

Contribution to the knowledge of Mantispoidea, Osmyloidea, and Myrmeleontoidea with new records for the Neuroptera fauna of northwestern Turkey

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Abstract: Extensive surveys were carried out between 1992 and 2011 to determine the occurrence and distribution of the neuropteran superfamilies of Mantispoidea, Osmyloidea, and Myrmeleontoidea in Bursa, northwestern Turkey. A total of 345 specimens from 20 species belonging to 7 families were collected at 48 localities using a sweep net. The families of Berothidae, Dilaridae, Mantispidae, Osmylidae, Ascalaphidae, Myrmeleontidae, and Nemopteridae were represented by 1, 1, 3, 1, 3, 10, and 1 species, respectively. Of these, 13 species were new records for Bursa Province, while 7 species were recorded from northwestern Turkey for the first time. The most widespread species were *Libelloides rhomboideus rhomboideus*, *Distoleon tetragrammicus*, and *Mantispa aphavexelte*. Predatory *Mantispa styriaca* adults were commonly found on *Quercus cerris* trees. The total number of species was highest during June, with 12 species that month. There were 14, 18, and 11 species occurring at altitudes of 1–500 m, 500–1000 m, and 1001–1500 m, respectively. Based on the zoogeographical categories of the collected species, the Pontomediterranean elements were dominant, with 10 species. The remaining categories included 8 Holomediterranean species, 1 Eremial species (*Cueta beieri*), and 1 species (*Myrmeleon formicarius*) originating from the Siberian centers.

Key words: Neuroptera, distribution, vertical distribution, zoogeography, Bursa

1. Introduction

Studies on the Neuroptera fauna of Turkey were initiated in the late 1800s by Brauer (1876) and followed by the works of other European entomologists (Popov, 1977; Aspöck et al., 1980; Monserrat and Hölzel, 1987). However, these foreign expeditions were conducted within a limited period. Additional surveys were carried out by Turkish researchers to determine the entire Neuroptera fauna, although most remained restricted to certain families such as Chrysopidae because of their importance in biological control (Şengonca, 1979; Düzgüneş et al., 1981; Kiyak and Ozdikmen, 1993; Canbulat, 2002; Canbulat and Ozsarac, 2004; Canbulat and Kiyak, 2005; Kovanci and Kovanci, 2007).

In Turkey, very few studies have been conducted in Central and South Anatolia on other Neuroptera families, including Berothidae, Mantispidae, Nemopteridae, and Myrmeleontidae (Şengonca, 1978, 1980, 1981; Canbulat and Kiyak, 2003). The neuropteran superfamilies of Mantispoidea, Osmyloidea, and Myrmeleontoidea have been largely neglected in northwestern Turkey. To date, only 11 species belonging to these 3 superfamilies have been recorded in Bursa Province (Hölzel, 1972; Aspöck et

al., 1980). Furthermore, there are no data available on their ecology and distribution.

The superfamily Mantispoidea includes 2 cosmopolitan families, Mantispidae and Berothidae (Gillott, 2005). Mantispidae or mantispids are named after their resemblance to praying mantises. They use their raptorial forelegs for catching and holding their prey like a praying mantis. Berothidae, also known as beaded lacewings, are considered the closest living relatives to Mantispidae (Aspöck, 1987). Adult berothids may feed on pollen, small arthropods, and fungal hyphae (Monserrat, 2006).

The superfamily Osmyloidea consists of the families of Osmylidae, Sisyridae, Dilaridae, and Nevrorthidae. Osmylid adults have moderate-sized and broad pigmented wings spanning up to 30 mm. They are typically found near aquatic habitats. The semiaquatic larvae of *Osmylus fulvicephalus* (Scop.), which is the most common species throughout Europe, prey on small arthropods (Gillott, 2005; Winterton et al., 2010).

The superfamily Myrmeleontoidea contains 3 families: Myrmeleontidae, Ascalaphidae, and Nemopteridae. These families are mainly associated with arid regions and steppe-type ecosystems. Myrmeleontidae is the largest

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neuropteran family, with approximately 2000 species (Aspöck et al., 2001). Their predatory larvae, also called antlions, construct pits and wait for their prey under stones. Ascalaphidae or owlfly larvae resemble antlions in both appearance and life habits. In contrast to crepuscular owlfly adults, some Nemopteridae adults belonging to the genus *Nemoptera* are diurnal, flying in open grasslands during periods of bright sunshine (Engel and Grimaldi, 2007).

Bursa Province, being part of the Mediterranean zoogeographic subregion, mainly supports species of southern origin. However, the presence of Mount Uludağ (2543 m) also creates favorable conditions for species of northern origin. Therefore, the number of extant species is very likely to increase as far as the diversity of natural and agricultural ecosystems in Bursa Province is concerned.

The objectives of this study were to determine the species composition of the neuropteran superfamilies of Mantispidae, Osmyloidea, and Myrmeleontoidea as well as their adult phenology, harboring plants, and spatiotemporal distribution in natural and human-altered habitats in Bursa, northwestern Turkey. In addition, the collected species were classified into zoogeographical categories on the basis of origin.

2. Materials and methods

Extensive surveys were carried out to determine the occurrence and distribution of the neuropteran superfamilies of Mantispidae, Osmyloidea, and

Myrmeleontoidea during 2003–2011 in Bursa Province, located between 39°N and 41°N and 28°E and 30°E in northwestern Turkey. In addition, neuropteran species collected from 1992 to 2001 within the framework of other studies were included.

Specimens were collected at 48 localities in 15 towns in Bursa Province (Figure). Altitudes, route tracks, and directions were measured using a manual GPS device (Magellan Sportrak Pro GPS, Thales Navigation, San Dimas, CA, USA).

Adult specimens were collected from flower heads or their harboring plants by using a sweep net and were killed with ethyl acetate. Adults were pinned with their wings spread, then dried and preserved in the Plant Protection Department Collection of the Faculty of Agriculture at Uludağ University. The neuropteran species were identified based on the descriptions of Aspöck and Aspöck (1969), Hölzel (1972), Gepp (1974), Aspöck et al. (1980), Şengonca (1980), Aistleitner (1982), Aspöck (1987, 1996), and Aspöck and Hölzel (1996).

