Bulletin of Insectology ***75*** *(2): 223-230, 2022*
ISSN 1721-8861 eISSN 2283-0332

New observations of Coleoptera associated with Mantodea ootheca and an overview of the previous records

Zohreh MIRZAEE[1], Saber SADEGHI[1], Jiri HÁVA[2], Roberto BATTISTON[3], Enrico RUZZIER[4]
[1]*Biology Department, Faculty of Sciences, Shiraz University, Iran*
[2]*Forestry and Game Management Research Institute, Prague-Zbraslav, Czech Republic*
[3]*Museo di Archeologia e Scienze Naturali 'G. Zannato', Montecchio Maggiore, Italy*
[4]*World Biodiversity Association Onlus, Verona, Italy*

Abstract

This paper presents the first observations of the Coleoptera genera: *Attagenus* Latreille 1802 (Dermestidae), *Phradonoma* Jacquelin du Val 1859 (Dermestidae), and *Trichodes* Herbst 1792 (Cleridae) in association with Mantodea oothecae; in particular, it is the first time that predator/inquiline beetle larvae are recorded on *Bolivaria* Stal 1877 (Mantodea Rivetinidae) oothecae. Furthermore, a new host species for *Thaumaglossa rufocapillata* Redtenbacher 1867 (Dermestidae) is documented. In addition, we provide a short review of the knowledge regarding the association between beetle larvae and Mantodea oothecae worldwide.

Key words: beetles, *Bolivaria*, Mantid, ootheca, larvae.

Introduction

The ootheca is a protein-based structure produced by female mantids during oviposition which is meant to enclose and protect eggs from extreme environmental conditions, parasitoids, and predators (Hackman and Goldberg, 1960). Because of their protective function, multiple arthropods have evolved the advantageous ability to use both viable and evacuated oothecae as nesting sites or occasional shelters (Mirzaee *et al*., 2021a; 2021b). Coleoptera has been recorded multiple times as inquiline and predators of mantis oothecae (Ramsay, 1990) and this type of association involves different beetle families and several different Mantodea genera worldwide (references cited in table 1). Predation and/or collateral activities by arthropods, including beetles, may compromise not only the structure and functionality of the ootheca but also affect eggs and nymphal survival rate, ultimately influencing the population dynamics of mantids in their habitats. This study aims to increase and update knowledge on interactions between Coleoptera and mantis oothecae, providing new species and new host records, together with a literature review on the subject.

Materials and methods

Specimens' collection

During research by the first author in 2020-2021 aimed at monitoring and documenting the biology of praying mantids of Iran, a series of oothecae were collected for more study in the laboratory. A total of twenty-eight oothecae belonging to *Bolivaria brachyptera* (Pallas 1773) (Mantodea Rivetinidae), and *Hierodula tenuidentata* Saussure 1869 (Mantodea Mantidae) were collected in two districts of Fars (Darab: 28°46'45"N 54°34'08"E; Dalkhan 30°14'32"N 52°06'09"E) and one district of Hormozgan (Bandar Abbas: 27°11'11"N 56°16'50"E) (figure 1) provinces. From these oothecae, 19 of them showed signs of predation or activities by other arthropods (four oothecae of *B. brachyptera*, and 15 of *H. tenuidentata*). Two oothecae of *B. brachyptera* were deposited on the rocks, four under rocks, and three were attached to the branches of thorny bushes. All *H. tenuidentata* oothecae were attached to tree branches, mostly at the middle (figure 2). They were removed from their deposition sites, placed in plastic jars with some cotton inside, and then stored under laboratory conditions (26 ± 1 °C, 40-50% RH, and 16L:8D). The oothecae were checked daily and their conditions recorded. The collected specimens were deposited in the Zoology Museum of Shiraz University, Shiraz- Iran (ZM-CBSU). Photos were taken using a Canon 700D digital camera.

Two oothecae of *Hierodula* cf. *patellifera* Serville 1839 (Mantodea Mantidae), a native species of the Japanese fauna, were collected in Chikusa-ku, Nagoya (Japan) by Shinichiro Ishikawa. The egg cases were conferred to Katsumi Akita, who stored them in sealed plastic cases until the emergence of both mantid nymphs and beetles. The specimens collected are deposited in the Katsumi Akita private collection, Tsu City, Mie Pref., Japan.

Literature review

In order to compile and then review the most exhaustive literature on beetles associated with mantis oothecae (via Google Scholar), we used keywords such as "ootheca", "mantid*", "beetle", "host", integrated using the Boolean operators AND, OR, NOT and the use of " " for specific word combinations. Further, we recovered information from volumes not available online or on PDF. The results of the research have been summarized in table 1.

