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The Sawflies of Crete (Hymenoptera, Symphyta)

Andrew D. Liston[1], Hans-Joachim Jacobs[2], Marko Prous[1,3]

1 *Senckenberg Deutsches Entomologisches Institut, Eberswalder Str. 90, 15374 Müncheberg, Germany*

2 *Dorfstr. 41, 17495 Ranzin, Germany*

3 *Department of Zoology, Institute of Ecology and Earth Sciences, University of Tartu, Vanemuise 46, 51014 Tartu, Estonia*

http://zoobank.org/6CEA4772-755A-464E-B641-BE82D01160E2

Corresponding author: *Andrew Liston* (andrew.liston@senckenberg.de)

Abstract

Forty-two sawfly species are now known from Crete, including twelve species here recorded for the first time, and excluding earlier published records of *Allantus didymus* (Klug, 1818) based on misidentifications. *Allantus nigrolinearis* (Zirngiebl, 1937) is treated as a distinct species within the *laticinctus-didymus* group. *Aneugmenus oertzeni* (Konow, 1887) is allied to the Sardo-Corsican *A. bibolinii* Zombori, 1979 and belongs to *Aneugmenus* Hartig, 1837 s. str., not *Atoposelandria* Enslin, 1913. *Pristiphora nievesi* Haris, 2002 is a new synonym of *P. tetrica* (Zaddach, 1883). Of the newly recorded species, *Chevinia mediterranea* Lacourt, 2003, *Dolerus puncticollis* Thomson, 1871 and *Empria archangelskii* Dovnar-Zapolskij, 1929 are simultaneously new for the country of Greece. Four species (*Allantus nigrolinearis*, *Aneugmenus oertzeni*, *Periclista cretica* (Schedl, 1981) and *Pristiphora* sp. [*subbifida* group]) have not been recorded outside Crete, and may be endemic. It is not clear whether the morphologically and genetically distinctive Cretan specimens of *Strongylogaster multifasciata* (Geoffroy, 1785) should be regarded as a Cretan endemic species, for which the name *S. cretensis* Konow, 1887 is available, or as an isolated population of *S. multifasciata*. This requires further study, as also the taxonomic status of *Heterarthrus imbrosensis* Schedl, 1981 (only known from Crete) and *H. wuestneii* (Konow, 1905) (widespread in the West Palaearctic). The sympatric occurrence of three related *Pristiphora* species on *Acer sempervirens*, two of which differ in their choice of host individuals that are at different stages of vegetative development, is remarkable. A checklist of the Symphyta of Crete is presented.

Introduction

The Greek island of Crete, in the southern Aegean Sea, is well known for its richness in endemic plant and animal species (Legakis and Kypriotakis 1994). Although the Cretan flora has been studied very intensively, much less is known about many invertebrate groups. The sawfly fauna has been treated by Schedl (1981, 1985, 1993, 2011), who based his studies mainly on material which he collected during six visits to the island, together with specimens made available by other entomologists or housed in public collections. His first paper on this topic (Schedl 1981) also collated the fragmented earlier literature containing records of Cretan sawflies. Schedl (1993) remarked on the general scarcity of Symphyta in Crete,

and stated that only a total of about 150 specimens had been available to him for study. It seemed from his data, that little collecting had been done in the earlier part of spring (March and April). We accordingly chose these months for two visits to Crete in 2013. Many of the species which we encountered, represented by a total of over 600 specimens, were previously recorded in Crete only from very few individuals. For this reason we list all the material that was recently obtained.

Material and methods

A visit to Crete by Liston alone at the end of March was followed by a visit by all three authors at the end of April.

The first visit was centered on Iraklion, with day trips mainly into central Crete. Excursions during the second visit, based at Daratsos near Chania, were mainly in western Crete and focussed on localities in and around the Lefka Ori (White Mountains). Here we paid particular attention to endemic plant species such as *Zelkova abelicea*: a Tertiary relict, endemic Cretan member of the Ulmaceae (Kozlowski, 2013). The two excursions allowed us to do field work at a wide range of localities spread throughout most of the island except for the most easterly part. We collected using aerial nets with extendable handles, mainly by sweeping. Most material, including vouchers of all species, is deposited in the collection of the Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany (SDEI). Additional specimens are in the private collection of H.-J. Jacobs, and some duplicates in the US National Museum, Washington DC. Results of DNA barcoding (sequencing of part of the COI mitochondrial gene) conducted as part of the Barcode of Life Project (BOLD) (Ratnasingham and Hebert 2007) are included for some taxa whose taxonomic status is discussed. The specimen codes used in BOLD are given. Numbers preceded by DEIGISHym refer to specimens deposited in the SDEI; the prefix BC ZSM HYM denotes specimens held by the Zoologische Staatssammlung, Munich, Germany. Tissue for sequencing was obtained by detaching the right-hand mid leg, or part thereof, of pinned, dried specimens. Taxonomy and nomenclature follows Taeger et al. (2010) with modifications by Liston and Prous (2014), Malm and Nyman (2015) and Prous et al. (2014).

The approximate coordinates and altitudes of the collection localities, listed alphabetically under their prefecture (from West to East), are:

Chania. Agia, 35.477°N, 23.930°E, 30 m. Agia Irini, 35.328°N, 23.837°E, 580 m. Askifou, 35.288°N, 24.191°E, 690 m. Daratsos, 35.506°N, 23.974°E, 30 m. Drakona, 35.406°N, 24.020°E, 510 m. Drakona 2, 35.416°N, 24.032°E, 320 m. Fournes, 35.418°N, 23.940°E, 200 m. Fournes-Meskla, 35.417°N, 23.950°E, 320 m. Kakopetros, 35.417°N, 23.750°E, 470 m. Kandanos, 35.333°N, 23.733°E, 420 m. Komitades, 35.208°N, 24.173°E, 170 m. Kournas and Georgiopolis, 35.347°N, 24.273°E, 25 m. Lakki, 35.371°N, 23.896°E, 900 m. Lousakies, 35.458°N, 23.629°E, 260 m. Meskla, 35.401°N, 23.955°E, 210 m. Moni, 35.285°N, 23.822°E, 110 m. Nea Roumata, 35.383°N, 23.850°E, 410 m. Omalos, 35.322°N, 23.913°E, 1100 m. Omalos 2, 35.325°N, 23.891°E, 1060 m. Platanias, 35.500°N, 23.900°E, 20 m. Samonas, 35.407°N, 24.108°E, 310 m. Sempronas, 35.376°N, 23.824°E, 660 m. Strovles, 35.369°N, 23.670°E, 430 m. Theriso-Drakona, 35.400°N, 23.983°E, 600 m. Topolia, 35.424°N, 23.687°E, 270 m.

Rethimnon. Anogeia, 35.289°N, 24.882°E, 750 m. Armeni, 35.295°N, 24.453°E, 400 m. Livadia, 35.303°N, 24.808°E, 395 m. Moni Kato Preveli, 35.171°N, 24.466°E, 170 m.

Iraklion. Krasi, 35.234°N, 25.467°E, 600 m. Marathos, 35.347°N, 24.972°E, 400 m. Mesa Potami, 35.213°N, 25.521°E, 720 m. Potamies, 35.256°N, 25.387°E, 170 m.

Lasithi. Katharo Plateau, Kopraki, 35.147°N, 25.565°E, 1150 m. Mesa Lasithi, 35.181°N, 25.512°E, 820 m. Pinakiano, 35.197°N, 25.464°E, 820 m.

Results

Names of species not previously recorded in Crete are preceded by an asterisk (*) and those for which sequences of COI barcode region of Cretan specimens are available, are indicated by a dagger (†). Unless otherwise stated, specimens were collected by the authors.

We found no evidence that any sawfly species uses *Zelkova abelicea* as a host. However, we only encountered trees and bushes of this species during two visits to Omalos, and further fieldwork at this and other sites should be undertaken.

Argidae

Arge scita (Mocsáry, 1880)

Material. Crete; 1♂, Drakona 2, 22.iv.2013. 1♀, Moni, 28.iv.2013. 2♂♂, Agia Irini, 28.iv.2013.

Cimbicidae

Corynis krueperi (J. Stein, 1876)

Material. Crete; 1♂, Potamies, 27.iii.2013, swept from inflorescences of *Papaver rhoeas*: a known host (Greathead 1978).

The name *C. krueperi* is used instead of *C. similis* (Mocsáry, 1880) for this taxon, as also in Liston and Jacobs (2012), in accordance with a revision of *Corynis* (Jacobs et al., in preparation).

