

Anthrenus sarnicus Mroczkowski (Coleoptera: Dermestidae: Megatominae): a peculiar species indeed

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Anthrenus sarnicus Mroczkowski (Coleoptera: Dermestidae: Megatominae): a peculiar species indeed

BY GRAHAM J. HOLLOWAY & DAVID B. PINNIGER

GJH*: Cole Museum of Zoology, School of Biological Sciences, HLS Building, The University of Reading, Whiteknights, Reading RG6 6EX, U.K.; email: g.j.holloway@reading.ac.uk

DBP: 83 Westwood Green, Cookham SL6 9DE, U.K.; email: d.pinniger@btinternet.com

*corresponding author [as footnote]

ORCID ID: <https://orcid.org/0000-0003-0495-0313>

ABSTRACT

In several respects, *Anthrenus (Anthrenodes) sarnicus* Mroczkowski, 1962, is a ‘peculiar species’, a term used by Mroczkowski (1962) to describe the structure of the male genitalia. Here we review what is known about the species’ distribution, carry out a morphological examination, and present images of the male and female genitalia.

Keywords: Anthrenini, *Anthrenodes*, dissection, genitalia, museum, distribution

INTRODUCTION

Anthrenus (Anthrenodes) sarnicus Mroczkowski, 1962, was first described from specimens found in a domestic dwelling on Guernsey, Channel Islands, sent to Rentokil and subsequently to the British Museum, Natural History (now Natural History Museum, London (NHML)) for identification (Mroczkowski 1962). Since then, *A. sarnicus* has been noted in many places forming self-sustaining populations. Since *A. sarnicus* is self-sustaining in Britain, Holloway (2020a) maintained that it belongs on the British list of Dermestidae as a native species, a point also made by Woodroffe (1967) and Alexander (2017). It occurs indoors and is considered a pest (Halstead 1975; Pinniger & Lauder 2018; Holloway & Pinniger 2020) and work has been carried out on its biology (Coombs & Woodroffe 1983; Armes 1988, 1990, 1991) to facilitate the control of indoor populations (Finnegan & Chambers 1993; Ackery, Pinniger & Chambers 1999; Pinniger & Lauder 2018). In more natural settings, hardly anything

is known about the species, a common situation for a variety of beetle pests of museums and historic houses (Pinniger 2001, 2013).

Mroczkowski (1962) produced some accurate illustrations of the male genitalia and described the species as ‘very peculiar’. He stated this either because he considered the male genitalia to be relatively small, or that they resembled genitalia of some species in other subgenera. In the present study we examine the known distribution of *A. sarnicus* and carry out morphological examination of specimens to produce species metrics and images of the male and female genitalia.

MATERIALS AND METHODS

Eleven specimens of *A. sarnicus* were obtained, five from culture (Pest Infestation Laboratory, Slough), one from the British Museum, and five from Aberdeen University’s Zoology Building captured on a sticky trap. The Aberdeen specimens were lifted from the glue using ethyl acetate. All specimens were macerated in a solution of 2% acetic acid for five days for softening prior to dissection. Dissection was carried out under a Brunel BMSL zoom stereo LED microscope and involved detaching the abdomen from the rest of the insect using two entomological pins. The soft tergites were peeled away from the harder ventrites to expose the genitalia. For males, the aedeagus was detached from the ring sclerite, and then sternite IX was detached from the ring sclerite and the aedeagus. Females were dissected to isolate the bursa copulatrix. The bursa copulatrix was cut along one side using a pin and opened to expose the sclerotinised elements. Habitus images were captured at $\times 20$ magnification using a Canon EOS 2000D camera mounted on the BMSL microscope. Images of aedeagi, (male) sternite IX, and female sclerites within the bursa copulatrix were captured at $\times 200$ magnification using a Canon EOS 1300D camera mounted on a Brunel monocular SP28 microscope. After dissection, all body parts were mounted on card. The antennae were teased out and images were taken at $\times 200$ magnification through the SP28 microscope. Images were fed through Helicon Focus Pro focus-stacking software (version 8.2.2). All measurements were made using DsCap.Ink software (version 3.90).