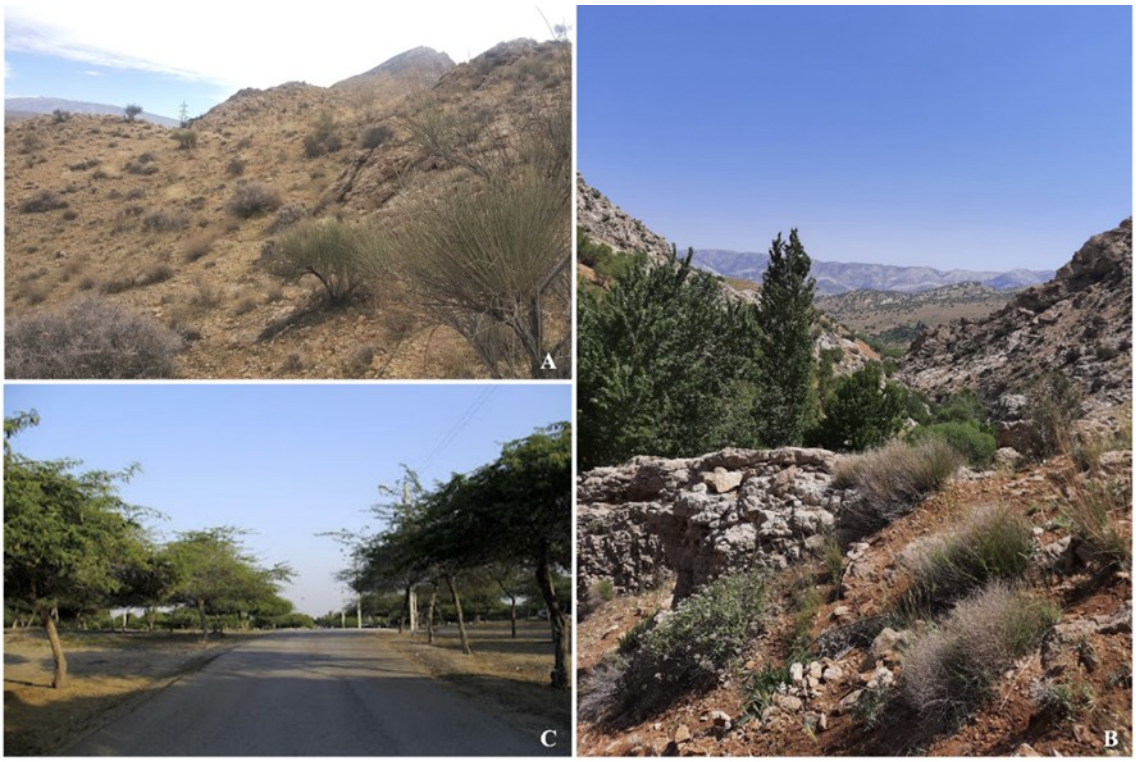

Figure 1. General view of the collecting sites in Iran: **A)** Darab habitat, **B)** Dalkhan habitat, **C)** Bandar Abbas habitat.

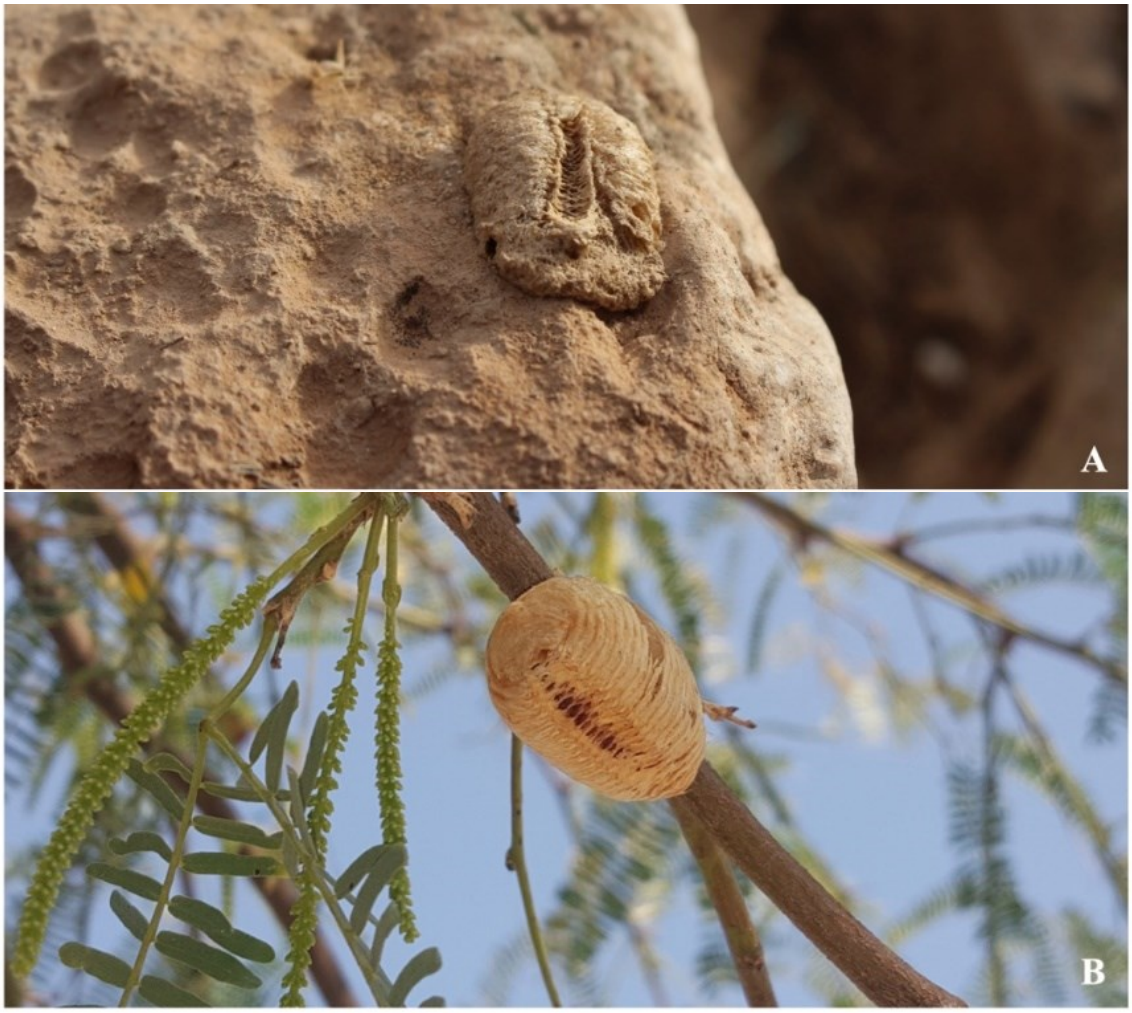

Figure 2. A) Ootheca of *B. brachyptera* attached to the lower part of a stone; **B)** ootheca of *H. tenuidentata* on a tree branch.