The zoogeographical categories proposed by Popov and Letardi (2010) were used to classify the collected species in groups according to their origin.

3. Results

A detailed list of families and species of Mantispidae, Osmyloidea, and Myrmeleontoidea collected at 48 localities in 15 towns in Bursa, northwestern Turkey during 1992–2011 is given in Table 1. The occurrence and the

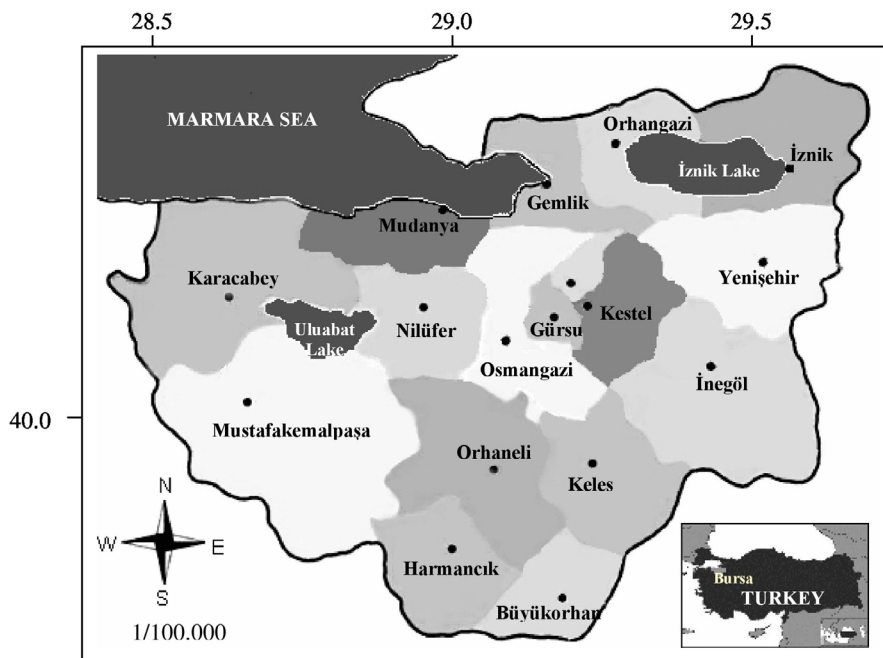


Figure. Map of Bursa Province, northwestern Turkey.

Table 1. List of Neuropteran species and families collected during 1992–2011 in Bursa, Turkey, including data on their abundance, monthly occurrence, and altitudinal distribution.

FAMILY–Species	Total number of adults caught	Total number of localities recorded	Monthly occurrence	Elevation of habitat (m)
MANTISPIDAE				
<i>Mantispa aphavexelte</i> **	57	10	V, VII–VIII	160–1005
<i>Mantispa styriaca</i> **	25	9	VI–VIII	460–1100
<i>Sagittalata perla</i>	11	3	VI–VII	460–930
BEROTHIDAE				
<i>Isoscelipteron fulvum</i>	6	3	V, VIII	425–800
OSMYLIDAE				
<i>Osmylus fulvicephalus</i> *	7	3	VI	60–1050
DILARIDAE				
<i>Dilar turcicus</i> **	7	3	VII–VIII	570–1430
MYRMELEONTIDAE				
<i>Creoleon plumbeus</i>	17	6	VII–VIII	60–880
<i>Cueta beieri</i> *	8	6	VII–VIII	460–1060
<i>Distoleon tetragrammicus</i>	20	11	VI–VII	60–1200
<i>Macronemurus bilineatus</i> *	8	3	VI–VIII	300–1010
<i>Megistopus flavicornis</i> **	1	1	VI	60
<i>Myrmecaelurus trigrammus</i> *	30	6	VI–VIII	450–1200
<i>Myrmeleon formicarius</i> **	3	2	VII	1050–1180
<i>Nemoleon poecilopterus</i> **	3	2	VI, VIII	600–970
<i>Neuroleon assimilis</i>	3	2	VIII	925–1430
<i>Palpares libelluloides</i> *	19	8	VI–VII	15–700
ASCALAPHIDAE				
<i>Deleproctophylla variegata</i> **	16	2	VI	300–720
<i>Libelloides lacteus</i>	29	5	V–VI	580–1060
<i>Libelloides rhomboideus rhomboideus</i>	52	18	V–VII	60–1200
NEMOPTERIDAE				
<i>Nemoptera sinuata</i> *	23	2	VI	725–800

*: First record for Bursa.

**: First record for northwestern Turkey.

altitudinal distribution of these species are also provided. A total of 345 specimens belonging to 20 species from 7 families were caught. The families of Berothidae, Dilaridae, Mantispidae, Osmylidae, Ascalaphidae, Myrmeleontidae, and Nemopteridae were represented by 1, 1, 3, 1, 3, 10,

and 1 species, respectively. Of these, 13 species were new records for Bursa Province while 7 species were recorded from northwestern Turkey for the first time.

Adults of a few species emerged in May, but adults of most species appeared in June (Table 1). The total number

of species was highest during June, with 12 species that month. Adult flight activity was restricted to hot summer months. The most widespread species were *Libelloides rhomboideus rhomboideus* (Schneider), *Distoleon tetragrammicus* (Fabricius), and *Mantispa aphavexelte* (Aspöck and Aspöck), which were found in 18, 11, and 10 out of 48 localities, respectively (Table 1). On the other hand, the most abundant species were *M. aphavexelte*, *L. rhomboideus rhomboideus*, *Myrmecaelurus trigrammus* (Pallas), and *Libelloides lacteus* (Brullé), with percent dominance values of 16.52%, 15.07%, 8.69%, and 8.40%, respectively.

