# Hoverfly diversity (Diptera: Syrphidae) in a Mediterranean scrub community near Athens, Greece

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**Abstract.** We studied the syrphid fauna of a Mediterranean scrub community near Athens, Greece. Collecting was carried out systematically using entomological net for flower-visiting insects (4-year survey: 1983–1987) and a Malaise trap for passive collection (2-year survey: 1991–1993). A total of 59 species were collected by both methods combined. Twenty-six species have a Mediterranean distribution and another 27 a European to worldwide distribution. Among the Mediterranean species one is new to science and another one new to Greece. There was a strong year-to-year variation in the number of hoverfly species recorded, a finding that was detectable in both surveys/methods considered independently. Neither of the collecting methods yielded 100% of the total hoverfly fauna and 55.9% of the species were caught by one method only (19 species by net and 14 by Malaise trap). This may be due partly to the strong interyear variation in hoverfly phenology as well as to the differential efficiency of the entomological net vs. Malaise trap in catching hoverflies. We conclude that in order to draw a complete species list of an area both collecting methods should be combined. A comparison with the hoverfly fauna of five well-studied East Mediterranean areas showed that the study area enjoys a higher contribution of Mediterranean hoverfly species vs. other East Mediterranean areas located at higher latitudes, viz. Thessaly (C. Greece) and Morinj (Montenegro). Still, the high contribution of non-Mediterranean species (viz. 54%) indicates that a large proportion of the hoverfly fauna originates from other habitats both present to date (e.g. surrounding the study site) or pre-existed in the area (e.g. disappeared forests).

**Résumé. Diversité des syrphes (Diptera : Syrphidae) dans une communauté de garrigue méditerranéenne près d'Athène, Grèce.** Nous avons étudié la faune de syrphides d'une communauté de garrigue près d'Athène, Grèce. La collecte a été accomplie de manière systématique en utilisant un filet entomogique pour les insectes floricoles (4 ans d'échantillonnage 1983–1987) et un piège Malaise pour la collecte passive (2 ans d'échantillonnage 1991–1993). Un total de 59 espèces ont été collectées par la combinaison de ces deux méthodes. Vingt-six espèces ont une distribution méditerranéenne et vingt-sept autres espèces ont une distribution europénne à mondiale. Parmi les espèces méditerranéennes, une est nouvelle pour la science et aune utre nouvelle pour la Grèce. Il y a une très forte variation d'une année à l'autre dans le nombre d'espèces de syrphes collectées, constatation perceptible indépendamment avec les deux méthodes de collectes. Aucune des deux méthodes n'a permi de collecter 100% de la faune de syrphes tandis que 55,9% des espèces ont été collectées par une seule méthode des deux méthodes (19 espèces au filet, 14 espèces au le piège Malaise). Ceci peut être dû, en partie, à la forte varition annuelle mais en partie aussi à la plus grande efficacité, pour les syrphes, du filet par rapport au piège Malaise. Nous en concluons que pour élaborer une liste complète d'espèces dans une zone, les deux méthodes devraient être combinées. Une comparaison avec la faune de cinq autres zones est-méditerranéennes a montré que la zone d'étude présentait une plus forte proportion d'espèces de syrphes méditerranéennes que les zones situées à plus haute latitude, par exemple Thessaly (C. Grèce) et Morinj (Montenegro). Toutefois, la forte proportion d'espèces non-méditerranéennes (54%) indique qu'une large proportion d'espèces de syrphes provient soit de milieux environnant, soit des milieux originels (par. ex. forêts disparues).

**Keywords:** Faunistics, species richness, Malaise trap, entomological net, sampling methods, phrygana.

Worldwide hoverflies provide crucial ecosystem services and are considered to be second to bees in importance as pollinators. This is why they enjoyed remarkable scientific interest by researchers worldwide, although there is still a lot to be investigated as to their biogeography and ecology. This is especially true for the East Mediterranean, where several studies investigated the importance and outstanding richness of bees (Michener 1979; O'Toole & Raw 1991; Petanidou & Ellis 1993, 1996; Potts *et al.* 2003; Petanidou & Potts 2006), but none focused on hoverflies as pollinators.