Table 1. Recorded beetles associated with mantids oothecae from the world.

Beetle species	Beetle family	Mantid species	Country	Reference
Opilo domesticus (Sturm 1837)	Cleridae	*Sphodromantis viridis* (Forskal 1775) (Mantidae)	Tunisia	Ehrmann, 2002
Trichodes sp.	Cleridae	*Bolivaria brachyptera* (Pallas 1773) (Rivetinidae)	Iran	this paper
Anthrenocerus australis (Hope 1843)	Dermestidae	*Miomantis* sp. (Miomantidae)	New Zealand?	Ramsay, 1990
Anthrenus sp.	Dermestidae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Pintilioaie *et al*., 2021
Anthrenus sp.	Dermestidae	*Stagmomantis Carolina* (Johansson 1763) (Mantidae)	USA	Rau and Rau, 1913
Anthrenus (*Nathrenus*) *verbasci* (L. 1767)	Dermestidae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Rădac and Háva, 2021
Attagenus fasciatus (Thunberg 1795)	Dermestidae	*Bolivaria brachyptera* (Pallas 1773) (Rivetinidae)	Iran	this paper
Dermestes maculatus De Geer 1774	Dermestidae	*Archimantis latistyla* Serville 1838 (Mantidae)	Australia	Hawkeswood, 2003
Dermestes sp.	Dermestidae	*Hierodula saussurii* Kirby 1904 (Mantidae)	China	Kershaw, 1910
Globicornis (*Globicornis*) *nigripes* (F. 1792)	Dermestidae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Rădac and Háva, 2021
Orphinus sp.	Dermestidae	*Archimantis latistyla* (Serville 1839) (Mantidae)	Australia	Coombs, 1994 a; 1994b
Phradonoma nobile (Reitter 1881)	Dermestidae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Iran	this paper
Thaumaglossa bimaculate Arrow 1915	Dermestidae	*Sphodromantis gastrica* (Stal 1858) (Mantidae)	South Africa	Arrow, 1915
Thaumaglossa bimaculate Arrow 1915	Dermestidae	*Sphodromantis viridis* (Forskal 1775) (Mantidae)	South Africa	Arrow, 1915
Thaumaglossa indiana Indiana Vijay Veer 2004	Dermestidae	*Hierodula westwoodi* Kirby 1904 (Mantidae)	India	Vijay Veer *et al*., 2004
Thaumaglossa indiana pakistana Hava 2006	Dermestidae	*Hierodula westwoodi* Kirby 1904 (Mantidae)	Pakistan	Háva, 2006
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	*Tenodera angustipennis* Saussure 1869 (Mantidae)	Japan	Matsura, 1979
Thaumaglossa hilleri Reitter 1881	Dermestidae	*Tenodera aridifolia* Stoll 1813 (Mantidae)	Japan	Iwasati *et al*., 2000
Thaumaglossa hilleri Reitter 1881	Dermestidae	*Tenodera angustipennis* Saussure 1869 (Mantidae)	Japan	Iwasati *et al*., 2000
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	*Hierodula* cf. *patellifera* Serville 1839 (Mantidae)	Japan	this paper
Thaumagiossa pauliani Paulian 1953	Dermestidae	*Brancsikla* sp. (Majangidae)	Madagascar	Paulian, 1953
Thaumaglossa pauliani Paulian 1953	Dermestidae	*Empusa* sp. (Empusidae)	Madagascar	Paulian, 1953
Thaumaglossa pauliani Paulian 1953	Dermestidae	*Sphodromantis* sp. (Mantidae)	Madagascar	Paulian, 1953
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	*Tenodera* sp. (Mantidae)	Japan, Java	Iwasaki *et al*., 1998; Dresner, 1970
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	*Tenodera aridifolia* Stoll 1813 (Mantidae)	Japan	Iwasaki *et al*., 1996
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	*Tenodera angustipennis* Saussure 1869 (Mantidae)	Japan	Iwasaki *et al*., 1996
Thaumaglossa rufocapillata Redtenbacher 1867	Dermestidae	Unknown	Indonesia	Dresener, 1970
Thaumaglossa sp.	Dermestidae	*Tenodera sinensis* (Saussure 1871) (Mantidae)	Japan	Curtis, 1940
Thaumaglossa ooparasitica Hava et Meriguet 2018	Dermestidae	*Paramantis prasina* (Serville 1839) (Mantidae)	Madagascar	Háva and Mériguet, 2018
Thaumaglossa petrstanda Hava 2003	Dermestidae	Unknown (Mantidae)	Bali	Háva and Suprayitno, 2020
Trogoderma carteri Armstrong 1942	Dermestidae	Unknown	Australia	Amstrong, 1949
Trogoderma signatum Sharp 1877	Dermestidae	*Miomantis* sp.? (Miomantidae)	New Zealand?	Ramsay, 1990
Anthocomus (s.str.) fasciatus (L. 1758)	Melyridae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Plonski *et al*., 2021
Dasytes (*Mesodasytes*) *aeratus* Stephens 1830	Melyridae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Plonski *et al*., 2021
Dasytes sp.	Melyridae	*Hierodula tenuidentata* Saussure 1869 (Mantidae)	Romania	Pintilioaie *et al*., 2021
Aplocnemus pectinatus (Kuster 1849)	Rhadalidae	*Mantis religiosa* (L. 1758) (Mantidae)	Malta	Plonski *et al*., 2021

Results

The field observations and rearing of the specimens from the oothecae collected in Iran allowed the identification of the following beetles: *Attagenus fasciatus* (Thunberg 1795) (Dermestidae Attageninae), *Trichodes* sp. (Cleridae Trichodinae), and *Phradonoma nobile* (Reitter 1881) (Dermestidae Megatominae).

