

# REVISION OF THE HOVERFLIES (DIPTERA: SYRPHIDAE) FROM THE AZORES ARCHIPELAGO WITH NOTES ON MACARONESIAN SYRPHID FAUNA

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ROJO, S., P.M. ISIDRO, C. PEREZ-BAÑÓN & M.A. MARCOS-GARCÍA 1997. Revision of the hoverflies (Diptera: Syrphidae) from the Azores archipelago with notes on Macaronesian syrphid fauna. *Arquipélago*. Life and Marine Sciences 15A: 65-82. Ponta Delgada. ISSN 0873-4704.

A revision and taxonomic update of the Syrphidae species (Diptera) known in the Azores archipelago is provided. Data about larval feeding, environment preference and flight period are also given. The percentage of endemism is about 9% out of twenty three species. The most common hoverflies are *Eristalis tenax*, *Eristalinus aeneus*, *Episyrphus balteatus*, *Eupeodes corollae*, *Sphaerophoria scripta* and *Xylota segnis*. Regarding the larval biology, the rate of predacious and saprophagous species is similar to continental Mediterranean ecosystems although the proportion of phytophagous larvae is much lower. The Palaearctic influence is more important in the Azores than in other Macaronesian islands. According to our data, the four Macaronesian archipelagos have only three species in common: *Eristalis tenax*, *Eristalinus aeneus* and *Eupeodes corollae*. Cape Verde, the Canaries and Madeira have two species in common: *Ischiodon aegyptius* and *Scaeva albomaculata*. A check-list of all Macaronesian syrphids and an identification key for Azorean species are also included.

ROJO, S., P.M. ISIDRO, C. PEREZ-BAÑÓN & M.A. MARCOS-GARCÍA 1997. Revisão dos sirfídeos (Diptera: Syrphidae) do arquipélago dos Açores, incluindo notas sobre a sirfidofauna macaronésica. *Arquipélago*. Ciências Biológicas e Marinhas 15A: 65-82. Ponta Delgada. ISSN 0873-4704.

Neste trabalho apresenta-se uma revisão e actualização taxonómica das espécies da família Syrphidae (Diptera) conhecidas para os Açores. São, também, apresentados dados sobre alimentação de larvas, preferências ambientais e período de voo. Num total de vinte e três espécies encontradas, a percentagem de endemismos foi de 9%. As espécies de sirfídeos mais comuns são *Eristalis tenax*, *Eristalinus aeneus*, *Episyrphus balteatus*, *Eupeodes corollae*, *Sphaerophoria scripta* e *Xylota segnis*. Quanto à biologia, a relação entre espécies predadoras e saprófagas é semelhante à do Mediterrâneo continental, contudo a proporção de fitófagas é bastante mais baixa. A influência do Paleártico é bastante mais importante nos Açores do que noutras ilhas Macaronésicas. De acordo com os dados, os quatro arquipélagos Macaronésicos apenas possuem três espécies em comum: *Eristalis tenax*, *Eristalinus aeneus* and *Eupeodes corollae*. Cabo-Verde, Canárias e Madeira possuem duas espécies em comum: *Ischiodon aegyptius* and *Scaeva albomaculata*. É também apresentada uma "check-list" de todos os sirfídeos da Macaronésia e uma chave de identificação para as espécies dos Açores.

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## INTRODUCTION

Adult syrphids, known as hoverflies or flowerflies, are among the most abundant and conspicuous of Diptera. In Europe there are about 1200 species and some 6000 species exist worldwide, found in every geographical region except the Antarctic (ROTHERAY 1993). Most species are flower visiting and certain European species migrate over very long distances (AUBERT et al. 1976). Images use both nectar and pollen as a food supply and females as a source of protein vital to egg maturation, some species being significant pollinators (HIPPA & KOPONEN 1976), and active agents in biological control (ANKERSMIT et al. 1986). The larvae of these Diptera can be found throughout the year in a wide variety of habitats (phytophagous, predacious, saprophagous, saproxylic, mycophagous, etc.), being used as bio-indicators of site quality such as nature reserve assessment (SPEIGHT 1986), or future areas for protection (MARCOS-GARCÍA & GALANTE 1989; BARENDREGT 1994) and as an insect-test of insecticide effects (HASSAN 1989).

The study of syrphids in the archipelago has been poor and unconnected. The first data of syrphid fauna from the Azores, result from expeditions by L. Chopard and A. Méquignon in 1930 and R. Frey in 1938. No more data exist until the papers of GOMES (1980, 1982) where this author includes the results of two aphidological expeditions by F. A. Ilharco during the years 1967 and 1979 and other specimens from private collections. Since these works, excluding some isolated data appearing in non-specific papers, there have been no new contributions to the knowledge of this group of flies.

The objectives of this work are: a) to review all published data of syrphid species from the Azores Islands, b) to summarise and complete this information providing data about the biology, ecology and corology of these species, c) to elaborate a key for the identification of the Azorean species of Syrphidae and d) a biogeographical analysis of the syrphid fauna.

## MATERIAL AND METHODS

### STUDY AREA

The Azores archipelago is situated in the Atlantic Ocean between 36° 55' and 39° 42' N latitude and between 25° and 31° 30' W longitude. It is composed of nine islands of volcanic origin, in three groups: two islands form the western group (Flores, Corvo), five represent the younger central group (Faial, Pico, São Jorge, Graciosa and Terceira), and two make up the older eastern group (São Miguel, Santa Maria). Distances to the mainland vary from 1,378 km for Santa Maria to 1,889 km for Flores. The total area of the archipelago is 2304 km<sup>2</sup> and the highest altitude is on Pico (2351 m).

Geological conditions for the Azorean vegetation are rather uniform. Basaltic rock predominates and traquita is also present in zones of eruption, offering the chemical soil conditions very little bases for differentiation of the vegetation (SJÖGREN 1973). The islands were once covered with evergreen forests. These, together with those of the Canaries and Madeira, are considered relicts from the Tertiary forests of southern Europe (TUTIN 1953). The antiquity of the vegetation is reflected in eight of the eleven native trees being endemic to the Azores and two other species being endemic to the Azores and Madeira. The Azores islands have only about 300 natural plant species but 816 more have been introduced by man in the last 50 years. The endemic rate is about 23% and many of them are restricted to the montane forest (HAGGAR 1988; DIAS 1994).

The archipelago has an oceanic climate, progressively wetter moving towards the west and with small variations of temperature and water regimen and high levels of precipitation and high air humidity. The mean annual temperature is about 17.5°C. Frosts are rare below 600 m but night frosts can occur all year round at altitudes above 1600 m. The precipitation is about 1000 mm annually at sea level, increasing about 25% for every 100 m increase in altitude (SJÖGREN 1973).

## LITERATURE SURVEY

In order to complete the catalogue of the syrphids species present in the Azores archipelago, we obtained all the faunistic citations published in SÉGUY (1936), FREY (1945), GOMES (1980, 1982) and CRUZ DE BOELPAEPE (1991). Similar, to complete the knowledge of the geographic distribution of syrphid species in other Macaronesian islands, we have also consulted the revisions of Madeira (GOMES & BÁEZ 1990), Canaries (BÁEZ 1977a, b; 1982a; 1986; CLAUSSEN 1981) and Cape Verde (CLAUSSEN & BARKEMEYER 1987).

## SAMPLED DATA

During the last two weeks of September 1995, we sampled on São Miguel island looking for hoverflies in several habitats.

With all these data we made the check-list of all syrphid species known on the 9 islands in the Azores archipelago. We include the updated names of syrphids mainly according to: PECK (1988), ROTHERAY & GILBERT (1989) and VOCKEROTH (1986, 1990). In the species accounts we indicate some aspects of the identification, geographical distribution (with remarks to Macaronesia), preferred environment, flight period, preferred habitats and other aspects of biology. The details of localities where each species was cited are also included.

