

Short scientific noteSubmitted: February 24th, 2017 - Accepted: April 7th, 2017 - Published: June 30th, 2017**Trogoderma variabile Ballion, 1878: a possible new pest of Italian entomological collections (Coleoptera: Dermestidae)**Gianluca NARDI^{1,2,*}, Vincenzo VOMERO³¹ Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale Carabinieri "Bosco Fontana" - Strada Mantova 29, I-46045 Marmirolo (Mantova), Italy - l_nardi@hotmail.com² Università degli Studi di Roma "Sapienza", Dipartimento di Biologia e Biotecnologie "Charles Darwin" - Via Alfonso Borelli 50, I-00161 Roma, Italy - gianluca.nardi@uniroma1.it³ c/o Museo Civico di Zoologia, Via Ulisse Aldrovandi 18, I-00197 Roma, Italy - v.vomero@museiscientificiroma.eu

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Abstract

The first infestation of an entomological collection in Italy by *Trogoderma variabile* Ballion, 1878 is recorded; it was detected in Rome in 2014. This record and another one from the Molise Region, are herein discussed. Distributional, biological and nomenclatural data on this polyphagous alien pest are summarized, and its possible local establishment is discussed.

Key words: Dermestidae, new record, peninsular Italy, stored product pests, museum pests.

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Introduction

Trogoderma variabile Ballion, 1878 (Figs 1–2) is a cosmopolitan (Háva 2015) polyphagous species of high economic relevance, since it represents a pest of stored products and of zoological and botanic collections (Hagstrum & Subramanyam 2009; Hagstrum et al. 2013; see also <http://www.MuseumPest.net>).

Hereunder, captures of this alien species in Italy are discussed in order to alert museum curators handling botanical and zoological collections.

Material and Methods

The specimens were identified following various works (Bousquet 1990; Kingsolver 1991; Peacock 1993; Banks 1994; Háva 2011) and finally, identification was confirmed by Jiří Háva (Praha-západ, Czech Republic).

Acronyms of specimen depositories:

CGN G. Nardi collection, Cisterna di Latina (Latina), Italy

CJH J. Háva collection, Praha-západ, Czech Republic (J. Háva, pers. comm., 2017)

CVV V. Vomero collection, Rome (Italy)

Results***Trogoderma variabile* Ballion, 1878**

Trogoderma variabilis [sic!] Ballion, 1878: 277.

Trogoderma (Phradonoma) variabilis [sic!] Ball.: Sumakov 1907: 17.

Globicornis 4-guttata [(Reitter, 1878)] ssp. *unifasciata* Pic, 1908: 41.

Globicornis quadriguttata ssp. *subfasciata* [sic!] Pic, 1908: Dalla Torre 1911: 64.

Phradonoma variabile Ballion, 1878: Dalla Torre 1911: 66.

Trogoderma persica [sic!] Pic, 1914: 10.

Trogoderma parabile Beal, 1954: 53.

Material examined. Italy: Lazio, Roma, Nuovo Salario, 41.57.18.59N, 12.31.6.94E (WGS84), Jun 2014, V. Vomero leg., on dry beetles, many adults and larvae (CGN; CVV); Molise, Campomarino (Campobasso), 25 May 1993, J. Háva sen. & Y. Elznicova leg., at light, 2 adults (CJH).

Chorotype and distribution. Cosmopolitan (Háva 2015). This species, indigenous to Central Asia (cf. Ballion 1878; Mroczkowski 1968; Hagstrum et al. 2013), is currently known from all zoogeographical regions, but is mainly

distributed in the Holarctic Region (cf. Hagstrum & Subramanyam 2009; Háva 2015). In Europe, it was firstly recorded from Caucasus (Mroczkowski 1968) and since 1975 in other regions (cf. Šefrová & Laštůvka 2005; Denux & Zagatti 2010). In Europe it is known from: Armenia, Belarus, Czech Republic, Finland, Great Britain, Greece, Italy, Latvia, Lithuania, South European Russia, Sweden and The Netherlands (Barševskis 2001; Hagstrum et al. 2013; Zhantiev 2013; Háva 2015).

This species was also recorded from Belarus (Barševskis 2001), Kyrgyzstan (Ovchinnikov 1996), “Syrie” (Pic 1908, as *Globicornis 4-guttata unifasciata*; Háva 2007), and The Netherlands (cf. Hagstrum et al. 2013; Zhantiev 2013) and these countries were not included in the distributional data provided by Háva (2015).