A. fasciatus was obtained from three oothecae of *B. brachyptera* (Mantodea Rivetinidae) collected in Dalkhan (figure 3). These oothecae presented a few holes in the outer layer of the case; their removal from the substrate caused the exposure of the inner part that revealed the presence of beetle larvae. At the time of collection, both viable eggs and mantid protonymphs were present. No nymphs emerged from the oothecae after the hatching of adult *Attagenus*, suggesting that their larvae completely fed upon mantid immature stages. All of these oothecae were 100% damaged by these beetles and no mantid nymphs emerged from them. *A. fasciatus* is a new faunistic record for the study area. This species was recorded by Modarres Awal (1997) from Tehran and also by Mroczkowski (1968), Zhantiev (1976), and Háva (2007; 2015) with no precise localities cited.

Trichodes sp. was recorded as larva when removing one ootheca of *B. brachyptera* that was attached to a stone (figure 4), in the Darab district. Before the discovery, the ootheca did not show any sign of attack; only the

Figure 3. *A. fasciatus*: **A)** mature larva, exuvia and immature adult collected from *B. brachyptera* ootheca; **B)** mature adult showing the typical colour pattern of the species.

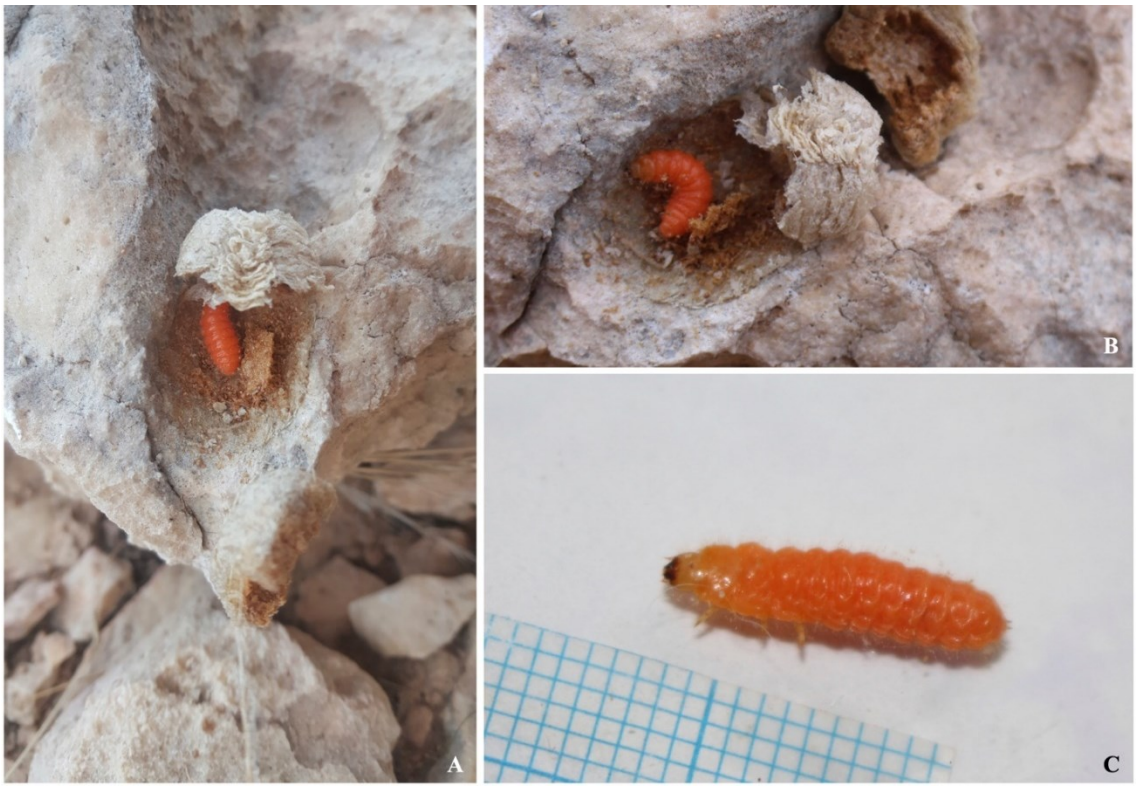

Figure 4. *Trichodes* sp.: **A-B)** different views of the larva after the removal of the external part of the ootheca from the stone; **C)** dorsolateral view of the larva collected for the rearing under laboratory conditions.

removal of the hardened cover showed how the beetle larva had mined the inner part and eaten all the eggs. Unfortunately, the rearing of the larva to the adult stage failed.

Both *Attagenus* and *Trichodes* were recorded in association with mantid oothecae for the first time; *B. brachyptera* represents a new host record.

P. nobile emerged from nineteen hatched oothecae of *H. tenuidentata* from the Bandar Abbas district (figure 5). The adults hatched three months after the collection date. This record represents the first observation of the association between this species and the mantid oothecae.