List of abbreviations concerning localities and papers used in the compilation of records:

### Corvo (17 km<sup>2</sup>):

Ca	Caldeira
VC	Vila do Corvo
VN	Vila Nova

### Faial (170 km<sup>2</sup>):

Cl	Caldeira
Fe	Feteira
H	Horta
P	Pedregulho
RCa	Ribeira do Capo
RE	Ribeira Escabra
RFl	Ribeira Flamengos

### Flores (143 km<sup>2</sup>):

Ae	Aeroporto
Al	Alagoas
CS	Caldeira Seca
Ce	Cedros
FG	Fajã Grande
FSC	Fazenda de Santa Cruz
M	Mato
MF	Miradouro da Fajãzinha
PDe	Ponta Delgada
PR	Ponta Ruiva
RB	Ribeira Borqueros
RCz	Ribeira da Cruz
RFz	Ribeira Fazenda
RdB	Rocha dos Bordões
SCF	Santa Cruz das Flores
SCM	Santa Cruz Monte
SCz	Santa Cruz
SM	Santa Maria
Va	Vales

### Graciosa (60 km<sup>2</sup>):

Cd	Caldeira
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### Pico (433 km<sup>2</sup>):

LC	Lagoa do Caiado
Md	Madalena
S	Silveira

### Santa Maria (97 km<sup>2</sup>):

AP	Alto do Pico
A	Alto
Aj	Anjos
F	Fontinhas
G	Ginjal
ME	Miradouro do Espigão
PSP	Pedras de São Pedro
Pa	Praia
SP	São Pedro
VP	Vila do Porto

### São Jorge (238 km<sup>2</sup>):

C	Calheta
IT	Ilhéu do Topo
LCh	Lagoa do Calheta
RS	Ribeira do Salto
RF	Ribeira Funda

### São Miguel (747 km<sup>2</sup>):

AA	Água de Alto
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Ba	Barrosa
CM	Chã do Marcela
Car	Carvão
FC	Fajã de Cima
FL	Fenais da Luz
FRG	Furnas da Ribeira Grande
Fu	Furnas
Gi	Ginetes
GP	Grota das Pedras
Gr	Gorreana
LCa	Lagoa do Canario
LCo	Lagoa do Congro
LF	Lagoa do Fogo
LFu	Lagoa Furnas
PC	Pico Castanheiro
PCr	Pico de Carvão
PV	Pico da Vara
PDI	Ponta Delgada
RG	Ribeira Grande
RQ	Ribeira Quente
SR	San Roque
SI	Santa Iria
SAP	Serra da Água de Pau
SC	Sete Cidades
<b>Terceira (397 km<sup>2</sup>):</b>	
Ac	Achada
Ag	Aigualva
AH	Angra do Heroísmo
An	Angra
B	Bagacina
CGM	Caldeira de Guilherme Moniz
Fn	Furnas
Ft	Feteira
MS	Miradouro da Serreta
MB	Monte Brazil
PVe	Pau Velho
Pe	Peneireiro
PVi	Praia da Victoria
R	Riviera
SB	Santa Barbara
SA	St.º Amaro
SG	SÉGUY 1936
FR	FREY 1945
GO	GOMES 1980
GM	GOMES 1982
CZ	CRUZ DE BOELPAEPE 1991
OD	Own Data (1995)

## RESULTS

### *Baccha elongata* (Fabricius, 1775)

Adults are an unmistakably slender and elongated hoverfly species (at narrowest, no wider than scutellum). Only two European species of this genus are recognised: *Baccha elongata* and *Baccha obscuripennis* Meigen, 1822. However, most authors think that only one single variable species is involved (SPEIGHT & LUCAS 1992).

**DISTRIBUTION AND BIOLOGY:** EuroSiberian and Nearctic species. In the Macaronesian islands only cited in the Azores. Adults are common in forests, also in scrub woodland and often flying in the shade under trees or along woodland margins. *Baccha elongata* is associated with a range of ground layer aphids in shaded sites (ROTHERAY 1993).

**FLIGHT PERIOD:** April to October.

**ACTUAL STATUS:** Since 1930 only one finding of *Baccha elongata* has been recorded in the Azores archipelago. SÉGUY (1936) identified this material and since then no more individuals have been detected or cited in the bibliography. It is necessary to confirm the presence of this species with new material.

**LOCALITIES:** São Miguel: Fu, VIII-IX 1930-SG.

### *Chrysotoxum intermedium* Meigen, 1822

The genus *Chrysotoxum* can be easily identified because the adults have very long antennae that point forwards. The characteristic feature of *Chrysotoxum intermedium* is that the length of the 3rd antennal segment is equal to or longer than 1st plus 2nd (STUBBS & FALK 1993).

**DISTRIBUTION AND BIOLOGY:** Palaearctic species found primarily in southern Europe (abundant in the Mediterranean area). In Macaronesian only cited from the Azores. This species is a very good wasp mimic. *Chrysotoxum intermedium* is usually common in forest or open habitats with dry soil and flies fast and low, over ground vegetation. The larva is undescribed and its precise feeding habits are unknown but probably related to root-aphids and ants (ROTHERAY & GILBERT 1989).

**FLIGHT PERIOD:** March to October.

ACTUAL STATUS: The only data on the presence of this species in the Azores archipelago, is a single specimen on São Miguel island in 1930.

LOCALITIES: São Miguel: Fu, VIII-IX 1930-SG.

### *Episyrphus balteatus* (De Geer, 1776)

This hoverfly has a unique and distinctive abdominal pattern with an upper and lower black band on tergites 3 and 4. However, the upper band is sometimes divided into a pair of narrow stripes while dark forms have the lateral margins of tergites darkened. *Episyrphus balteatus* is the only species of this genus in Europe.

DISTRIBUTION AND BIOLOGY: This hoverfly is present in Palaearctic, Oriental and Oceanic regions and in Macaronesia has been cited in the Canaries, Madeira and the Azores. *Episyrphus balteatus* shows a wide range of environmental preferences, being ubiquitous and abundant in most habitats including highly anthropogenic areas. It is a polyvoltine species with a very wide range of aphid-prey. For this reason it has been investigated as a potential biological control for aphids on cereal and other crops (WNUK 1977; ANKERSMIT et al. 1986)

FLIGHT PERIOD: February to November in North Europe but present all year round in the South. Overwinters as an adult (females) hibernating in caves, holes in trees etc. Obligatory migrant from southern Europe in the spring and reaches the north in the summer, but in the autumn re-migrates south (ROTHERAY 1993).

ACTUAL STATUS: This species is probably one of the most abundant syrphid species in the Azores. Except on Graciosa and Corvo, *Episyrphus balteatus* has been observed on all the islands and is probably active all year, even though it has been cited only from May to November in the literature.

LOCALITIES: Faial: Cl, VII 1938-FR; Fe, VI 1967-GM; RFl, VII 1938-FR. Flores: Ae, IX 1979-GO; PDe, IX 1979-GO; PR, IX 1979-GO; RFz, VI 1938-FR; SCF, IX 1979-GO; SCM, VI 1938-FR; SM, IX 1979-GO; Va, VI 1938-FR. Pico: S, VII 1938-FR. Santa Maria: A, VI 1979-GO; PSP, IX 1979-GO; SP, IX 1979-GO; VP, IX 1979-GO. São Jorge: C, VI 1938-FR; RF, VI 1938-FR; RS, VI 1938-FR. São Miguel: Ba, 27-IX-1995, 3♂♂-

OD; Car, 24-IX-1995, 1♀-OD; CM, IX 1979-GM; FL, VI 1979-GM; FRG, X 1979-GO; Fu: VIII-IX 1930-SG; V+VIII 1938-FR; X 1979-GO; Gi, V 1967-GM; Gr, X 1979-GO; 29-IX-1995, 5♂♂ 2♀♀-OD; LCo, V 1938-FR; LCa, 24-IX-1995, 1♂ 2♀♀-OD; PCr, 24-IX-1995, 2♀♀-OD; PDI: V 1938-FR; X 1979-GO; V 1967-GM; V 1969-GM; SC, VIII-IX 1930-SG; SI, X 1979-GO; SR, V 1938-FR; without locality, VII-VIII 1990-CZ. Terceira: AH: VI 1938-FR; X 1978-GM; Ft, V 1967-GM; MB: V 1938-FR; VIII-IX 1930-SG; MS, VI 1967-GM; PVe, XI 1978-GM; SA, V 1967-GM.

### *Eristalinus aeneus* (Scopoli, 1763)

The body of this species is typically glossy black or greenish bronze. The spotted eyes are very distinctive but to ensure identification it is necessary to check that only the upper surface of the eyes is hairy.

DISTRIBUTION AND BIOLOGY: *Eristalinus aeneus* is present in all continents except in the Neotropical region. It is very abundant in the Mediterranean area (DIRICKX 1994). This species lives on all the islands of Macaronesia but its presence on Madeira may be a recent introduction (GOMES & BÁEZ 1990). The ecology of this species is related to rock pools containing decaying seaweed and salt marshes. It is a typical coastal species and the larvae live in wet decaying vegetation.

FLIGHT PERIOD: April to September but this period is probably longer in the Azores islands related to the hibernating habits of the adults.

ACTUAL STATUS: This species has been cited in three islands of the archipelago but its presence in Flores and Santa Maria shows that it is probably also present on the other islands.

LOCALITIES: Flores: SCz, VI 1938-FR. Santa Maria: Aj, IX 1979-GO; G, IX 1979-GO. São Miguel: PDI: V 1938-FR; IX 1979-GO; RG, V 1938-FR; SR, VII 1938-FR.

### *Eristalis arbustorum* (Linnaeus, 1758)

The best characteristic for distinguishing this species is the completely dusted face but

sometimes it is necessary to use the male terminalia. The pattern on the abdomen is very variable and individuals reared at low temperatures are darker (even completely black) than those in high temperatures (HEAL 1981).

**DISTRIBUTION AND BIOLOGY:** Holarctic region including North Africa and reaching North India. This species is not present in the Canaries nor in Madeira. *Eristalis arbustorum* is abundant in many anthropogenic environments. The larvae are saprophagous aquatic or subaquatic, occurring in pools and ponds polluted with dung, stagnant water, farm yards etc. The adult has an important role as a pollinator of some plants (KRANNITZ & MAUN 1991).

**FLIGHT PERIOD:** April to October. The adult is more or less constantly present from spring to autumn because of a series of overlapping generations (SPEIGHT & LUCAS 1992). This species disperses away from its breeding sites and has been collected migrating over an alpine pass (AUBERT et al. 1976).

