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THE EMBIOPTERA FROM THE STRAIT OF SICILY ISLANDS: FIRST RECORDS FROM PANTELLERIA AND LAMPEDUSA AND NEW DATA FROM LAMPIONE (SICILY, ITALY)

SUMMARY

The occurrence of Embioptera in the Strait of Sicily islands was up to date known only from Lampione (the smallest of the Pelagie islands), where the only species reported was provisionally assigned to *Embia ramburi* Rimski-Korsakow, 1905. Based on material recently collected by the authors, the presence of Embioptera is here reported for the first time in the Islands of Pantelleria (Sicily, Trapani) and Lampedusa (Sicily, Agrigento). In the Island of Pantelleria the occurrence of the typical small silky tunnels produced by Embioptera has been verified in many sites, from sea level to Montagna Grande (836 m). In many of these sites, several juveniles and some adult or subadult specimens were collected and reared, obtaining an adult male belonging to *Cleomia guareschii* Stefani, 1953. Moreover, a single adult male of *E. ramburi* was collected in Lampedusa, the largest of the Pelagian Islands. Finally, the fauna of Embioptera from Lampione remains still poorly known, as it was possible to examine only two females recently collected in the island, and identified as *Embia* sp.

Key words: webspinners, *Cleomia guareschii*, *Embia ramburi*, Mediterranean.

RIASSUNTO

Gli embiotteri delle isole del canale di Sicilia: prima segnalazione per Pantelleria e Lampedusa e nuovi dati per Lampione (Sicilia, Italia). L'ordine degli Embioptera nelle isole del Canale di Sicilia fino ad oggi era conosciuto solo per Lampione (la più piccola delle isole Pelagie), dove l'unica specie trovata era stata provvisoriamente identificata come *Embia ramburi* Rimski-Korsakow, 1905. Sulla base di materiale raccolto recentemente dagli autori, viene qui segnalata per la prima volta la presenza di Embioptera nelle Isole di Pantelleria (Sicilia, Trapani) e Lampedusa (Sicilia, Agrigento). Nell'isola di Pantelleria, la presenza dei piccoli cunicoli serici tipicamente prodotti dagli Embiotteri è stata verificata in molti siti, dal livello del mare fino a Montagna Grande (836 m). In molti di questi siti sono stati raccolti e allevati diversi giovani e alcune femmine adulte o subadulte, ottenendo un maschio adulto di *Cleomia guareschii* Stefani, 1953. Un solo maschio adulto di *E ramburi* è stato rac-

colto a Lampedusa, la più grande delle Isole Pelagie. Per quanto riguarda Lampione, l'identità degli Embiotteri presenti nell'isola rimane da confermare, dal momento che è stato possibile esaminare solo due femmine, recentemente raccolte, identificate come *Embia* sp.

Parole chiave: *Cleomia guareschii*, *Embia ramburi*, *Embia* sp., Mediterraneo.

INTRODUCTION

Embioptera, commonly known as webspinners are a small order of gregarious insects living in galleries or tunnels located under stones or near grass roots, that are constructed through the secrection of silk by specialised glands located in the swollen basal tarsomere of forelegs. Living in these silk tunnels protect all the webspinner instars, preventing predators or parasitoids from detecting their presence. At the same time, the occurrence of their characteristic silken galleries facilitates their detection and study, and their easy rearing allows to obtain the adult stages for specific identification and, at the same time, to investigate their bioethology.

In Europe and in the Mediterranean basin these insects are very little studied, and almost all the known species have been described earlier than 1966, while only two new species have been described in more recent years by FONTANA (2001, 2002). In the XX century, studies on Embioptera from Europe are mainly due to the Italian zoologist Renzo Stefani (1922-2007), who described many Mediterranean species and published numerous and in-depth studies on their bio-ethology, and to the American entomologist Edward Shearman Ross (1915-2016). Webspinners are perhaps the least studied insect order in Italy and Europe and the knowledge on the distribution of these insects is very incomplete. This is due also to the scarce material available in private or public collections, which is generally of little value for taxonomic or biogeographic studies. Indeed, in most cases, webspinners, mainly juvenile instars, are collected with the various techniques used for the study of soil arthropods and adult males, which are needful for taxonomical identification, are scarcely represented (VENTURA, 1963; BATTISTON & FONTANA, 2007). Therefore, as adult males are generally present for very short periods during the year, collecting winged males with light traps or young individuals (much more frequent than adults) in the field and rearing them until adult stage are essential in the study of webspinners.

