First observations on the biology of *Scaeva mecogramma* (Bigot, 1860) (Diptera, Syrphidae) and notes on some other syrphids preying on psyllids (Hemiptera, Aphalaridae and Triozidae)

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Observations of the biology of *Scaeva mecogramma* and other syrphids species [*Meliscaeva auricollis* (Meigen, 1822) and *Heringia heringi* (Zetterstedt, 1843)] preying on psyllid pests are reported. These are the first data about the diet of the larvae and adults of *S. mecogramma*.

Zusammenfassung

Beobachtungen zur Biologie von *Scava mecogramma* und anderer Schwebfliegenarten [*Meliscaeva auricollis* (Meigen, 1822), *Heringia heringi* (Zetterstedt, 1843)], die sich von wirtschaftlich schädlichen Blattflöhen (Psyllidae) ernähren, werden mitgeteilt. Damit liegen erstmals Daten über die Nahrung der Larven und Imagines von *Scaeva mecogramma* vor.

Introduction

The majority of entomophagous syrphids are hemipteran predators and their larvae mainly feed on aphids and related (Aphidoidea), but some use "scale insects" (Coccoidea), "whiteflies" (Aleyrodoidea) or psyllids (Psylloidea). There are few citations of syrphids predacious on psyllids in Europe and most of them concern cultivated (Giunchi 1980, Landi 1997) or wild trees (Hodkinson & Flint 1971, Rotheray & Gilbert 1989), although there are also citations from herbaceous plants (Lyon 1968, Láska 1974).

Psyllids are small, sap-feeding insects that feed on leaves, stems and other parts of wild and cultivated plants, many species being gall-forming. Their nymphs mostly produce honeydew but some species secrete waxy filaments, sometimes in very large quantities (Hill 1987). The wax secretions and galls provide defence against predators. However, some predatory syrphid species show a clear preference for preys with these types of defences (Rojo & Marcos-García 1997).

In this paper we present data for *Scaeva mecogramma* (Bigot, 1860) and other species preying on psyllid pests. We record the feeding habits of larvae and several aspects of their life cycle and annual activity in SW Europe. So far as we are aware, there is no previously-published information on the diet of the larvae or adults of *S. mecogramma*.

Materials and methods

During a survey of natural enemies of psyllid pests in Mediterranean areas, we collected syrphid larvae from Olive trees (*Olea europaea* L.) and Bay laurel (*Laurus nobilis* L.). The Olive crops were sampled in Alicante and Valencia provinces (SE Spain) and the samples of Bay laurel were taken in Valladolid province (Central Spain). Adult feeding preferences of *S. mecogramma* were studied in the Natural Park of the Columbretes Archipelago (39°54' N, 0°41' E), a group of small volcanic islands located 28 miles east from the Iberian Mediterranean Coast.

Samples of psyllid colonies were harvested and transferred to rearing boxes (20 x 10 x 15 cm) with their corresponding host plant, to allow the development of syrphid larvae. Once in the laboratory, the rearing boxes were first stored in an environmentally controlled room (19-21 °C, 70-80% R.H. and 14 h day-length) for 3-4 days. Each syrphid larva or pupa was then isolated in a Petri dish (5.5 cm diameter), where it was fed until the appearance of the last larval stage, or the emergence of the adult. The larvae were fed on the prey organisms with which they had been captured. Occasionally, adult hoverflies present near the psyllid colonies were also collected, using an entomological net.

The flower feeding of *S. mecogramma* were determined by pollen analysis of gut contents. For this, the content of the abdomen was examined using a mounted needle and fine forceps, the fresh flies being dissected to reveal the alimentary tract, the gut then being released onto a slide. Samples of pollen were taken from the intestine by making careful ruptures in its wall. In addition, pollen loads borne on the bodies of flies were studied. The pollen load was removed using a small piece of adhesive jelly, made up of distilled water, glycerine, gelatine, phenol and fuchsin (Beattie 1971). This was warmed using a Bunsen burner and afterwards covered with a glass coverslip and put aside until the jelly had solidified. The pollen was identified to species or genus level, under a light microscope (magnification of x400) using reference pollen material collected on the islands.