The altitudinal distribution of the captured Neuroptera species is summarized in Table 1. There were 14, 18, and 11 species occurring at altitudes of 1–500 m, 500–1000 m, and

1001–1500 m, respectively. Among these, 6 species were found at altitudes below 100 m. Conversely, *Myrmeleon formicarius* L. adults were only caught at altitudes above 1000 m.

Based on the zoogeographical categories of the collected species, the Pontomediterranean elements were dominant, with 10 species. The remaining categories included 8 Holomediterranean species, 1 Eremial species (*Cueta beieri* Hölzel), and 1 species (*M. formicarius*) originating from the Siberian centers (Table 2).

Data on the number and sex of the specimens, dates of adult flights, and harboring plants, if determined, are given below. Localities and altitudes where specimens were collected are also listed. Town names are indicated in bold letters.

Table 2. Zoogeographical categories of the taxa belonging to the Neuropteran superfamilies of Mantispoidea, Osmyloidea, and Myrmeleontoidea occurring in Bursa, Turkey, according to their origin based on Popov and Letardi (2010).

Zoogeographical categories–Taxa	Number of species	Percentage
Holomediterranean	8	40
Mantispidae		
<i>Mantispa aphavexelte</i>		
<i>Mantispa styriaca</i>		
<i>Sagittalata perla</i>		
Osmylidae		
<i>Osmylus fulvicephalus</i>		
Myrmeleontidae		
<i>Distoleon tetragrammicus</i>		
<i>Megistopus flavicornis</i>		
<i>Myrmecaelurus trigrammus</i>		
<i>Palpares libelluloides</i>		
Pontomediterranean	10	50
Berothidae		
<i>Isoscelipteron fulvum</i> (Anatolian)		
Dilaridae		
<i>Dilar turcicus</i> (Anatolian)		
Myrmeleontidae		
<i>Creoleon plumbeus</i> (Anatolian)		
<i>Macronemurus bilineatus</i> (Balkan)		
<i>Nemoleon poecilopterus</i> (Anatolian)		
<i>Neuroleon assimilis</i> (Anatolian)		
Nemopteridae		
<i>Nemoptera sinuata</i> (Anatolian)		
Ascalaphidae		
<i>Deleproctophylla variegata</i> (Anatolian)		
<i>Libelloides lacteus</i> (Balkan)		
<i>Libelloides rhomboideus rhomboideus</i> (Anatolian)		
Siberian	1	5
Myrmeleontidae		
<i>Myrmeleon formicarius</i>		
Eremial	1	5
Myrmeleontidae		
<i>Cueta beieri</i>		

SUPERFAMILY MANTISPOIDEA

Family: Mantispidae

Mantispa aphavexelte Aspöck and Aspöck, 1994

Material examined: Gemlik; Hamidiye, 2 km W, 460 m, 25.VII.2006, 2 ♂, 2 ♀; 25.VII.2006, 1 ♂; Gürsu, Ericek, 500 m W, 715 m, 25.VII.2006, 1 ♀; İznik; central town, 7.5 km NE, 580 m, 29.VII.2004, 4 ♀; 18.VII.2007, 1 ♀; 5.VII.2008, 1 ♀; Hisardere, 2 km SE, 625 m, 11.VIII.2005, 1 ♀; 30.VII.2010, 1 ♀; **Mustafakemalpaşa;** Muradiyesarnıcı, Suuçtu waterfall vicinity, 415 m, 27.VII.2004, 1 ♂, 2 ♀; 16.VII.2011, 2 ♂, 2 ♀; Kayabaşı, 1 km SW, 160 m, 6.VII.2005, 5 ♂, 6 ♀; 4.VIII.2005, 2 ♂, 7 ♀; 22.VII.2008, 3 ♂, 2 ♀; 10.VIII.2010, 1 ♂, 1 ♀; **Nilüfer;** Kayapa inlet vicinity, 180 m, 19.VIII.2004, 1 ♂, 8.VII.2005, 2 ♂, 1 ♀; Kuruçeşme, 3 km NW, 380 m, 19.VIII.2004, 1 ♂; 12.VIII.2009, 1 ♀; **Orhangazi;** Hamzalı 2 km NE, 355 m, 18.V.2005, 1 ♂; **Osmangazi;** Hüseyinalan, 50 m W, 1005 m, 3.VIII.2004, 1 ♂; 26.VII.2007, 1 ♂.

All specimens were found on *Q. cerris*.*Mantispa styriaca* (Poda, 1761)

Material examined: Gemlik; Hamidiye, 2 km W, 460 m, 25.VII.2006, 1 ♂, 1 ♀, on *Q. cerris*; 15.VII.2007, 2 ♀, on *Q. cerris*; Gürsu; Ericek, 500 m E, 715 m, 18.VI.2005, 2 ♂, 1 ♀, on *Q. cerris*; 23.VI.2006, 1 ♂, on *Q. cerris*; 25.VII.2006, 1 ♂, 2 ♀, on *Q. cerris*; 8.VII.2009, 1 ♂, on *Q. cerris*; 30.VI.2010, 1 ♀, on *Q. cerris*; **İznik;** İhsaniye, 3 km W, 865 m, 7.VIII.2004, 1 ♀, on *Q. cerris*; **Kestel;** Şevketiye, 1 km S, 800 m, 27.VI.2004, 1 ♀, on wild pear; 14.VI.2008, 1 ♀, Alaçam, 100 m S, 1050 m, 3.VII.2004, 1 ♂, on *Q. cerris*; 24.VI.2011, 1 ♂; **Orhaneli;** Göktepe, 3 km NW, 725 m, 30.VI.2005, 1 ♂ on *Q. cerris*; 17.VI.2008, 1 ♂; **Orhangazi;** Kadı köyü, 500 m SW, 880 m, 30.VI.2005, 2 ♂, on *Q. cerris*; **Osmangazi;** Kirazlı, 875 m, 3.VIII.2004, 1 ♂, on *Q. cerris*; Bağlı, 1 km NE, 1100 m, 25.VI.2005, 1 ♂, on *Q. cerris*; 6.VII.2009, 1 ♂, on *Q. cerris*.