Tenthredinidae
Allantinae

†*Allantus nigrolinearis* (Zirngiebl, 1937), new status

= *Emphytus balteatus* var. *nigrolinearis* Zirngiebl, 1937: 646; ♀, holotype [not examined]. Type locality: Kristallenia (Kreta) [= Panagia Kristalenia, Lasithi Plateau, East Crete]. Blank 1996; synonym of *Allantus balteatus* (Klug, 1818). Lacourt 1999; synonym of *Emphytus laticinctus* (Serville, 1823).
= *Allantus didymus* var. *nigrolinearis* (Zirngiebl, 1937); Schedl 1981; misidentification.

Material. Crete; 2♀♀, 1♂, Agia Irini, 26.iv.2013. 1♀, 1♂, Agia Irini, 28.iv.2013.

Barcode data. The barcodes of two sequenced *A. nigrolinearis* specimens (DEIGISHym20641, 20642) are identical and amongst 34 sequenced specimens of *A. didymus* and *A. laticinctus* sensu lato, are most similar to those of *A. ariadne* Liston and Jacobs, 2012 from Cyprus (DEIGISHym11089, 11093), with divergence of about 3.9%. Minimal divergence

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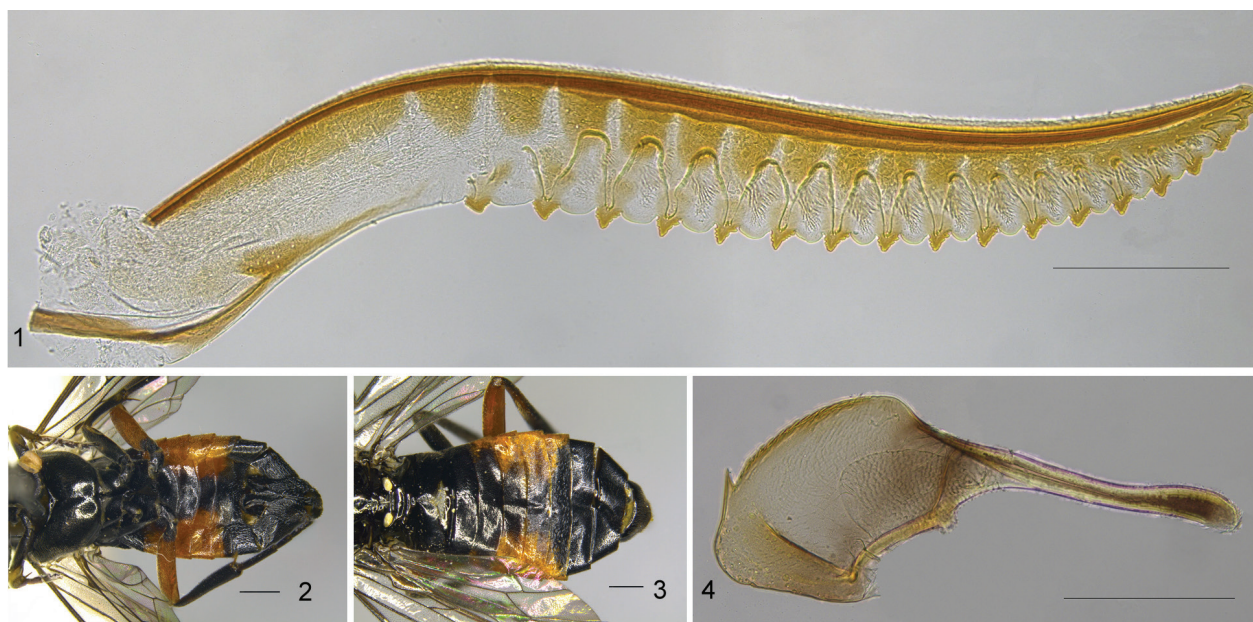
Figures 1–4. *Allantus nigrolinearis*, Crete. **1,** lancet, ♀, scale = 0.2 mm. **2,** underside of abdomen, ♀, scale = 1 mm. **3,** upperside of abdomen, ♀, scale = 1 mm. **4,** penis valve, ♂, scale = 0.2 mm.

of *A. nigrolinearis* from *A. laticinctus* (France BC ZSM 01149 and Italy, Sicily DEIGISHym11042) is 6.4%. Noteworthy is that divergence of 5.3% between *A. nigrolinearis* and *A. didymus* (Klug, 1818) (Italy DEIGISHym18775, and Germany; 10 specimens) is somewhat less than from *A. laticinctus*. Several other segregates cluster around the four named taxa in the barcode similarity tree, indicating that the species group requires revision and may contain more taxa than previously thought.

As noted by Blank (1996), Zirngiebl apparently had no clear concept of species, subspecies and varieties. His var. *nigrolinearis* was described within a paragraph discussing colour variability of a reared series of female *Emphytus balteatus* from Germany. However, his wording does not make it clear what relationship he considered his new variety to have to the other specimens. In the absence of any clear indication that Zirngiebl considered *nigrolinearis* to be of infrasubspecific rank, the name is available (ICZN 1999, Article 45.6.4.).

Female *A. nigrolinearis* differ from those of *A. laticinctus* and *A. ariadne* in having an uninterrupted, broad, median, black vitta through the otherwise red sterna of the abdomen (Fig. 2). In the other species a number of sterna are entirely red. The metatibia of *A. nigrolinearis* females is also darker: apical half, and base narrowly, fuscous. In the other species the metatibia is entirely red except for apex. In two *A. nigrolinearis* the otherwise red abdominal terga 3–6 have a median black stripe (Fig. 3). In the third female, this stripe is interrupted on tergum 5 and the metatibia is somewhat paler than in the other specimens. The four basal serrulae of the lancet of *A. nigrolinearis* (Fig. 1) are subtriangular and similar to the other serrulae, whereas the four basal serrulae of *A. laticinctus* and *A. ariadne* are more rounded than the others (Liston and Jacobs 2012, Figs 4, 6). The males of *A. nigrolinearis* and

A. ariadne are indistinguishable, apparently including their penis valves (*A. nigrolinearis*: Fig. 4. *A. ariadne*: Liston and Jacobs 2012, Fig. 7), but differ in leg colour from *A. laticinctus*. In *A. nigrolinearis* and *A. ariadne* the mid femur is almost entirely black except for the apex, but in *A. laticinctus* approximately the apical half of the mid femur is pale. The holotype of var. *nigrolinearis* was mistakenly considered by Schedl (1981, 1993) to belong to *Allantus didymus* (Klug, 1818) (Schedl 2011). Schedl (2011) added a record from Crete of a male specimen which he determined as *A. didymus*. However, confusion of *A. didymus* with *A. laticinctus* (sensu lato) has been widespread, particularly of the males (Koch 1988). Until more convincing evidence for the occurrence of *A. didymus* in Crete is presented, the name should be removed from the faunal list of the island.

A. laticinctus has only definitely been reared from *Rosa*, in central and western Europe (Taeger et al. 1998, Knight 2006). The host(s) of *A. nigrolinearis* are likely to be Rosaceae (because the known hosts of other species in this complex are Rosaceae), but as for *Empria archangelskii* (see below), several host species seem possible.

**†Allantus viennensis* (Schrank, 1781)

Material. Crete; 1♀, 6♂♂, Daratsos, on roses (garden cultivar) in hotel garden, 21–25.iv.2013. 1♂, Meskla, 22.iv.2013, near roses (garden cultivar). *Rosa* spp. are the known hosts: Taeger et al. 1998.

The garden habitat and association of the Cretan specimens with horticultural varieties of rose, suggest that *A. viennensis* may have been introduced to the island. *A. viennensis*, probably native to southern and central Europe, is also an introduced and established species in the eastern USA (Smith 2003).

*†*Ametastegia glabrata* (Fallén, 1808)

Material. Crete; 1♀, Strovles, 24.iv.2013.

One of the most cosmopolitan of sawflies, introduced to North America, South America and Australia from its (presumed) native range in the Palaearctic (Liston and Zerafa 2012).

**Empria archangelskii* Dovnar-Zapolskij, 1929

Material. Crete; 1♀ "Ajos Joánnis Ep. Ajos Wássilis" 21.iii.1925 , leg. A. Schulz, Museum für Naturkunde, Berlin. 1♀, Agios Nicolaos, Almyros (Lasithi), 11.iv.1976, leg. Matti Viitasaari, Viitasaari Collection, Helsinki. 1♀, Mesa Potami, 28.iii.2013, swept from *Crataegus monogyna*. 1♀, Anogeia, 29.iii.2013, swept from flowering *Acer sempervirens*. 1♀, 1♂, Kathario Plateau, Kopraki, 30.iii.2013, swept from low vegetation on riverbank. 1♀, Agia Irini, 26.iv.2013, swept from low vegetation on a dry slope.

