



Ecological distribution and seasonality of Chrysopids (Neuroptera: Chrysopidae) in the east Mediterranean Region of Turkey

Türkiye'nin Doğu Akdenizi'nde Chrysopid'lerin (Neuroptera: Chrysopidae) ekolojik dağılımı ve mevsimselliği

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Abstract

This study was conducted to establish Chrysopidae fauna and assess habitat preferences and diversity of species in the East Mediterranean Region of Turkey. The specific family (Neuroptera: Chrysopidae) in this region is poorly known and this survey. Traps (sweeping net, light traps) were used to catch of Chrysopidae species from all study sites at the four provinces (Adana, Hatay, Mersin, Osmaniye) in the East Mediterranean Region of Turkey between the years 2012 and 2013. The most abundant species were *Nineta flava* (Scopoli, 1763). From all sites a total of 1841 Neuroptera were trapped, representing 18 species. All the species were found in all sites while species *Chrysopa dorsalis* Burmeister, 1839, *Chrysopa viridana* Schneider, 1845, *Chrysopa astarte* Hölzel, 1967 were confined to 3 sites. All the species reached peak abundance respectively in the June and July. The appearance and distribution of the Chrysopidae species were strongly linked with seasonal changes.

Özet

Bu çalışma; Türkiye'nin Doğu Akdeniz Bölgesindeki Chrysopid'lerin fauna, habitat tercihleri ve tür çeşitliliğini değerlendirmek amacıyla yürütülmüştür. Familya (Neuroptera: Chrysopidae) bu bölgede çok az bilinmektedir ve familya ile ilgili çalışma da çok az gerçekleştirilmiştir. Chrysopidae türlerini yakalamak için Türkiye'nin Doğu Akdeniz Bölgesinde 2012-2013 yılları arasında, dört şehirde (Adana, Hatay, Mersin, Osmaniye) atrap ve ışık tuzakları kullanılmıştır. En yaygın tür, *Nineta flava* (Scopoli, 1763) olarak tespit edilmiştir. Dört sahadan 18 türle temsil edilen toplam 1841 Neuroptera örneği toplanmıştır. *Chrysopa dorsalis* Burmeister, 1839, *Chrysopa viridana* Schneider, 1845 ve *Chrysopa Astarte* Hölzel, 1967 3 bölge ile sınırlıyken, diğer tüm türlere, çalışılan her bölgede saptanmıştır. Tüm türler sırasıyla Haziran ve Temmuz aylarında en yüksek bolluk değerine ulaşmıştır. Chrysopidae türlerinin doğada gözlenişi ve dağılımı mevsimsel değişikliklerle çok az ilgilidir.

INTRODUCTION

The family Chrysopidae is a cosmopolitan family of Neuroptera with over 1500 species currently recognized. They are of particular interest to applied entomologists because the predaceous larvae of some species have been used successfully in the biological control of certain homopterous pests. Larvae of chrysopids are known to feed on a wide variety of small, soft-bodied insects, spiders and mites, as well as on eggs and small larvae of a number of lepidopteran insects. Members of the family has been used in biological and integrated control mainly of field crop pests, and augmentation programmes (Mc Ewen et al. 2001; Özcan 2008; Makarkin and Archibald 2013).

Based on its geographical structure, the East Mediterranean Area divides into three provinces (Adana, Osmaniye, Hatay and Mersin). The climate of study area is very favourable for its flora and fauna. The greatest number of flora and fauna elements are found in this area (Akman 1973). The provinces of Adana, Osmaniye and Hatay belong to the Mediterranean subregion, and have a particular assorted vegetation. This area is of special interest, being one of the warmest of all Turkey. This area is the most exciting one in every respect of entomological research work (Avgin and Colonnelli 2011). This region has an excellent position due to the above mentioned reasons. Only few data (Aspöck and Aspöck 1969; Gepp 1974; Popov 1977; Şengonca 1979; 1980;

1981) are known on the Chrysopidae fauna of East Mediterranean Area of Turkey.

The present study conduct to determine Ecological Distribution and Seasonality of Chrysopids (Neuroptera: Chrysopidae) in the East Mediterranean Region of Turkey.

MATERIAL and METHODS

Study Location

The study was carried out in Adana, Osmaniye, Hatay and Mersin provinces in the East Mediterranean of Turkey. The climate varies from Mediterranean in the southeast to terrestrial towards the North. During the survey, collecting localities were chosen in the ecological-geographical area of Chrysopidae so as to belong proportionately to all types of habitat.

Sampling methodology

Light traps were checked weekly. Each week the Chrysopidae's removed and counted. In the species identification process, not only outer morphology also, the male and female genitalia has been used. When preparing genital preparations, primarily, dry samples were softened by waiting one day in the softening containers. After softening process occurs, for the genital preparations, the abdomen was cut carefully with a scalpel under the stereo-microscope. The cut abdomen was taken to 10% KOH solution and kept about 24 hours at the room temperature. The abdomen held KOH was washed twice with water after cleaning of internal organs. Washed Genital was taken up to the 70% alcohol and expected a few hours for the withdraw water. Afterwards preparations were analyzed under the stereo-microscope is made available drawing apparatus. Several literatures were used for the diagnosis of samples (Aspöck et al. 1980; Hölzel 1967; Şengonca 1980).

RESULTS

In this study, we compared the Chrysopidae family species diversity especially the abundance, seasonality and distribution in 4 sites (Adana, Hatay, Osmaniye, Mersin Provinces and their Boroughs). During 2012-2013.