Even beyond their function as pollinators, hoverfly

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species composition is still poorly known in the East Mediterranean. For Greece, for instance, scientific references on the hoverfly fauna are available only for the last two decades. In his 'Atlas of Mediterranean syrphids' Dirickx (1994) listed 98 species for this country, whereas ten more species were published in the first part of the revision of the genus *Merodon* by Hurkmans (1993). Another 63 species new to Greece were published by Van de Weyer & Dils (2002), in a study including *Eupeodes luniger* which was also recorded by Pérez-Bañón *et al.* (1999-2000). An additional 58 species new to Greece were published by Vujić *et al.* (2000) as a result of a 10 year-long study. The growing number of recent publications for Greece with new species recorded for the area (Nielsen 2004; Claussen & Ståhls 2007; Standfuss & Claussen 2007; Vujić *et al.* 2007; Smit & Vujić 2008) and new species to science (Vujić *et al.* 2007 and unpublished data) indicates that the geographical area is interesting and this field of research very dynamic. It also highlights that to date the hoverfly fauna of Greece is far from being completely known.

Alarming declines in the populations of pollinators are often reported from various European countries and elsewhere especially for wild bees (e.g. Buchmann & Nabhan 1997; Allen-Wardell *et al.* 1998; Committee on the Status of Pollinators in North America 2007). Recent investigations, however, based on long time series datasets from the UK and the Netherlands documented the decline of hoverflies along with that of bees (Biesmeijer *et al.* 2006; Zeegers & van Steenis 2009). Considering that the Mediterranean area is expected to be seriously hit by climate change (Giorgi & Lionello 2008), it is most likely that hoverflies, with their general preferences for damp conditions, will be among the first to respond negatively to a future increase in temperature and aridity. This, however, may not apply to genera associated with arid habitats, such as *Merodon* and *Eumerus*.

The overall goal of this study is to investigate the composition and diversity of the hoverfly fauna in an East Mediterranean phryganic community. The phrygana, with a physiognomy determined by woody chamaephytic plants (e.g. *Thymus capitatus, Sarcopoterium spinosum)* and a diversity dominated by annuals, is a low scrub community, the counterpart of the West Mediterranean garrigue, and one of the most important habitats for anthophilous insects in the Mediterranean region (Petanidou & Ellis 1993; Potts *et al.* 2006).

We assessed insect diversity as species richness at the same time considering the species' geographical distribution. In order to assess hoverfly diversity we employed two different collecting techniques, viz. entomological net and Malaise trap. For both techniques we employed rigorous and systematic protocols and for extended periods in order to have the best possible species coverage in our samplings.

Entomological net (hereafter referred to simply as 'net') is the most common method used for capturing hoverflies. The major advantage is that it allows recording plant–hoverfly interactions, but it requires a large sampling effort and may have a significant collector bias (Westphal *et al.* 2008). Malaise traps were also used in many faunistic surveys (Pérez-Bañón 1995; Keil & Konvicka 2005), because they have three major advantages: they collect passively all passing through insects including those that are rarely found on flowers; they are practical for long lasting surveys; and they are much less labour-intensive compared to nets – at least as far as fieldwork effort is concerned (Pompé & Cölln 1991; Dirickx 1994; Pérez-Bañón 1995). These two methods are the most effective in collecting hoverflies (Keil & Konvicka 2005; but see Disney *et al.* (1982) and Campbell & Hanula (2007), who found colour pan traps being more effective than Malaise traps).

Specific questions addressed in this study are the following: 1) What is the diversity and composition of hoverflies in a Mediterranean scrub, one of the most insect species-rich communities of the world, at least regarding bees (Michener 1979)? 2) Are the results typical for the Mediterranean habitats in general? 3) Is there a year-to-year variation in species richness and composition and to what extent is this detectable by either collecting techniques?