Measurements and statistical analysis

Body length (BL) = distance from anterior margin of pronotum to the apex of the elytra; Body width (BW) = maximum distance across the elytra; Paramere length (PL) = distance from the anterior end of the parameres to the apex of the parameres; Median lobe length (ML) =

midline distance from the tip of the median lobe to the end of the anterior horns; Sternite IX length (SL) = distance from the tip of one anterior horn to the tip of the posterior lobe.

The data for the distribution map (Shorthouse 2010) were derived from iRecord (2023) and iNaturalist (2023). Statistical analysis (Kruskal Wallis) was carried out using Minitab version 21.2. (www.Minitab.com).

RESULTS

Habitus dorsal and ventral sides are shown in Figs 1A and 1B. The dorsal habitus has been described in detail elsewhere (Mroczkowski 1962; Woodroffe 1967). Separation of *A. sarnicus* from all other north-western European *Anthrenus* species is straightforward. Its body is extensively covered in triangular, grey scales producing a distinctive appearance. An image showing the sternites has not been published elsewhere.

An *A. sarnicus* antenna is shown in Fig. 1C: it is 10-segmented typical of subgenus *Anthrenodes*. The antennal club gradually expands and consists of three dark brown terminal antennomeres that contrast in colour with the pale yellow of antennomeres 1–7.

Male genitalia and sternite IX are shown in Fig. 2. The parameres (Figs 2A, B) are orientated dorsoventrally. The median lobe is very short, terminating in a strong dorsally orientated hook. On the ventral surface of the median lobe is a membranous tube (Fig. 2A) with the open end of the tube lying adjacent to the hooked end of the median lobe (Fig. 2B). Sternite IX (Fig. 2C) is often used in *Anthrenus* species diagnosis. It is worth noting that Fig. 2C is the first time *A. sarnicus* sternite IX has been imaged.

The female genitalia (Fig. 3A) have large sclerites of complex structure within the bursa copulatrix. *In vivo* the bursa copulatrix is a sac-like structure; it has been opened and laid flat in Fig. 3A. Three sclerites have laterally flattened hooks with blunt, rounded, posterior-pointing tips. Each of these hooks is set into large sclerotinized pads anchoring them to the side of the bursa copulatrix. The two lateral hooks are longer than the hook sitting between them on the ventral side of the bursa copulatrix. The fourth component within the bursa copulatrix is a hollow, strongly curved horn that when *in situ* lies between the lateral hooks with the convex surface resting on top of the ventral hook so that the open end of the horn points dorsally. The horn ends in a membranous tube (Fig. 3B). The ventral (convex) surface of the horn has a deep, long groove in the surface into which (most likely) the ventral surface hook fits.

Eleven specimens (7♂♂ [one consisting only of an abdomen] and 4♀♀) were measured. ♂ mean BL = 3.25 ± 0.17 mm (standard deviation); ♀ mean BL = 2.98 ± 0.13 mm. Even with the small sample size, there is a strong indication that ♂♂ are larger than ♀♀ ($H = 4.55$, $DF = 1$, $p = 0.03$) (BL range in the study insects of both sexes = 2.60 to 3.40 mm). ♂ mean BL/BW ratio = 0.627 ± 0.017 , ♀ mean BW/BL ratio = 0.619 ± 0.003 ($H = 0.18$, $DF = 1$, not significant); overall mean BW/BL ratio = 0.624 ± 0.014 .

For all sexes, mean PL = 298 ± 20 μ m; mean ML = 165 ± 5 μ m; mean SL = 328 ± 20 μ m.