Webspinners are widely present in southern Europe and are mainly known from Iberian Peninsula and Canary Islands, France, Italy, Balkan Peninsula and Ukraine. In Italy, 3 genera and 6 species are known (FONTANA, 2021): *Embia ramburi* Rimsky-Korsakow, 1905; *E. nuragica* Stefani, 1953; *E. tyrrhenica* Stefani, 1953; *E. girolamii* Fontana, 2001; *E. cynthiae* Fontana, 2002; *Cleomia guareschii* Stefani, 1953 and *Haploembia solieri* Rambur, 1842. While in Sardinia 4 species

are known (STEFANI, 1983), Sicily is little studied from this point of view (VENTURA, 1963). Several species are also known for Mediterranean islands of various surface (STEFANI, 1953, 1959; KOHLMEYER, 1960; ROSS, 1966; BATTISTON & FONTANA, 2007; LO CASCIO & PASTA, 2012). An example of the lack of data and interest relating to webspinners is given by the Maltese islands. In 1999 no species was reported for these islands (AXIAK *et al.*, 1999), in 2000 their presence was known but the data were not published (MIFSUD, 2000) and in 2003 two unidentified species were reported (SCHEMBRI, 2003).

No Embioptera species were previously reported for two of the most studied islands of the Strait of Sicily, namely Pantelleria and Lampedusa (BACCETTI *et al.*, 1995; ROMANO, 2020). Since 1960 (KOHLMEYER, 1960) Embioptera were known from the smallest of the Pelagian Islands, Lampione, and the only specimen collected in the Island was provisionally assigned to *E. ramburi*. More recently, new specimens have been collected on the island of Lampione, showing clear morphological differences compared to *E. ramburi*; this material is still under study (LO CASCIO & PASTA, 2012).

MATERIALS AND METHODS

Study areas

Lampedusa, Lampione and Pantelleria are all three islands of the Sicilian Channel, the first two (together with Linosa) are part of the Pelagie archipelago (Fig. 1). The environmental characteristics of these islands have been the subject of numerous publications (see numerous papers on volume edited by MASSA, 1995). Pantelleria Island (Italy) (83 km^2; 36°47'27"N-11°59'38"E) is a volcanic island with a typical Mediterranean climate, most of the precipitation between October and February, a mean annual rainfall of 531 mm, and monthly average temperatures ranging from 13.7 °C. Lampedusa (20,2 km^2; 35°30'05"N-12°36'34"E) is the biggest island of Pelagie Archipelago, the most common rock outcrops are limestones and marls, the mean annual rainfall is 300 mm with extremely irregular yearly rain events, usually concentrated between October-March. mean annual temperature is 19 °C. Lampione (0.021 km^2; 35°33'00"N-12°19'11"E) is the smallest of the Pelagian Islands, it is unpopulated, calcareous, the climatic condition are probably similar to Lampedusa.

Insect collecting and mounting

Several webspinners, mainly juvenile stages, were collected in island of Pantelleria, in April and May 2021 in various sites and environments. The insects were bred, obtaining, at the beginning of June, an adult male. In Lampione two adult specimens have been collected at the beginning of June 2021,

Fig. 1 — The Strait of Sicily islands.

whereas, the only examined specimen from the island of Lampedusa was a male preserved in alcohol in the Fontana collection at the Rovereto Civic Museum Foundation. All material was processed through fixation in alcohol 70° (for at least 1 hour) then clarified in KOH 10% water solution for 24 hours. From the potash, the specimens were transferred in distilled water in alcohol 70°, in alcohol 85° and in alcohol 95°. Each step lasted 10 minutes. Finally, specimens were put in a xylene bath lasting 20 minutes and later mounted on slide by inclusion in Canadian Balm (FONTANA *et al.*, 2002).

All studied material is preserved in the Fontana collection at Fondazione Museo Civico di Rovereto (Trento, Italy).

Abbreviations: PFMCR = Fontana collection at Fondazione Museo Civico di Rovereto (Trento, Italy)

RESULTS

Pantelleria Island

Examined material

Cleomia guareschii Stefani, 1953: Sicily (TP), Pantelleria is., Montagna

Grande, 36°47'28,2" N, 11°59'41,9" E, 525 m, 8.IV.2021, leg. P. Fontana & V. Malagnini; 1 adult male on slide (obtained after rearing in June 2021), PFMCR.