## Material and Methods

### Study area

The fieldwork was conducted in a semi-natural Mediterranean scrub community in the nature reserve 'I. and A. Diomedes Botanical Garden of the University of Athens' at Daphni, ca. 10 km west of the centre of Athens, Greece. A detailed description of the site is available in earlier studies (Petanidou & Ellis 1993, 1996; Petanidou & Potts 2006; Petanidou *et al.* 2008). The hoverfly collection was carried out in a 30 ha section of the scrub community occupying a total area of ca.130 ha.

### Hoverfly collection

**Entomological net.** Catching hoverflies with a net was carried out from individual flowers only and not by sweeping. All insect-pollinated plant species occurring in the study site (viz. 133 species) were surveyed using a rigorous and systematic methodology explained in previous studies (Petanidou & Ellis 1996; Petanidou & Potts 2006; Petanidou *et al.* 2008). Briefly, insect collection was carried out by one and the same researcher throughout the survey. It was done on each plant species twice per day, for ca. 20 min each time, and for at least two days during its flowering period. Collecting rounds were repeated

**Table 1.** List of the hoverfly species collected in this study by entomological net (noted with +) and Malaise trap (noted by the number of specimens caught).
Distribution range is abbreviated as E (European and worldwide) and M (Mediterranean). Unidentified taxa of uncertain range are noted as "unknown".

| Species | Distribution | Species caught by net | Number of specimens caught by Malaise trap |
|---|---|---|---|
| *Ceriana conopsoides* (L. 1758) | E | + | 0 |
| *Chrysotoxum intermedium* Meigen 1822 | M | + | 4 |
| *Dasysyrphus albostriatus* (Fallen 1817) | E | | 2 |
| *Epistrophe eligans* (Harris 1780) | E | | 1 |
| *Epistrophe nitidicollis* (Meigen 1822) | E | | 1 |
| *Episyrphus balteatus* (de Geer 1776) | E | + | 3 |
| *Eristalinus megacephalus* (Rossi 1794) | M | + | 1 |
| *Eristalinus sepulchralis* (L. 1758) | E | | 1 |
| *Eristalinus taeniops* (Wiedemann 1818) | M | + | 0 |
| *Eristalis arbustorum* (L. 1758) | E | + | 6 |
| *Eristalis similis* (Fallen 1817) | E | + | 0 |
| *Eristalis tenax* (L. 1758) | E | + | 2 |
| *Eumerus amoenus* Loew 1848 | M | + | 0 |
| *Eumerus basalis* Loew 1848 | M | + | 0 |
| *Eumerus pulchellus* Loew 1848 | M | + | 110 |
| *Eumerus pusillus* Loew 1848 | M | + | 21 |
| *Eumerus tricolor* (Fabricius 1798) | M | + | 0 |
| *Eumerus* sp. 1 | M | | 3 |
| *Eumerus* sp. 2 | M | | 17 |
| *Eumerus* sp. 3 | M | + | 0 |
| *Eumerus* sp. 4 | M | + | 0 |
| *Eupeodes corollae* (Fabricius 1794) | E | + | 64 |
| *Eupeodes luniger* (Meigen 1822) | E | | 2 |
| *Helophilus trivittatus* (Fabricius 1805) | E | + | 0 |
| *Heringia heringi* (Zetterstedt 1843) | E | + | 0 |
| *Heringia latitarsis* (Egger 1865) | E | + | 0 |
| *Lapposyrphus lapponicus* (Zetterstedt 1838) | E | + | 1 |
| *Melanostoma mellinum* (L. 1758) | E | + | 16 |
| *Meliscaeva auricollis* (Meigen 1822) | E | + | 6 |
| *Merodon albifrons* Meigen 1822 | M | + | 33 |
| *Merodon avidus* sensu Milankov *et al.* (2009) | M | + | 18 |
| *Merodon clavipes* (Fabricius 1781) | M | + | 12 |
| *Merodon clunipes* Sack 1913 | M | + | 0 |
| *Merodon dobrogensis* Bradescu 1982 | M | | 1 |
| *Merodon erivanicus* Paramonov 1925 | M | | 9 |
| *Merodon longicornis* Sack 1913 | M | + | 77 |
| *Merodon* **sp. nov.** | M | + | 0 |
| *Merodon minutus* Strobl 1893 | M | + | 1 |
| *Merodon natans* (Fabricius 1794) | M | + | 244 |
| *Merodon nigritarsis* Rondani 1845 | M | + | 3 |
| *Merodon* spp. | unknown | + | 0 |
| *Myathropa florea* (L. 1758) | E | + | 0 |
| *Paragus bicolor* (Fabricius 1794) | M | + | 9 |
| *Paragus bradescui* Stanescu 1981 | E | | 1 |
| *Paragus haemorrhous* Meigen 1822 | E | + | 0 |
| *Paragus quadrifasciatus* Meigen 1822 | M | + | 3 |
| *Paragus tibialis* (Fallen 1817) | E | + | 109 |
| *Paragus* sp. | unknown | | 4 |
| *Pelecocera* sp. 1 | unknown | + | 0 |
| *Pelecocera* sp. 2 | unknown | | 2 |
| *Platycheirus* sp. | unknown | | 1 |
| *Scaeva albomaculata* (Macquart 1842) | M | + | 2 |
| *Scaeva pyrastri* (L. 1758) | E | + | 3 |
| *Scaeva selenitica* (Meigen 1822) | E | + | 1 |
| *Sphaerophoria scripta* (L. 1758) | E | + | 134 |
| *Sphaerophoria* sp. | unknown | | 10 |
| *Syritta pipiens* (L. 1758) | E | + | 2 |
| *Syrphus vitripennis* Meigen 1822 | E | + | 0 |
| *Xanthandrus comtus* (Harris 1776) | E | + | 0 |