Sagittalata perla (Pallas, 1772)

Material examined: Gemlik; Hamidiye, 2 km W, 460 m, 25.VII.2006, 1 ♂, 1 ♀; 8.VII.2008, 1 ♀; Gürsu; Ericek, 500 m E, 715 m, 25.VII.2006, 2 ♀; 3.VII.2007, 1 ♂, 1 ♀; 31.VII.2010, 2 ♀; **İnegöl;** Çiftlikköy, 1 km W, 930 m, 27.VI.2005, 1 ♀; 12.VII.2011, 1 ♀.

All specimens were found on *Quercus cerris*.

Family: Berothidae

Isoscelipteron fulvum Costa, 1863

Material examined: **Büyükorhan;** central town, 300 m NE, 800 m, 22.VIII.2006, 1 ♀, on *Quercus cerris*; 10.VIII.2009, 1 ♀, on *Quercus cerris*; **Orhaneli;** Erenler, 6 km NE, 425 m, 21.V.2005, 1 ♀, on *Q. cerris*; 6.VI.2011, 1 ♀, on *Q. cerris*; Mahaller, 2 km E, 970 m, 3.VIII.2005, 1 ♂, on *Pinus nigra*; 28.VII.2007, 1 ♂, on *Pinus nigra*.

SUPERFAMILY OSMYLOIDEA

Family: Osmylidae

Osmylus fulvicephalus (Scopoli, 1763)

Material examined: Kestel; Alaçam, 100 m S, 1050 m, 6.VI.2004, 1 ♂, on *P. nigra*; 17.VI.2007, 1 ♂, on *P. nigra*; Alaçam, waterfall vicinity, 860 m, 12.VI.2004, 1 ♂, on *Prunus avium*; 26.VI.2010, 1 ♂, **Nilüfer;** Uludağ University, Görükle Campus, orchard, 60 m, 1.VI.2001, 1 ♀, on *Q. cerris*; 14.VI.2006, 1 ♀, on *Q. cerris*; 28.V.2010, 1 ♂, on *Q. cerris*.

Family: Dilaridae

Dilar turcicus Hagen, 1858

Material examined: Kestel; Şevketiye, 2 km N, 570 m, 10.VII.2004, 1 ♂; on *Pinus brutia*; 19.VII.2007, 1 ♂; on *Pinus nigra*; Alaçam, 1 km N, 775 m, 24.VII.2004, 2 ♂, on *Q. cerris*; 7.VII.2010, 1 ♂, on *Q. cerris*; **Osmangazi;** Soğukpınar-Ketenlik plateau, 6.VIII.2005, 1 ♂ on *Pinus nigra*; 30.VII.2008, 1 ♂ on *Pinus nigra*.

SUPERFAMILY MYRMELEONTOIDEA

Family: Myrmeleontidae

Creoleon plumbeus (Olivier, 1811)

Material examined: **Büyükorhan;** central town, 300 m NE, 800 m, 20.VIII.2004, 1 ♀; 30.VI.2005, 1 ♂; 3.VIII.2008, 1 ♀; 17.VI.2011, 1 ♂; **Mudanya;** Bademli vicinity, 185 m, 19.VIII.1992, 2 ♂; **Nilüfer;** Uludağ University, Görükle Campus, orchard, 60 m, 22.VI.2007, 1 ♂; **Orhaneli;** Sadağı canyon, 450 m, 20.VI.2004, 3 ♀; 30.VI.2005, 1 ♂; 12.VI.2008, 1 ♂; 25.VI.2010, 3 ♀; Mahaller, 2 km E, 970 m, 3.VIII.2005, 1 ♀; Kadı köyü, 500 m SW, 880 m, 23.VIII.2005, 1 ♀.

Cueta beieri Hölzel, 1969

Material examined: **Büyükorhan;** central town, 300 m NE, 800 m, 23.VIII.2005, 1 ♂; Balaban, 3 km N, 730 m, 22.VIII.2006, 1 ♂; 18.VIII.2009, 1 ♂; **Gemlik;** Hamidiye, 2 km W, 460 m, 25.VII.2006, 1 ♂; Gürsu; Ericek, 500 m E, 715 m, 25.VII.2006, 1 ♀; 2.VII.2007, 1 ♀; **Osmangazi;** Karaislah, 1 km N, 925 m, 16.VIII.2003, 1 ♀; Soğukpınar, 1 km NW, 1060 m, 16.VIII.2003, 1 ♂.

Distoleon tetragrammicus (Fabricius, 1798)

Material examined: **Büyükorhan;** central town, 300 m NE, 800 m, 30.VI.2005, 1 ♂; 11.VI.2010, 1 ♂; **İznik;** central town, 7.5 km NE, 580 m, 2.VII.2005, 1 ♀; 22.VI.2008, 1 ♀, 1 ♀; 8.VII.2009, 1 ♂; **Keles;** Kocayayla, 1200 m, 26.VII.2005, 1 ♀; **Kestel;** Alaçam, 100 m S, 1050 m, 10.VII.2004, 1 ♂; Alaçam, 970 m, 7.VIII.2004, 1 ♀; **Mudanya;** Bademli vicinity, 185 m, 19.VII.1992, 2 ♀; **Nilüfer;** Uludağ University, Görükle Campus, orchard, 60 m, 21.VI.2004, 1 ♀; 1.VII.2004, 1 ♂; **Orhaneli;** Erenler, 6 km NE, 425 m, 7.VI.2005, 1 ♂; **Osmangazi;** Gündoğdu, 2.5 km SW, 245 m, 11.VII.2000, 1 ♀; Soğukpınar, 1 km NW, 1060 m, 8.VII.201, 1 ♀; 1.VII.2004, 1 ♀; Kirazlı, 875 m, 10.VII.2003, 1 ♀; 19.VII.2003, 1 ♂, 6.VII.2007, 1 ♂.