In Japan, the rearing of *Hierodula* cf. *patellifera* under lab conditions resulted in 116 *Thaumaglossa rufocapillata* Redtenbacher 1867; it was interesting to note that the emergence of the beetles took place almost simultaneously with the emergence of the mantid nymphs (figure 6).

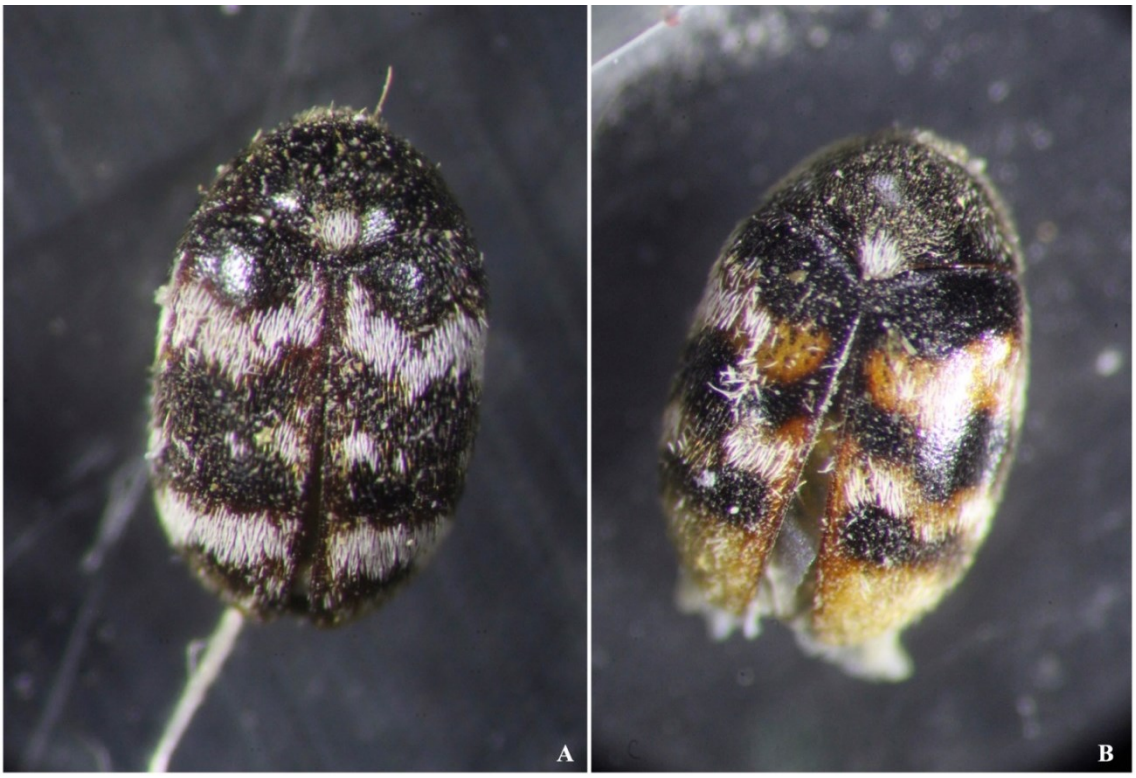

Figure 5. *P. nobile*: **A)** adult specimens showing the complete hairs vestiture on elytra; **B)** adult specimens lacking hair patches on elytra, showing the yellowish-orange spots on elytral integuments.

Figure 6. *T. rufocapillata*: **A)** adult beetles emerged in association with mantid nymphs; **B)** adult beetles remained on the hatched ootheca.

The literature review produced 25 records prior to the present contribution (table 1). Dermestidae, with 19 references, is the group most represented, followed by Melyridae (3), Cleridae (2), and Rhadalidae (1).

Dermestidae associated with mantid oothecae have been recorded in all the biogeographic regions, with the only exception of Antarctica and Neotropics, and include the genera *Dermestes* L. 1758 (Dermestinae Latreille 1807), *Anthrenocerus* Arrow 1915, *Anthrenus* Geoffroy 1762, *Globicornis* Latreille 1829, *Orphinus* Motschulsky 1858, *Thaumaglossa* Redtenbacher 1867 and *Trogoderma* Dejean 1821 (Megatominae Leach 1815). *Thaumaglossa* sp. and the species *Thaumaglossa indiana* Vijay Veer 2004, *Thaumaglossa pauliani* Paulian 1953 and *Thaumaglossa rufocapillata* Redtenbacher 1867 constitute the majority of records, further confirming the specialization of this genus for mantid oothecae, as indicated by Kiselyova and McHugh (2006).

Mantid genera that were involved in an association with Coleoptera larvae were primarily *Archimantis* Saussure 1869; *Hierodula* Burmeister 1838; *Mantis* L. 1758; *Sphodromantis* Stal 1871; *Stagmomantis* Saussure 1869; *Tenodera* Burmeister 1838; and then followed by Miomantidae, *Miomantis* Saussure 1870, and Empusidae, *Empusa* Illiger 1798.

Discussion

According to the literature review and the new observations presented in the paper, mantid oothecae seem to be a valuable resource for several beetle larvae worldwide. It is interesting to note that oothecae of large-sized mantids (*Hierodula* spp. and *Tenodera* spp.) are preferred, possibly due to their greater size and volume that might offer more abundant trophic resources and a better shelter. The fact that several records involve native beetles in association with exotic mantid oothecae also suggests that the exploitation of the ootheca is generic and not species-specific.

