Recognition of *Trogoderma glabrum* (Coleoptera; Dermestidae) and differentiation from *Anthrenocerus australis*

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Abstract

As climate change progresses, the distributions and activities of many insect species are changing, in particular those that live out of doors. *Trogoderma glabrum* occurs widely across continental Europe Here we report on the occurrence of *T. glabrum* in Austrian museums and consider how to identify the species. It is compared with *Anthrenocerus australis*, a common pest in some historic houses and museums, and a species that resembles *T. glabrum* both in terms of size and colouration.

Keywords: IPM, pest management, museum, historic houses, identification

Introduction

One of the cornerstones of integrated pest management (IPM) in museums is the correct identification of pest species (Pinniger, 2015; Querner, 2015). Different species could utilize different food sources, e.g., α-keratins (mammalian hair and skin), β-keratins (feathers), or plant-based material (Querner, 2015), and what an insect feeds on could influence where in the museum it is likely to be found or how it enters the building, so correct identification is crucial. Several Coleoptera species are well known to IPM managers in museums and historic houses, for example *Anthrenus verbasci* (Linnaeus, 1767), *A. sarnicus* Mroczkowski, 1963, *Attagenus smirnovi* Zhantiev, 1973, *Stegobium paniceum* (Linnaeus, 1758), and *Lasioderma serricorne* (Fabricius, 1792). In Europe, especially NW Europe, some of these species are almost entirely found in buildings (e.g., *A. sarnicus* and *At. smirnovi*) as self-sustaining populations, whilst others occur out of doors, e.g., *A. verbasci* and *S. paniceum*, and probably enter buildings on an annual basis. It is possible that distributions and activities of species found naturally out of doors are influenced by climate change, so the current communities of beetles found in museums and historic houses could change as new species enter the fray (Pinniger, 2013; Querner *et al*. 2022).

The genus *Trogoderma* Dejean, 1821 contains a number of species that are difficult to identify and to differentiate from each other (Peacock, 1993). One such species is *T. glabrum* (Herbst, 1783). *Trogoderma glabrum* is spread widely across Europe, Russia, USA (Peacock, 1993), and Australia (Rees, 2004). It can be found out of doors under bark feeding on insect remains (Mulsant and Rey, 1868), sap (Mroczkowski, 1962), and in Hymenoptera nests (Hämäläinen and Mannerkoski, 1984). From the little information available, it does not appear to be very common. It is the least common of the *Trogoderma* species in California (Peacock, 1993), rare in Finland (Hämäläinen and Mannerkoski, 1984), and it wasn't found at all in a survey of *Trogoderma*

Fig. 1. Trogoderma glabrum Herbst, 1783 A: male habitus (scale = 1 mm), B: male antenna (scale = 100 µm), C: female antenna (scale = 100 µm)

species in Spanish mills (Castañé *et al*. 2020). In the UK, it has only been found on imports (Peacock, 1993). *Trogoderma glabrum* is a minor pest of stored products in North America (Peacock, 1993), but since it is able to feed on a variety of commodities, both plant and animal based, it is possible that their status as pests of natural science collections could develop.

The purpose of the current study is to raise awareness of *T. glabrum* to museum IPM managers following the discovery of specimens in Vienna and southern Austria . In addition, *Trogoderma glabrum* is compared with *Anthrenocerus australis* Hope, 1843, the most likely species to be found in museums with which it can be confused.

Methods

Sticky traps set in museums and historic houses across Austria in 2022 were examined for Coleopteran pests. Along with the usual species, a number of *T. glabrum* were found. Beetles were lifted from the sticky trap glue using ethyl acetate, which makes the glue fluid, and specimens were then dropped into dry cleaning fluid (K2r ®) to remove any remaining surface glue. Insects were mounted on card and the antennae were teased out for imaging.