***Macronemurus bilineatus* Brauer, 1868**

Material examined: Gürsu; Ericek, 500 m E, 715 m, 25.VII.2006, 1 ♂, 1 ♀; 16.VII.2008, 1 ♂, 1.VIII.2011, 1 ♀; **Harmancık**; 11 km NW, 1010 m, 3.VIII.2005, 1 ♀; **Nilüfer**; Hasanağa, 3.5 km SW, 240 m, 29.VI.2006, 1 ♂, 20.VI.2010, 2 ♂.

***Megistopus flavicornis* (Rossi, 1790)**

Material examined: **Nilüfer**; Uludağ University, Görükle Campus, orchard, 60 m, 9.VI.2004, 1 ♀.

***Myrmecaelurus trigrammus* (Pallas, 1771)**

Material examined: **Büyükorhan**; central town, 300 m NE, 800 m, 30.VI.2005, 3 ♂, 4 ♀; 24.VI.2006, 7 ♂, 1 ♀; 11.VI.2009, 2 ♂, 1 ♀; **Orhaneli**; Sadağı canyon, 450 m, 9.VII.2004, 2 ♂; 20.VIII.2004, 2 ♂, 1 ♀; 30.VI.2005, 1 ♀; **Celepler**, 2 km SW, 720 m, 24.VI.2006, 1 ♀; 5.VI.2010, 1 ♀; **Osmangazi**; Soğukpınar-Gölcük, 1200 m, 2.VIII.1997, 1 ♂; Soğukpınar, 1 km NW, 1060 m, 8.VII.2001, 1 ♂; **Karaislah**, 1 km N, 925 m, 19.VIII.2003, 1 ♀; 10.VIII.2007, 1 ♀.

***Myrmeleon formicarius* Linnaeus, 1767**

Material examined: **Keles**; Epçeler, 1 km E, 1180 m, 26.VII.2005, 1 ♂, **Kestel**; Alaçam, 100 m S, 1050 m, 12.VII.2005, 1 ♀. **Kestel**; Alaçam, 100 m S, 1050 m, 12.VII.2005, 1 ♀, 20.VII.2008, 1 ♀.

***Neuroleon assimilis* (Navás, 1915)**

Material examined: **Osmangazi**; Soğukpınar-Ketenlik plateau, 1430 m, 16.VIII.2003, 1 ♂; 6.VIII.2010, 1 ♀; **Karaislah**, 1 km N, 925 m, 26.VIII.2004, 1 ♀.

***Nemoleon poecilopterus* (Stein, 1863)**

Material examined: **Orhaneli**; Erenler, 500 m NE, 600 m, 2.VI.2004, 1 ♀; 8.VII.2011, 1 ♀; Mahaller, 2 km E, 970 m, 3.VIII.2005, 1 ♀.

***Palpares libelluloides* (Linnaeus, 1764)**

Material examined: **Gemlik**; Hamidiye, 2 km W, 460 m, 25.VII.2006, 1 ♀; **Karacabey**; Çarık, 1 km SW, 15 m, 19.VI.2004, 1 ♀; **Kestel**; Derekızık, 2 km N, 300 m, 13.VII.2003, 1 ♀; **Mustafakemalpaşa**; Kayabaşı, 1 km SW, 160 m, 6.VII.2005, 1 ♂, 2 ♀; 5.VII.2006, 3 ♂, 3 ♀; **Nilüfer**; Uludağ University, Görükle Campus, forest, 125 m, 18.VI.2001, 1 ♂, 1 ♀; 26.VI.2001, 1 ♀; **Hasanağa**, 3.5 km SW, 240 m, 29.VI.2006, 1 ♀; 16.VI.2008, 1 ♀; **Maksempınar**, 2 km SE, 390 m, 29.VI.2006, 1 ♀; **Osmangazi**; **Karaislah** 2 km W, 700 m, 20.VI.2006, 1 ♀; 26.VI.2009, 1 ♀.

Family: Ascalaphidae***Deleproctophylla variegata* (Klug, 1834)**

Material examined: **Nilüfer**; **Hasanağa**, 3.5 km SW, 240 m, 29.VI.2006, 7 ♂, 4 ♀; 14.VI.2007, 2 ♂, 1 ♀; 22.VI.2011, 1 ♂; **Orhaneli**; **Celepler**, 2 km SW, 720 m, 24.VI.2006, 1 ♀.

***Libelloides lacteus* (Brullé, 1832)**

Material examined: **İznik**; central town, 7.5 km NE, 580 m, 24.V.2005, 2 ♂, 3 ♀; 24.V.2006, 5 ♀; 21.V.2009, 2 ♀; **Hisardere**, 2 km SE, 625 m, 24.V.2006, 1 ♂; 10.V.2008, 1 ♂; **Osmangazi**; Soğukpınar, 1 km SE, 1000 m, 19.V.1995, 2 ♀;

Soğukpınar, 1 km NW, 1060 m, 13.V.2000, 2 ♂; 3.VI.2006, 1 ♀; 21.V.2009, 1 ♀; **Karaislah**, 1 km N, 925 m, 19.V.2004, 4 ♂, 5 ♀.