Distribution

Records of *A. sarnicus* from iRecord and iNaturalist (2023) are shown in Fig. 4. These records, most probably biased by recorder effect, are generally from indoor locations; where they are from outdoors, records are almost always from urban areas next to a building believed to hold a breeding population (e.g., NHML). Fig. 4 suggests that *A. sarnicus* is widely but thinly spread across the mainland United Kingdom and the Channel Islands. Given that the first recorded case of *A. sarnicus* in the UK was by Woodroffe (1967), Fig. 4 shows records from potentially a 50-year period, suggesting that it is a scarce species in the UK. There are no records of *A. sarnicus* in iNaturalist from beyond the UK.

From iRecord and iNaturalist (2023), *A. sarnicus* appears to be a relatively scarce species of urban regions, which is usually associated with old buildings, such as museums. Thomson Webb (2023), however, has compiled a list of records from museums and historic buildings. The map of these records (Fig. 5) provides a different picture of *A. sarnicus* in the UK. It would seem, in fact, to be a more common and widespread species.

DISCUSSION

Anthrenus sarnicus is a distinctive species and relatively easy to identify from habitus features (Peacock 1993; Holloway & Pinniger 2020). It is found in museums, especially those housing natural history collections, and historic houses (Pinniger & Lauder 2018). As a result of this, we know quite a lot about its biology and control methods. The purpose of the current study has been to fill in some gaps and raise some interesting questions about the species.

Within the subgenus *Anthrenodes*, *A. sarnicus* has an unusual coloration. No other species that we are aware of has an extensive covering of pale grey scales or has large areas of black scales on the sternites. Mroczkowski (1962) described the species and on seeing the male aedeagus commented that it was ‘very peculiar’. The aedeagus is relatively very small; in particular, the median lobe is minute. In *Anthrenus* (*Anthrenus*) species studied, the median

lobe is between 350µm to 500µm in length (Holloway 2019, 2020, 2021; Holloway & Bakaloudis 2020; Holloway *et al.* 2020) equating to 12–18% of BL. In *Anthrenus (Anthrenodes) sarnicus*, which has a mean male BL of 3.25mm, the median lobe is a mere 5% of BL, and the aedeagus can presumably only achieve superficial penetration during copulation.

This is the first time that *A. sarnicus* female genitalia have been studied and images produced. They form a complicated structure and whilst it is not possible to see how the various elements, both male and female, operate and interact during copulation, it is possible to suggest how it occurs. The bursa copulatrix contains four obvious hardened structures, three sclerites carrying broad, flattened, hooked shaped structures that curve round to point to the insect's posterior, and a hollow horn with a membranous, open tip at the posterior end.

We suggest that during copulation, the two lateral hooks press against the horn to prevent lateral movement and the ventral hook fits into the groove on the ventral surface of the horn to facilitate movement backwards and forwards. For the median lobe to reach, we suggest that the horn is pushed posteriad to meet the median lobe and when in range the male uses the hook on the tip of the median lobe to attach to the tip of the horn.

Sperm pass along the membranous tube on the ventral surface of the median lobe (a feature noted and illustrated by Mroczkowski (1962)) and into the bursa copulatrix. Mroczkowski (1962) also noted that the *A. sarnicus* male genitalia resembled those in some other *Anthrenus* species. It is possible that these species have female mating structures similar to *A. sarnicus*, but the female genitalia in these species have received little attention and we currently do not know the answer to this.

We are not aware of BL measurements for *A. sarnicus* having been published elsewhere. Our measurements suggest that *A. sarnicus* has a mean BL of around 3.0mm or slightly above (both sexes included), with a range in the study insects of 2.6 to 3.4mm. Herrmann (2023) records a range of 2.0–3.5mm. Our data correspond well with the top end of this range, but we had no specimens approaching 2.0mm.

The distribution of *A. sarnicus* is peculiar for more than one reason. *A. sarnicus* distribution appears to be restricted to the UK and the Channel Islands, although Háva (2023) suggests that it might have been recorded from the Netherlands and Finland. No publications have so far been found to substantiate this claim. In fact, there is no evidence of *A. sarnicus* as pests in natural history museums in the Netherlands (Oscar Vorst, curator Naturalis Biodiversity Center, pers. comm.), Finland (Jaakko Mattila, curator Finnish Museum of Natural

History, pers. comm.), or Germany (Prof. Michael Kuhlmann, curator Fabricius collection, Zoological Museum, Kiel University, pers. comm.).