During a visit to Pantelleria in April 2021, as part of a research on pollinators entrusted by the Pantelleria Island National Park to the Edmund Mach Foundation of San Michele all'Adige (Technology Transfer Center) and to the University of Palermo (Department of Agricultural, Food and Forestry Sciences), attention was also paid to the presence of Embioptera, being this order not yet known from the island. Traces of the presence of these insects, namely the silky tubes in which they live (Fig. 2), were found in all the visited places. In several cases some individuals were also found inside the silky tubes, mostly juveniles but also some adult or sub-adult instars (Fig. 3). Among the various sites visited at the beginning of April, the one that provided the greatest number of individuals was located in the center of the island, in a clearing of an holm oak forest at about 525 m above sea level, on the southern slope of Montagna Grande. Embioptera were also found at

Fig. 2 — The silk tubes that testify to the presence (present or past) of webspinners. Pantelleria Island, Montagna Grande, 525 m (Photo P. Fontana, 8. IV.2021).

Fig. 3 — Adult or subadult webspinner female inside the silk tubes. Pantelleria Island, Montagna Grande, 525 m (Photo P. Fontana, 8. IV.2021).

almost sea level, in a green area located in front of the main church of the town of Pantelleria. All the specimens were collected alive and immediately placed in breeding conditions. At the end of May, a single individual, probably subadult, was found on the top of Montagna Grande, at 836 m. This individual has also been reared but unsuccessfully. The other individuals, probably adult females, were left in the rearing container to obtain a new and more abundant generation. From specimens collected at the beginning of April, an adult male was obtained at the beginning of June (Fig. 4). It was preserved in alcohol and processed for its slide mount in Canadian balm. The adult male has been identified, both on the basis of the original description (STEFANI, 1953) and on the redescription by ROSS (1966), as belonging to *Cleomia guareschii* Stefani, 1953.

It should be noticed that some small differences are reported in the descriptions of *C. guareschii* from STEFANI (1953) and ROSS (1966), both in the shape of the left cercus and, above all, in the structure called by STEFANI (1953) "processo dorsale mediano" ("*median dorsal process*") and by ROSS (1966) "median flap". STEFANI (1953) does not describe the apex of this

