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Author(s): Holloway, G. J. & D. B. Pinniger

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Anthrenus species (Coleoptera; Dermestidae) found in UK museums with special reference to *A. museorum* Linnaeus, 1761, the museum beetle.

Graham J. Holloway[1*] and David B. Pinniger[2]

[1]*Centre for Wildlife Assessment and Conservation, School of Biological Sciences, The University of Reading, Reading, RG6 2AS, UK*

[2]*83, Westwood Green, Cookham, Berks SL6 9DE*

**Corresponding author: g.j.holloway@reading.ac.uk*

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Abstract

An important component of integrated pest management in natural history museums is the identification of pest insects. A small number of *Anthrenus* spp. can be encountered including *A. verbasci*, varied carpet beetle, and *A. sarnicus*, Guernsey carpet beetle. A species that would reasonably be expected to be found in natural history museums is *A. museorum*, museum beetle. However, the museum beetle is rarely, if ever, found indoors. A possible reason for this is provided. Identification of four *Anthrenus* spp. is considered including potential sources of confusion and levels of variation that need to be taken into account.

Key Words: *Anthrenus*, *Anthrenus museorum*, *Anthrenus verbasci*, *Anthrenus sarnicus*, IPM, pest management, carpet beetle.

Introduction

Pest management is an integral part of day to day operations in many modern museums (Pinniger, 2015; Querner, 2015). Pest species, such as insects and mammals, can cause irreparable damage to museum specimens so it is essential to pay attention to where they come from, how to keep them out, how to deal with them if you find them. Different species of insect pests of museums have different life cycles; different origins, feed on different materials, and might be susceptible to different control methods. As a result of this, an essential component of integrated pest management (IPM) is to know your enemy, and this can only be achieved through accurate identification. Misidentification could result in inappropriate management mechanisms being put into place or spending resources on control when none is required.

Almost everybody working in the museum sector, in particular museums and heritage institutions housing natural history collections in the UK, will have heard of the varied carpet beetle, *Anthrenus verbasci* Linnaeus, 1767. In its natural environment, *A. verbasci* feeds on dead insects, skin, hair and other keratinous materials. Our own homes frequently contain an abundance of this type of resource derived from us, our pets, or dead insects in quiet corners, windowsills, attic rooms and so on. It is likely that *A. verbasci* and other species of Dermestidae have been associated with us for a long time (Woodroffe and Southgate 1954). In some types of museums *A. verbasci* is a major pest capable of destroying dried insect collections, stuffed animals, hair and woollen products.

One of the great challenges in museums housing these materials is to keep the building clear of dead insects, hair and dust (from visitors and staff) that can attract and maintain a population of *A. verbasci* even though the museum specimens might be free of the pest.

Anthrenus museorum Linnaeus, 1761

Anthrenus verbasci is not the only *Anthrenus* species likely to be encountered in museums. One species that you might reasonably expect to encounter would be the museum beetle, *A. museorum*. The museum beetle is often quoted as a 'frequent and feared pest in museum collections' by eminent entomologists, a belief that has spread via electronic media (Háva, 2015). However, *A. museorum* is very rarely (if ever) found in buildings in the UK even though, again, it is often claimed to do so (Cooter, 1991; Háva, 2015). It has been proposed that it was once a pest in museums and has been superseded by other species (Peacock, 1993); we are not aware of any evidence to support this assertion. In fact, *A. museorum* appears to be quite a scarce species in the UK (NBN Atlas). This begs the question why Linnaeus named the species *Byrrhus* (later *Anthrenus*) *museorum* in the first place in 1761. In the middle of the 18th century there were very few natural history museums as we would recognise them today offering *A. museorum* very limited scope to achieve pest status in museums. However, many homes at the time housed curiosity cabinets which often contained natural history specimens. Perhaps it was here that *A. museorum* achieved notoriety. If this was the case it is odd that *A. museorum* is no longer a pest whilst *A. verbasci* clearly has pest status. *Anthrenus verbasci* was also described by Linnaeus in 1767. Perhaps it was realised that *A. verbasci* was the pest species but by then *A. museorum* had already been named and so the pest-status myth has persisted. There are records of *A. museorum* being collected from museums across continental Europe (Ackerlund, 1991); a critical examination of these records could be interesting.