Why a pest species of museums has not been spread far and wide beyond the UK through movement of items among collections, as has been the case for *Attagenus smirnovi* Zhantiev, 1973 (Hanson *et al.* 2012) and *Anthrenus verbasci* (Linnaeus, 1767) (Pinniger & Lauder 2018), is a mystery. Why has its range remained so restricted for 60 years since its original description? Peacock (1993) listed records for *A. sarnicus*, which included an occasional record of *A. sarnicus* breeding on feathers and insects out of doors (although in close proximity to a building). Consequently, Peacock (1993) stated ‘the chances of it [*A. sarnicus*] eventually spreading throughout southern England seem high’. This has not happened so far, assuming Peacock (1993) was referring to out of doors breeding. The evidence suggests that *A. sarnicus* remains an endemic UK species, despite being a pest of museums and historic houses. Some entomologists might consider an endemic beetle species a national treasure rather than a pest!

The other strange observation is that nearly all records relate either to indoors or out of doors but next to a historic house or large museum, such as NHML. We are unaware of the natural habitat of the species. Where was it originally to be found? What was it feeding on before museums became available? Presumably, the species can still be found in natural situations, but we have no idea what these might be.

The current study has shed light on how the species manages to mate, but also illustrates how little we know about the species beyond its presence in domestic dwellings (its type locality), historic buildings and museums. This is quite extraordinary given that it is a straightforward species to recognize. The Dermestidae are generally very poorly studied and understood. Little is known about *A. sarnicus*, although we do know more about it than the vast majority of other Dermestidae species. There remains a very large amount of research to be carried out just to provide a basic knowledge of the family.

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Figure legends

Fig. 1. — *Anthrenus sarnicus* Mroczkowski, 1962: A, habitus dorsal aspect (scale bar = 1mm); B, habitus ventral aspect (scale bar = 1mm); C, antenna (scale bar = 100µm).

Fig. 2. — *Anthrenus sarnicus* Mroczkowski, 1962, ♂: A, aedeagus dorsal aspect; B, aedeagus dorsolateral aspect; C, sternite IX. Scale bars = 100µm.

Fig. 3. — *Anthrenus sarnicus* Mroczkowski, 1962, ♀: A, sclerites in bursa copulatrix; B, 'horn' in bursa copulatrix. Scale bars = 100µm.

Fig. 4. — *Anthrenus sarnicus* Mroczkowski, 1962: global distribution. Data from iRecord and iNaturalist.

Fig. 5. — *Anthrenus sarnicus* Mroczkowski, 1962: UK distribution across museums and historic buildings (from Thompson Webb 2023).

