much damage on museum objects, especially in ethnological and natural history collections.

ACKNOWLEDGEMENTS

We thank the different museums for supporting and funding an IPM program and for their openness to testing and funding the use of parasitoid wasps in their collections. We also thank all the conservators we have worked with for their part in the IPM program

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