every ca. 20 days. The entire sampling lasted 50 consecutive months, from March 1983 until May 1987. The extended sampling period made possible the establishment of a relatively complete spectrum of the flower visiting fauna, given that the populations of flower-visiting insects vary significantly in space and time (Moldenke 1979; Herrera CM 1988; Williams *et al.* 2001; Price *et al.* 2005; Petanidou *et al.* 2008).

**Malaise trap.** We used one Malaise trap installed at an appropriate spot (i.e. rich in flowering species and located on an open vegetation corridor used by flying insects in the middle of the study community) for two full years (June 1991 until July 1993). The trap, made of white gauze, was emptied three times per week. As a result of the very strong and destructive sunlight the white gauze had to be replaced twice. Due to the minimal management applied (no grazing, no fires, minimal bee-keeping) to the study community that excluded disturbances at any scale (e.g. grazing or fires), no major changes have taken place in the plant community between the two collecting periods (i.e. between the years 1987 and 1991).

### Taxonomy

The collected material was sent to European specialists for identification (see Acknowledgments for the list of taxonomists). All insect material, except from a few *Merodon* specimens (see Results section) underwent a final taxonomical inspection by one of the authors (AV). The identified material is kept at the 'Goulandris Natural History Museum' in Athens (species collected by net), and at the section Entomology of the Zoological Museum of the University of Amsterdam (species collected by Malaise trap).

### Data analysis

Insect diversity was simply assessed as species richness. As to their geographic distribution, hoverflies were distinguished into two groups. The first comprised species having a narrow Mediterranean distribution. The second group comprised species with a broader distribution, including species distributed on the European continent as well as species having a worldwide distribution regardless whether this distribution was natural or anthropogenic (e.g. *Eristalis tenax*).

All phenological data presented in the study are referenced by using the calendar days the species were observed or caught on. Calendar day 1 corresponds to 1 January of the first year the research started, day 366 to 1 January of the second year, etc. Collections by net and by Malaise trap were considered separately. In this way, the first day of the net collecting is day 79 (20 March 1983) and the last day 1401 (6 November 1986). Similarly, the first day of Malaise trap observations is 152 (1 June 1992) and the last 927 (16 July 1994).