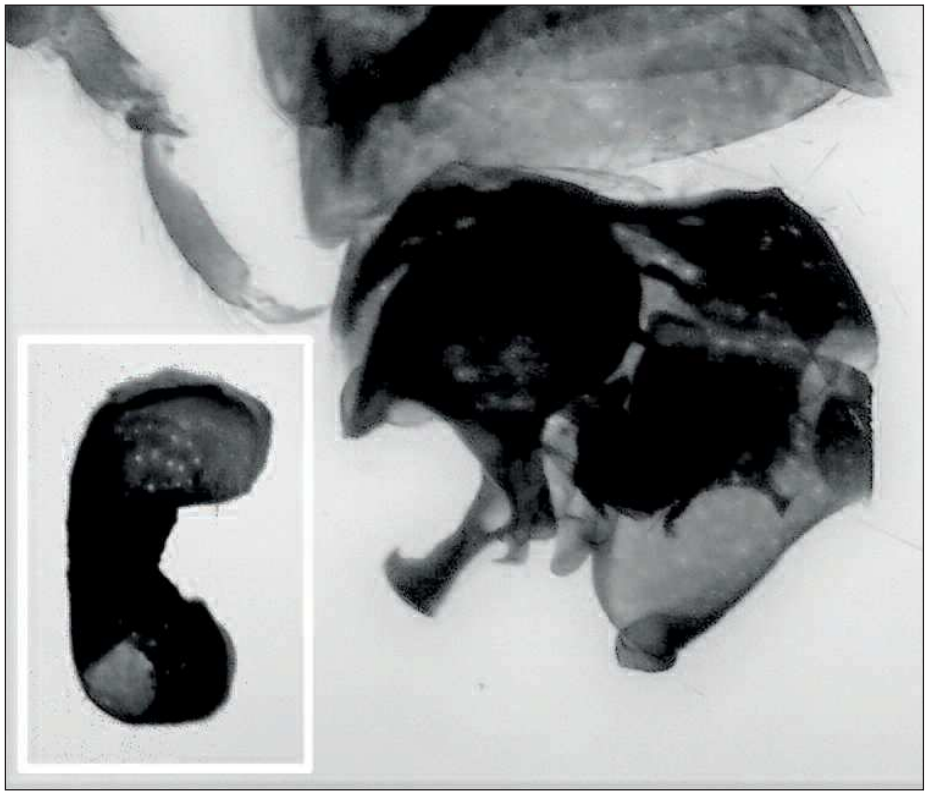

Fig. 4 — Terminalia of the single adult male (mounted on slide) obtained from the living specimens collected in Pantelleria (Montagna Grande, 525 m) and identified as *Cleomia guareschii* Stefani, 1953. Bottom left the cercus (Photo P. Fontana, 8. IV.2021).

structure in the text but he presents a clear drawing of the whole terminalia showing such apex as a round ending protuberance more or less membranous. On the other hand, ROSS (1966) describes this anatomical structure as a "median flap (MF) sclerotic with apex narrowly-acute and curved mesad" and provides the corresponding illustration. The male terminalia of the specimen from Pantelleria, have the median flap exactly corresponding in shape and consistence to the description and the drawing presented by STEFANI (1953). The left cercus has been examined before inclusion in Canadian balm, and corresponds to that of *C. guareschii*.

Moreover, it is not possible to understand whether the description and the related illustration of *C. guareschii* by ROSS (1966) refer to a specimen from Sardinia or the Balearic Islands, the only localities known at that time for this species. From the above, the male from Pantelleria corresponds per-

fectly to Stefani's original description of the species based on Sardinian specimens and therefore must be attributed to *C. guareschii.*

However, further studies are needed to assess if specimens described and illustrated by Ross belong to the same species, comparing the typical material, partly preserved at the Museo Civico di Storia Naturale "G. Doria" in Genoa (POGGI, 1993), with specimens from the Balearic Islands, Tunisia, and Pantelleria. In his text ROSS (1966), referring to *C. guareschii*, writes that "It seems improbable that it is confined to its recorded range and collectors should be alert to the possibility of finding it, or additional species of the genus in such places as Spain and North Africa". In the Fauna Europaea (https://fauna-eu.org/) *C. guareschii* is reported for Spain mainland, without bibliographic data relating to this region, while for North Africa, a specimen from Tunisia (Tabarka 10.V.1971, leg. E.S. Ross), identified by E.S. Ross as *C. guareschii* and preserved in the National Museum of Natural History in Sofia (Bulgaria), seems to confirm the presence of this species or at least of the genus *Cleomia* in the African continent (BERON, 2015).

The finding of *C. guareschii* in Pantelleria therefore represents a new record for the order Embioptera in the island, and allows to confirm a wider distribution of this genus, which is known today, with only one species, only from Balearic Islands, Sardinia and Tunisia.

Lampione Island

Examined material

Embia sp.: Italy, Sicily, Lampione island (AG) 1.VI.2021, leg. G. Lo Verde, 2 females, PFMCR.

The first report for these insects in the Lampione Island is related to a single specimen provisionally identified as *E. ramburi* (KOHLMEYER, 1960). Several decades later, other webspinners were collected, which were not assigned to *E. ramburi* but instead reported to "show strong morphological differences from *E. ramburi*" (LO CASCIO & PASTA, 2012). Therefore, ROMANO (2020), in his update of the checklist of insects from Lampedusa, Linosa and Pantelleria (LO VALVO & MASSA, 1995), reports for the island two species: *E. ramburi*, and according to LO CASCIO & PASTA (2012) "a second species of Embioptera collected in Lampione, still under investigation and not yet determined". During a visit to the island at the beginning of June 2021, two adult females were collected. Unfortunately the two adult females, of slightly different size and also characterized by a slightly different coloration, are assignable to the genus *Embia,* but are not identifiable at a specific level. The identity of the Embioptera from the island of Lampione therefore still remains doubtful.

Lampedusa Island

Examined material

Embia ramburi Rimski-Korsakow, 1905: **Italy**, Sicily, Lampedusa island (AG), Crociera Nave Oceanografica Bannock, 4.IV.1990, leg. Agnelli & Borri; 1 adult male, PFMCR.