**ACTUAL STATUS:** In spite of *E. arbustorum* only having been cited in 4 islands, this species is probably present in all the islands of the archipelago.

**LOCALITIES:** Flores: Ae, IX 1979-GO; FG, IX 1979-GO; SCF, IX 1979-GO; Va, V 1938-FR. Santa Maria: AP, IX 1979-GO; Aj, IX 1979-GO; G, IX 1979-GO; PSP, IX 1979-GO; SP, IX 1979-GO; VP, IX 1979-GO. São Miguel: Ba, 27-IX-1995, 2♂♂ 2♀♀-OD; Car, 24-IX-1995, 3♂♂ 1♀-OD; Fu, VIII-IX 1930-SG; Gr, 29-IX-1995, 1♀-OD; LCa, 24-IX-1995, 2♀♀-OD; PCr, 24-IX-1995, 2♂♂ 2♀♀-OD; PDI: VIII-IX 1930-SG; V+VII 1938-FR; X 1979-GO; RG, 26-IX-1995, 6♀♀-OD. Terceira: MB, V 1938-FR.

### *Eristalis tenax* (Linnaeus, 1758)

This common species is a very good mimic of drones (male hive bees). Other species of the genus *Eristalis* are similar to *E. tenax* but the presence of dark front tarsi and very broad black facial stripe are typical of this fly (STUBBS & FALK 1993).

**DISTRIBUTION AND BIOLOGY:** Cosmopolitan, known from all biogeographical regions except the Antarctic. In about 1870, *E. tenax* spread via

Asia to North-West America and is now abundant in all the continent. The same process occurred in New Zealand in about 1888 (GILBERT 1986). It is present in all the Macaronesian islands. *Eristalis tenax* is an anthropogenic and almost ubiquitous hoverfly species. The larva is found in a wide range of aqueous and semiaqueous habitats with organic materials, polluted ditches, compost, cow-dung etc. The larval stages have been described by many authors. This species is probably the most important hoverfly from a pollination point of view (FERRAZZI & MARLETTO 1990) and possesses morphological adaptations for collection of pollen (HOLLOWAY 1976).

**FLIGHT PERIOD:** February to November. Both males and females hibernate but if the winter is not very cold, they can be active all year round. *Eristalis tenax* is a highly migratory species (AUBERT et al. 1976).

**ACTUAL STATUS:** Cited in all the islands except Corvo and Graciosa but undoubtedly could also be present in these islands.

**LOCALITIES:** Faial: CI, VII 1938-FR. Flores: CS, VI 1938-FR; FG, IX 1979-GO; RFz, VI 1979-GO; SCF, IX 1979-GO; SCz, VI 1938-FR; Va, VI 1938-FR. Pico: S, VII 1938-FR. Santa Maria: AP, IX 1979-GO; G, IX 1979-GO; VP, IX 1979-GO. São Jorge: LCh, VI 1938-FR. São Miguel: Ba, 27-IX-1995, 1♂ 1♀-OD; Car, 24-IX-1995, 1♀-OD; Fu, VIII-IX 1930-SG; LCa, 24-IX-1995, 1♀-OD; LF, VIII 1938-FR; PDI: V 1938-FR; IX-X 1979-GO; VIII-IX 1930-SG; RG: X 1979-GO; 26-IX-1995, 1♀-OD; SR, V 1938-FR. Terceira: AH, V-VI 1938-FR; MB: V 1938-FR; VIII-IX 1930-SG; SB, VI 1938-FR.

### *Eumerus amoenus* Loew, 1848

There are at least 140 species belonging to the genus *Eumerus* in the Palaearctic region (PECK 1988) but the taxonomic status and nomenclature of most of them are confused (SPEIGHT & LUCAS 1992).

**DISTRIBUTION AND BIOLOGY:** *Eumerus amoenus* occurs from southern Europe and North Africa to Central Asia and Mongolia. It has been cited from the Canaries and the Azores but not from Madeira. This species is one of the most abundant

species of the genus *Eumerus* in the Mediterranean Region (DIRICKX 1994). Few data exist on the biology of this species but the larvae probably live on rotting bulbs and roots. The larval stages are not described.

ACTUAL STATUS: Cited by SÉGUY (1936) and GOMES (1980) from São Miguel and Santa Maria islands. The latter author thinks that the record from Corvo by FREY (1945) may be *Eumerus strigatus*. More studies are necessary to confirm the presence of *E. strigatus* in the Azores. *Eumerus strigatus* has been introduced in many countries by the importation of bulbs and vegetables.

LOCALITIES: São Miguel: PDI, VIII-IX 1930-SG. Corvo: VN, VI 1938-FR. Santa Maria: AP, IX 1979-GO.

#### *Eupeodes corollae* (Fabricius, 1794)

This species is one of the most common aphid-killing hoverfly species in the Palaearctic region. The abdominal pattern is different in both sexes but the yellow markings on tergites 3 and 4 cover parts of lateral margins. The male terminalia are remarkably large.

DISTRIBUTION AND BIOLOGY: This species is present in the Palaearctic Region, including all the Macaronesian islands. *Eupeodes corollae* is also present in Africa and China. This hoverfly lives in a wide range of ecosystems, mainly in open areas but it is also abundant in many agroecosystems (e.g. arable fields, gardens). The larvae are found feeding on a wide range of ground layer aphids. The high mobility of this species and its ability to prey on several species of aphid pests, have been tested for use in biological control. *Eupeodes corollae* is highly migratory and, for this reason, can be very numerous some years (STUBBS & FALK 1993).

FLIGHT PERIOD: May to September, but this range can be longer in the southern Europe.

ACTUAL STATUS: Cited from all the islands except Graciosa but without doubt should also be present in this island.

LOCALITIES: Corvo: VN, VI 1938-FR. Faial: H, V+VII 1938-FR; P, V+VII 1967-GM. Flores: Ae, IX 1979-GO; FG, IX 1979-GO; PDe, IX 1979-GO; RB, VI 1938-FR; RFz, VI 1938-FR; SCF, IX

1979-GO; SCz, VI 1938-FR. Pico: Md, VII 1938-FR. Santa Maria: PSP, IX 1979-GO; VP, IX 1979-GO; without locality, V 1967-GO. São Jorge: C, VI 1938-FR. São Miguel: FC, VII 1979-GM; Fu, VIII-IX 1930-SG; PC, V 1938-FR; PDI: V 1967-GM, V+VII 1979-GM, V 1938-FR; SR, V+VII 1938-FR. Terceira: AH, V 1967-GM; B, V 1938-FR; CGM, X 1978-GM; Ft, V 1967-GM; MB: VIII-IX 1930-SG; V 1938-FR; Pe, VI 1967-GM; PVi, VI 1938-FR; R, V 1967-GM.

#### *Melanostoma mellinum* (Linnaeus, 1758)

Males and females of *Melanostoma mellinum* have a black face and a short abdomen with yellow spots of distinctive orientation. It is very common for melanic females to appear.

DISTRIBUTION AND BIOLOGY: This Holarctic species is abundant in the Mediterranean Region. It is present in Madeira (GOMES & BÁEZ 1990) and old records from the Azores and the Canaries exist. *Melanostoma mellinum* is an important pollinator of anemophilous plants (STELLEMAN & MEEUSE 1976) and sometimes preying on serious aphid pests (MALINOWSKA 1979).

FLIGHT PERIOD: March to November in the South of Europe.

ACTUAL STATUS: Since 1930 no more recent records exist of this species from the Azores. It is necessary to take more samples to confirm the current situation of this species.

LOCALITIES: São Miguel: Fu, VIII-IX-SG

#### *Meliscaeva auricollis* (Meigen, 1822)

*Meliscaeva auricollis* is a narrow-bodied hoverfly with a typical pattern on the third and fourth abdominal segments. On these tergites yellow bands exist, deeply cut at the middle, often giving separate spots. Nevertheless, there is a wide range of variation in this pattern for example the variety *maculicornis* is a common dark form.

DISTRIBUTION AND BIOLOGY: The main area of distribution of *Meliscaeva auricollis* is the West Palearctic Region. Moreover, it has been cited from all the Macaronesian islands. Preferred environments of this species are forests and conifer plantations but it is also abundant in some

anthropogenic habitats (SPEIGHT & LUCAS 1992). This species is also highly migratory and the larvae prey on several species of aphids and larvae of other insects (GOELDLIN DE TIEFENAU 1974).

FLIGHT PERIOD: March to September but hibernating adults are able to fly during autumn and winter, in southern Europe.

ACTUAL STATUS: This species has been only cited by FREY (1945) during the summer of 1938. However, this highly migratory species is probably present in all the islands of the archipelago.

LOCALITIES: Flores: RCz, VI 1938-FR. Pico: Md, VII 1938-FR; S, VII 1938-FR. São Jorge: LCh, VI 1938-FR; RS, VI 1938-FR. São Miguel: Fu, VII 1938-FR; RQ, VII 1938-FR. Terceira: An, VI-VII 1938-FR.

#### *Myathropa florea* (Linnaeus, 1758)

This syrphid can be easily recognised by the pattern of the thoracic dorsum which is partially divided by a pair of yellow pale bars.