Habitus images were captured at ×20 magnification using a Canon EOS 2000D camera mounted on a BMSL microscope. Images of antennae were captured at ×100 magnification using a Canon EOS 1300D camera mounted on a Brunel monocular SP28 microscope. All images were fed through Helicon Focus Pro version 8.2.2 focus-stacking software. All figure scales were made using DsCap.Ink software version 3.90.

Results

Trogoderma glabrum

Figure 1 shows an image of male *T. glabrum* (Fig. 1A). Identification was confirmed using culture specimens from the Pest Infestation Laboratory, York, UK, held by Oxford Natural History Museum (ONHM). The sexes are similar in appearance, both broad bodied, but not very convex. The pronotum is black and the elytra are blackish basally, progressively becoming a reddish brown towards the elytral apices. The elytra are sparsely covered in white and yellow hairs, but the white hairs are focussed in three horizontal bands across the elytra, and the yellow hairs are most notable around the shoulders of the elytra. Body length 2 – 4.2 mm (Herrmann, 2023). The male antennal segments (Fig. 1B) progressively expand from the base rather than forming a well-defined club. The basal four antennomeres are yellowish, the rest are brown apart from the apical half of the terminal segment which is yellow. The male antenna shown in Fig. 1B is long, >0.6 mm. The

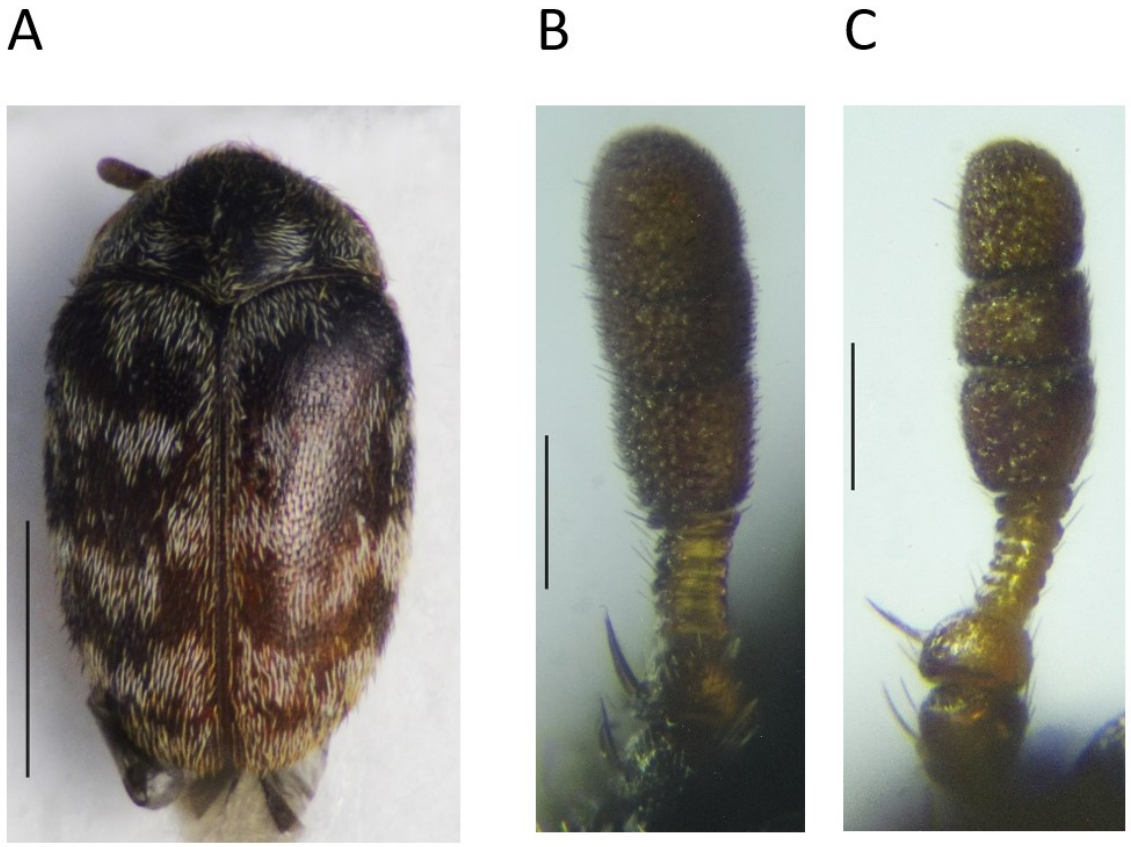

Fig. 2. Anthrenocerus australis Hope, 1843 A: male habitus (scale = 1 mm), B: male antenna (scale = 100 µm), C: female antenna (scale = 100 µm)