Based on the serrulae of the lancet, Prous (2012) treated the Cretan specimens preliminarily as a different species (sp4) from *E. archangelskii*. Serrulae in Cretan specimens are narrower and more protruding (Fig. 5) than in mainland specimens (Fig. 6). Although the three studied lancets of Cretan females are very similar to each other and slightly different from the two specimens studied from the mainland (one from Crimea, and the syntype of *E. archangelskii* from Tuapse, Krasnodar Krai, Russia), the penis valves of males appear to be indistinguishable (Figs 9–10). Because no consistent external differences were detected between the specimens from Crete and elsewhere, and a normal variability of lancets cannot be excluded, we consider them conspecific. *Selandria labialis* Brullé, 1832, currently treated as a synonym of *E. immersa* (Klug, 1818) (Taeger et al. 2010), was described from Methoni [Plaine de Modon], Messenia, Peloponnese, an area with habitats probably similar to those in Crete. The description of *S. labialis* can be interpreted as referring to *E. immersa* or *E. archangelskii*, although "Chaperon très-peu échancré" [clypeus very slightly emarginate] fits better with the former. Neither of these species has otherwise been recorded from mainland Greece. The Cretan *E. archangelskii* are the first recorded from Greece and are the most westerly records of the species, which is otherwise known from the North coast of the Black Sea (Russia, Ukraine), Cyprus, Israel, Lebanon and Syria (Prous 2012).

The closest species to *E. archangelskii* is *E. excisa* (Thomson, 1871). *E. archangelskii* can be easily distinguished by the red-yellow pale colour of its legs, with femora mainly pale (black and whitish in *E. excisa*, with femora mainly black). There appear also to be slight differences between lancets and penis valves: serrulae are more protruding in *E. archangelskii* (Figs 5–6) than in *E. excisa* (Figs 7–8) and valviceps of penis valves might be slightly narrower and differently shaped in *E. archangelskii* (Figs 9–10) than in *E. excisa* (Figs 11–12).

The hostplant(s) of *E. archangelskii* are unknown. However, the larvae of *Empria* species which are morphologi-

cally and genetically closest to *E. archangelskii* all feed on non-woody Rosaceae. The plants from which the specimens were collected and were growing near the collecting sites did not offer clues as to the identity of a possible host. The only Rosaceae obviously present at all Cretan collecting sites was *Crataegus monogyna*, but presumably the widespread *Sanguisorba minor*, *Sarcopoterium spinosum* and *Rubus sanctus* were also present somewhere not too distant.

Athaliinae

Athalia circularis (Klug, 1815)

Material. Crete; 1♂, Agia, 29.iv.2013, netted from *Veronica* sp. growing in wet bed of a stream. *Veronica* spp. are known hosts (Taeger et al. 1998).

†*Athalia cordata* Serville, 1823

Material. Crete; 1♂, Potamies, 27.iii.2013. 4♀♀, Mesa Potami, 28.iii.2013. 1♀, Krasi, 28.iii.2013. 1♂, Daratsos, pool at hotel, 21.iv.2013. 1♀, 6♂♂, Omalos, 21.iv.2013. 1♀, Sempronas, 21.iv.2013. 1♂, Drakona, 22.iv.2013. 1♀, 8♂♂, Thériso-Drakona, 22.iv.2013. 1♂, Askifou, 23.iv.2013. 3♂♂, Kakopetros, 24.iv.2013. 1♀, 1♂ Strovles, 24.iv.2013. 3♀♀, 14♂♂, Omalos 2, 25.iv.2013. 14♀♀, 25♂♂, Agia Irini, 26.iv.2013. 1♂, Samonas, 27.iv.2013. 7♂♂, Moni, 28.iv.2013. 2♀♀, 3♂♂, Agia Irini, 28.iv.2013. 4♂♂, Agia, 29.iv.2013.

We did not collect all male specimens that were seen. During both visits to Agia Irini, males were very abundant in the uppermost part of the gorge.

†*Athalia rosae* (Linnaeus, 1758)

Material. Crete; 1♂, Strovles, 24.iv.2013.

Blennocampinae

*†*Chevinia mediterranea* Lacourt, 2003

Material. Crete; 1♀, Drakona, 22.iv.2013, swept from *Quercus* sp. (either *Q. ilex* or *Q. coccifera*).

C. mediterranea was described from localities on the Mediterranean coast of mainland France and Corsica (Lacourt 2003). Specimens recorded as ? *Chevinia* sp. from Thessaly, mainland Greece, by Standfuss et al. (2010) also belong to this species (comparison with paratypes of *C. mediterranea* by A. Mol, S. Blank and A. Liston, 2013). The mainland specimens were also collected from *Quercus* spp. (K. Standfuss, personal communication), so perhaps the larval host is one or more oak species.

Halidamia affinis (Fallén, 1807)

Material. Crete; 1♀, Daratsos, pool at hotel, 22.iv.2013. 1♀, Meskla, 22.iv.2013. 2♀♀, Fournes-Meskla, 22.iv.2013.

Figures 5–8. *Empria*, lancets, ♀. **5,** *E. archangelskii*, Crete. **6,** *E. archangelskii*, Crimea. **7,** *E. excisa*, France. **8,** *E. excisa*, Estonia.
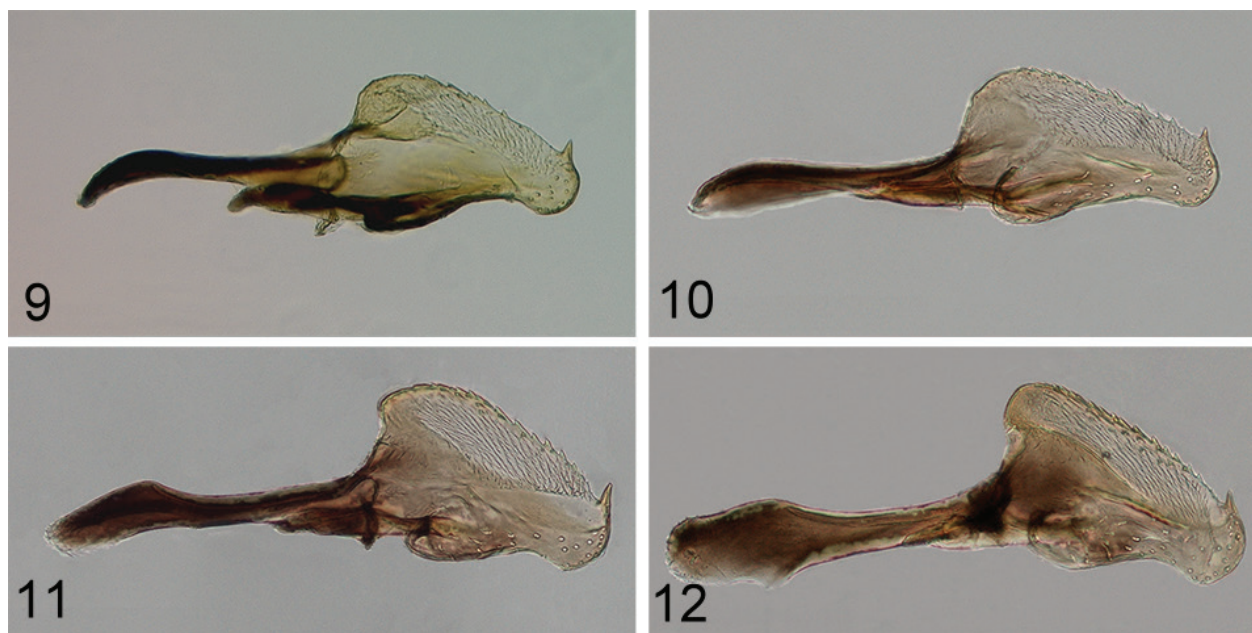
Figures 9–12. *Empria*, penis valves, ♂. **9,** *E. archangelskii*, Crete. **10,** *E. archangelskii*, Crimea. **11,** *E. excisa*, France. **12,** *E. excisa*, Estonia.

1♀, Drakona, 22.iv.2013. 4♀♀, Agia Irini, 26.iv.2013. 1♀, Samonas, 27.iv.2013. 1♀, Moni, 28.iv.2013.

[†]*Heterarthrus imbrosensis* Schedl, 1981

Material. Crete; 5♀♀, 7♂♂, Omalos, 25.iv.2013, swept from *Acer sempervirens*: the host (Schedl 1981).