DISTRIBUTION AND BIOLOGY: This Palaearctic species is present in the Canaries and Azores. On Madeira occurs the endemic *Myathropa mallotiformis* Frey, 1939. Adults are abundant in forests and the larvae are associated with wet decaying vegetation in rot-holes and similar habitats (ROTHERAY 1993).

FLIGHT PERIOD: May to October.

ACTUAL STATUS: The subspecies cited by FREY (1945) and GOMES (1980) are considered in the Palaearctic Catalogue of PECK (1988) as synonyms of *M. florea*. This species has not been cited from all the islands but is probably present on those that allow the development of its biological cycle.

LOCALITIES: Flores: RFz, VI 1938-FR; SCF, IX 1938-GO. Santa Maria: AP, IX 1979-GO; Pa, IX 1979-GO; VP, IX 1979-GO. São Jorge: RF, VI 1938-FR. São Miguel: Fu: VIII-IX 1930-SG, V 1938-FR; LCa, 24-IX-1995, 1♂ 3♀ -OD; LFu, VII 1938-FR. Terceira: MB, V 1938-FR.

#### *Platycheirus albimanus* (Fabricius, 1781)

The males of the genus *Platycheirus* often have the front tibiae and tarsi conspicuously flattened.

Females of *Platycheirus albimanus* have grey spots on the tergite but in the male they are usually a dull bronze.

DISTRIBUTION AND BIOLOGY: Present in Palaearctic and Nearctic Regions, but in Macaronesia only in the Azores. This species is found in a wide range of biotopes, especially abundant in association with man-modified environments (SPEIGHT & LUCAS 1992). AUBERT et al. (1976) cited this species as migratory.

FLIGHT PERIOD: March to November in southern Europe.

ACTUAL STATUS: Cited only from Flores and São Miguel but probably also present in the central islands.

LOCALITIES: Flores: RdB, IX 1979-GO. São Miguel: PDI, VIII-IX 1930-SG.

#### *Platycheirus rosarum* (Fabricius, 1787)

This species has a typical pattern with only two yellow pale spots at the front margin of tergite 3 of the black abdomen.

DISTRIBUTION AND BIOLOGY: Holarctic species but in Macaronesia is only present in the Azores. The preferred habitats are wetlands, streams or river banks. The larva is undescribed but the puparia have been found in flood debris (ROTHERAY & GILBERT 1989).

FLIGHT PERIOD: May to September.

ACTUAL STATUS: Only cited in 1930 on Terceira. More records would be necessary to confirm the presence of this species in the Azores.

LOCALITIES: Terceira: MB, VIII-IX 1930-SG

#### *Sphaerophoria nigra* Frey, 1945

Endemic species from the Azores without the typical yellow stripe on the sides of the thoracic dorsum. All the body is black except the yellow scutellum. VOCKEROTH (1971) drew the surstylus of male genitalia.

DISTRIBUTION AND BIOLOGY: Only present in the Azores. There are no data about the biology of this species but it probably preys on species of aphids.

FLIGHT PERIOD: *Sphaerophoria nigra* has been cited from June to September.



ACTUAL STATUS: Cited from six islands but probably exists on more. It is necessary to know the ecology of this species in order to protect the habitats where it lives.

LOCALITIES: Faial: CI, VII 1938-FR; RCa, VII 1938-FR. Flores: M, VI 1938-FR; MF, IX 1979-GO; RdB, IX 1979-GO; Va, VI 1938-FR; Pico: S, VII 1938-FR. São Jorge: RS, VI 1938-FR. São Miguel: Car, 24-IX-1995, 1♀-OD; LCa, 24-IX-1995, 2♀♀-OD; LF, VIII 1938-FR; PV, VII 1938-FR. Terceira: B, VII 1938-FR.

### *Sphaerophoria philanthus* (Meigen, 1822)

Considerable care is needed using old records and the specimens need re-examination observing genitalia characteristics. Identification must be based on the male genitalia, the toothed lobe being very broad (STUBBS & FALK 1993).

DISTRIBUTION AND BIOLOGY: Palaearctic species but in Macaronesia only cited from the Azores. The larva is undescribed.

FLIGHT PERIOD: May to August.

ACTUAL STATUS: Since SÉGUY (1936) no more data exist about this species in the Azores. This author cites the species as *Sphaerophoria menthastri* (L.) var *philanthus* Meigen.

LOCALITIES: São Miguel: Fu, VIII-IX 1930-SG.

### *Sphaerophoria rueppellii* (Wiedemann, 1830)

The short body, broadened towards the apex is the most distinctive character of this species.

DISTRIBUTION AND BIOLOGY: Present in all the Palaearctic Region and very common in the Mediterranean region (DIRICKX 1994). In Macaronesia *Sphaerophoria rueppellii* has been cited from the Canaries and the Azores. Several authors note that this species is abundant in several crops and probably plays a great role in the control of some species of aphids (HUBICKA & ZUKOWSKA 1969; LASKA 1984).

FLIGHT PERIOD: April to November in South Europe.

ACTUAL STATUS: Cited recently from São Miguel (CRUZ DE BOELPAEPE 1991), it is probably a recent introduction.

LOCALITIES: São Miguel: without locality, VII-VIII 1990-CZ.

### *Sphaerophoria scripta* (Linnaeus, 1758)

This abundant aphidophagous species may be easily recognized in the field by the long abdomen of the males.

DISTRIBUTION AND BIOLOGY: *Sphaerophoria scripta* is present in the Holarctic region and some parts of Asia. It has been cited from all the Macaronesian islands. This species can be present in a wide range of habitats but is more abundant in open ground and grassland (including agroecosystems). Together with *Episyrphus balteatus* and *Eupeodes corollae*, this species has been used in the biological control of aphids (LASKA 1984).

FLIGHT PERIOD: April to November in South Europe. This species is polyvoltine and highly migratory (AUBERT et al. 1976) with marked dispersal during the summer months (SPEIGHT & LUCAS 1992).

ACTUAL STATUS: Probably the most common species of hoverfly in the Azores archipelago. It has been cited from all the islands.

LOCALITIES: Corvo: Ca, VI 1938-FR; VC, IX 1979-GO. Faial: CI, VIII 1938-FR; H, V+VIII 1938-FR; RFI, VII 1938-FR. Flores: Ae, IX 1979-GO; AI IX 1979-GO; Ce, IX 1979-GO; FG, IX 1979-GO; FSC, IX 1979-GO; MF, IX 1979-GO; PDe, IX 1979-GO; PR, IX 1979-GO; RB, VI 1938-FR; RFz, VI 1938-FR; RdB, IX 1979-GO; SCz, VII 1938-FR; SCF, IX 1979-GO; Va, VI 1938-FR. Graciosa: Cd, VII 1938-FR. Pico: LC, VII 1938-FR; Md, VII 1938-FR; S, VII 1938-FR. São Jorge: C, VI 1938-FR; IT, VI 1938-FR; RS, VI 1938-FR. Santa Maria: G, IX 1979-GO; without locality, V 1967-GO. São Miguel: AA, VII 1978-GM; Ba, 27-IX-1995, 1♂ 1♀-OD; Car, 24-IX-1995, 1♀-OD; Fu, VIII-IX 1930-SG; GP, VI 1979-GM; LF, VIII 1938-FR; PCr, 24-IX-1995, 2♂♂ 2♀♀-OD; PDI: VIII-IX 1930-SG; V 1938-FR; VI-VII+IX 1979-GM; X 1979-GO; RG: V 1938-FR; 26-IX-1995, 1♂-OD; SR, V+VII 1938-FR; SAP, VI 1979-GM. Terceira: Ac, VII 1938-FR; An, V 1938-FR; B, V 1938-FR; Fn, VI 1938-FR; MB: VIII-IX 1930-SG; V 1938-FR.

*Syrpna pipiens* (Linnaeus, 1758)

This species has a narrow body with a pair of orange spots on tergites 2 and 3. The hind femora are very strong.

DISTRIBUTION AND BIOLOGY: This hoverfly is present in all regions of the world except Australia. It has been cited from all the Macaronesian islands. Usually, this species is abundant, especially in wetlands, along the border of fresh-water and in anthropogenic environments. Larva found in various kinds of wet decaying matter.

FLIGHT PERIOD: March to November.

ACTUAL STATUS: Cited from six but probably abundant on all islands.

LOCALITIES: Faial: H, VII 1938-FR; RCa, VII 1938-FR. Flores: Ce, IX 1979-GO; FG, IX 1979-GO; MF, IX 1979-GO; RCz, VI 1938-FR; RFz, VI 1938-FR; RdB, IX 1979-GO; SCz, VII 1938-FR; SCF, IX 1979-GO; Va, VI 1938-FR. Santa Maria: AP, IX 1979-GO; F, IX 1979-GO; G: IX 1976-GO; IX 1979-GO; ME, IX 1979-GO; PSP, IX 1979-GO; Pa, IX 1979-GO; VP, IX 1979-GO. São Jorge: C, VI 1938-FR; RF, VI 1938-FR. São Miguel: Ba, 27-IX-1995, 1♂ 1♀-OD; Car, 24-IX-1995, 2♂♂ 4♀♀-OD; Fu: VIII-IX 1930-SG; V+VII 1938-FR; Gr, 26-IX-1995, 2♂♂-OD; LCa, 24-IX-1995, 5♀♀-OD; LF: VIII 1938-FR; IX-X 1979-GO; LFu, VII 1938-FR; PCr, 24-IX-1995, 1♂ 1♀-OD; PDI, V 1938-FR; RG, 26-IX-1995, 1♂-OD; SR, V+VIII 1938-FR; SC: VIII-IX 1930-SG; V 1938-FR. Terceira: Ac, VI 1938-FR; Ag, VI 1938-FR.