Other examined material

Italy, Tuscany, Viareggio, Marina di Levante, riserva naturale "La Lecciona" (LU), 20.IX.2000, leg. P. Fontana, 7 adult males on slide and 2 adult males in alcohol (obtained after rearing), PFMCR. Marche, Marotta (PU), 2 m, coastal habitat, 43°45'0,97"N, 13°10'03,1"E, 26.III.2021, leg. P Fontana, 1 adult male on slide and 4 adult males in alcohol (obtained after breeding in June 2021) (PFMCR). Marche, Villafurlo, Fermignano (PU), 170 m, 4.VI.2004, leg. P. Fontana, 2 males on slide (PFMCR). Marche, San Martino del Piano, Fossombrone (PU), 120 m, 4.VI.2004, leg. P. Fontana, 2 males on slide, PFMCR. **France**, Montferrier sur Lez (Montpellier), in the garden of Heliotel, 22.II.2001, leg. P. Fontana, 3 males on slide (obtained after rearing) (PFMCR).

A single adult male was collected at Lampedusa during the expedition conducted in April 1990 by the Bannock ship, one of the two oceanographic vessels of the Italian C.N.R. (National Research Council) which carried out a research expedition in the small islands of the Sicilian Channel, and is now preserved in the collection of Embioptera gathered by the first author at the Civic Museum Foundation of Rovereto (Trento, Italy). The specimen was preliminarily studied in alcohol and later clarified and mounted on a slide in Canadian balm, resulting undoubtedly assignable to the genus *Embia*. Even if there are some small differences both in the shape and size of the head and in the sclerotization and sizes of the median flap, compared to the other *E. ramburi* specimens examined, the specimen of Lampedusa is assigned to this species (Figs. 5, 6 and 7).

Embia ramburi is known from southern France (the type locality is Villafranche sur Mer), Spain, Italy and some islands in the western Mediterranean (Ross, 1966). In Italy *E. ramburi* is present, based also on the data presented here for the first time, both along the Tyrrhenian and Adriatic coasts. The species is also known from Tunisia, where it was collected and identified by E. S. Ross (Beron, 2015).

Remarks

The presence of webspinners in Pantelleria and Lampedusa, although still unknown, was largely expected, especially based on the past records from the island of Lampione. The knowledge on these insects is in fact largely