Barcode data. the barcode of one specimen collected from *Acer sempervirens* from the Peloponnese and determined as *H. wuestneii* (Konow, 1905) (DEI-GISHym11102), diverges by 0.7% from two Lower Austrian specimens of *H. wuestneii* (BC ZSM HYM 04121, 04122). The minimum barcode divergence of the two barcoded Cretan *H. imbrosensis* (DEIGISHym20655, 20656) from the Peleponnesian *H. wuestneii* specimen is 1.8%.

Morphologically. *H. imbrosensis* closely resembles *H. wuestneii*. Specimens from Crete are darker than Central European (German and Austrian) *H. wuestneii*. The face may be entirely black in Cretan females, but usually there are at least small white patches on the inner orbits, whilst the tegula varies from entirely black to black with the posterior edge white. The *H. wuestneii* specimens from the Peloponnese are intermediate in coloration. According to Schedl (1981), *H. imbrosensis* is distinguished from similar species of the *aceris* group by the shape of the head behind the eyes in dorsal view. No such difference was found between the specimens of *H. wuestneii* and *H. imbrosensis* available to the authors. Furthermore, the apparently apically widened sawsheath of the holotype of *H. imbrosensis* [examined] as drawn by Schedl (1981) is the result of disruption of the valves of the sheath during extraction of the saw. As pointed out by Leppänen et al. (2012), the status of some of the *Acer*-feeding *Heterarthrus* needs further study, ideally including sequencing of nuclear DNA.
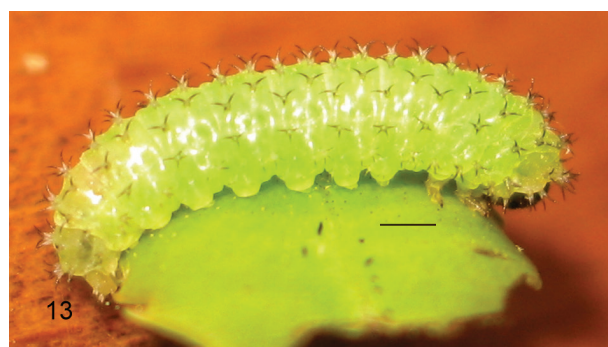

Figure 13. *Periclista cretica*, larva, Crete, scale = 1 mm.

[†]*Periclista cretica* (Schedl, 1981)

Material. Crete; 3♀♀, 32♂♂, Krasi, 27–28.iii.2013. 3♂♂, Livadia, 29.iii.2013. 2 larvae (Fig. 13) beaten from *Quercus coccifera*, Drakona 2, 22.iv.2013 (determined by barcode congruence of one larva with 2 adults).1♀, Askifou, 23.iv.2013. All specimens swept from, or netted near, upper branches of *Quercus coccifera* (plants 3–5 m tall).

The buds of the bushes and small trees of *Quercus coccifera* from which these were collected were swollen, but had not burst. Males were obtained mostly by netting them as they flew around the twigs in the upper crowns (at Krasi reached by standing on the many large boulders), and less so by sweeping around all accessible lower parts of the oaks. Sweeping yielded the only few females that we were able to obtain. The identification of the larvae allows us to state that *Q. coccifera* is the host plant. *P. cretica* was previously only known from the female holotype and a single male paratype (Schedl 1981), both of which we examined.

The taxonomy of this species will be dealt with in detail in a revision of West Palaearctic *Periclista* (A. Mol, in preparation).

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Nematinae

*†*Cladius ordubadensis* **Konow, 1892**

Material. Crete; 1♀, Krasi, 28.iii.2013. 1♀, Agia Irini, 26.iv.2013. Swept from low vegetation containing *Sanguisorba minor*, which is possibly a host plant (Liston and Jacobs 2012).

*†*Cladius pectinicornis* **(Geoffroy, 1785)**

Material. Crete; 1♀, 6♂♂, Topolia, 29.iv.2013, on *Rosa* sp.: the main hosts are *Rosa* spp. (Taeger et al. 1998).

Euura atra* **(Jurine, 1807)

Material. Crete; 2♀♀, 4♂♂, Moni Kato Preveli, 25.iii.2013, swept from *Salix alba*, one of the main hosts: Taeger et al. 1998.

Euura proxima **(Serville, 1823)**

Material. Crete; 3 galls in leaves of *Salix alba*, Meskla, 22.iv.2013. Galls very abundant (hundreds) on *Salix alba*, Agia, 29.iv.2013.

No adults were found by sweeping foliage of the three large trees at Agia. The majority of larvae were very small when about 200 galls were collected. Nevertheless, about 30 individuals had spun cocoons by 7.v.2013. Three females emerged in June 2013. Some others seemed to have entered prolonged diapause, but no adults were reared.

*†*Hoplocampa brevis* **(Klug, 1818)**

Material. Crete; 1♀, Marathos, 24.iii.2013. 2♀♀, Pinakiano, 27.iii.2013. 2♀♀, Mesa Potami, 28.iii.2013. 1♀, Anogeia, 29.iii.2013. 2♀♀, Omalos, 25.iv.2013. Specimens mostly collected from inflorescences of *Pyrus* cultivars: the normal hosts are *Pyrus* spp. (Taeger et al. 1998).

†*Hoplocampa chrysorrhoea* **(Klug, 1816)

Material. Crete; 4♀♀, Marathos, 24.iii.2013. 9♀♀, Pinakiano, 27.iii.2013. 7♀♀, Mesa Potami, 28.iii.2013. 1♀, Krasi, 28.iii.2013. 10♀♀, Anogeia, 29.iii.2013. 1♀, Omalos, 21.iv.2013. Most specimens were swept from *Crataegus monogyna* with unopened inflorescences, and some others from inflorescences of cultivated *Pyrus* growing near *Crataegus*.

At none of the localities were *Prunus* spp. seen, although these are usually considered to be the larval hosts of *H. chrysorrhoea* in northern parts of Central Europe (e.g. Taeger et al. 1998). Perhaps *Crataegus monogyna* is a host in Crete.

†*Mesoneura opaca* **(Fabricius, 1804)

Material. Crete; 1♂, roadside between Kournas and Georgiopolis, 26.iii.2013. 1♀, Livadia, 29.iii.2013. Both specimens swept from freshly flushed *Quercus pubescens*: *Quercus* spp. are the known hosts (Liston 2012).

The depressed medial areas of the apical abdominal terga of the male are partly pale, unlike the completely dark terga of males so far examined from mainland Greece (see Liston 2012).

Pristiphora abbreviata **(Hartig, 1837)**

Material. Crete; 4 larvae on cultivated *Pyrus* sp., Fournes, 25.iv.2013. One larva, larger than the others, had spun a cocoon by 7.v.2013.

*†*Pristiphora cretica* **Schedl, 1981**

Material. Crete; 7♂♂, Pinakiano, 27.iii.2013. 5♂♂, Mesa Lasithi, 28.iii.2013. 1♀, 8♂♂, Katharo Plateau, Kopraki, 30.iii.2013. 6♀♀, 8♂♂, Omalos, 21.iv.2013. 11♀♀, 19♂♂, Askifou, 23.iv.2013. 7♀♀, 16♂♂, Omalos, 25.iv.2013. 2♀♀, Agia Irini, 26.iv.2013. All specimens swept from *Acer sempervirens*: because all species of the *Pristiphora subbifida* group use *Acer* spp. as hosts (Liston and Späth 2008), *A. sempervirens* (the only *Acer* sp. occurring in Crete) is probably a host.

Barcode data. Minimum divergence of three Cretan *P. cretica* (DEIGISHym20657–20659) from two northern Greek *P. cretica* (DEIGISHym11052, 19646) is approximately 1.2%. Interspecific divergence from the next nearest species, *P. schedli* (Cyprus: DEIGISHym10980, 10981) is about 3.8%.

In Crete *Acer sempervirens* displays considerable infraspecific variability in the timing of bud burst. Although *Pristiphora cretica* occurred at some localities together with *P. tetrica* (Zaddach, 1883), it was observed that these species have strongly differing preferences for trees at different stages of leaf and flower development. *P. cretica* is found exclusively on trees whose buds have fully opened and which are already flowering, whereas *P. tetrica* is found on trees whose buds have not yet burst, or have just opened. The preference is so strong, that this phenomenon could be observed on trees standing beside each other which were at different stages of flushing (Fig. 14). The difference in habit is also reflected in the temporal distribution of collection data: a larger number of *P. cretica* and higher proportion of females were recorded during the second 2013 visit than during the first, whereas most specimens of *P. tetrica* were collected during the first visit.