Identification of *Anthrenus* spp.

Reference to museum collections from the late 18th century, early 19th century indicates that entomologists appeared to have difficulty distinguishing various species of *Anthrenus* from each other (Holloway et al., 2018). The most likely species to confuse with *A. museorum* is *A. fuscus* Olivier, 1789. Holloway and Foster (2018) described how to distinguish *A. museorum* from *A. fuscus* (Figure 1). Both species are primarily covered in dark chocolate brown scales with similar distributions of golden coloured scales. With a stereo-microscope it should be possible to distinguish the segmented antennal club, characteristic of *A. museorum*, whereas *A. fuscus* has a single segmented club. An easier feature that can be seen with a simple hand lens is the distribution of patches of white scales on the elytra. Both species have three white spots close to the elytral suture ⅓, ½ and ⅔ the way of

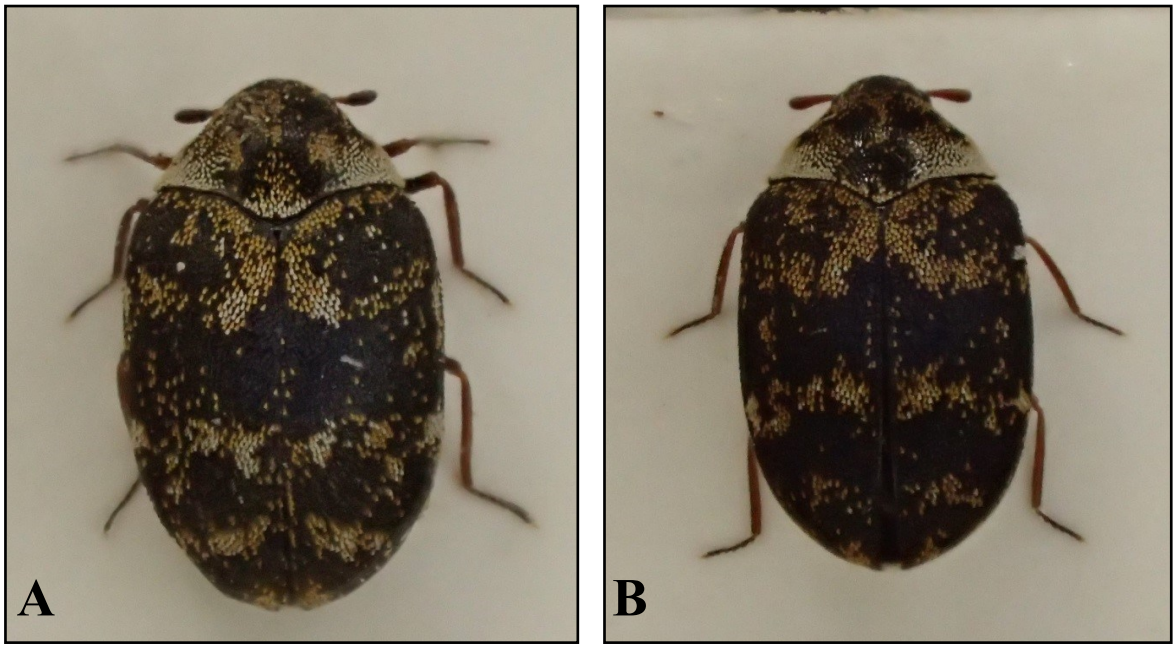

Figure 1. A: Anthrenus museorum *(body length of specimen 2.9mm) and B: A. fuscus (body length of specimen 2.45mm). The white patches are particularly obvious in A. museorum. Images © Graham J. Holloway 2018*

along the elytra but *A. museorum* has bolder, larger spots. In particular the most anterior white spot is obvious in *A. museorum* but vague or even absent in *A. fuscus*. Also, *A. museorum* has an obvious spot white scales in the middle of the trailing edge of the pronotum; a feature not shared by *A. fuscus*.