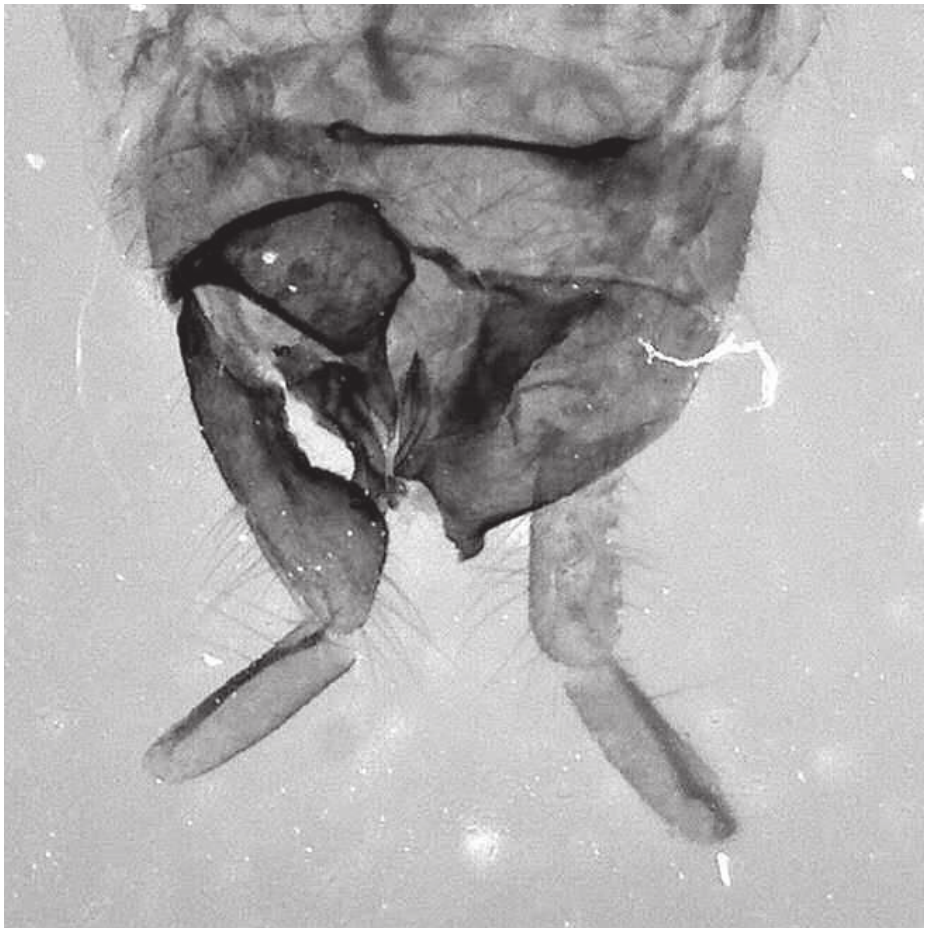

Fig. 5 — Terminalia of the single adult male (mounted on slide) up to date known from Lampedusa Island (4.IV.1990) and identified as *Embia ramburi* Rimski-Korsakow, 1905 (Photo P. Fontana).

incomplete both as regards their taxonomy as well as their distribution. Although they are insects which typically live in Mediterranean habitats and often coastal habitats, Embioptera are much more widespread than it is known. In Italy, for example, *E. tyrrhenica* Stefani, 1953 is also present on the Euganean Hills (Veneto, Padova), on the slopes of the Berici Mountains (Veneto, Vicenza) and it penetrates the Apennines at least inside to Popoli (Abruzzo, Pescara) (FONTANA *et al.*, 2002; FONTANA, 2021).

The two species of Embioptera reported from Pantelleria (*Cleomia guareschii* Stefani, 1953) and Lampedusa (*Embia ramburi* Rimski-Korsakow, 1905) have a typical western Mediterranean distribution and both are known

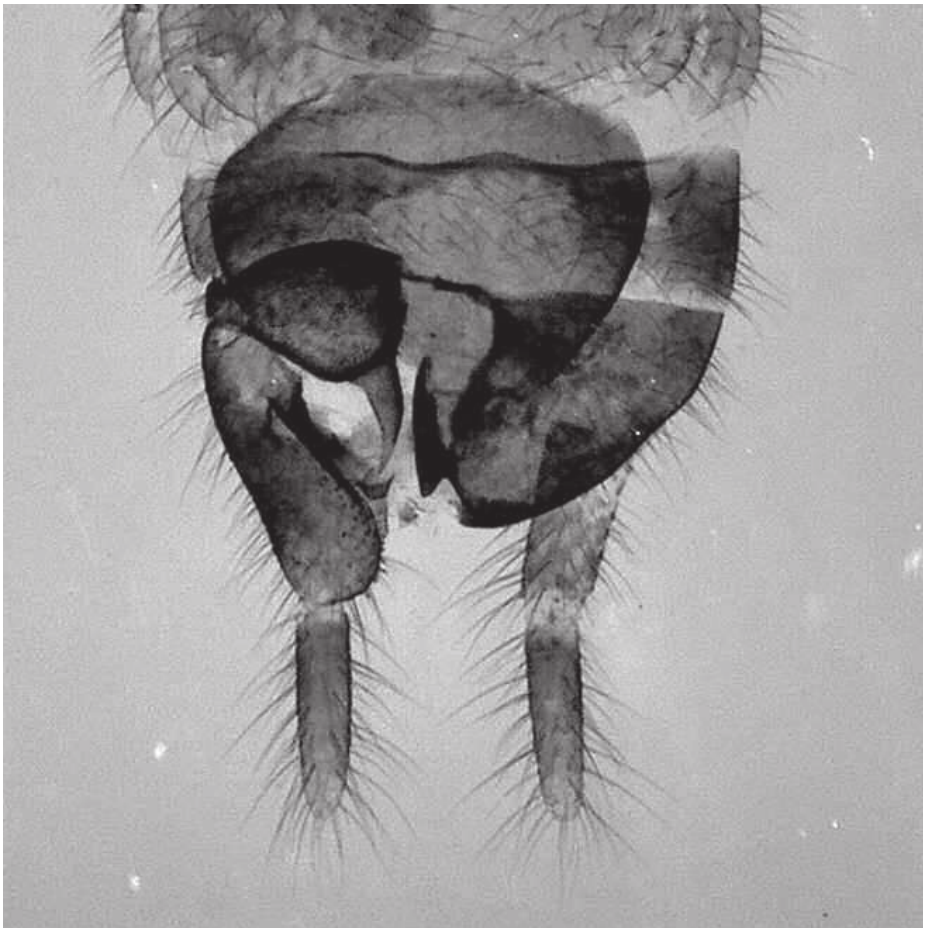

Fig. 6 — Terminalia of an adult male (mounted on slide) of *Embia ramburi* Rimski-Korsakow, 1905 from South France, Montferrier sur Lez (Montpellier) 22.II.2001, not far from the type locality of the species (Photo P. Fontana).