Statistical tests (basically chi-square tests) were carried out using the statistical package STATISTICA (StatSoft, Inc. 2004).

## Results

### Faunistics

Fifty-eight species were collected at the study community by both methods combined, from which 49 were identified to species level and 9 to genus level (Table 1). A few specimens belonging to the genus *Merodon* were untraced (i.e. track was lost) in the Museum depository and, thus, could not undergo a final taxonomical inspection by the authors (AV). For this reason, these specimens remain undetermined and appear as a group referred to as *Merodon* spp. in Table 1. The same applied to some specimens belonging to the genus *Eumerus*, thus appearing as four morphospecies in Table 1, but in fact they may belong to several undescribed species. Out of the total number of species, 27 had a Mediterranean distribution and another 27 a European to worldwide distribution range. Of the remaining 5 species we could not reliably ascertain their distribution status.

The record of *Merodon dobrogensis* Bradescu 1982 collected in the study community is the first report for the fauna of Greece. Another species is new to science, viz. *Merodon* sp. nova (Table 1).

Table 2 illustrates the hoverfly species richness in four areas representing a complex of Mediterranean

**Table 2.** Number of hoverfly species in five well studied East Mediterranean areas. The species are distinguished according to their known distribution range (cf. Table 1).

M: Mediterranean distribution; E: European-to-worldwide distribution. Percentage is over the total number of species.

| | GREECE | | | | MONTENEGRO |
|---|---|---|---|---|---|
| **Number of species** | **Daphni**[1] | **Crete island**[2] | **Lesvos island**[3] | **SE Thessaly**[4] | **Morinj bay5** |
| Total number | 59 | 61 | 93 | 96 | 128 |
| *Europe-to-world-distributed* | 27 | 33 | 40 | 57 | 92 |
| *Mediterranean-distributed* | 26 (44%) | 28 (46%) | 53 (57%) | 39 (41%) | 36 (28%) |
| *unknown* | 6 | | | | |
| Species unique to the community | 2 (1M, 1E) | 7 (6M, 1E) | 22 (20M, 2E) | 15 (6M, 9E) | 49 (10M, 39E) |
| Species shared by all communities | | | 25 (9M, 16E) | | |

1: 1 collection site, 30 ha (present study)
2: 51 sites on the island having a surface of 8247 km$^2$ (Claussen & Lucas 1988)
3: 39 sites on the island having a surface of 1640 km$^2$ (Garcia-Gras 2008)
4: a complex of Mediterranean sites occupying ca. 600 ha (Standfuss & Claussen 2007)
5: a complex of sites occupying ca. 100 ha (Vujić, unpublished data)

habitats within the East Mediterranean as compared with the present study (Daphni; 1 collection site, 30 ha). The four areas are (fig. 1): the island of Crete (S Aegean; 51 sites throughout the island having a surface area of 8247 $km^2$); the island of Lesvos (NE Aegean; 39 sites throughout the island of 1640 $km^2$); SE Thessaly (C Greece; several collection sites over an area of 600 ha); and Morinj bay (Montenegro; a complex of sites occupying a total of ca. 100 ha). The proportion of Mediterranean species differed significantly among these five areas (Table 2; $\chi^2$, P < 0.001) with the highest contribution observed in the islands and the study area (Table 2). Considering the mainland alone, the proportion of Mediterranean species decreased significantly with latitude across the Balkan Peninsula: Daphni, S Greece > Thessaly, C Greece > Morinj, Montenegro (Table 2; $\chi^2$, P < 0.001).

The five areas share 25 hoverfly species, i.e. 42% of the hoverfly fauna of Daphni (cf. Table 1). Out of these 25 shared species, however, only nine have Mediterranean distribution, viz. *Chrysotoxum intermedium*, *Eumerus amoenus*, *E. basalis*, *Merodon albifrons*, *M. avidus A* (sensu Milankov *et al.* 2009), *Eristalinus taeniops, Paragus bicolor, P. quadrifasciatus*, *Scaeva albomaculata*. The remaining species have a more or less wide distribution, encompassing species spanning from Central to South Europe to species with a worldwide distribution (e.g. *Eristalis tenax*).