***Libelloides rhomboideus rhomboideus* (Schneider, 1845)**

Material examined: **Gemlik**; Hamidiye, 2 km W, 460 m, 23.VI.2006, 1 ♂, 3 ♀; **Harmancık**; central town, 11 km NW, 1010 m, 24.VI.2006, 1 ♂; **İznik**; central town, 7.5 km NE, 580 m, 2.VII.2005, 4 ♀; **Keles**; Kocayayla, 1200 m, 20.VI.2006, 1 ♂; Şevketiye, 2 km N, 570 m, 27.VI.2004, 1 ♂, 4 ♀; **Mustafakemalpaşa**; Kayabaşı, 1 km SW, 160 m, 7.VI.2006, 3 ♂, 8 ♀; **Doğanalan**, 2 km SW, 460 m, 16.VI.2006; 2 ♀; **Kazanpınar**, 1 km S, 460 m, 16.VI.2006, 1 ♀; **Körekem**, 1 km W, 480 m, 16.VI.2006, 1 ♀; 20.VI.2009, 1 ♀; **Nilüfer**; Uludağ University, Görükle Campus, forest, 125 m, 16.V.1997, 1 ♀; 22.V.2001, 1 ♀; 29.V.2003, 1 ♂; 11.VI.2003, 1 ♂; Uludağ University, Görükle Campus, orchard, 60 m, 22.V.2001, 1 ♂; **Maksempınar**, 2 km NE, 390 m, 6.VI.2006, 1 ♂, 1 ♀; **Hasanağa**, 3.5 km SW, 240 m, 15.VI.2006, 4 ♀; 29.VI.2006, 1 ♀; 20.VI.2009, 1 ♀; **Orhaneli**; Erenler, 500 m NE, 2.VI.2004, 1 ♂; 7.VI.2008, 1 ♂; **Osmangazi**; Soğukpınar, 1 km SE, 1000 m, 9.VI.1995, 1 ♂; Soğukpınar, 1 km NW, 1060 m, 31.V.1997, 1 ♂; Soğukpınar-Ketenlik plateau, 1430 m, 20.VI.2006, 1 ♂; **Karaislah**, 1 km N, 725 m, 20.VI.2006, 3 ♀.

Family: Nemopteridae***Nemoptera sinuata* Olivier, 1811**

Material examined: **Büyükorhan**; central town, 300 m NE, 800 m, 30.VI.2005, 2 ♂, 5 ♀; 24.VI.2006, 6 ♀; 21.VI.2008, 2 ♀, **Orhaneli**; Göktepe, 3 km NW, 725 m, 24.VI.2006, 5 ♀, 15.VI.2010, 1 ♂, 2 ♀.

4. Discussion

In this study, 345 neuropteran specimens of 20 species from 7 families were collected and identified. Of these, 13 species were new additions to the fauna of Bursa Province and 7 species were new additions to the fauna of northwestern Turkey. This study confirmed the presence of 7 species previously recorded by Hölzel (1972) in Bursa Province. These species were also reported on the map of the Neuroptera fauna of Turkey drawn by Aspöck et al. (1980). Four of the species previously recorded by these researchers were not found during this survey. The missing species were *Bubopsis andromache* Aspöck and Aspöck (Ascalaphidae), *Libelloides macaronius* Scopoli (Ascalaphidae), *Nedroledon anatolicus* Navás (Myrmeleontidae), and *Nemoptera coa* L. (Nemopteridae). With the addition of these species, the total number of species belonging to the superfamilies of Mantispoidea, Osmyloidea, and Myrmeleontoidea has reached 24 in Bursa, northwestern Turkey.

Mantispidae is one of the largest neuropteran families, with approximately 400 described species. Both larvae

and adults of *Mantispa* species are predacious. *Mantispa* larvae feed on spider eggs (Devetak et al., 2012), and adults can prey on other insects, especially flies, based on our observations.

Among the mantispids, *M. aphavexelte* and *M. styriaca* were widespread, whereas *S. perla* was rare in Bursa Province (Table 1). *M. styriaca* is also widely distributed in Turkey (Şengonca, 1979; Aspöck et al., 1980; Canbulat and Ozsarac, 2004; Canbulat and Kiyak, 2005). The other 2 mantispids were rare species in Turkey. *M. aphavexelte* has been previously reported only in Bitlis Province (Aspöck, 1996) and Antalya Province (Canbulat and Kiyak, 2005). Likewise, *S. perla* has been caught in small numbers in 6 provinces of Turkey, including Bursa Province (Şengonca, 1979, 1980; Aspöck et al., 1980; Canbulat and Kiyak, 2005).

Quercus cerris L. was recorded as a harboring plant for *M. styriaca*. Mantispid adults prefer to spend their time on Turkish oak trees, where they sit and wait to ambush their prey on hot, sunny days. Being an expansive Holomediterranean species, *M. styriaca* lives in warm coastal areas, as indicated by high numbers of captures in hot and humid areas of İznik Lake and the Marmara Sea.

Some Berothidae species such as *Isoscelipteron fulvum* Costa originated from Anatolia (Popov, 2002). Although this species was rarely found in Bursa Province, it is widely distributed in Turkey (Aspöck et al., 1980; Şengonca, 1980; Monserrat and Hölzel, 1987; Canbulat and Kiyak, 2005).

The superfamily Osmyloidea includes about 240 species worldwide (Gillott, 2005). *Osmylus fulvicephalus* is a rare species in Bursa Province, as in other parts of Turkey. Large adults were often found in woodlands near streams or cascades, where their semiaquatic or aquatic larvae live. *O. fulvicephalus* was previously recorded in İstanbul and Konya provinces (Aspöck et al., 1980) and in Southwest Turkey (Kaçirek 1998; Canbulat and Kiyak, 2005).

Dilaridae is a small family of the superfamily Osmyloidea (Winterton et al., 2010). *D. turcicus* adults were found in deciduous and coniferous forests in Bursa Province. Only adult males of this species were captured. Although *D. turcicus* is a Pontomediterranean element of Anatolian origin, it is a rare species in Bursa Province. This species has been also rarely found in Ankara, Antalya, Aydın, and İzmir provinces (Aspöck et al., 1980; Kiyak and Ozdikmen, 1993; Canbulat and Kiyak, 2005).

Among 7 neuropteran families examined in this study, Myrmeleontidae was the most representative family with 10 species. Of these, *D. tetragrammicus* and *M. trigrammus* were the most widespread and the most abundant antlion species in Bursa Province, respectively. In addition to these 2 common species, *C. plumbeus*, *M. bilineatus*, and *P. libelloides* are widely distributed in Turkey (Hölzel, 1972; Popov, 1977; Şengonca, 1979; Aspöck et al., 1980; Canbulat and Kiyak, 2002, 2005). *C. beieri* was not an

abundant species despite its presence at 6 localities in Bursa. This species has been reported in southern and southwestern Turkey in addition to İstanbul and Kayseri provinces (Hölzel, 1972; Popov, 1977; Aspöck et al., 1980; Canbulat and Kiyak, 2005).