Figure 1

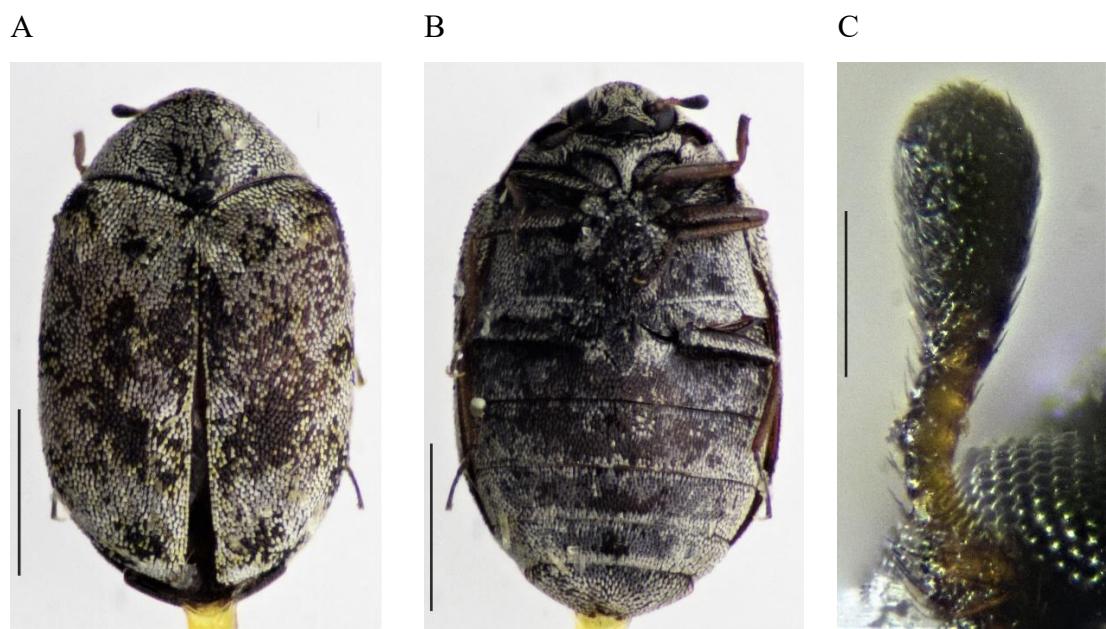


Figure 2

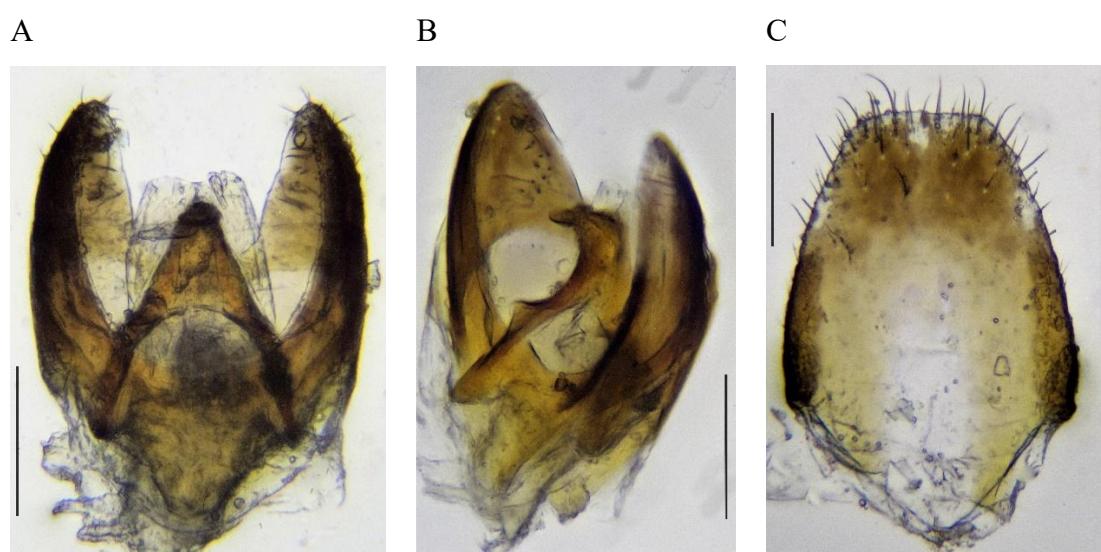