We know very little about the natural breeding habitats of *A. museorum* and *A. fuscus*. It is possible that they live as larvae under loose bark on old trees feeding on carcases of insects caught by spiders. In any event, the discovery of a dark chocolate brown species of *Anthrenus* in a museum might not be cause for concern (although they sometimes appear in numbers in historic houses). Much greater threat comes from *A. verbasci* which is widely spread and abundant out of doors across the UK, in particular England and Wales. The identification of *A. verbasci* brings its own problems largely because, true to its name, its colour pattern is exceptionally variable (Figure 2 illustrates the range of colours and patterns that can be shown). This colour pattern range has clearly caused identification problems for entomologists for a very long time. For example, many of the *Anthrenus* spp. within Stephens' collection (late 18th, early 19th century) in the NHM, London, are incorrectly identified (Holloway et al., 2018). Examination of the characteristically narrow, lozenge shaped scales on the elytra of *A. verbasci* (Figure 4A) will confirm identification and should immediately distinguish the species from other candidates, including *A. museorum* and *A. fuscus*. The only other *Anthrenus* species that a museum worker is likely to come across is the Guernsey carpet beetle: *A. sarnicus* Mroczkowski, 1963 (Figure 3). This s pecies can cause considerable damage to natural history (e.g. taxidermy and insect collections), woollen and other specimens rich in keratin. Its colour pattern differs from *A. verbasci.* The scales on the back of the insect are a mixture of white, grey with some orange and the individual scales are much broader than *A. verbasci* and triangular shaped Figure 4B), a similar shape to *A. museorum* and *A. fuscus* but the body colour is very different.