The diversity of Dermestidae recorded on oothecae is attributable to their great ecological and trophic adaptability (Zhantiev, 2000; 2009); the larvae of this family are opportunistic scavengers, and capable of exploiting feeding substrates that vary in nutrients and water content (Ruzzier *et al*., 2020; 2021). The dermestid subfamilies recorded, *i.e*., Dermestinae, Attageninae Laporte 1840, and Megatominae, possess different levels of trophic specialization and it is plausible they develop at the expense of the oothecae at different ages. Dermestinae (*Dermestes* sp.) larvae specialize in feeding on substrates rich in water and are characterized by fast development, probably by predating fresh or relatively fresh oothecae, in the phases in which larvae and nymphs are still present. On the other hand, Attageninae (*Attagenus* sp.) and Megatominae (*Anthrenocerus* sp., *Anthrenus* spp., *Globicornis* sp., *Orphinus* sp., *Phradonoma* sp., *Thaumaglossa* spp., *Trogoderma* spp.), adapted to water-poor substrates and with slower larval development, might occur on mature oothecae and, especially the latter subfamily, may have species capable of developing on very old oothecae, feeding on the ootheca itself or on insects remains, such as exuviae or dead inquiline arthropods. The biology of *Thaumaglossa* spp. (Megatominae) requires clafication as the only genus considered a specialist on mantid oothecae.

The occurrence of *Trichodes* sp. on mantid oothecae represents a novel observation for a genus that is usually a nest parasite of bees and wasps (Linsley and MacSwain, 1943; Carré, 1980). However, previous rare observations of larvae of *Trichodes* and other clerids feeding upon Orthoptera eggs (Arias *et al*., 1994; Dysart, 2000) would seem to confirm that this family is able to parasitize orthopteroid insects and that is the current record might not just be a sporadic event.

The observations regarding Melyridae and Rhadalidae, as correctly argued by Plonski *et al*. (2021), constitute a possible case of predatory activity but most probably represent the use of the ootheca as a shelter for wintering.

Investigating these particular associations has many implications for species distribution dynamics. Recently, many mantids species have been recorded in non-native countries (see e.g. Schwarz and Ehrmann, 2018 for Europe or Andreson, 2018 for North America), mostly coming from Asia, including *H. tenuidentata* (Battiston *et al*., 2018). The spread of these alien mantid species has been recorded as ootheca traveling attached to merchandise (Battiston *et al*., 2020), sold for organic integrated pest control agents traditional medicine (Battiston *et al*., 2010), or even released directly into the wild (Shcherbakov and Govorov, 2020) presumably along with alien parasites that may have an impact on native mantids species, on other fauna, or even have an economic impact on food supplies as pests.

Conclusions

Mantis oothecae undoubtedly represent an important resource for various groups of Coleoptera, both for food and protection purposes. However, the true nature of these interactions remains, at least partly, obscure especially given the difficulty of collecting data and conducting observations in a systematic way. In particular, further investigations are needed in order to qualify whether beetles can be considered predators or parasites of mantids immature stages or inquiline species on oothecae.

Acknowledgements

We would like to thank our colleagues Mahnaz Barmeshori, and Mohamad Javad Ghasempour for their support during fieldwork. We are also grateful to Katsumi Akita for providing data regarding Japanese records and to Kris Anderson for his valuable comments on the manuscript and language revision. The paper was supported by the Ministry of Agriculture of the Czech Republic, institutional support MZE-RO0118 (Jiří Háva).

References

ANDERSON K., 2018.- *Praying mantises of the United States and Canada*.- Independently Published, Las Vegas, USA.

ARIAS A., SÁNCHEZ M., JIMÉNEZ J., SANTOS R., MARTÍNEZ DE VELASCO D., 1994.- Distribución en el suelo de las ootecas de *Dociostaurus maroccanus* (Thunb.) e importancia de su depredación en dos fincas de Extremadura.- *Boletin de Sanidad Vegetal, Plagas*, 20: 3-22.

ARROW G. J., 1915.- A new species of *Thaumaglossa* bred from the egg-clusters of Mantidae.- *Proceedings of the Entomological Society of London*, 1915: 112-113.

BATTISTON R., PICCIAU L., FONTANA P., MARSHALL J., 2010.- *Mantids of the Euro-Mediterranean area*.- WBA Books, Verona, Italy.

BATTISTON R., LEANDRI F., DI PIETRO W., ANDRIA S., 2018.- The giant Asian mantis, *Hierodula tenuidentata*, spreads in Italy: a new invasive alien species for the European fauna?- *Biodiversity Journal*, 9 (4): 399-404.

BATTISTON R., AMERINI R., DI PIETRO W., GUARIENTO L. A., BOLOGNIN L., MORETTO E., 2020.- A new alien mantis in Italy: is the Indochina mantis *Hierodula patellifera* chasing the train for Europe?- *Biodiversity Data Journal*, 8: e50779.

CARRE S., 1980.- Biologie de deux prédateurs de l'abeille solitaire *Megachile rotundata* F. (= *pacifica* Panz.) [Hymenoptera Megachilidae]: *Trichodes alvearius* F. et *Trichodes apiarius* L. [Coleoptera, Cleridae]: méthodes de lutte.- *Apidologie*, 11 (3): 255-295.

COOMBS M.,1994a.- Seasonality and host relationships of insects associated with oothecae of *Archimantis latistyla* (Serville) (Mantodea: Mantidae).- *Australian Journal of Entomology*, 33 (3): 295-298.

COOMBS M., 1994b.- Insects associated with oothecae of *Archimantis latistyla* (Serville) (Mantodea: Mantidae).- *Journal of the Entomological Society of Queensland*, 22 (2): 19-22.