*Syrphus ribesii* (Linnaeus, 1758)

*Syrphus* species have bands on tergites 3 and 4. Both sexes of *Syrphus ribesii* present basal cells of the wing completely covered by microtrichia, but there are no hairs on the eyes.

DISTRIBUTION AND BIOLOGY: Present in the Holarctic region and recently in the Macaronesian islands: Canaries (BAEZ 1977a), Madeira (GOMES & BAEZ 1990), Azores (CRUZ DE BOELPAEPE 1991). Probably all these records are new introductions. *Syrphus ribesii* is specially abundant in anthropogenic habitats such as crops,

conifer plantations or gardens. This hoverfly is often abundant at aphid colonies with a wide range of ground layer and arboreal aphids. Overwinter as larvae.

FLIGHT PERIOD: March to November in South Europe.

ACTUAL STATUS: Colonization is probably recent.

LOCALITIES: São Miguel: without locality, VII-VIII 1990-CZ.

*Xanthandrus azorensis* Frey, 1945

*Xanthandrus azorensis* and *Sphaerophoria nigra* are endemic to the Azores archipelago. Both are black species.

DISTRIBUTION AND BIOLOGY: Only present in the Azores. There are no data about the biology but it probably preys on aphids or larvae of Lepidoptera as do continental species of the genus *Xanthandrus*.

FLIGHT PERIOD: June to September.

ACTUAL STATUS: There have been no records of this species since 1938 but we collected several individuals (males and females) in peat-bog areas.

LOCALITIES: Faial: H, VIII 1938-FR; RE, VII 1938-FR; RFI, VII 1938-FR. Pico: LC, VII 1938-FR; without locality, VII 1938-FR; S, VII 1938-FR. São Jorge: RF, VI 1938-FR; RS, VI 1938-FR. São Miguel: Ba, 27-IX-1995, 2♂♂ 1♀-OD; Fu, V+VII-VIII 1938-FR; LCa, 24-IX-1995, 3♀♀-OD; SC, VIII-IX 1930-SG.

*Xanthandrus comtus* (Harris, 1776)

The abdomen of this fly has a distinctive pattern with a pair of round spots on the second tergite.

DISTRIBUTION AND BIOLOGY: Present in all the Palaearctic region but in the Macaronesia it is only present in the Azores. *Xanthandrus comtus* occurs in meadows and woodland borders (STUBBS & FALK 1993). It is a migratory species (AUBERT et al. 1976), and predator of several tortricid and other caterpillars (LYON 1968; ROTHERAY & BLAND 1992).

FLIGHT PERIOD: March to November but probably all year round in southern Europe.

ACTUAL STATUS: Probably a recent colonization. Locally abundant in São Miguel and might be present on other big islands.

LOCALITIES: São Miguel: Ba, 27-IX-1995, 1 ♂-OD; LCa, 24-IX-1995, 3 ♂♂-OD; PCr, 24-IX-1995, 1 ♀-OD; PDI, X 1979-GO.

*Xylota segnis* (Linnaeus, 1758)

The abdomen of this species has parallel sides and a reddish orange band uniformly coloured at the hind edge of the second tergite.

DISTRIBUTION AND BIOLOGY: *Xylota segnis* is present in most parts of the Palaearctic region and eastern parts of N. America. Moreover it has been cited from all the Macaronesian archipelagos. This is an anthropogenic species living in forests including gardens and other agroecosystems. The larvae feed on decaying sap under bark and various types of rotting vegetable material e.g. rotting potatoes.

FLIGHT PERIOD: March to November in southern Europe. According to AUBERT et al. (1976), *Xylota segnis* is more of a migrant than other species of the genus.

ACTUAL STATUS: Common species on São Miguel and probably present on all islands.

LOCALITIES: Faial: RE, VII 1938-FR. São Miguel: Fu: X 1979-GO; VIII-IX 1930-SG; V+VII 1938-FR; Gr, X 1979-GO; 29-IX-1995, 2 ♂♂ 1 ♀-OD; PDI, X 1979-GO. Terceira: Ac, VI 1938-FR; Ag, VI 1938-FR.

KEY TO SYRPHID SPECIES CITED FROM THE AZORES

This key should be used only to identify syrphids from the Azores islands. It includes all the species cited from the literature till now. For descriptions and keys of European hoverfly species, GIL-COLLADO (1930), SACK (1932), SÉGUÉ (1961), VAN DER GOOT (1981), STUBBS & FALK (1993) and TORP (1994), should be consulted.

- 1a Upper outer cross vein re-entrant (Fig. 1-Ia) 2  
 1b Upper outer cross vein not re-entrant (Fig. 1-IIa) 3

- 2a Third antennal segment black or brown  
*Eumerus strigatus*  
 2b Third antennal segment red or reddish  
*Eumerus amoenus*  
 3a Wing with R<sub>4+5</sub> shallowly dipped or more nearly straight (Fig. 1-IIb) 4  
 3b Wing with R<sub>4+5</sub> strongly looped (Fig. 1-IIIa) 8  
 4a Wing with inner cross vein before middle of discal cell (Fig. 1-IIc) 5  
 4b Wing with inner cross vein at or beyond middle of discal cell (Fig. 1-IIb) 6  
 5a Tergite 2 with two small yellow markings. Hind femur noticeably swollen and arched  
*Syritta pipiens*  
 5b Tergite 2 largely orange. Hind femur slender  
*Xylota segnis*  
 6a Face entirely yellow or at least yellow at the sides 11  
 6b Face entirely black 7  
 7a Abdomen very thin (at narrowest, no wider than scutellum)  
*Baccha elongata*  
 7b Abdomen more compact 19  
 8a Wing with the two anterior radial veins (R<sub>1</sub> and R<sub>2+3</sub>) meeting to form a short stalk before reaching the wing margin (Fig. 1-IIc) 9  
 8b Wing with these veins only just meeting at the wing margin or widely separated (Fig. 1-IId)  
*Myathropa florea*  
 9a Scutellum black; eyes with spotted pattern  
*Eristalinus aeneus*  
 9b Scutellum not black; eyes never with a spotted pattern 10  
 10a Face with black central stripe very wide, maximum one third width  
*Eristalis tenax*  
 10b Face entirely pale dusted, absolutely no trace of a central black stripe  
*Eristalis arbustorum*  
 11a Thoracic pleura with clear yellow markings 12  
 11b Thoracic pleura entirely dark or pale areas obscured by dust 13  
 12a Antennae long and prominent  
*Chrysotoxum intermedium*  
 12b Antennae otherwise. Small narrow species 17

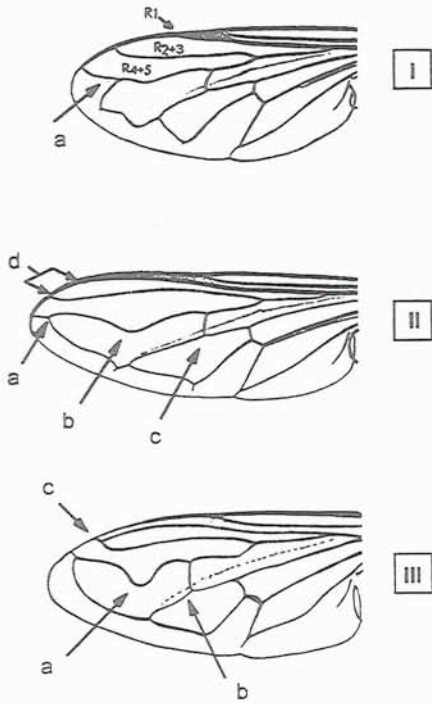


Fig. 1. Syrphid wing diagrams showing term (lettering) used in the key.