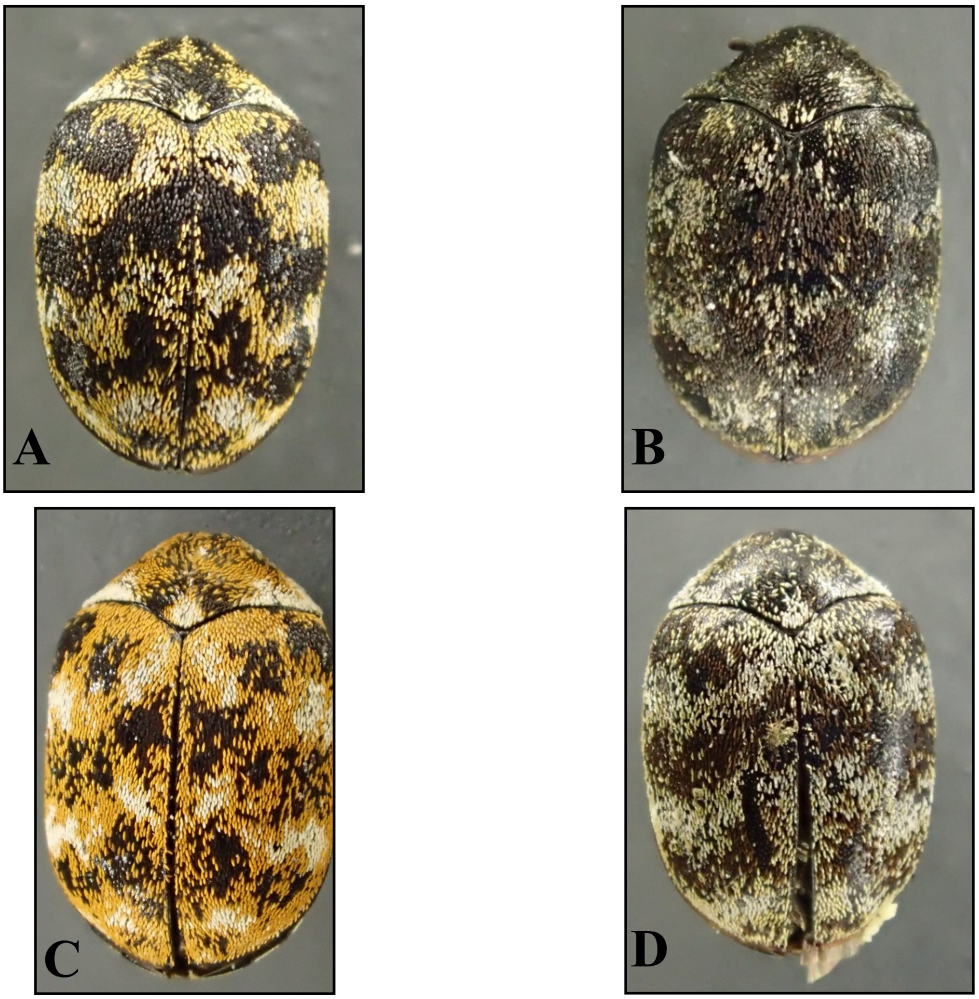

Figure 2. The range of colour patterns typically exhibited by Anthrenus verbasci *(average body length of specimens 2.9mm). Images © Graham J. Holloway 2018*

Figure 3. Adult Anthrenus sarnicus *(British Museum, London, 2015) (body length of specimen 4.1mm). Image © Graham J. Holloway 2018*

Here we have considered the species of *Anthrenus* that could be found in museums. The degree of threat posed varies hugely among species. Accurate identification of any *Anthrenus* found in a museum setting is of great value when deciding on a suitable and cost-effective course of action. As always, IPM managers should remain vigilant and seek assistance if they are unsure of the identity of a specimen. New *Anthrenus* spp. are establishing themselves in the UK (Foster and Holloway, 2015). To date there is no evidence of any of these newly established species posing a threat, but the identity of any individuals trapped or collected during IPM activities should be confirmed and recorded (e.g. www.whatseatingyourcollection.com/recordings.php).

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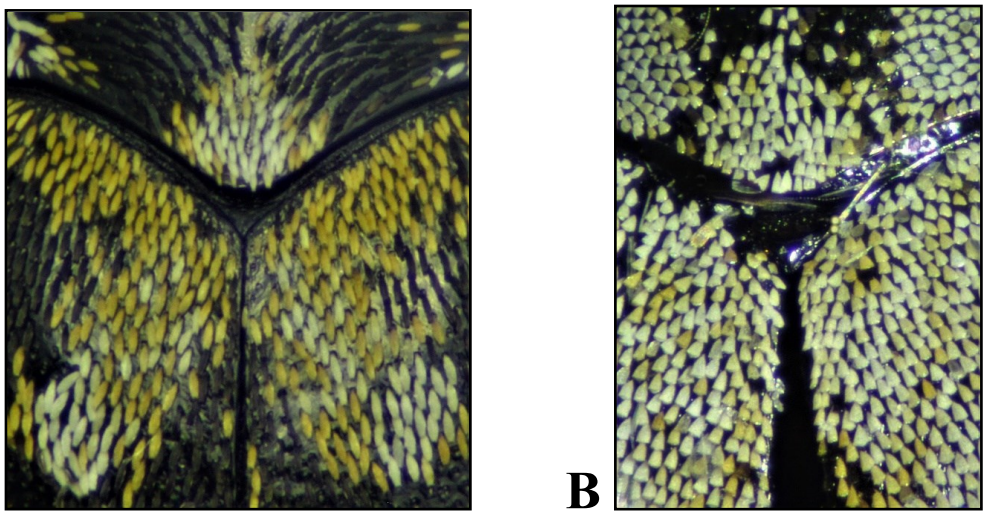

Figure 4. A: shape of scales on the dorsal surface of A. verbasci, *B: shape of scales on the dorsal surface of* A. sarnicus. *Image © Graham J. Holloway 2018*