DYSART R. J., 2000.- I.7 Insect predators and parasites of grasshopper eggs, pp. I.7/1-I.7/3. In: *Grasshopper integrated pest management user handbook* (CUNINGHAM G. L., SAMPSON M. W., Eds).- United States Department of Agriculture Animal and Plant Health Inspection Services Technical Bulletin No. 1809. Issued Spring 1996 - Summer 2000. Washington, DC, USA.

EHRMANN R., 2002.- *Mantodea - Gottesanbeterinnen der Welt*.- Natur und Tier - Verlag, Münster, Germany.

ENE J. C., 1962.- Parasitism of mantid oothecae in West Africa, pp. 725-727. In: *Proceedings of the XI international congress of entomology*, vol. 2, Vienna 17-25 August 1960.

FAURE J. C., 1940.- Maternal care displayed by mantids (Orthoptera).- *Journal of the Entomological Society of South Africa*, (3): 139-150.

GERSTMEIER R., HALPERIN J., CHEKATUNOV V., 1999.- An annotated list of Cleridae and Thanerocleridae (Coleoptera) of Israel.- *Phytoparasitica*, 27 (1): 27-33.

GUNTER N. L., LEAVENGOOD J. M., BARTLETT J. S., CHAPMAN E. J., CAMERON S. L., 2013.- A molecular phylogeny of the checkered beetles and a description of Epiclininae a new subfamily (Coleoptera: Cleroidea: Cleridae).- *Systematic Entomology*, 38: 626-636.

HACKMAN R. H., GOLDBERG M., 1960.- Composition of the oothecae of three Orthoptera.- *Journal of Insect Physiology*, 5 (1): 73-78.

HÁVA J., 2003.- World catalogue of the Dermestidae (Coleoptera).- *Studie a zprávy Oblastního Muzea Praha-východ v Brandýse nad Labem a Staré Boleslavi*, Supplementum 1: 1-196.

HÁVA J., 2006.- Descriptions of three new Dermestidae (Insecta: Coleoptera) from Pakistan and India. pp. 463-465. In: *Biodiversity and natural heritage in the Himalaya II* (HARTMANN M., WEIPERT J., Eds).- Verein der Freunde und Förderer des Naturkundemuseums Erfurt e. V., Germany.

HÁVA J., 2007.- Dermestidae, pp. 299-320. In: *Catalogue of Palaearctic Coleoptera. Vol. 4, Elateroidea, Derodontoidea, Bostrichoidea, Lymexyloidea, Cleroidea, Cucujoidea* (LÖBL I., SMETANA A., Eds).- Apollo Books, Stenstrup, Denmark.

HÁVA J., 2015.- *World catalogue of insects. Volume 13. Dermestidae (Coleoptera)*.- Brill, Leiden, The Netherlands.

HÁVA J., MÉRIGUET B., 2018.- Contribution to the knowledge of *Thaumaglossa* Redtenbacher, 1867 from Madagascar (Coleoptera: Dermestidae: Megatominae).- *Folia Heyrovskyana*, 26 (2): 8-11.

HÁVA J., SUPRAYITNO N., 2020.- New Dermestidae (Coleoptera) from Indonesia, Bali Island.- *Euroasian Entomological Journal*, 19 (4): 227-228.

HAWKESWOOD T. J., 2003.- Notes on the biology and food items of three Australian Dermestidae (Coleoptera).- *Calodema*, 1: 1-4.

HINTON H., 1945.- *A monograph of the beetles associated with stored products. Volume 1*.- Order of the Trustees of the British Museum, London, UK.

IWASAKI T., AOYAGI M., DODO Y., ISHII M., 1996.- Life history of the first generation of the dermestid beetle, *Thaumaglossa rufocapillata*.- *Applied Entomology and Zoology*, 31: 389-395.

IWASAKI T., AOYAGI M., DODO Y., ISHII M., 1998.- Adult overwintering and oviposition of first generation of dermestid beetle, *Thaumaglossa rufocapillata*.- *Japanese Journal of Applied Entomology and Zoology*, 42: 170-171.

IWASAKI T., AOYAGI M., DODO Y., ISHII M., 2000.- Life history of the dermestid beetle, *Thaumaglossa hilleri* Reitter.- *Japanese Journal of Entomology*, 3: 105-109 (in Japanese, English abstract).

JAMES H. G., 1959.- Egg development, hatching, and prey taken by the European mantis, *Mantis religiosa* L., in several habitats.- *Annual Report of the Entomological Society of Ontario*, 89: 50-55.

KERSHAW J. C., 1910.- The formation of the ootheca of a Chinese mantis, *Hierodula saussuri*.- *Psyche: a Journal of Entomology*, 17: 136-141.

KISELYOVA T., MCHUGH J. V., 2006.- A phylogenetic study of Dermestidae (Coleoptera) based on larval morphology.- *Systematic Entomology*, 31: 469-507.

KRUNIĆ M., STANISAVLJEVIĆ L., PINZAUTI M., FELICIOLI A., 2005.- The accompanying fauna of *Osmia cornuta* and *Osmia rufa* and effective measures of protection.- *Bulletin of Insectology*, 58 (2): 141-152.

KUMAR R., 1973.- The biology of some Ghanaian mantids (Dictyoptera: Mantodea).- *Bulletin de l'Institut Fondamental d'Afrique Noire*, 35: 551-578.

LINSLEY E. G., MACSWAIN J. W., 1943.- Observations on the life history of *Trichodes ornatus* (Coleoptera, Cleridae), a larval predator in the nests of bees and wasps.- *Annals of the Entomological Society of America*, 36 (4): 589-601.