The Cretan specimens listed above closely resemble the female holotype and male paratype (examined: Liston and Späth 2008), the only specimens previously known from Crete. Variability in the newly collected specimens affects the extent of pale coloration on the

Figure 14. *Acer sempervirens* at different stages of bud-break. On the tree at left only *Pristiphora cretica* adults were found and on tree at right only *P. tetrica*. Crete, Lasithi Pref., Pinakiano, late March 2013.

pronotum, outer orbits, clypeus and labrum in both sexes, and the extent of pale colour on the abdominal sternites. Specimens from the Vikos area, northern Greece (1♀, 7♂♂, Nom. Ioannina, Aristi, 16.4.2008, leg. Liston, SDEI) are very dark, with pronotum, abdominal sterna and metafemora nearly completely black. In a series (3♀♀, 3♂♂; SDEI) collected by S. M. Blank and C. Kutzscher in the western Peloponnese, the females are much paler than either the Cretan or Vikos specimens: abdomen including terga almost completely pale, in some specimens central part of mesepisternum pale. Colour of the Peleponnesian males falls within the range of variability seen in Cretan specimens. Some of the paler individuals of *P. cretica* could be mistaken for *P. tetrica* (Zaddach, 1883). Specimens of these species from the Mediterranean Region can be distinguished as follows:

– Metafemur at least with black stripes on anterior and posterior edges of dorsal face. Female with clypeus and labrum pale marked; male with at least labrum pale (brown). Abdominal terga largely black, rarely yellow (Peloponnesian ♀♀) and if so then tergum 1 also largely yellow. Female length 5–6 mm; male 4–5 mm...*P. cretica*
– Metafemur entirely yellow, except for black area on extreme base. Clypeus and labrum entirely black. Abdominal tergum 1 black; other terga yellow, except at most for small medial flecks on terga 2–3. Female length 4.0–4.5 mm; male 3.5–4.0 mm..........*P. tetrica*

*Pristiphora pallidiventris (Fallén, 1808)

Material. Crete; 1♀, Daratsos, pool at hotel, 21.iv.2013. 1♀, Theriso-Drakona, 22.iv.2013.

These specimens are of the colour form with a very pale abdomen, which has sometimes been treated as a separate species, *P. denudata* Konow, 1902.

Pristiphora parnasia Konow, 1902

Material. Crete; 1♀, Krasi, 27.iii.2013. 1♀, Livadia, 29.iii.2013. Both specimens swept from *Quercus coccifera*.

†Pristiphora sp. [subbifida group]

Material. Crete; 1♂, Omalos, 21.iv.2013. Swept from *Acer sempervirens*, which is probably a host plant, because this is the only *Acer* sp. occurring in Crete and all species of the *Pristiphora subbifida* group use *Acer* spp. as hosts (Liston and Späth 2008).

Barcode data: the sequence of this specimen (DEI-GISHym20661) diverges by about 4.8% from its nearest neighbour, *P. tetrica* (Zaddach, 1883) from Sicily (DEI-GISHym10972). Divergence from two Cretan *P. tetrica* (see below) is approximately 5.3% and from *P. schedli* Liston and Späth, 2008 (Cyprus) approx. 8.6%.

Externally, the specimen differs from Cretan *Pristiphora tetrica* males only in the apex of the metatibia and most of metabasitarsomere being pale: Fig. 15 (largely black in *P. tetrica*: Fig. 19) and its slightly larger body length of 4.5 mm (*P. tetrica*: 3.5–4.0 mm). However, the penis valve of the unidentified species (Fig. 16) differs substantially from *P. tetrica* (Fig. 17), and resembles that of *P. schedli*: valvispina medially thickened and not strongly upcurved (in other *subbifida* group species not medially thickened, but strongly upcurved), apex of paravalva at base of valvispina not strongly expanded (other species: strongly expanded). On the other hand, the coloration of the head and thorax is much darker in *Pristiphora* sp. than in *P. schedli*, while the legs of the former are paler. Despite its morphological similarity to *P. schedli*, the very large barcode divergence of the single Cretan specimen suggests that it probably represents a previously unrecognized species. Possibly one of the two unidentified female *Pristiphora* specimens mentioned by Schedl (2011) belongs here. Further material should be obtained so that its status can be evaluated.

*†Pristiphora tetrica (Zaddach, 1883)

= *Nematus tetricus* Zaddach in Brischke, 1883: 148–149; ♀, holotype. Type locality: Gumperda, Thüringen. Type probably destroyed (Liston and Späth 2008).
= *Nematus velatus* Zaddach in Brischke, 1883: 149; ♀, holotype. Type locality: Baiern [Bavaria]. Type should be in the Zoologische Staatssammlung, Munich, but was not located (Liston and Späth 2008).
= *Pristiphora tetrica*: Lacourt 1976, description of male.
= *Pristiphora nievesi* Haris, 2004: 164–165; ♀, holotype and paratypes [Museo Nacional de Ciencias Naturales, Madrid; examined]. Type locality: El Ventorillo, Madrid. **New synonym**.

Material. Crete; 7♀♀, 3♂♂, Pinakiano, 27.iii.2013. 2♀♀, 11♂♂, Mesa Lasithi, 28.iii.2013. 1♂, Livadia,

Dtsch. Entomol. Z. 62 (1) 2015, 65–79

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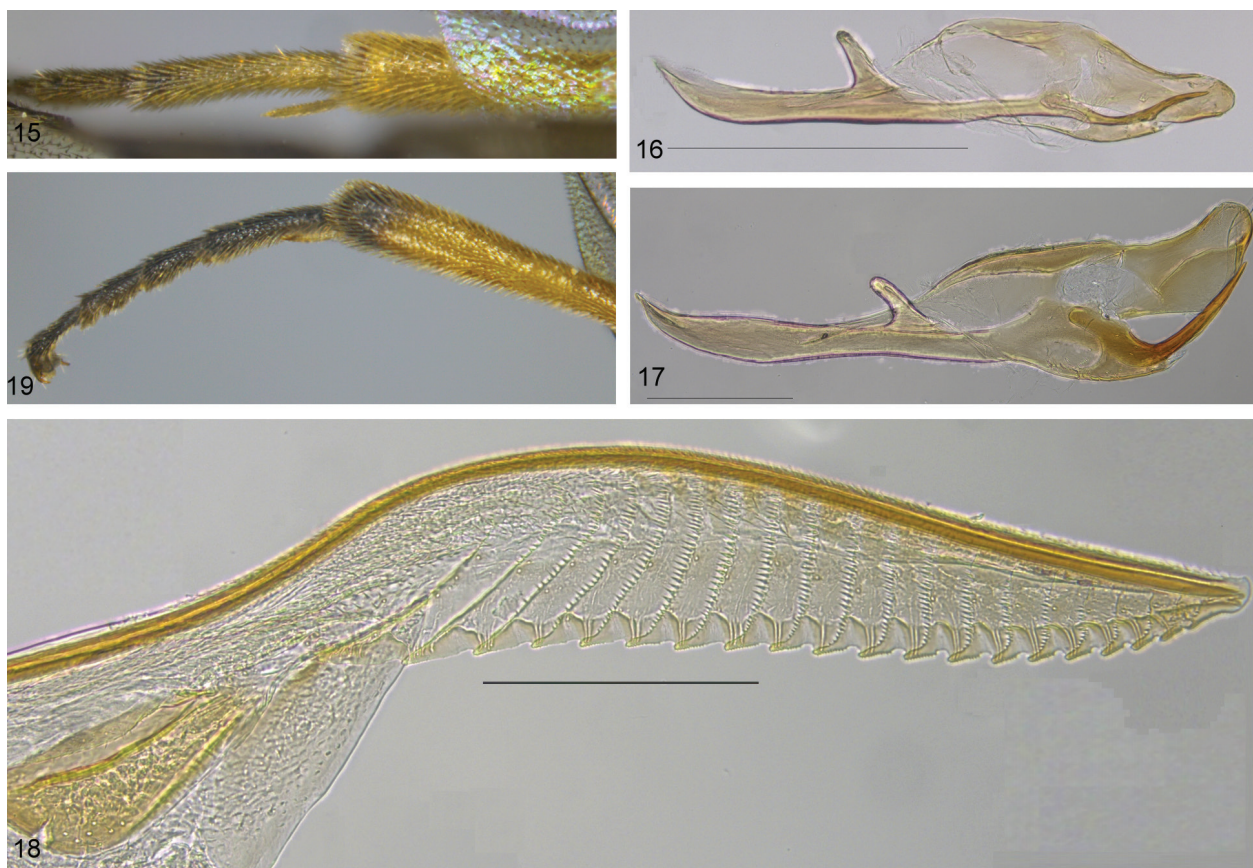
Figures 15–19. 15–16. *Pristiphora* [*subbifida* group], Crete, ♂. **15,** apex of metatibia and part of tarsus. **16,** penis valve, scale = 0.5 mm. **17–19.** *Pristiphora tetrica*, Crete. **17,** penis valve, ♂, scale = 0.2 mm. **18,** lancet, ♀, scale = 0.2 mm. **19,** metatarsus and apex of metatibia, ♂.