13a Long yellow hairs on the upper surface of the squama, especially on posteromedian portion

*Syrphus ribesii*

13b Upper surface of the squamae with only microscopic pile (If doubtful, continue here)

14a Tergites 3 and 4 with double black bands, sometimes reduced

*Episyrphus balteatus*

14b Markings otherwise

15a Line of hairs on the side margins of tergites 3-5 all black

*Eupeodes corollae*

15b Hairs on the side margins of tergites 3-5 partly pale

16a Narrow species. Tergites 3 and 4 with wedge shaped spots

*Meliscaeva auricollis*

16b Broader species. Tergites 3 and 4 with bands always sweeping forwards at lateral margins. Hind femora yellow for at least apical third

*Syrphus ribesii*

17a Thorax with yellow side stripe interrupted above wing base

*Sphaerophoria rueppellii*

17b Thorax with continuous yellow side stripe

18a Abdomen extends well beyond wing tips. Genital lobes from side view very broad

*Sphaerophoria scripta*

18b Abdomen extends to about wing tips. Genitalia seen from beneath elongate with lobes longer than broad

*Sphaerophoria philanthus*

19a Large oval bodied species

20

19b Smaller species with elliptical or parallel sided abdomen

21

20a Second abdominal segment with a pair of dorsal yellowish spots

*Xanthandrus comtus*

20b Second abdominal segment without spots

*Xanthandrus azorensis*

21a Abdomen entirely black

*Sphaerophoria nigra*

21b Abdomen with spots or bands

22

22a Abdomen black with distinctive band or pair of yellowish spots only on tergite 3

*Platycheirus rosarum*

22b Abdomen with a different pattern

23

23a Males (eyes meet on top of head)

24

23b Females (eyes separated on top of head)

25

24a Front tibiae broadened at apex and tarsi partly flattened. Tergites black with silver spots

*Platycheirus albimanus*

24b Front tibiae and tarsi cylindrical; abdomen strongly widening posteriorly. Tergites extensively yellowish.

*Melanostoma mellinum*

25a Tergites with silver spots or bands

*Platycheirus albimanus*

25b Tergites 3 and 4 with roughly triangular spots pointing outwards towards sides.

*Melanostoma mellinum*

## DISCUSSION

There have been 23 species of hoverflies cited from the Azores archipelago. However after the L. Chopard and A. Méquignon expedition in 1930, no new data of the following four species has been produced: *Baccha elongata*, *Chrysotoxum intermedium*, *Platycheirus rosarum*

and *Sphaerophoria philanthus*. The presence of *Eumerus strigatus* should also be confirmed (see *Eumerus amoenus* paragraph). Moreover, none of these species has been cited on the other Macaronesian islands. On the other hand, although *Melanostoma mellinum* has not been cited since 1930, we consider this species present in the Azores, as it is a common syrphid in Madeira (GOMES & BÁEZ 1990) and other species of this genus are known in the Canary islands (BAEZ 1977a).

Though more exhaustive sampling would be necessary on some of the Azores islands (i.e.: Graciosa and Corvo), probably the total number of hoverfly species living in the archipelago is not greater. According to the theory of island biogeography (MACARTHUR & WILSON 1967) there would be a correlation between area and number of species. We can show this relation plotting the log of island-areas against log of species number, on a double logarithmic scale. In the case of syrphids, we get low values of regression between both factors ( $r^2 = 0.520$ ). However we can improve these results ( $r^2 = 0.718$ ) by removing the former five doubtful species and consider the presence of 4 common synanthropic or highly migratory species, and with wide geographical distribution on all islands (*Eristalis tenax*, *Eristalinus aeneus*, *Episyrphus balteatus* and *Eupeodes corollae*) (Fig. 2).

Related to the larval biology of syrphids present in the Macaronesian archipelagos, we can observe that the rate of the three main lines of feeding ecology (predacious, saprophagous and phytophagous) differs (Fig. 3). The percentage of predacious and saprophagous species is similar in continental Mediterranean ecosystems (ISIDRO 1995; PEREZ-BAÑÓN 1995). In relation to this, the syrphids with more capacity to fly including highly migratory species, belong to predacious and saprophagous groups (TORP 1994). However, the proportion of phytophagous larvae is much too low, in all the Macaronesian islands except Canaries (Fig. 3) probably because this archipelago is closer to mainland. *Eumerus* is the only genus of phytophagous syrphids cited from the

Macaronesian islands. In Azores, Madeira and Cape Verde exist only one species of this genus, but there are 9 cited from the Canaries (BÁEZ 1982a), 7 endemic and one more living in the Canaries and Madeira (Table 1).

Analysing the biogeographic elements, we observe that the percentage of syrphid endemic species in Azores is 9 % (Fig. 4). This rate is similar to the total of endemic species of insects in the archipelago (BIVAR DE SOUSA 1985). This percentage is similar in Cape Verde (8.3 %), in Madeira it is about 15 %. The highest is in the Canary Islands with 36 % of syrphid endemic species. In accordance with this, the Canaries is

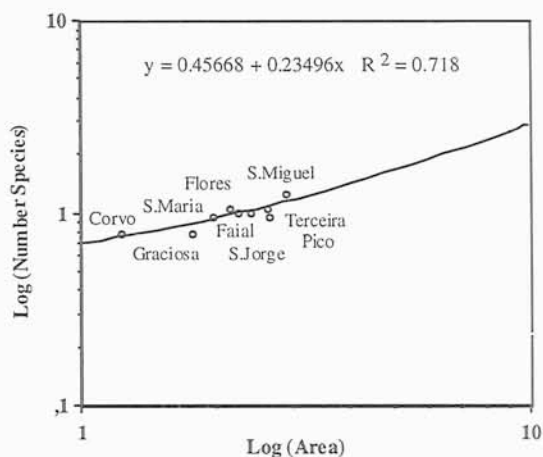


Fig. 2. Regression between Area and Number of syrphid species present in Azores Archipelago.

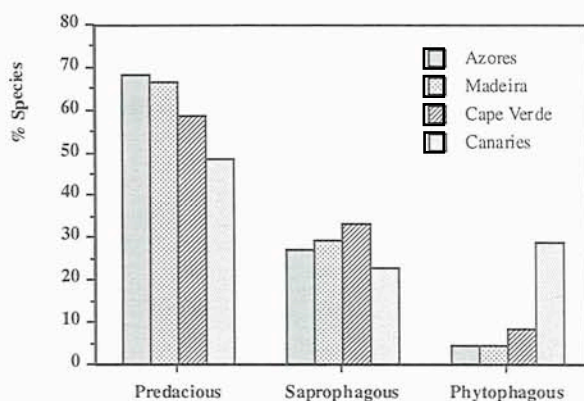


Fig. 3. Larval feeding habits of the hoverflies present in the Macaronesian region.

also the archipelago with more endemic plants (BOLOS 1996). The Palaearctic influence is more important in the Azores and Madeira than in the Canaries. However, in Cape Verde the influence of Afrotropical elements is the highest (BAEZ 1982b). The Nearctic element has not been cited in the syrphid fauna from the Macaronesia and the presence of Holarctic species is only important in the Azores and Madeira (CLAUSSEN & BARKEMEYER 1987). We can explain these results by the long distance to the continent from the Azores and their geographical position in the north of the Macaronesia, far from Afrotropical influence.

We can compare the syrphid species composition in the archipelagos of Macaronesia

(Fig. 5). With the UPGMA analysis (group average clustering) using the Sørensen Index (SØRENSEN 1948), we found that Madeira and the Canaries are more related to the Azores than to Cape Verde. According to these data, there are only 3 species of hoverflies present in all four archipelagos: *Eristalis tenax* (Cosmopolitan), *Eristalinus aeneus* (Sub-cosmopolitan) and *Eupeodes corollae* (Palaearctic+Palaeotropical species). On the other hand, six species (*Episyrphus balteatus*, *Meliscaeva auricollis*, *Sphaerophoria scripta*, *Syrirta pipiens*, *Syrphus ribesii* and *Xylota segnis*) are present in the Azores, Canaries and Madeira. However, only two species *Ischiodon aegyptius* and *Scaeva albomaculata* are present in Cape Verde, the