Unlike crepuscular or nocturnal antlion species, *P. libelloides* adults were seen resting on tall grass during the daytime. This species is mostly diurnal, but a few adults were active and caught around sunset. If disturbed, they could easily be recognized by their slow and short flight. Adults mainly inhabited open and dry biotopes, which were characterized by scrub vegetation consisting of low trees, shrubs, and bushes.

The family Ascalaphidae contains about 400 owlfly species. Adult owlflies are mainly diurnal predators of other flying insects (Aspöck and Aspöck, 1999). They look like dragonflies, except for their long clubbed antennae. The most common and widespread owlfly taxon in Bursa Province was *L. rhomboideus rhomboideus*. This subspecies has also been commonly found in other parts of Turkey (Aspöck et al., 1980; Kaçirek, 1998; Canbulat and Kiyak, 2002, 2005). Popov (2004) previously recorded this subspecies at an altitude of 250 m. In this study, 1 specimen was captured in a deciduous fruit orchard at a minimum altitude of 60 m. In addition, other specimens were collected from varying altitudes of up to 1200 m.

Other owlfly species such as *L. lacteus* and *D. variegata* were rare or highly localized species in Bursa Province. The former is widespread in Turkey (Aspöck et al., 1980; Kiyak and Ozdikmen, 1993; Canbulat and Kiyak, 2005), while the latter has been found only in southern and southwestern Turkey (Aspöck et al., 1980; Kaçirek, 1998; Hava, 2000; Canbulat and Kiyak, 2005).

Neoptera sinuata Olivier was the only spoon-winged lacewing species living in the forests of Bursa Province. Large adults, which have characteristic long and slender hind wings, were captured on flowers during feeding on pollen and nectar. This species was rare despite its widespread distribution in Turkey (Şengonca, 1979, 1981; Aspöck et al., 1980; Kaçirek, 1998; Canbulat and Kiyak, 2005).

When the habitat altitudes of 19 neuropteran species were compared with those from Europe (Aspöck et al., 1980), the habitats of 6 species living in northwestern Turkey had higher maximum altitude values than did the same species in Europe, while 2 species had lower minimum altitude values (Table 1).

On the other hand, the upper limits of habitats in Bursa Province were lower for *M. aphavexelte*, *M. styriaca*, *I. fulvum*, *N. sinuata*, *P. libelloides*, *M. trigrammus*, *M. bilineatus*, *D. tetragrammicus*, *N. poecilopterus*, *C. plumbeus*, and *M. flavicornis* than those of the Near East and Anatolia based on the findings of Aspöck et al. (1980).

The altitudinal range of the habitat for *C. beieri* adults was not reported in Greece. Adults of this eremial species were collected between 460–1060 m in northwestern Turkey. With altitudinal ranges varying from 100 to 1310 m, there are wider opportunities for habitat choice by *C. beieri* in Southwest Turkey than in northwestern Turkey (Canbulat and Kiyak, 2005).

Cold-adapted or psychrophilic species such as *M. formicarius* only inhabit the mountains, whereas *C. beieri* prefers to live in the warm and dry habitats of Anatolia. Among all of the species, Pontomediterranean elements were dominant with 10 species, followed by the occurrence of 8 Holomediterranean species in northwestern Turkey. One of the Holomediterranean elements, *L. lacteus*, was categorized by Popov and Letardi

(2010) as Pontomediterranean. According to these results, all species except *M. formicarius* were elements of the Mediterranean zoogeographic subregion. Given that small families of the Turkish neuropteran fauna have not been extensively studied, taxonomic and faunistic studies at the regional level are needed to learn more about the ecology and biology of the present species, as well as to discover potential new species in the future.

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References

- Aistleitner E (1982). *Libelloides jungei* sp. n., eine neue Ascalaphide aus der Türkei (Neuroptera, Planipennia, Ascalaphidae). Entomofauna 3: 209–216 (in German).
- Aspöck H, Aspöck U (1969). Die Neuropteren Mitteleuropas. Ein Nachtrag zur Synopsis der Systematik, Ökologie und Biogeographie der Neuropteren Mitteleuropas. Naturkundliches Jahrbuch der Stadt Linz 1969: 17–70 (in German).
- Aspöck H, Aspöck U, Hölzel H (1980). Die Neuropteren Europas. Eine zusammenfassende Darstellung der Systematik, Ökologie und Chorologie der Neuropteroidea (Megaloptera, Raphidioptera, Planipennia) Europas. Krefeld: Goecke and Evers (in German).
- Aspöck H, Hölzel H (1996). The Neuropteroidea of North Africa, Mediterranean Asia and of Europe: a comparative review (Insecta). In: Canard M, Aspöck H, Mansell MW, editors. Pure and Applied Research in Neuropterology. Proceedings of the Fifth International Symposium on Neuropterology; 2–6 May 1994; Cairo, Egypt. Toulouse, France: Michel Canard, pp. 31–86.
- Aspöck H, Hölzel H, Aspöck U (2001). Kommentierter Katalog der Neuropterida (Raphidioptera, Megaloptera, Neuroptera) der Westpaläarktis. Denisia 2: 1–606 (in German).
- Aspöck U (1987). The Berothidae (Neuropteroidea: Planipennia) of the Middle East. In: Krupp F, Schneider W, Kinzelbach R, editors. Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East; 1985; Mainz, Germany. Beihefte zum Tobinger Atlas des Vorderen Orients. Wiesbaden, Germany: Reichert-Verlag, pp. 160–167.
- Aspöck U (1996). Die Mantispiden Europas (Neuropteroidea: Neuroptera: Mantispidae). In: Gerstmeier R., editor. Verhandlungen des 14. Internationalen Symposiums über Entomofaunistik in Mitteleuropa (SIEEC); 4–9 September 1994; München, Germany, pp. 224–230 (in German).
- (2010) as Pontomediterranean. According to these results, all species except *M. formicarius* were elements of the Mediterranean zoogeographic subregion. Given that small families of the Turkish neuropteran fauna have not been extensively studied, taxonomic and faunistic studies at the regional level are needed to learn more about the ecology and biology of the present species, as well as to discover potential new species in the future.
- Aspöck U, Aspöck H (1999). Kamelhäse, Schlammfliegen, Ameisenlöwen... Wer sind sie? (Insecta: Neuropterida: Raphidioptera, Megaloptera, Neuroptera). Stapfia 60: 1–34 (in German).
- Brauer F (1876). Die Neuropteren Europas und insbesondere Österreichs mit Rücksicht auf ihre geographische Verbreitung. In: Festschrift zur Feier des fünfundzwanzigjährigen Bestehens Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft, Vienna, Austria, pp. 263–300 (in German).
- Canbulat S (2002). Contributions to the knowledge of Turkish Neuroptera from Kayseri Province (Insecta: Neuroptera). Journal of the Institute of Science and Technology of Gazi University 15: 633–639.
- Canbulat S, Kiyak S (2002). A study on the Neuroptera fauna of Çanakkale Province (Insecta: Neuroptera). Journal of the Institute of Science and Technology of Gazi University 15: 413–418.
- Canbulat S, Kiyak S (2003). A new record of antlions for the Turkish fauna (Insecta, Neuroptera, Myrmeleontidae). J Ent Res Soc 5: 17–20.
- Canbulat S, Kiyak S (2005). Contribution of the fauna of Neuroptera (Insecta) of South-Western Anatolia. Annals of the Upper Silesian Museum (Entomology) 13: 9–60.
- Canbulat S, Ozsarac O (2004). Neuropterida (Insecta: Neuroptera, Raphidioptera) fauna of Cicekdagi (Kirsehir province). Journal of the Institute of Science and Technology of Gazi University 17: 1–9.
- Devetak D, Dobosz R, Jaskula R, Podlesnik J, Klokočovnik V (2012). First record of Mantispidae (Insecta: Neuroptera) from Albania. Acta Entomol Sloven 20: 153–156.
- Düzgüneş Z, Toros S, Kılınçer N, Kovancı B (1981). Ankara İlinde bulunan Aphidoidea türlerinin parazit ve predatörleri. Doga Bilim Derg Vet Hayv Tarım Orman 5: 221–233 (in Turkish).