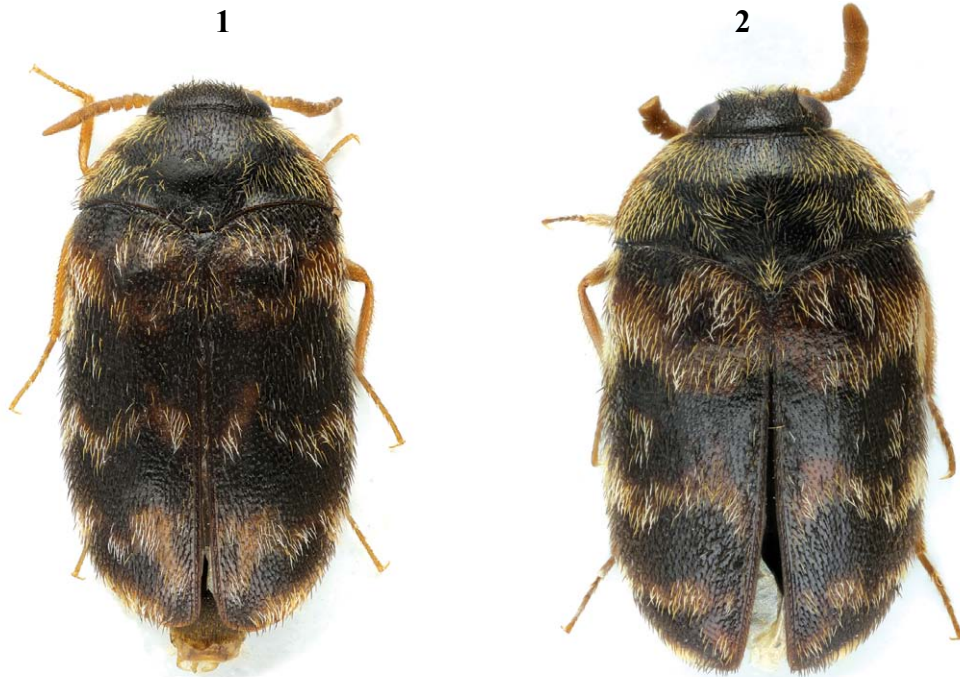
Ecology. In synanthropic environments, the larvae of *T. variable* feed on grain, seeds, cereals, legumes, cocoa, nuts, milk powder and a wide range of other dried high-protein materials, including specimens of zoological collections and of herbaria (cf. Bousquet 1990; Peacock 1993; Beal 2003; Hagstrum et al. 2013). The adults do not feed (Peacock 1993). The synanthropic association of *T. variable* is very old; Chu and Wang (1975, as *T. persicum* Pic) recorded this species from a Chinese tomb of ca. 100 B.C. In natural habitats, this dermestid develops in bees’ and birds’ nests and these can act as a source of infestation (Peacock 1993; Ikin et al. 1999).

Females of *Trogoderma variable*, exhibit a diel pattern of calling behavior, and they produce a potent sexual

pheromone to attract males (cf. Tobin & Bell 1986; Wright & Delves 1994); both males and females have four categories of antennal sensilla (Wei et al. 2015), that probably are involved also in the sexual communication.

The females of this species, as those of other congeners, are known to develop through a higher number of larval instars than males: on average, female larvae pupate after six larval instars, whereas males pupate after five. Under optimal conditions the life cycle of *Trogoderma variable* from egg to adult is completed in 30 to 37 days. Nevertheless, if conditions are unfavorable larvae can enter diapause during which period they can survive more than a year without food (cf. Esperk et al. 2007; Hagstrum & Subramanyam 2009; see also <http://www.MuseumPest.net>). The larvae (Fig. 3), have numerous hastisetæ on the dorsal surfaces of all segments (Peacock 1993). Hastisetæ are easily pulled from the larva when setae of another arthropod become wedged in the slots, so their function is defensive, incapacitating possible arthropods predators by entangling their appendages (cf. Hagstrum & Subramanyam 2006). Anyway, the larvae and pupae of this species are the host of some ectoparasitic wasps of the genus *Laelius* Ashmead, 1893 (Hymenoptera, Bethyridae) (cf. Hagstrum & Subramanyam 2009), moreover, some nematode species are endoparasites of this dermestid (Rumbos & Athanassiou 2017), and a coccidian Protist can infect larvae, pupae, and adults of this species (Loschiavo 1969, as *T. parabile* Beal).