## Phenology and year-to-year variation

Hoverfly species richness was evenly distributed throughout the year except in winter time where it was somewhat lower (Fig. 2: data from net collection). However, population numbers were particularly high in certain periods of the year (May-June; September-October; Fig. 2: collection by Malaise trap). These differences were due to the high population numbers of particular species such as *Sphaerophoria scripta*, *Eumerus pulchellus*, and *Paragus tibialis* in summer; and *Merodon natans* in autumn (cf. Table 1).

There was a high year-to-year variation in the number of species caught throughout the different survey years and this was documented for both methods tested (24 to 39, and 27 to 30 for net and Malaise trap, respectively; Table 3). Using the Jaccard index, i.e. the number of species commonly present in both years divided by the total number of species recorded across these two years, we revealed that the similarity of species identity present in different pairs of survey years varies between 43% and 58%.

## Sampling effects

None of the two methods yielded 100% of the total number of hoverfly species that was found in the study community (Table 1). Out of the total 59 species, 40 (67.8%) were collected by Malaise trap and 45 (76.3%) by net. Both methods, however, performed quite similarly in terms of the sampling time needed to catch a certain number of species as shown by the cumulative species numbers in Fig. 3. This figure illustrates that two years of continuous capturing by the Malaise trap and four years of net collection using a rigorous and systematic protocol were indispensable to lead to the levelling off of the cumulative curve of

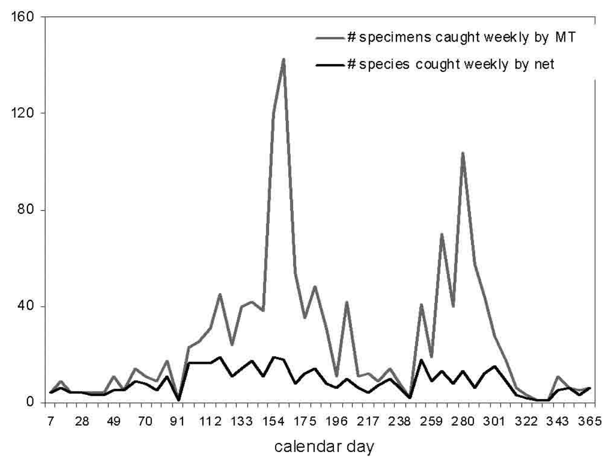


**Figure 1**
Map showing the geographical location of the study area (Daphni; number 1) and the compared areas shown in Table 2 (2: Crete island; 3: Lesvos island; 4: SE Thessaly; 5: Morinj bay).

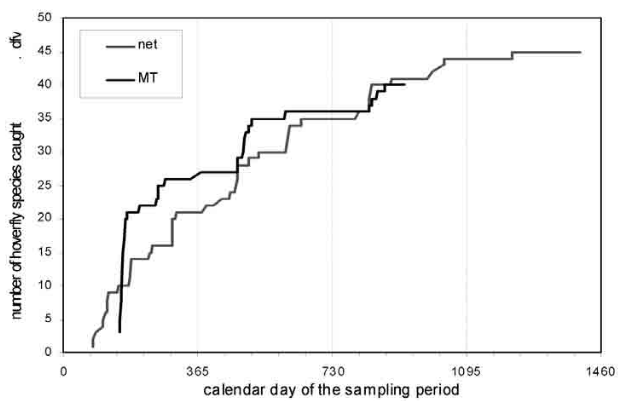


**Figure 2**
Phenology of the hoverfly fauna in the study community in terms of (i) number species caught by net alone in the period 1983-1987 (black line) and (ii) number of specimens caught by Malaise trap alone in 1991–1993 (grey line). Numbers are summarized over weekly intervals.