female antenna (Fig. 1C) is shorter (0.4 – 0.45 mm) with the terminal five segments forming a more well-defined club than the male. All antennal segments are brown apart from the yellowish terminal segment.

Anthrenocerus australis

Fig. 2A shows an image of male *An. australis*. The sexes are similar in appearance, small and convex. The pronotum is dark brown and the elytra are dark brown basally, usually a lighter reddish brown in the apical half. The elytra have three bands of white hairs, sub-basal, medial, and sub-apical. The bands curve posteriad, particularly the sub-basal and medial bands. There are also patches of white hairs on the elytral base and apex, the outer corners of the pronotum and on the pronotum anterior to the scutellum. Body length 2 – 3.4 mm (Herrmann, 2023). The male antennae (Fig. 2B) have a well-defined, brown cylindrical club consisting of the terminal three segments that contrasts with the yellow of the basal eight segments. The antenna is about .45 mm long with the club accounting for about 0.25 mm of the total length. The female antenna is in many respect similar to the male, except that the antennal club segments are more accentuated, and is approximately the same length as the male antenna.

Discussion

Many species are altering their distributions in response to climate change, although for the majority of insect species we do not have enough information to be able to predict accurately how their distributions might be changing. *Trogoderma glabrum* is found naturally out of doors in Europe and consequently subject to pressures from climate change, so the distribution of this species might be changing. *Trogoderma glabrum* appears on the checklist of beetles of the British Isles (Duff, 2018), but it has not been noted as a self-sustaining population and as such it should not appear on the British Isles list (Peacock, 1993; Holloway, 2020; 2023). It has been recorded on stored product imports (Peacock, 1993). *Trogoderma glabrum* has the capacity to feed on a wide variety of food types, both plant and animal based, and should be a species of concern for IPM managers in museums and historic houses. At a

glance, *T. glabrum* could be confused easily with *An. australis*; they are dark, about the same size and shape with white hairs on the elytra. A more detailed examination should reveal the structure of the antennae and *An. australis* has more extensive white hairs across the elytra.

IPM managers are familiar with the possibility of new species becoming established in the UK and developing into pests of collections and historic artefacts. For example, *An. australis* was first noted in the UK fewer than 100 years ago (Hinton, 1945), and *A. sarnicus* fewer than 60 years ago (Woodroffe, 1967). *Anthrenus sarnicus* has become significant pests of collections and *A. australis* has remained present in many historic houses since then (Pinniger, 2010; Pinniger, 2015; Pinniger and Lauder, 2022; Holloway and Pinniger, 2024). *Anthrenus sarnicus* is a major pest in some establishments in the UK (e.g., Natural History Museum, London), but has no pest status beyond the UK (Holloway and Pinniger, 2024). *Anthrenus museorum* is a pest in collections in many parts of the world, but not in the UK (Holloway and Pinniger, 2020). Other species, such as *A. flavipes*, can devastate collections in warmer parts of Europe (Holloway and Bakaloudis, 2021), but is of less significance in cooler northern latitudes. It is not possible to predict how a new species will react to new conditions, so we do not know whether *T. glabrum*, should it become established in the UK, could develop into a major pest, remain a minor pest as it currently is across continental Europe, or develop no pest status at all. The first line of defence against this uncertainty is for IPM managers to monitor which insects are entering their establishments, and to be aware that new species are always a possibility.

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