Unlike many *Trogoderma* species, the adult of *T. variable* can fly and, at least, the males have a high degree



Figs 1-2 – *Trogoderma variable*, adults from Italy, Rome. **1**, dorsal view of a ♂ (body length: 3.15 mm); **2**, dorsal view of a ♀ (body length: 3.1 mm) (photos by M. Gigli).



Fig. 3 – *Trogoderma variabile* last instar larva (body length: 5.0 mm) from Rome (photo by V. Vomero).

of mobility, with individual beetles moving vertically and horizontally (cf. Hagstrum & Subramanyam 2006).

This species, as other congeners, can produce allergic reactions in humans (cf. Ikin et al. 1999; Bernstein et al. 2009).

In the U.S.A., *T. variabile* is the most economically serious dermestid pest of stored products (Beal 2003), and in Australia it was target of an eradication campaign (cf. Hagstrum & Subramanyam 2009; Castalanelli et al. 2011), while in Canada it is only considered as a minor pest (Bousquet 1990).

Notes. *Trogoderma variabile* is similar to *T. versicolor* (Creutzer, 1799), but differs by the morphology of the antennae, elytral maculation and male genitalia (cf. Bousquet 1990; Kingsolver 1991; Peacock 1993; Banks 1994; Háva 2011).

Trogoderma variabile (excluding some generic citations – “Italy” and “mainland Italy”) was recorded with certainty from three Italian regions: Piedmont, Emilia-Romagna and Sardinia (cf. Nardi & Háva 2013 and references herein). According to Nicoli Aldini (2014), it seems established in the Emilia-Romagna Region. It is possible that prior to this study, this species was overlooked or misidentified owing to its similarity to other closely related species (Peacock 1993; Bank 1994).

The above-mentioned records of *T. variabile* are the first from peninsular Italy. The record from the Molise region is two years older than the previous records from other Italian regions (cf. Nardi & Háva 2013 and references herein). The above-mentioned record from Rome is based on several adults and larvae (Figs 1–3) infesting dry beetles housed in the entomological collection of V. Vomero, collected from Laos and Italy. This Italian material was

collected by V. Vomero, while the Asian beetles have been borrowed directly from local collectors and later sent for preparation in Czech Republic, where the dermestid infestation began, in fact *T. variabile* occurs in this country (cf. Háva 2011).

The potential establishment of this species is high, since it can breed on a variety of stored foodstuffs and it is also capable of establishing in the natural environment, moreover, larvae often conceal themselves in cracks and crevices and can be difficult to detect (Ikin et al. 1999). In this framework, the above infested collection underwent a fumigation treatment with insecticide containing permethrin 25/75, tetramethrin and piperonyl butoxide, and, the species seems to be eradicated in these premises.

The damage produced by larvae of this species in beetle collections is different from those of *Anthrenus* spp. (V. Vomero, unpublished data). The infested specimens by *T. variabile* are heavily damaged but sclerotized parts (e.g. male genitalia, and female styles) remain intact. Examination of the droppings of *T. variabile* revealed that only the soft tissue of dead beetles is consumed by this pest.

Discussion. Seven species of *Trogoderma* Dejean, 1821 occur in Italy, and five of them are now known from peninsular regions (cf. Nardi & Háva 2013).

The above new records show that to avoid the spreading in Italy of *T. variabile*, it is, obviously, necessary to survey imported foodstuffs, using also pheromone-baited traps and to disinfest dry insect collection (cf. Peacock 2003; Hagstrum & Subramanyam 2006, 2009; Hagstrum et al. 2013). In both cases, it is important to check the possible signs of infestation (live or dead beetles, larval exuviae, a fine dust, emergence holes in whole grains), and to remember that during diapause the larvae may be unresponsive to many common pest control treatments (see <http://www.MuseumPest.net>).

Finally, from a nomenclatorial point of view, this species was described as *Trogoderma variabilis* Ballion, 1878. According to ICZN (1985, art. 34b), the species name must agree in gender with the generic name (neuter), so this termination is incorrect and was changed accordingly by Mroczkowski (1968) to *T. variabile*. The same is valid also for *T. persica* Pic, 1914 (cf. Háva 2015).

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