- Engel MS, Grimaldi DA (2007). The neuropterid fauna of Dominican and Mexican amber (Neuropterida, Megaloptera, Neuroptera). *Am Mus Novit* 3587: 1–58.
- Gepp J (1974). Beitrag zur Kenntnis der Neuropteren der Türkei. *Entomol Ber* 34: 102–104 (in German).
- Gillott C (2005). *Entomology*. 3rd ed. Dordrecht, the Netherlands: Springer.
- Hava J (2000). The genus *Deleproctophylla* Lefebvre, 1842 (Insecta: Neuroptera Planipennia: Ascalaphidae) from the collection of the Department of Entomology National Museum, Praha. *Čas Nár Muz Ř Přírod* 169: 16.
- Hölzel H (1972). Die Neuropteren Vorderasiens IV. Myrmeleonidae. *Beitr nat kdl Forsch Südwestdtchl* 1: 3–103 (in German).
- Kaçırek A (1998). Beitrag zur Kenntnis der Familien Myrmeleontidae, Ascalaphidae und Nemopteridae (Neuroptera) der Türkei. *Klapalekiana* 34: 183–188 (in German).
- Kiyak S, Ozdikmen H (1993). Über Einige Neuropterenarten Von Soguksu Nationalpark (Kizilcahamam, Ankara). *Priamus* 6: 156–160 (in German).
- Kovanci B, Kovanci OB (2007). An annotated list of the green lacewings (Neuroptera: Chrysopidae) of Northwestern Turkey, with new records, their spatio-temporal distribution, and harbouring plants. *Entomol News* 118: 90–104.
- Monserrat VJ (2006). Nuevos datos sobre algunas especies de la familia Berothidae (Insecta: Neuroptera). *Heteropterus Rev Entomol* 6: 173–207 (in Spanish).
- Monserrat VJ, Hölzel H (1987). Contribucion al conocimiento de los neuropteros de Anatolia (Neu. Planipennia). *Rev Esp Entomol* 63: 133–142 (in Spanish).
- Popov A (1977). Wissenschaftliches Ergebnis der zoologischen Expedition des Nationalmuseums in Prag nach der Türkei. Raphidioptera, Neuroptera and Mecoptera. *Acta Entomol Mus Nat Pragae* 39: 271–277 (in German).
- Popov A (2004). The Ascalaphidae (Neuroptera) of the Balkan Peninsula. *Denisia* 13: 229–237.
- Popov A, Letardi A (2010). Comparative zoogeographical analysis of Neuropterida of the Apennine and Balkan peninsulas. In: Devetak D, Lipovšek S, Arnett AE, editors. *Proceedings of the Tenth International Symposium on Neuropterology*; 22–25 June 2008; Piran, Slovenia. Maribor, Slovenia: University of Maribor, pp. 239–256.
- Şengonca Ç (1978). *Berothera fulva* (Costa 1855) - neu für die Türkei (Planipennia, Berothidae). *Turk Bit Kor Derg* 2: 103–106 (in German).
- Şengonca Ç (1979). Beitrag zur Neuropterenfauna der Türkei. *Nachr bl Bayer Entomol* 28: 10–15 (in German).
- Şengonca Ç (1980). Türkiye Mantispidae (Insecta: Neuroptera) faunası üzerinde sistematik ve taksonomik araştırmalar. *TÜBİTAK VII. Bilim Kongresi TBAG Biyoloji Seksiyonu* 545: 457–473 (in Turkish).
- Şengonca Ç (1981). Türkiye Nemopteridae (Insecta: Neuroptera) faunası üzerine taksonomik araştırmalar II. Faunistik. *Turk Bit Kor Derg* 5: 101–114 (in Turkish).
- Winterton SL, Hardy NB, Wiegmann BM (2010). On wings of lace: phylogeny and Bayesian divergence time estimates of Neuropterida (Insecta) based on morphological and molecular data. *System Ent* 35: 349–378.