Table 1

Macaronesian hoverfly species

AZORES	MADEIRA	CANARIES	CAPE VERDE
<i>Bacha elongata</i>	<i>Episyrphus balteatus</i>	<i>Chamaesyrphus nigricornis</i>	<i>Allograpta nasuta</i>
<i>Chryxotoxum intermedium</i>	<i>Eristalinus aeneus</i>	<i>Chryxotoxum triarcuatum</i>	<i>Eristalinus aeneus</i>
<i>Episyrphus balteatus</i>	<i>Eristalis tenax</i>	<i>Episyrphus balteatus</i>	<i>Eristalinus megacephalus</i>
<i>Eristalinus aeneus</i>	<i>Eumerus purpureus</i>	<i>Eristalinus aeneus</i>	<i>Eristalis tenax</i>
<i>Eristalis arbostorum</i>	<i>Eupeodes corollae</i>	<i>Eristalinus taeniops</i>	<i>Eumerus erythrocerus</i>
<i>Eristalis tenax</i>	<i>Eupeodes luniger</i>	<i>Eristalis tenax</i>	<i>Eupeodes corollae</i>
<i>Eumerus amoenus</i>	<i>Ischiodon aegyptius</i>	<i>Eumerus canariensis</i>	<i>Ischiodon aegyptius</i>
<i>Eupeodes corollae</i>	<i>Melanostoma babyssa</i>	<i>Eumerus dubius</i>	<i>Ischiodon feae</i>
<i>Melanostoma mellinum</i>	<i>Melanostoma mellinum</i>	<i>Eumerus latitarsis</i>	<i>Paragus borbonicus</i>
<i>Meliscaeva auricollis</i>	<i>Meliscaeva auricollis</i>	<i>Eumerus nivariae</i>	<i>Paragus pusillus</i>
<i>Myiatropa florea</i>	<i>Milesia crabroniformis</i>	<i>Eumerus pulchellus</i>	<i>Scaeva albomaculata</i>
<i>Platycheirus albianus</i>	<i>Myiatropa mallotiformis</i>	<i>Eumerus purpurariae</i>	<i>Syrirta flaviventris</i>
<i>Platycheirus rosarum</i>	<i>Neoascia podagrica</i>	<i>Eumerus purpureus</i>	
<i>Sphaerophoria nigra</i>	<i>Paragus coadunatus</i>	<i>Eumerus santosabreui</i>	
<i>Sphaerophoria philanthus</i>	<i>Scaeva albomaculata</i>	<i>Eumerus terminalis</i>	
<i>Sphaerophoria rueppellii</i>	<i>Scaeva pyrastris</i>	<i>Eupeodes corollae</i>	
<i>Sphaerophoria scripta</i>	<i>Scaeva selenitica</i>	<i>Eupeodes interrumpens</i>	
<i>Syrirta pipiens</i>	<i>Sphaerophoria scripta</i>	<i>Heringia adpropinquans</i>	
<i>Syrphus ribesii</i>	<i>Syrirta pipiens</i>	<i>Ischiodon aegyptius</i>	
<i>Xanthandrus azorensis</i>	<i>Syrphus ribesii</i>	<i>Melanostoma incompletum</i>	
<i>Xanthandrus comtus</i>	<i>Syrphus torvus</i>	<i>Meliscaeva auricollis</i>	
<i>Xylota segnis</i>	<i>Syrphus vitripennis</i>	<i>Myiatropa florea</i>	
	<i>Xanthandrus parhyalinatus</i>	<i>Paragus coadunatus</i>	
	<i>Xylota segnis</i>	<i>Paragus tibialis</i>	
		<i>Scaeva albomaculata</i>	
		<i>Scaeva pyrastris</i>	
		<i>Sphaerophoria rueppellii</i>	
		<i>Sphaerophoria scripta</i>	
		<i>Syrirta pipiens</i>	
		<i>Syrphus ribesii</i>	
		<i>Xylota segnis</i>	

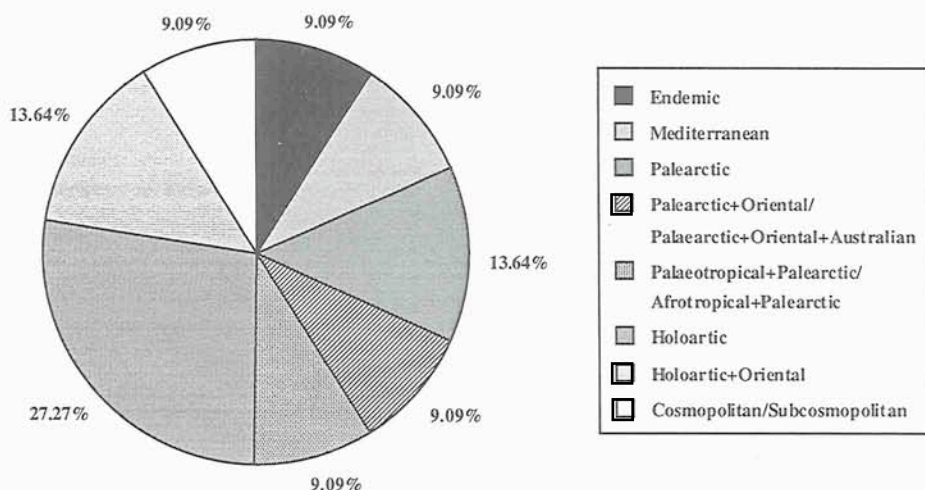


Fig. 4. Biogeographical elements in the Azores archipelago referring to syrphid fauna.

Canaries and Madeira (Table 1). The absence of genus *Scaeva* in the Azores is surprising because these hoverflies are strong flyers and have been cited from all the other Macaronesian islands.

The terrestrial fauna and flora of the northern Macaronesian islands are more related to the west European than to African (BALLETO et al. 1990). The Azores archipelago never had "land-bridges" with the European or the African mainland. Flies (Diptera) are the most abundant insects in the Azores archipelago with a percentage of species near to 30% (BIVAR DE SOUSA 1985) and the order has more endemic species than any other, 40 in 420, i.e. about 10% (Bivar de Sousa pers. comm). Our data on Syrphidae show an endemism of about 9% (2 of 23), the endemic species being *Sphaerophoria nigra* and *Xanthandrus azorensis*. However, more faunistic studies and analysis of the ecology of the most representative species of these fascinating islands are needed.

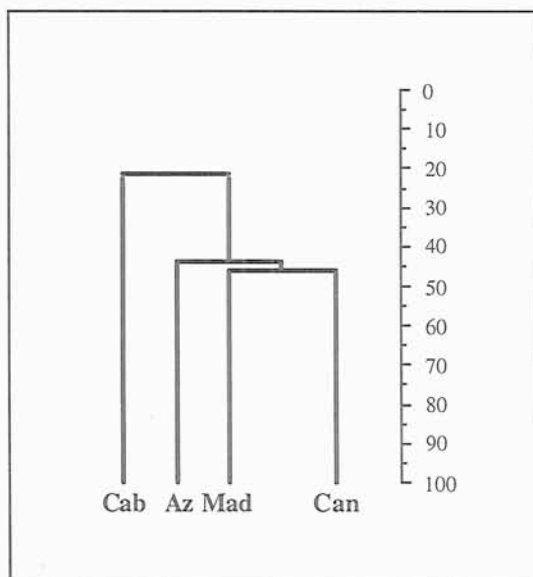


Fig. 5. UPGMA analysis (group average clustering) of species of hoverflies in Macaronesian region.

#### ACKNOWLEDGMENTS

We wish to thank Dr. Marcos Báez (University of La Laguna, Tenerife) and Dr. Matthew Sullivan (Department of Biological Sciences, The

Manchester Metropolitan University) for allowing us to study specimens from Macaronesian islands. This study was supported in part by a grant from the Research Project GV-1175/93 from Generalitat Valenciana.

## REFERENCES

- ANKERSMIT, G.W., N.J. DIJKAM, N.J. KEUNING, H. MERTENS, A. SINS & H.M. TACOMA 1986. *Episyrphus balteatus* as a predator of the aphid *Sitobion avenae* on winter wheat. *Entomologia Experimentalis et Applicata* 42: 271-277.
- AUBERT, J., J.J. AUBERT & P. GOELDLIN DE TIEFENAU 1976. Douze ans de captures systématiques de Syrphides (Diptères) au col de Bretolet (Alpes valaisannes). *Bulletin de la Société Entomologique Suisse* 49: 115-142.
- BÁEZ, M. 1977a. *Los Sírfidos de las Islas Canarias*. Instituto de Estudios Canarios (Universidad de la Laguna, Monografías; Sección IV (XV): 143 pp.
- BÁEZ, M. 1977b. Revisión del género *Paragus* en las Islas Canarias (*Dip. Syrphidae*). *Boletín de la Asociación española de Entomología* 1: 119-122.
- BÁEZ, M. 1982a. Nuevas especies del género *Eumerus* en las Islas Canarias (Diptera, Syrphidae). *Annali del Museo Civico di Storia Naturale di Genova*, 84: 41-51.
- BÁEZ, M. 1982b. Consideraciones zoogeográficas sobre la fauna de Dípteros de Cabo Verde (Insecta, Diptera). *Forschungsinstitut Senckenberg* 52: 231-240.
- BÁEZ, M. 1986. Notas sobre el género *Chamaesyrphus* en las Islas Canarias (*Dip., Syrphidae*). *Boletín de la Asociación española de Entomología* 10: 309-311.
- BALLETTO, E., C. GIACOMA, C. PALESTRINI, A. ROLANDO, M. SARÀ, A. BARBERIS, S. SALVIDIO, P. MENSÌ & L. CASSULO. 1990. On some aspects of the biogeography of Northern Macaronesia. *Atti Dei Convegni Lincei* 85: 167-199.
- BARENDREGT, A. 1994. Possibilities of nature-development from the target group of the hoverflies (Diptera: Syrphidae). *Entomologische Berichten (Amsterdam)* 54(4): 75-79.
- BIVAR DE SOUSA, A. 1985. Alguns dados sobre a fauna entomológica dos Açores e a origem da sua fauna endêmica. *Boletim da Sociedade Portuguesa de Entomologia* 75(3): 1-9.
- BOLOS, O. 1996. Acerca de la Flora Macaronésica. *Anales del Jardín Botánico de Madrid* 54: 457-461.
- CLAUSSEN, C. 1981. *Metasyrphus interruptens* (Walker, 1871) und andere Schwebfliegen von Gran Canaria (Diptera: Syrphidae). *Entomologische Zeitschrift* 91(15): 174-176.
- CLAUSSEN, C. & W. BARKEMEYER 1987. Zur Syrphidenfauna der Kapverden (Insecta: Diptera: Syrphidae). *Forschungsinstitut Senckenberg* 95: 71-86.
- CRUZ DE BOELPAEPE, M. 1991. Fluctuations saisonnières des insectes entomophages capturés par piégeage, dans plusieurs biotopes de l'île de São Miguel, Açores. *Arquipélago. Life and Earth Sciences* 9: 11-23.
- DIAS, E. 1994. *Património Vegetal dos Açores*. Centres of Plant Diversity: A guide and strategy for their conservation. IUCN Plant Conservation Office & WWF International (eds.), Angra do Heroísmo 1-17 pp.
- DIRICKX, H.G. 1994. *Atlas des Diptères syrphides de la région méditerranéenne*. Documents de travail de L'I.R.Sc.N.B., 75: 317 pp.
- FERRAZZI, P. & F. MARLETTO 1990. Interesse apistico di *Reynoutria japonica* Houtt. *Apicoltore Moderno* 81: 71-76.
- FREY, R. 1945. Tiergeographische Studien über die Dipteren-fauna der Azoren. *Commentationes Biologicae* 8 (10): 114 pp.
- GIL COLLADO, J. 1930. Monografía de los Sírfidos de España. *Trabajos del Museo nacional de Ciencias Naturales*. 376 pp.
- GILBERT, F.S. 1986. *Hoverflies*. Naturalists' Handbooks 5. Cambridge University Press. 66 pp.
- GOELDLIN DE TIEFENAU, P. 1974. Contribution à l'étude systématique et écologique des Syrphidae (Dipt.) de la Suisse occidentale. *Mitteilungen der schweizerischen entomologischen Gesellschaft* 47(3/4): 151-252.
- GOMES, A. 1980. Sírfidos capturados pela 2.<sup>a</sup> Expedição afidológica ao arquipélago dos Açores (Diptera, Syrphidae). *Boletim da Sociedade Portuguesa de Entomologia* 9: 1-6.
- GOMES, A. 1982. Notícia sobre a sírfidofauna do arquipélago dos Açores (Diptera, Syrphidae). *Boletim da Sociedade Portuguesa de Entomologia* 7(A): 293-299.
- GOMES, A. & M. BÁEZ 1990. Contribución al conocimiento de los Sírfidos del archipiélago de Madeira (Diptera, Syrphidae). *Vieraea* 19: 339-345.
- HAGGAR, J.P. 1988. The Structure, Composition and Status of the Cloud Forests of Pico island in the Azores. *Biological Conservation* 46: 7-22.
- HASSAN, S.A. 1989. Standard methods to test the side effects on natural enemies of insects and mites developed by the IOBC/WPRS Working Group "Pesticides And Beneficial Organisms. *EPPO Bulletin* 15: 214-255.
- HEAL, J.R. 1981. Colour patterns of Syrphidae. III. Sexual dimorphism in *Eristalis arbustorum*. *Ecological Entomology* 6: 119-127.
- HIPPA, H. & S. KOPONEN 1976. Preliminary studies on flower visitors to and potential pollinators of the cloudberry (*Rubus chamaemorus* L.) in subarctic Lapland. *Annales Agriculturae Fennicae* 15: 56-65.