29.iii.2013. 1♀, 4♂♂, Anogeia, 29.iii.2013. 5♀♀, 5♂♂, Katharo Plateau, Kopraki, 30.iii.2013. 1♀, 1♂, Omalos, 21.iv.2013. 2♀♀, Omalos, 25.iv.2013. All specimens swept from *Acer sempervirens*: because all species of the *Pristiphora subbifida* group use *Acer* spp. as hosts (Liston and Späth 2008), *A. sempervirens* (the only *Acer* sp. occurring in Crete) is probably a host.

Barcode data: sequences have been obtained for five specimens that were previously identified as *P. nievesi*: one specimen each from France, DEIGISHym19640; Italy, Sicily, DEIGISHym10972; mainland Greece, DEIGISHym10965, and two from Crete (DEIGISHym20660, 20662). Nested within this cluster in the barcode similarity tree are three specimens of *P. tetrica* from Germany (BC ZSM HYM 09418, BC ZSM HYM 20222, DEIGISHym18864). Although the minimum sequence divergence of the Cretan specimens from the German ones is about 1.9%, the Sicilian specimen differed from the German ones by only 0.6%. This is a comparatively small barcode difference (Hebert et al. 2004).

P. tetrica and *P. nievesi* have been recognized as being morphologically the most similar *Pristiphora* species within the *Pristiphora subbifida* group (Haris 2004, Liston and Späth 2008); even the penis valves and lancets (Cretan specimens: Figs 17, 18) are indistinguishable. However, the phenotypes do display minor differences in colour and size:

– At least metafemur mainly yellow. Abdomen predominantly yellow; black are only tergum 1 and at most small medial flecks on terga 2–3. Wing membrane subhyaline. Female length 4.0–4.5 mm; male 3.5–4.0 mm..*P. nievesi*
– Hind legs completely black. Abdomen usually with numerous terga medially and contiguously black. Wing membrane fuscous. Female length 5.0–6.5 mm; male 4.0–5.0 mm..*P. tetrica*

Note. Occasional Central European specimens of *P. tetrica* occur that are unusually pale. They are larger than the types of *P. nievesi* but similarly coloured, apart from having black metafemora. One such individual is the type of *Nematus velatus*, described as having an almost completely yellow abdomen and less fuscous wings than typical *P. tetrica*. Specimens formerly identified as *P. nievesi* differ from each other in the colour pattern of the legs. The metatibia of the type specimens and the French specimen (Savina et al. 2014) is extensively or completely black. The base of the metatibia of the Sicilian and northern Greek specimens is obscurely paler. The Cretan specimens are paler than all of these, with the metatibia only apically black. For the following reasons, it seems best to regard the southern European *P. nievesi* as merely a series of relict populations of *P.*

tetrica, and to treat them all as conspecific: a continuous gradient of variability in colour and size occurs between Central European *P. tetrica* specimens and specimens which have recently been treated as *P. nievesi*; morphology of lancets and penis valves is identical; genetic data at present reveals no clear difference between these nominal species.

See comments on phenology and distinction of *P. tetrica* from *P. cretica*, under *P. cretica* (above). Colour variability in *P. tetrica* from Crete is in the extent of pale on the outer orbits, tegulae and posterior edges of the pronotum. These parts are usually partly pale, but are entirely black in the darkest individuals. Males tend to be darker than females. Occasionally in females, the mesepisternum is partly pale medially.

Selandriinae

†*Aneugmenus oertzeni* (Konow, 1887)

Material. Crete; 2♀♀, 2♂♂, Marathos, 24.iii.2013. 20♀♀, 23♂♂, Armeni, 25.iii.2013. 2♀♀, Lakki, 21.iv.2013. 7♀♀, 19♂♂, Sempronas, 21.iv.2013. 2♀♀, 5♂♂, Drakona, 22.iv.2013. 5♀♀, 4♂♂, Theriso-Drakona, 22.iv.2013. 7♀♀, 3♂♂, Strovles, 24.iv.2013. 7♀♀, 11♂♂, Agia Irini, 26.iv.2013. 2♀♀, 12♂♂, Topolia, 29.iv.2013. 1♀, 16♂♂, Agia, 29.iv.2013. All swept from, or netted near, *Pteridium aquilinum*, the only known host (Schedl 2011).

Barcode data. The barcodes of four sequenced Cretan specimens (DEIGISHym20637–206340: infraspecific variability about 0.7%) diverge by a minimum of 6.1% from the nearest neighbour *A. bibolinii* Zombori, 1979, represented by one male each from Corsica (first record from France: Ascu, 02.05.2004, leg. Liston, SDEI (DEIGISHym19725) and Sardinia (DEIGISHym19684): infraspecific variability about 0.7%. Minimum divergence of *A. oertzeni* to the next nearest species *A. padi* is 9.2% (many specimens from central and southern Europe, and Iran).

According to Benson (1968), *A. oertzeni* occurs not just in Crete (its type locality), but also in "Turkey and S. E. Europe". However, in the same publication Benson stated that he had never seen specimens of this species. His statement may have been influenced by Konow (1905), who gave the distribution as Crete, Asia Minor and Moscow. The occurrence of *A. oertzeni* outside Crete has not been confirmed.

Niu and Wei (2013) placed *Aneugmenus oertzeni* in *Atoposelandria* (type species *Selandria fuerstenbergensis* Konow, 1885), which they treated as a genus distinct from *Aneugmenus* (type species *Tenthredo coronata* Klug, 1818). *A. fuerstenbergensis* is indeed distinguished from the other West Palaearctic *Aneugmenus* species by several characters: see for example key by Blank (1998). Niu and Wei (2013) stated that "*Atoposelandria* differs from *Aneugmenus* in the clypeus roundly and deeply incised; the frontal wall very sharp; claw slender and weakly bent, without basal lobe, and the inner tooth ab-

sent". The depth and shape of the excision of the clypeus is by no means so different between *A. fuerstenbergensis* and other *Aneugmenus* as they suggest, and the development of the frontal wall shows considerable differences between the other W. Palaearctic species. On the other hand, *A. fuerstenbergensis* is unique amongst West Palaearctic species in the claws lacking an inner tooth, the densely transversely striated and matt abdominal terga and the lack of a sinus sexualis in the male. Nevertheless, at present there are no compelling arguments for the recognition of a separate genus, because insufficient phylogenetic evidence is available to support this, and because the practical value of the distinction is low: apart from *A. fuerstenbergensis* and *A. oertzeni*, Niu and Wei (2013) place only two other species, from the Oriental Region, in *Atoposelandria*. For the present, we point out that according to Niu and Wei's definition of *Atoposelandria*, *A. oertzeni* does not belong there, but shares the "generic" characters of other W. Palaearctic *Aneugmenus*. In particular, its claw has an inner tooth, at least half as long as the outer. The inner one is however easy to overlook, as in all *Aneugmenus* species, because it arises close to the base of the claw and is obscured by setae and other parts of the apical tarsomere. Schedl (1981), who examined the types of *Selandria oertzeni* in the SDEI observed that *A. oertzeni* resembles *A. coronatus* (Klug, 1818). This is closer to reality than the comments of Benson (1968), who wrote of *A. oertzeni*: "This species, which I have never seen, is distinguished from *A. padi* by its untoothed tarsal claws. From *A. fuerstenbergensis* it is distinguished in the ♂ by having the 6th tergite emarginate apically and a transverse groove (*sinus sexualis*) across the 7th tergite (as in *A. padi*) and the tergites yellow from the 3rd segment; and in both sexes by the shining surface of the tergites which in *A. fuerstenbergensis* are dull with transverse striations." On reading the original description of *S. oertzeni*, one sees how Benson was misled. Konow (1887) wrongly stated that *oertzeni* has simple claws and accordingly compared the taxon with the only other West Palaearctic *Aneugmenus* species that does have simple claws, namely *A. fuerstenbergensis*. Our examination of the types of *A. oertzeni* and the recently collected specimens revealed that this species is morphologically similar to *A. padi*. Externally, they can only be distinguished by colour characters and the larger inner tooth of the claw of *A. padi*. However, barcoding suggests a closer relationship of *A. oertzeni* to *A. bibolinii* than to *A. padi*. A revised key to West Palaearctic *Aneugmenus* species is in preparation.