also from Tunisia. The data above presented and the widespread presence of these insects on the Island of Pantelleria, allow to presume the occurrence of other species on these islands, as often different genera and species can co-occur in the same site, probably thanks to a different phenology (ROSS, 1966; FONTANA, 2001). The identity of the Embioptera present on the islet of Lampione still remains to be clarified.

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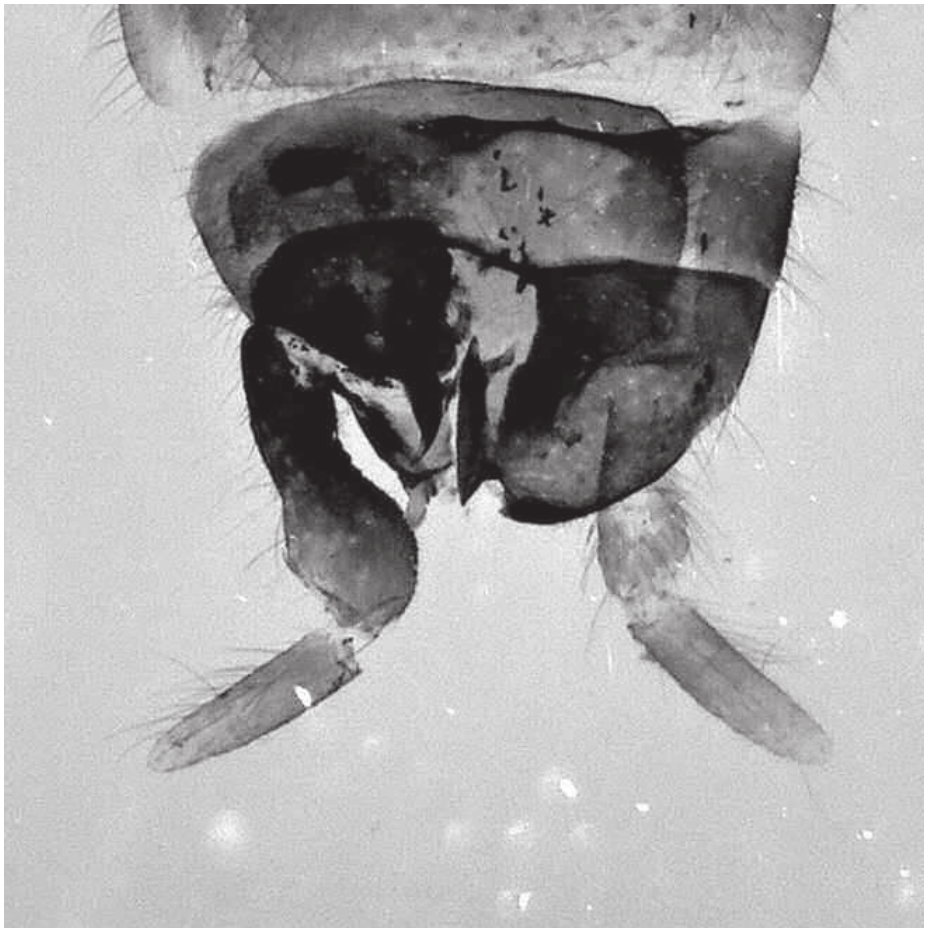

Fig. 7 — Terminalia of an adult male (mounted on slide) of *Embia ramburi* Rimski-Korsakow, 1905 from Italy, Marche, Marotta (PU) 26.III.2021 (Photo P. Fontana).

Foundation which, despite the difficulties of access due to the recent Covid pandemic, has facilitated in every way the study of the material preserved in the museum's collection. Material collected during the Crociera by Bannock ship has been made available from B. Massa. A heartfelt thanks to our friend Bruno Massa for the continuous help and support given to our research activity.

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