**Table 3.** Jaccard similarity indexes calculated for the hoverfly species present in all possible pairs of survey years for both methods tested.

| Number of hoverfly species | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| present in one year | | | | | | present in two years | | Jaccard index |
| 1983–4 | 1984–5 | 1985–6 | 1986–7 | 1991–2 | 1992–3 | common | total | |
| *Caught by net* | | | | | | | | |
| 24 | 29 | | | | | 16 | 37 | 0.43 |
| 24 | | 39 | | | | 20 | 43 | 0.47 |
| 24 | | | 29 | | | 16 | 37 | 0.43 |
| | 29 | 39 | | | | 24 | 44 | 0.55 |
| | 29 | | 29 | | | 20 | 36 | 0.56 |
| | | 39 | 29 | | | 25 | 43 | 0.58 |
| *Caught by Malaise trap* | | | | | | | | |
| | | | | 30 | 27 | 17 | 40 | 0.43 |

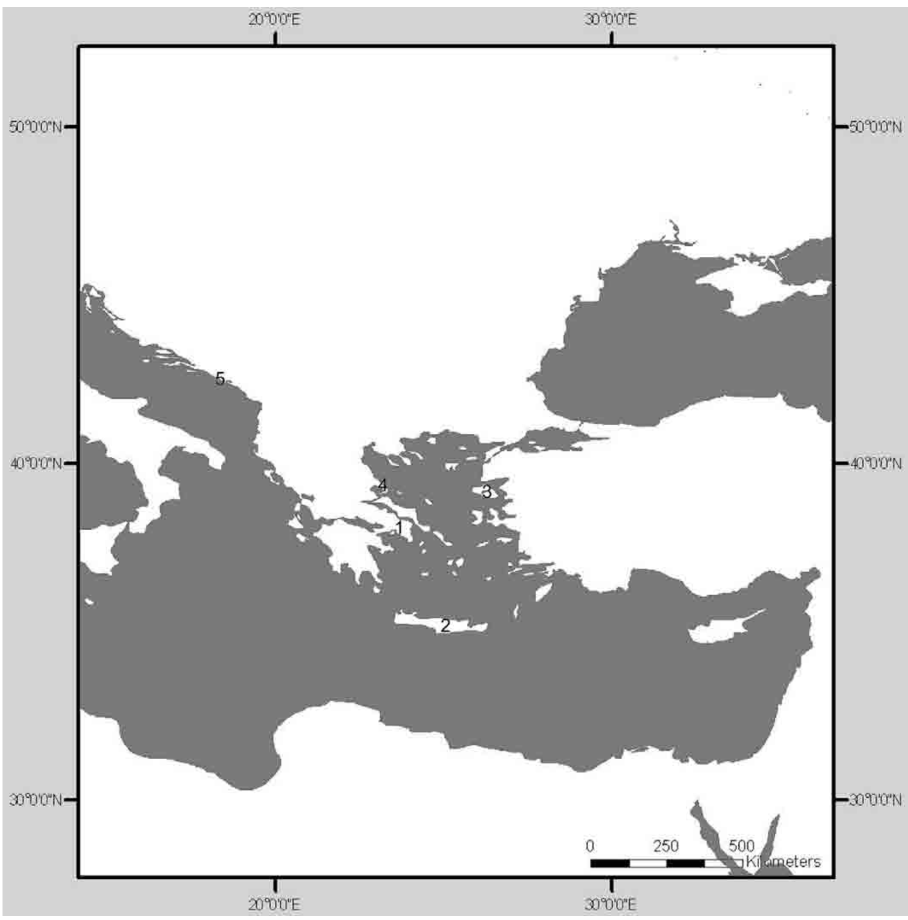


**Figure 3**
Cumulative number of hoverfly species caught by Malaise trap and by net in the study community.

hoverfly species. Yet, it also shows that it is very likely that some species remained unrecorded.