**Dolerus puncticollis* Thomson, 1871

Material. Crete; 1♀, Katharo Plateau, Kopraki, 30.iii.2013.

As well as being the first record of a *Dolerus* species from Crete, this also seems to be the first published re-

cord of *D. puncticollis* from Greece. This is the most widespread *Dolerus* (*Poodolerus*) species in the Mediterranean Region, and the only member of the subgenus known in North Africa (Lacourt 1977).

†*Strongylogaster multifasciata* (Geoffroy, 1785)

Material. Crete; 6♂♂, Marathos, 24.iii.2013. 2♀♀, 4♂♂, Armeni, 25.iii.2013. 1♂, Lakki, 21.iv.2013. 3♂♂, 1♀, Sempronas, 21.iv.2013. 1♀, 13♂♂, Thériso-Drakona, 22.iv.2013. 2♀♀, 3♂♂, Drakona, 22.iv.2013. 9♀♀, 6♂♂, Strovles, 24.iv.2013. 3♀♀, 2♂♂, Agia Irini, 26.iv.2013. 3♀♀, 2♂♂, Agia Irini, 28.iv.2013. 1♂, Topolia, 29.iv.2013. 1♂, Agia, 29.iv.2013. All swept from, or netted near *Pteridium aquilinum*, which is the only known host in Crete: Schedl 1981, 1993, 2011.

Barcode data. The barcodes of three sequenced Cretan specimens (DEIGISHym20648–20650) are identical and diverge by a minimum of 3.2% from 24 specimens of *S. multifasciata* collected throughout Europe (from Scotland to the Peloponnese) and Iran (infraspecific variability about 0.5%).

The Cretan specimens all belong to the form described as *S. cretensis* Konow, 1887, which was regarded as an allopatric local population of *S. multifasciata* by Naito (1996) and Blank (2002). Alternatively, Schedl (2011) treated *S. cretensis* as a distinct species. The Cretan specimens differ from mainland ones in a number of characters:

– Postocellar area with sculpture similar to that of adjoining parts of the temples: punctures on postocellar area about as large as those on temples, with shiny unsculptured interspaces (Fig. 20). Terga 3–9 and all sterna entirely yellow (Fig. 21). Female metatibia basally white with apical two-thirds black; coxa mainly yellow..*S. cretensis*
– Postocellar area with denser sculpture than on adjoining parts of temples: average puncture diameter on postocellar area smaller than on temples, with interspaces matt (Fig. 22). Terga 2–8 in female mainly black, with pale apical margin (Fig. 23); male often with several terga black-marked. Female metatibia basally white with apical two-thirds red-brown; coxa entirely black .... *S. multifasciata*

Further studies, including sequencing of nuclear genes, are required to clarify the status of the Cretan taxon.

Cephidae

†*Calameuta haemorrhoidalis* (Fabricius, 1781)

Material. Crete; 7♀♀, 1♂, Nea Roumata, 21.iv.2013. 1♂, Fournes-Meskla, 22.iv.2013. 1♂, Drakona, 22.iv.2013. 1♂, Drakona 2, 22.iv.2013. 1♀, Askifou, 23.iv.2013. 1♀, Komitades, 23.iv.2013. 1♀, 3♂♂, Vrises, 23.iv.2013. 1♀, Kakopetros, 24.iv.2013. 1♂, Kandanos, 24.iv.2013. 2♂♂, Platanias, 24.iv.2013. 1♀, Strovles, 24.iv.2013. 1♀,
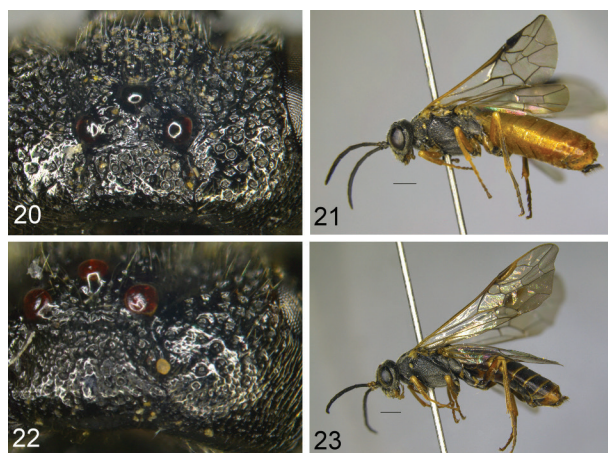
Figures 20–23. *Strongylogaster multifasciata*, ♀. **20,** head, Crete. **21,** habitus lateral, Crete, scale = 1 mm. **22,** head, Scotland. **23,** habitus lateral, Scotland, scale = 1 mm.

Fournes, 25.iv.2013. 2♂♂, Samonas, 27.iv.2013. 4♂♂, Agia Irini, 28.iv.2013. 1♂, Topolia, 29.iv.2013. 1♀, Lousakies, 29.iv.2013.

Calameuta idolon (Rossi, 1794)

Material. Crete; 1♂, Krasi, 28.iii.2013. 1♀, Samonas, 27.iv.2013. 2♂♂, Lousakies, 29.iv.2013. 1♂, Topolia, 29.iv.2013.

†Phylloecus faunus Newman, 1838

Material. Crete; 1♀, Fournes-Meskla, 22.iv.2013.

A remarkable species because of its thelytoky, unusual in the Cephidae, and its mainly southern European distribution which extends north along the Atlantic coast to the French Department of the Manche (Chevin 1993; as *Hartigia albomaculata*), and possibly, at least historically, into southern England (Liston and Prous 2014).

†*Trachelus tabidus* (Fabricius, 1775)

Material. Crete; 7♀♀, 1♂, Moni, 28.iv.2013.

Discussion

Affinities of the Cretan sawfly fauna

Turrisi (2011) compared the richness and diversity of the sawfly fauna of the larger Mediterranean islands and pointed out that the fauna of Crete is most similar to that of Cyprus. This is hardly surprising, given that these are the two most easterly of the large islands, are at nearly the same latitude, share similar climatic conditions, and are roughly equal in size (Crete 8336 km^2; Cyprus 9251 km^2). Furthermore, a shared history of massive alteration of the natural vegetation by human activity, continued

over many thousands of years, has created similar habitats in both. Sometimes the resulting niches are occupied by the same sawfly species. These are species that occur, probably in many cases naturally, widely in the Mediterranean region (e.g. *Calameuta idolon*), or are attached to plants that have a long history of cultivation (*Hoplocampa brevis* and *Pristiphora abbreviata* on pear [*Pyrus*]) and/ or were used as raw material for woven artefacts (*Euura atra* and *E. proxima* on *Salix alba*), a branch of technology already in use by c. 25000–22000 BCE (Soffer et al. 2000). Particularly sawflies that feed on plants important to humans can be suspected to have been introduced to regions outside their native ranges by human activity. Seaborne trade across the eastern Mediterranean is evident by Crete's Old Palace Period (c. 2000–1600 BCE), and Crete and Cyprus were important trade centres in the later 2nd millenium BCE (Wardle 1997, Pulak 1998). The use of common plants from the eastern Mediterranean shoreline as dunnage, or packing material, on ships of this period (Bass et al. 1967; Pulak 1998) represents another potential means of human-induced colonisation, involving sawfly species attached to plants which have no obvious direct use to humans. Long before recognisable trade patterns became evident, colonisation by humans using boats occurred, and the colonists can be assumed to have brought quantities of plant-derived material with them. It is therefore likely that some species of sawflies were already accidentally introduced to Crete and Cyprus long ago. Neither should the possibility be overlooked, that sawfly species may also have been transported in the other direction, but in general one would expect intraspecific genetic divergence between introduced island populations and populations in their area of origin to be less than between populations which are naturally present in Crete and their mainland counterparts, providing that in the latter case the populations have long been effectively isolated from each other. Unfortunately, we do not yet have sufficient genetic data to test this. The introduction of species to areas outside their natural range leads to homogenisation of faunas, obscuring biogeographic patterns (Poulakakis et al. 2014).

In contrast to the examples mentioned above, in rather more cases sawfly species of the same genera which feed on the same or closely related hosts belong to different species on each island. Examples are: on *Quercus* in Crete *Mesoneura opaca*, *Pristiphora parnasia*, *Periclista cretica* and possibly *Chevinia mediterranea* / on *Quercus* in Cyprus *Mesoneura lanigera* Benson, 1954, *Pristiphora calliprina* Liston & Jacobs, 2012 and *Periclista rufiventris* Zombori, 1979. On *Acer* in Crete *Heterarthrus imbrosensis*, *Pristiphora cretica*, *Pristiphora* sp. [*subbifida* group] and *P. tetrica* / on *Acer* in Cyprus *Heterarthrus cypricus* Schedl, 2005 and *Pristiphora schedli* Liston & Späth, 2008. We consider that these groups of species are assemblages which are naturally present on each island and that they illustrate a profound dissimilarity of their sawfly faunas, when these are compared at species level. On the other hand, six of the eight species mentioned above from Crete also occur in mainland Greece.