MIRZAEE Z., EBRAHIMI M., SADEGHI S., BATTISTON R., HAJIAN M., 2021a.- Mantid ootheca (Insecta: Mantodea: Hierodula) or a home for many arthropods?- *Iranian Journal of Science and Technology*, 45: 1925-1931.

MIRZAEE Z., LOTFALIZADEH H., SADEGHI S., 2021b.- Chalcidoid parasitoids (Hymenoptera: Torymidae and Eupelmidae) of mantids (Mantodea) oothecae in Iran.- *Phytoparasitica*, 50: 487-499.

MODARRES AWAL M., 1997.- Dermestidae. In: *List of agricultural pests and their natural enemies in Iran* (MODARRES AWAL M., Ed.).- Ferdowsi University Press, Mashhad, Iran.

MROCZKOWSKI M., 1968.- Rozmieszczenie Dermestidae (Coleoptera) na świecie wraz z katalogiem wszystkich znanych gatunków [Distribution of the Dermestidae (Coleoptera) of the world with a catalogue of all known species].- *Annales Zoologici*, 26: 15-19 (in Polish).

OPITZ W., 2002.- Cleridae Latreille 1804, pp. 267-280 In: *American Beetles. Volume 2. Polyphaga: Scarabaeoidea through Curculionoidea* (ARNETT R. H. JR., THOMAS M. C., SKELLEY P. E., FRANK J. H., Eds).- CRC Press LLC, Boca Raton, USA.

PAULIAN R., 1953.- Recherches sur les insectes d'importance biologique à Madagascar XII à XX.- *Mémoires de l'Institut Scientifique de Madagascar*, 3: 1-27.

PIC M., 1953.- XV. - *Thaumaglossa pauliani* Pic, pp. 12-15. In: Recherches sur les insectes d'importance biologique à Madagascar XII à XX (PAULIAN R., Ed.).- *Mémoires de l'Institut Scientifique de Madagascar*, 3: 1-27.

PLONSKI I. S., RĂDAC I. A., CASSAR T., 2021.- On larvae of soft-winged flower beetles (Coleoptera: Melyridae and Rhadalidae) found in oothecae of mantises (Mantodea: Mantidae).- *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen*, 73: 25-30.

RĂDAC I. A., HÁVA J. M., 2021.- *Globicornis nigripes* and *Anthrenus verbasci* (Coleoptera: Dermestidae) in oothecae of *Hierodula tenuidentata* (Mantodea: Mantidae) from Romania.- *Folia Heyrovskyana*, 29 (1): 105-106.

RAU P., RAU N., 1913.- The biology of *Stagmomantis carolina*.- *Transactions of the Academy of Science of Saint Louis*, 22: 1-58.

SCHWARZ C., EHRMANN R., 2018.- Invasive Mantodea species in Europe.- *Articulata*, 33: 73-90.

SHCHERBAKOV E., GOVOROV V., 2020.- *Statilia maculata* (Thunberg, 1784) - the first invasive praying mantis (Mantodea, Mantidae) in the fauna of Russia.- *Annales de la Société Entomologique de France*, 56 (3): 189-202.

RUZZIER E., KADEJ M., BATTISTI A., 2020.- Occurrence, ecological function, and medical importance of dermestid beetle hastisetae.- *PeerJ*, 8: e8340.

RUZZIER E., KADEJ M., DI GIULIO A., BATTISTI A., 2021.- Entangling the enemy: ecological, systematic, and medical implications of dermestid beetle hastisetae.- *Insects*, 12 (5): 436.

VALENTINE E. W., 1967.- A list of the hosts of entomophagous insects of New Zealand.- *New Zealand Journal of Science*, 10 (4): 1100-1209.

WILLIAMS C. E., 1904.- Notes in the life history of *Gongylus gongyloides*, a mantis of the tribe Empusides and a floral simulator.- *Transactions of the Entomological Society of London*, 52 (1): 125-137.

ZHANTIEV R. D., 1976.- *Zhuki kozheedy fauny SSSR* [*The skin eaters family Dermestidae of fauna of the USSR*].- Moskva Izdatelstvo Moskovskogo Universiteta, Moscow, Russia (in Russian).

ZHANTIEV R. D., 2000.- Classification and phylogeny of dermestids (Coleoptera, Dermestidae).- *Entomological Review*, 80: 1115-1129.

ZHANTIEV R. D., 2009.- Ecology and classification of dermestid beetles (Coleoptera, Dermestidae) of the Palearctic fauna.- *Entomological Review*, 89: 157-174.

Authors' addresses: Enrico RUZZIER (corresponding author: enrico.ruzzier@biodiversityassociation.org), World Biodiversity Association Onlus c/o Museo Civico di Storia Naturale, Lungadige Porta Vittoria 9, Verona, Italy; Zohreh MIRZAEE (z.Mirzaee@shirazu.ac.ir), Saber SADEGHI (ssadeghi@shirazu.ac.ir), Biology Department, Faculty of Sciences, Shiraz University, Shiraz- Iran; Jiri HÁVA (jh.dermestidae@volny.cz), Forestry and Game Management Research Institute, Strnady 136, CZ-252 02 Praha 5 - Zbraslav, Czech Republic; Roberto BATTISTON (roberto.battiston@comune.montecchio-maggiore.vi.it), Museo di Archeologia e Scienze Naturali "G. Zannato", piazza Marconi 17, Montecchio Maggiore, Italy.

Received April 5, 2022. Accepted June 9, 2022.