## Discussion

### The hoverfly fauna of Greece and East Mediterranean

From the 860 hoverfly species present in Europe (Speight 2008) only 249 are known to Greece including the findings of this study. The latter do not include an additional number of 52 species that are new to Greece and containing at least 10 undescribed taxa (Vujić & Renema, unpublished data). These results, together with the continuously accumulating literature with new species records for Greece the last few years covering a limited proportion of the Greek territory (Nielsen 2004; Claussen & Ståhls 2007; Standfuss & Claussen 2007; Vujić *et al.* 2007; Smit & Vujić 2008), show that the knowledge of the hoverfly fauna of Greece, and the East Mediterranean in general, is far from complete.

Hoverfly composition may differ largely even between communities or areas within the same geographical region. This is well illustrated in Table 2 showing that the five areas under consideration differ not only in their species richness but also in the composition of their species regarding the species' distribution type. Not surprisingly, the Greek islands representing the highest degree of "Mediterraneity" (e.g. extent and stress of summer drought) within our examples had the highest proportion of Mediterranean species. This endemic Mediterranean fauna may have developed vis-à-vis with the increasing isolation of the islands during the Pleistocene due to tectonic movements or/and sea level fluctuations (Koufos *et al.* 2005). Likewise the Daphni site, the most southern area in the Greek mainland included in Table 2, contains a comparably high proportion of Mediterranean species. As expected, the proportion decreases with the latitude (or the "Mediterraneity") of the regions, i.e. from S Greece to Montenegro.

It is very interesting that all the Mediterranean areas, including those of purely Mediterranean character as the Daphni scrub (Table 2), together with plain Mediterranean species they encompass many other non Mediterranean species. The latter originate from biomes including forests either surrounding the study area or formerly existing there. Finally, each of these five areas appears to be quite unique in hoverfly composition reflecting on the one hand their specific landscape history and at the same time their Mediterranean qualities.

### Hoverfly year-to-year variation and sampling effects

In none of the methods employed to assess hoverfly diversity the cumulative number of species curve leveled off even after systematic surveys of two (Malaise trap) and four years (entomological net). This, together with the high in-between year variation in species composition, implies that, either the existing hoverfly species do not appear every year or, most probably, that some hoverfly species occur in low population densities and have a very short flight period (e.g. a few weeks) so that the chance of encountering and capturing them is low. *Ceriana conopsoides* is a good representative of such a species, with maximum flight activity of only two weeks (Petanidou 1991). A strong year-to-year variation in activity and performance has been widely detected among other pollinating insects, such as bees (Moldenke 1979; Herrera CM 1988; Petanidou & Ellis 1993, Williams *et al.* 2001; Price *et al.* 2005; Petanidou *et al.* 2008).

The year-to-year variation in hoverfly activity may be responsible for the differences in species recorded by the two methods, which in fact were carried out in different years (Table 1). One the other hand, we can not be sure that these differences may not be partly due to the differential catching efficiency of the two methods as was shown in previous studies (Pérez-Bañón 1995; Keil & Konvicka 2005). Pérez-Bañón (1995) compared the efficiency of entomological net vs. Malaise trap by making time parallel hoverfly captures in a Mediterranean habitat similar to Daphni, in the region of Valencia, Spain. She found that 55.6% of a total of 63 species was caught by one method only, a percentage that was almost identical in our study (viz. 55.9%, n = 59). This striking similarity may reflect a complex of characteristics and driving forces present in both areas, such as (i) spatial heterogeneity of the community (Ouin *et al.* 2006); (ii) similar divergences in insect behaviour, with some hoverfly species only rarely visiting flowers and other being less prone to be captured by Malaise trap such as *Eristalis tenax*); and (iii) probably collector bias.

The above conclusions indicate that, both methods employed are complementary in assessing the hoverfly species composition of a Mediterranean study area. To fully profit from the potential of Malaise trap, one is obliged to carefully choose the right spot to install and run the traps for a prolonged time, which implies the sacrifice of very large numbers of specimens, also of groups other than hoverflies. Especially when a study has a narrow taxonomic scope the number of specimens killed may become difficult to justify, even though actual damage to the population may be limited. On the other hand, one must keep in mind that a number of species would have remained unnoticed if net had been the only method employed, as was shown in this study.

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