Figure 3

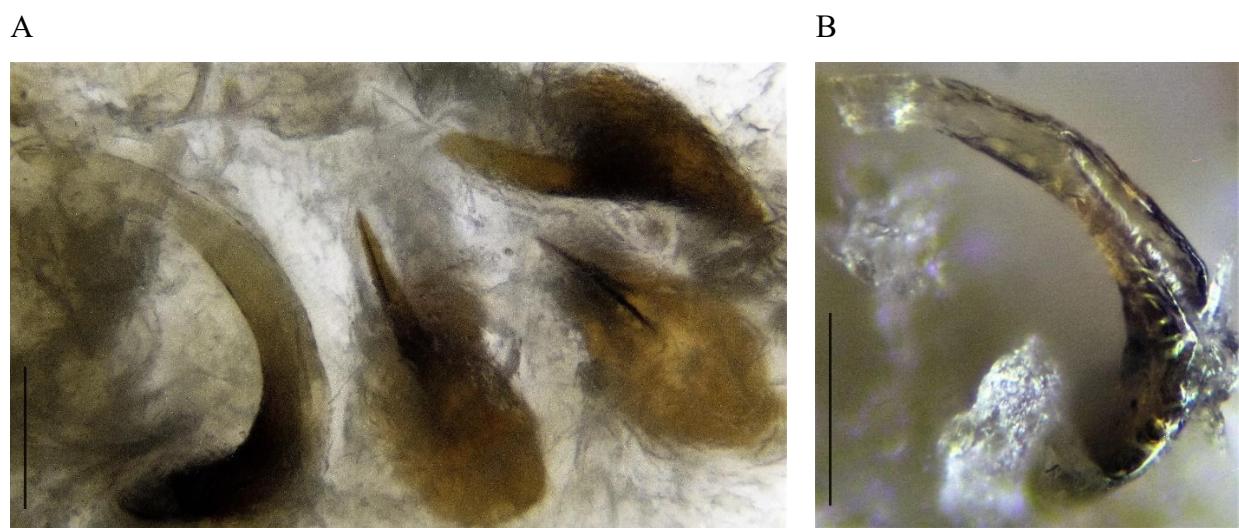


Figure 4

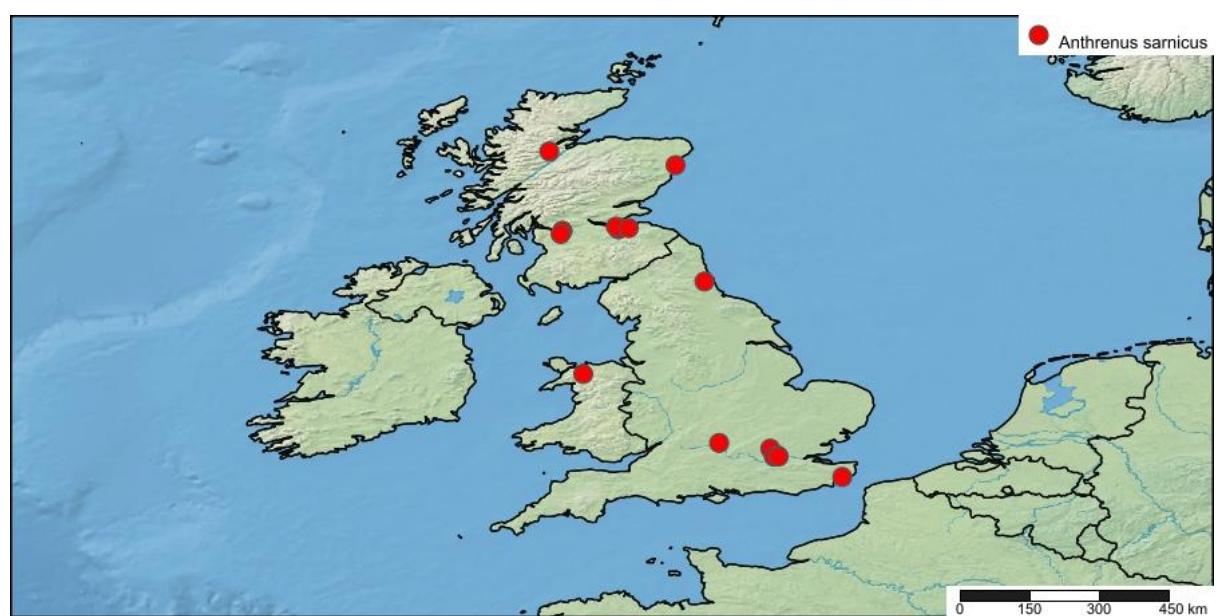


Figure 5