Age of the Cretan sawfly fauna: influenced by a high rate of extinction?

Both Crete and Cyprus have been separated from continental landmasses for at least 5 million years, and their degree of isolation since has sometimes been stated to be similar to that of today (Akin et al. 2010), although Ebmer (2014) drew attention to now vanished and still existing islands that could have functioned or might still function as "stepping stones" for winged insects to reach Crete. Poulakakis et al. (2014) reviewed the current state of knowledge of the phylogeography of animal taxa in the Aegean and surrounding areas and recognised four main patterns of colonisation. The first of these includes species present before the formation of the mid-Aegean Trench, more than 9 million years ago. The comparatively low degree of genetic divergence between mainland and island sawfly populations of the same or similar [morpho-] species, suggests that even the earliest species to have become established on Crete and Cyprus as part of the modern fauna arrived there considerably later than this, and probably even after the Messinian Salinity Crisis, 5–6 million years ago. That apparently no sawflies now use the Tertiary relict, endemic Cretan tree *Zelkova abelicea* as a host, is weakly indicative of a possible loss through extinction of ancient members of the Cretan sawfly fauna. Possibly much more important in its impact on the sawfly fauna was the change to the Mediterranean climate around 3.2 Ma (Fernández-Mazuecos and Vargas 2010).

Several other more recent events have at times been considered to be linked to a high rate of extinction in the Cretan flora and fauna, including for example the establishment of Neolithic culture 8400–7500 BP and the eruption of Santorini at around 3600 BP (Bottema and Sarpaki 2003). Recent studies do not support the hypothesis that the flora of Crete was devastated by ash deposition after the Santorini eruption (Bottema and Sarpaki 2003). On the contrary, a tendency noticeable in many recent works (e.g. Poulakakis et al. 2014) is to ascribe greater importance than previously to the shaping of the modern fauna and flora of Crete by human activities compared with natural events.

Cretan endemics

In many cases it is still impossible to state categorically whether a particular sawfly species is endemic to a Mediterranean island. This problem was discussed by Liston and Jacobs (2012) with reference to Cyprus. *Pristiphora cretica*, previously recorded only from Crete, is now known also to occur on the Greek mainland. Species which are probably endemic to Crete are *Allantus nigrolinearis*, *Aneugmenus oertzeni*, *Periclista cretica* and *Pristiphora* sp. [*subbifida* group]. The taxonomic status of *Heterarthrus imbrosensis* and *Strongylogaster cretensis* is equivocal: they could either be island endemic species, or are conspecific with taxa in mainland Europe. The Cretan sawfly fauna thus contains a higher proportion of endemic species than any other Mediterranean island, al-

though the number of endemics in Sicily, which has not been intensively investigated, may prove to be greater because the fauna is much richer (Turrisi 2011, Liston and Jacobs 2012, Liston et al. 2013). It is noteworthy that none of the single island endemic sawfly species known from the Mediterranean has so far been shown to have a single island endemic plant species as its larval host. On the contrary, for those of the endemic sawflies with known hosts, the plant species involved are rather widespread in the Mediterranean (e.g. *Pteridium aquilinum*, *Quercus coccifera*, *Acer sempervirens*) and the biology of the sawfly seems very similar to related mainland taxa. We suggest that this may be because most such sawflies are neoendemics, i.e. speciation has largely been driven by random genetic drift after isolation, rather than adaptive differentiation. If so, this situation contrasts strongly with that found in vascular plants. The endemic flora of Crete, comprising about 10% of the total, has a strongly relict character, although containing a not inconsiderable neoendemic element (Georghiou and Delepetrou 2010).

Niche specialisation of sawflies within the same plant host species

Three species of *Pristiphora* belonging to the same species group occur in Crete on the same host (*Acer sempervirens*) and partly at the same localities. It is remarkable that adults of two of these species were found on individual trees at different stages of vegetative development: *P. tetrica* on plants at a less advanced stage than those frequented by *P. cretica*. It would be interesting to know if the third species, *Pristiphora* sp. [*subbifida* group], also differs in this habit. Although a few examples of differing phenology between closely related species on the same host are known in other Tenthredinidae (e.g. *Parna apicalis* (Brischke, 1888) and *P. tenella* (Klug, 1816): leaf-miners on *Tilia*), *P. cretica* and *P. tetrica* are exceptional in that their adults can be found at the same locality on the same day, but on different trees. This is made possible by the very large variability in vegetative phenology of the host. Although the larva of *P. cretica* remains unknown, larvae of other species in the *subbifida* group are similar in appearance and behaviour: cryptically coloured, solitary, leaf-edge feeders. The rather low abundance of adults at any site, the small size of individuals, the [probably] solitary habits of the larvae and the abundance of the food resource (leaves) lead us to suppose that competition between the larvae of these species is negligible. It would be very interesting to know more about the apparently differing behavioural strategies of the Cretan *Acer*-feeding *Pristiphora*.

Conclusions

The quantitative similarity between the sawfly faunas of Crete and Cyprus identified by Turrisi (2011) still holds, with 42 species now known in Crete and 43 in Cyprus (Liston and Jacobs 2012), but the recent investigations on Cypriot sawflies and the present study on Crete revealed

that the faunas are qualitatively more dissimilar than previously supposed, at least when compared at species level. The majority of characteristic species in Cyprus have an exclusively eastern Mediterranean distribution, that only extends in two cases (*Empria archangelskii*, *Mocsarya syriaca* Benson, 1936) as far West as Crete. Many more species are shared between the fauna of Crete and mainland Greece, than between the two islands.

Although the Cretan sawfly fauna is species poor, it is valuable and worthy of conservation not only because of its proportionately high number of endemic species and genetically distinctive populations, but also because of those which are elsewhere known only from the southern Balkan peninsula (*Pristiphora cretica*), or are isolated populations on the western edge of the species range (*Empria archangelskii*, *Mocsarya syriaca*).

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Appendix

Checklist of the Symphyta of Crete

Xyelidae
Xyela graeca (J. Stein, 1876)

Cephidae
Cephus pygmeus (Linnaeus, 1767)
Calameuta haemorrhoidalis (Fabricius, 1781)
Calameuta idolon (Rossi, 1794)
Phylloecus faunus Newman, 1838
Trachelus tabidus (Fabricius, 1775)
Trachelus troglodyta (Fabricius, 1787)

Argidae
Arge melanochra (Gmelin, 1790)
Arge ochropus (Gmelin, 1790)
Arge scita (Mocsáry, 1880)

Cimbicidae
Corynis krueperi (J. Stein, 1876)

Tenthredinidae
Allantinae
Allantus nigrolinearis (Zirngiebl, 1937)
Allantus viennensis (Schrank, 1781)
Ametastegia glabrata (Fallén, 1808)
Athalia ancilla Serville, 1823
Athalia circularis (Klug, 1815)
Athalia cordata Serville, 1823
Athalia rosae (Linnaeus, 1758)
Empria archangelskii Dovnar-Zapolskij, 1929
Blennocampinae
Chevinia mediterranea Lacourt, 2003
Heterarthrus imbrosensis Schedl, 1981
Periclista cretica (Schedl, 1981)
Silliana lhommei (Hering, 1934)
Halidamia affinis (Fallén, 1807)
Nematinae
Cladius ordubadensis Konow, 1892
Cladius pectinicornis (Geoffroy, 1785)
Hoplocampa brevis (Klug, 1816)
Hoplocampa chrysorrhoea (Klug, 1816)
Mesoneura opaca (Fabricius, 1775)
Euura atra (Jurine, 1807)
Euura proxima (Serville, 1823)
Pristiphora abbreviata (Hartig, 1837)
Pristiphora cretica Schedl, 1981
Pristiphora pallidiventris (Fallén, 1808)
Pristiphora parnasia Konow, 1902
Pristiphora sp. [*subbifida* group]
Pristiphora tetrica (Zaddach, 1883)
Selandriinae
Aneugmenus oertzeni (Konow, 1887)
Dolerus puncticollis Thomson, 1871
Strongylogaster multifasciata (Geoffroy, 1785)

Orussidae
Mocsarya syriaca Benson, 1936
Orussus morio Guiglia, 1954