Results

Scaeva mecogramma (Bigot, 1860)

Larval feeding: While sampling predators of olive tree psyllids, we found several syrphid larvae preying on *Euphyllura olivina* (Costa, 1839) (Hemiptera, Aphalaridae). Psyllid colonies were found in spring and autumn. Larvae and puparia of *S. mecogramma* were present in olive trees during both peaks, with specially high levels of infestation, adjacent to the immature stages of *E. olivina*. The syrphid larvae were green with a broad, mid-dorsal white stripe, as in other species of *Scaeva* (see Rotheray 1993). However, in the field the larvae appear to be totally covered by whitish waxen flakes secreted by the young psyllids. We found empty puparia on the ground and within the olive shoots. The surface of the puparium also usually carried the waxy psyllid secretion. In the laboratory we observed L II and L III larval instars preying on both adults and young psyllids. *S. mecogramma* larvae move one body length and then, before crawling

further, thoroughly examine the vicinity with their foreparts while their posteriors remain fixed to the substrate (i.e.: casting, Chambers 1988).We obtained adults only by rearing larvae with *E. olivina*. Under controlled conditions, the total development time of *S. mecogramma* was from 3 weeks to 1 month. Larval develop-ment is complete within 12-16 days and the adult emerges from the puparium in a further 13-15 days.

Adult feeding: Pollen grains dissected from the gut of *S. mecogramma* mostly belonged to *Lobularia maritima* L., but we found pollen from at least 8 plant species on the body surface, among which *Daucus gingidium* L. was the most frequent (Table I). The dominant vegetation of the island when *S. mecogramma* was captured (May), comprised both plant species together with others such as the nitrophilous *Suaeda vera* Forsk and *Lavatera* spp. and herb communities dominated by *Euphorbia terracina* L. or *Medicago littoralis* Rohde, among others.

Material examined: Spain. Isla Grossa, (Islas Columbretes), Castellón: 1♀ 26.V.1996 and 1♀ 27.V.1996 (C. Pérez-Bañón leg); Moncada, Valencia: 23.XI.1996, 1♂ (ex larva) and 3♀ (ex larva) (M.J. Verdú leg); 18.XII.1996, 2♂(ex larva) and 1♀ (ex larva) (M.A. Marcos-García leg); 23.XII.1996, 1♂ (ex larva) and 8 larvae (S. Rojo leg); San Vicente del Raspeig, Alicante: 13.V.1998, 3 larvae (J.V. Falcó leg); 7.VI.1998, 1♂ (ex larva) and 2♀ (ex larva) (J.V. Falcó leg).

Meliscaeva auricollis (Meigen, 1822)

Larval feeding: We also found several larvae of *M. auricollis* preying on the colonies of olive tree psyllids. We found larvae of this species during the spring and autumn peaks of psyllids. In laboratory conditions *M. auricollis* larvae develop during 10-12 days emerging the imagines from pupae in 8-9 days.

Material examined: Spain: San Vicente del Raspeig, Alicante 20.V.1998 1♂ (ex larva) (S. Bordera leg.); Moncada, Valencia 25.XII.1996, 1♂ (ex larva) and 2♀ (ex larva); 5.XII.1996, 5 larvae (S. Rojo leg).

Heringia heringi (Zetterstedt, 1843)

Larval feeding. In early autumn we found several larvae of *H. heringi* on Bay, in reddish galls caused by the rolling of the leaf edge. The galls were formed by nymphs of *Trioza alacris* Flor, 1861 (Hemiptera, Triozidae), always on young plants (1 m tall) from gardens. This psyllid is specially abundant in Mediterranean areas (Alford 1991). Occasionally we found the young shoots dead, due to heavy psyllid infestation. We observed syrphid eggs and first instar larvae on the surface of the galls. In laboratory experiments we found that the first instar larvae were able to travel several times over the entire surface of the galls. Normally we found only one larva per leaf-roll. Pupation occurs on the trunk, leaves and shoots of the Bay. In natural conditions, L III instar of *H. heringi* remain in diapause during the winter (Rojo

Family		% of Pollen grains	
Plant species	Flower colour	Internal n=1274	External n=3492
Apiaceae			
Daucus gingidium	white	< 1.0	96.6
Asteraceae			
Phagnalon saxatile	yellow	--	< 1.0
Brassicaceae			
Lobularia maritima	white	> 99.0	12.6
Chenopodiaceae			
Suaeda vera	yellow	--	1.5
Cichoriaceae			
Sonchus tenerrimus	yellow	--	< 1.0
Euphorbiaceae			
Euphorbia terracina	yellow-green	--	< 1.0
Fabaceae			
Medicago citrina	yellow	--	< 1.0
Pinaceae			
Pinus spec.	--	--	< 1.0

Table 1: Percentage representation of pollen grains of different plants present in the gut and on the general body surface of *Scaeva mecogramma.*

& Marcos-García 1997); although adults can be obtained without larval diapause in the laboratory after a 16-20 days larval period and approximately two weeks in the pupation.