- HOLLOWAY, B.A. 1976. Pollen feeding in hover-flies (Diptera: Syrphidae). *New Zealand Journal of Zoology* 3(4): 339-350.
- HUBICKA, J. & N. ZUKOWSKA 1969. Materiały do poznania Syrphidae (Diptera) okolic Chelma. *Annales Universitatis Mariae Curie-Sklodowska Lublin-Polonia*. XXIV(20): 289-305.
- ISIDRO, P.M. 1995. *Biología y Ecología de los sirfidos (Diptera, Syrphidae) del parque natural del carrascal de la Font Roja (Alicante, España)*. Memoria de Licenciatura, Universidad de Alicante. Alicante. 158 pp.
- KRANNITZ, P.G. & M.A. MAUN 1991. Insect visitors to the Guelder Rose, *Viburnum opulus* var. *opulus* (Caprifoliaceae), in London, Ontario. *Canadian Field Naturalist* 105(1): 13-17.
- LASKA, P. 1984. A method of comparing the role of aphid parasitoids and predators exemplified by the cabbage aphid *Brevicoryne brassicae*. *Acta entomologica bohemoslovaca* 81: 81-89.
- LYON, J.P. 1968. Contribution à l'étude biologique de *Xanthandrus comtus* Harr. (Diptera, Syrphidae). *Annales des Épiphyties* 19: 683-693.
- MACARTHUR, R.H. & E.O. WILSON. 1967. *The theory of Island Biogeography*. Princenton University Press (ed). Monographs in Population Biology, Princenton. 203 pp.
- MALINOWSKA, D. 1979. Communities of aphidophagous syrphids (Diptera, Syrphidae) in the Lublin region. *Memorabilia Zoologica* 30: 37-62.
- MARCOS-GARCÍA M.A. & E. GALANTE 1989. Utilisation des régions entomofaunistiques dans la protection des zones naturelles. Pp. 161-174 in: Secretariat de la faune et de la flore. Museum National d'Historie Naturelle (Ed.). *Utilisation des inventaires d'invertébrés pour l'identification et la surveillance d'espaces de grand intérêt faunistique*. Paris. 53. 275 pp.
- PECK, L. V. 1988. Family Syrphidae. Pp. 11-230 in: Á SOÓS (Ed.). *Catalogue of Palaearctic Diptera. Syrphidae-Conopidae*, Vol 8. Budapest.
- PEREZ-BAÑÓN, M.C. 1995. *Estudio de la Comunidad de Sirfidos (Diptera, Syrphidae) de las Sierras Valencianas del Negrete y Utiel*. Memoria de Licenciatura. Universidad de Alicante. Alicante. 171 pp.
- ROTHERAY, G.E. 1993. *Colour Guide to Hoverfly Larvae (Diptera, Syrphidae)*. D. WHITELEY (ed). Dipterists Digest No. 9 Sheffield: 156 pp.
- ROTHERAY, G.E. & K.P. BLAND 1992. *Xanthandrus comtus* (Harris) (Dipt., Syrphidae) breeding in Scotland. *Entomologist's Monthly Magazine* 128: 57-58.
- ROTHERAY, G.E. & F.S. GILBERT 1989. The phylogeny and systematics of European predacious Syrphidae (Diptera) based on larval and puparial stages. *Zoological Journal of the Linnean Society* 95: 29-70.
- SACK, P. 1932. *Syrphidae*. pp 1-451 in: Lindner, E. (Ed.). *Die Fliegen der paläarktischen Region*. Stuttgart. 451+57.
- SÉGUY, E. 1936. Voyage de M.L. Chopard et A.Méquignon aux Açores. *Annales de la Société entomologique de France* 105: 11-26.
- SÉGUY, E. 1961. Diptères Syrphides de l'Europe occidentale. *Memoires du Muséum National d'Historie Naturelle*. Série A. Zoologie. XXIII 1-248 pp.
- SJÖGREN, E. 1973. *Recent changes in the vascular flora and vegetation of the Azores islands*. Instituto Botânico da Universidade de Coimbra. 453 pp.
- SØRENSEN, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analysis of the vegetation on Danish commons. *Biologiske Skrifter* 5: 1-34.
- SPEIGHT, M.C.D. 1986. Criteria for the selection of insects to be used as bio-indicators in nature conservation research. *Proceeding 3rd. European Congress of Entomology*. Amsterdam, 3: 37-43.
- SPEIGHT, M.C.D. & J.W.A. LUCAS 1992. Liechtenstein Syrphidae (Diptera). *Bericht der Botanische-Zoologische Gesellschaft für Liechtenstein-Sargans-Wedenberg*, 19, S. 327-463.
- STELLEMAN, P. & A.D.J. MEEUSE 1976. Anthecological relationships between reputedly anemophilous flowers and Syrphid Flies. 1. The possible role of Syrphid Flies as pollinators of *Plantago*. *Tijdschrift voor Entomologie* 119: 15-31.
- STUBBS, A.E. & S.J. FALK. 1993. *British hoverflies. An illustrated identification guide*. British Entomological and Natural History Society (Ed.) Cornwall, 1-253 pp.
- TORP, E. 1994. *Danmarks Svirrefluer (Diptera: Syrphidae)*. Apollo Books. Denmark. 490 pp.
- TUTIN, T.G. 1953. The vegetation of the Azores. *Journal of Ecology* 41: 53-61.
- VAN DER GOOT, V.S. 1981. *De zweefvliegen van Noordwest-Europa en Europees Rusland, in het bijzonder van de Benelux*. Koninklijke Nederlandse Natuurhistorische Vereniging. Amsterdam 1-275 pp.
- VOCKEROOTH, J.R. 1971. The identity of some holarctic and old world species of *Sphaerophoria* (Diptera: Syrphidae). *Canadian Entomologist* 103: 1627-1634.

- VOCKEROTH, J.R. 1986. Revision of the New World species of *Paragus* Latreille (Diptera: Syrphidae). *Canadian Entomologist* 118(3): 123-198.
- VOCKEROTH, J.R. 1990. Revision of the Nearctic species of *Platycheirus* (Diptera, Syrphidae). *Canadian Entomologist* 122: 659-766.
- WNUK, A. 1977. Ocena skuteczności drapieżnictwa *Episyrphus balteatus* (Deg) (Diptera, Syrphidae) w ograniczaniu *Aphis pomi* Deg (Hom., Aphididae). *Polskie pismo entomologiczne* 47: 755-760.

Accepted 28 May 1997