Material examined: Spain. Quintanilla de Onésimo, Valladolid: 2.IX.1997, 2♂ (ex larva) and 3.IX.1997, 4♀ (ex larva) (S. Rojo leg.); 28.VII.1997, 15 larvae (S. Rojo leg.).

Discussion

Scaeva mecogramma, originally described in *Lasiophthicus,* was placed in *Metasyrphus* by Goffe in 1952. However, Dušek & Láska (1985) show that this species belongs to the genus *Scaeva*, with a consequent necessity for modifying previous definitions of this genus. The similarity in overall appearance and pattern of searching for prey (adapted to search intensively) observed in the larvae of *S. mecogramma* and other *Scaeva* species such as *S. pyrastri* (Linnaeus, 1758), help to confirm this taxonomic position.

The known range of *S. mecogramma* is the mid-west part of the Mediterranean Basin from central Spain to southern France and Italy, including Corsica and Sicily (Dirickx 1994). Our data are the first for the Iberian Mediterranean coast. Nevertheless *Scaeva* is a genus very prone to migratory habits and a single female of *S. mecogramma* has been cited from Edinburgh (probably accidental importation) and two other females from Switzerland (Collin 1946, Maibach et al. 1992). The capture of this species in the Columbretes Archipelago, which is located 50 kilometres east from the mainland, support this point. Examination of the gut contents of *S. mecogramma* suggests that the pollen spectrum is related to the abundance of flowers in the sampled area. Speight (1998), indicates that this species visits yellow composites. Our data from external pollen are in accordance with this observation, but we also found pollen from non composite yellow flowers and from white legumes (Table I). The dominance of pollen from *Daucus* on the body surface of *S. mecogramma* and its absence from the gut could indicate that this hoverfly obtains mainly nectar from this plant, however pollen from *Lobularia maritima* was abundant in the gut.

According to Speight et al. (1986), the flight period of *S. mecogramma* is May/ June and August/September. There probably exists a close relationship between this species and the life history of the olive psyllid. In fact, males of *S. mecogramma* have been captured hovering at 3-6 m beside olive trees (Speight et al. 1986). *Euphyllura olivina* is a Mediterranean psyllid that completes several generations per year in Spain but the colonies are present in the olives mainly during spring and autumn (Alvarado et al. 1997). It is likely that the larvae of *S. mecogramma* also prey on other Mediterranean psyllids such us *Euphyllura phillyreae* Foerster, 1848, that infest olives and other plants belonging to the Oleaceae family (Prophetou-Athanasiadou 1997). Related with this, larvae of *Syrphus* spec. (probably misidentifications of *S. mecogramma*) has been cited preying on colonies of *Euphyllura* psyllids (Abdul Baki & Majid 1985, De Andres Cantero 1997). So far as we know, the only other syrphid species whose larvae are known to predate olive psyllids are *Meliscaeva auricollis* (De Andres Cantero 1997) also captured in the studied area, and *Xanthandrus comtus* (Harris, 1780) (Arambourg 1984).

On the other hand, according to the literature, the most important predatory syrphid of *Trioza alacris* on Bay is the polyphagous *Meliscaeva auricollis* and in second place *H. heringi* (Borelli 1919). However larvae of *H. heringi* appear to have a narrow host range based on gall-forming aphids (cf.: Dušek & Křístek 1959, Chandler 1969).

Our data confirm the predation of *H. heringi* on *T. alacris* and show that in Mediterranean areas larvae of this syrphid feed on leaf-curling aphids (Rojo & Marcos-García 1997) and different gall-forming hemipterans. According to Dušek & Láska (1966), the evolution of food specificity in the larvae of this species probably began through use of the plant galls as shelters and only later the larvae became adapted to feeding on gall-forming aphids. Our results suggest that the adult females of *H. heringi* are adapted at searching for galls or rolled leaves more than for a special type of prey.

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