A total of 1841 samples (18 species) belong to Chrysopidae family were captured. *Nineta flava* (Scopoli, 1763) were observed as the most dominant in terms of their density during survey period. *Chrysopa formosa* Brauer, 1850 were observed as the least. The total number, dominance and percent of distribution of Chrysopidae are presented in Table 1. The study area has a Mediterranean climate. Average temperature observed (min.) 12.6°C, (max.) 30.1°C during the survey (Figure 1). The total number of Chrysopidae species at four different study sites are presented in Tables (2, 3, 4, 5).

Site I (Adana Province): 519 individuals were collected from Site I by using sweeping net and light traps. The most abundant species were identified of the family Chrysopidae, represented by 149 samples from the Imamoğlu Borough. *Dichochrysa prasina* (Burmeister, 1839) with the number of 57 samples was observed as the most dominant in terms of their density and seasonal occurrence during the survey in Adana Province (Site 1). *Chrysopa dorsalis* Burmeister, 1839, *Chrysoperla carnea* (Stephens 1836), *Italoichrysa italica* (Rossi, 1790), *Chrysopa perla* (Linnaeus 1758) were observed as the second dominant species in terms of their density and seasonal occurrence. This five species is found to be associated with the plant species *Alyssum dasycarpum* Steph., *Cakile maritima*, *Pinus halepensis*, *Cupressus sempervirens*.

Site II (Hatay Province): Total 772 specimens were collected from Site II. Reyhanlı was chosen the most abundant borough with 218 samples, belong to 13 species of Chrysopidae. Respectively; *Nineta flava* (Scopoli, 1763), *Dichochrysa clathrata* (Schneider 1845), *Chrysopa perla* (Linnaeus 1758) species were found to be dominant at Site II in terms of their numbers and seasonal occurrence during survey. *Chrysopa dorsalis* Burmeister, 1839, *Dichochrysa flavifrons* (Brauer 1850), *Chrysopa hungarica* Klapalek, 1899, *Chrysopa septempunctata* Wesmael, 1841 species were observed infrequently at this site during the same period.

Site III (Mersin Province): A total number of 297 specimens were collected from Site III in pitfall traps that include 17 species of Chrysopidae.

Site IV (Osmaniye Province): Totally, 253 specimens were collected from Site IV iby using traps during the study period from March 2012 to September 2013. *Chrysopa dorsalis* Burmeister, 1839, *Chrysopa viridana* Schneider, 1845 were not found during the entire study period in the Site IV. Also, Osmaniye Province has a least number of samples (253 samples) all the survey sites (I, II, III).

Diversity and abundance in Site II was found to be higher compared to the rest of the studied sites. The number of Chrysopidae trapped was low in the months of September and March.

Table 1 Total number, dominance and percent of distribution of Chrysopidae Family % Distribution

Species No	Species	Total number of specimens	Specimen number of Site I	Specimen number of Site II	Specimen number of Site III	Specimen number of Site IV	Dominance (%)
1	<i>Chrysopa dorsalis</i> Burmeister, 1839	58	34	16	8	0	3,1
2	<i>Chrysopa formosa</i> Brauer, 1850	54	3	41	3	7	2,93
3	<i>Chrysopa perla</i> (Linnaeus, 1758)	111	35	65	8	3	6.02
4	<i>Chrysopa viridana</i> Schneider, 1845	81	28	23	30	0	4.39
5	<i>Chrysoperla carnea</i> (Stephens, 1836)	128	34	69	10	15	6.95
6	<i>Dichochrysa flavifrons</i> (Brauer, 1850)	90	50	18	11	11	4.8
7	<i>Dichochrysa prasina</i> (Burmeister, 1839)	99	57	22	16	4	5.3
8	<i>Italochrysa italica</i> (Rossi, 1790)	129	34	50	3	42	7.0
9	<i>Nineta flava</i> (Scopoli, 1763)	165	31	102	10	22	8.96
10	<i>Chrysopa commata</i> Kis ve Ujhelyi, 1841	85	25	32	13	15	4.61
11	<i>Chrysopa hungarica</i> Klapalek, 1899	121	30	19	31	41	6.57
12	<i>Chrysopa astarte</i> Hölzel, 1967	64	14	44	0	6	3.47
13	<i>Chrysopa septempunctata</i> Wesmael, 1841	82	9	8	50	15	4.45
14	<i>Rexa raddai</i> (Hölzel, 1966)	140	30	51	40	19	7.60
15	<i>Dichochrysa zelleri</i> (Schneider, 1851)	108	24	45	17	22	5.86
16	<i>Peyerimhoffina gracilis</i> (Schneider, 1851)	76	28	30	15	3	4.12
17	<i>Chrysopidia (Chrysotropia) ciliata</i> (Wesmael, 1841)	131	32	60	23	16	7.11
18	<i>Dichochrysa clathrata</i> (Schneider, 1845)	119	21	77	9	12	6.46

*Dominance = specimens abundance/total number of Chrysopidae specimens (1841) x 100.

%Distribution= specimens abundance per site/specimens abundance x100

Table 2 Site 1. Adana

Borough(s)	of	Sex of collected species
Adana		
Ceyhan		Sp.No:4; 1♂,3♀; Sp.No:7;3♂,1♀; Sp.No:11;1♂,5♀; Sp.No:14; 5♂,9♀; Sp.No:3; 1♂,2♀; Sp.No:9; 7♂,4♀; Sp.No:10; 2♂,2♀; Sp.No:8; 4♂,1 ♀; Sp.No:1; 3♂,3 ♀; Sp.No:13; 7♂,2♀; Sp.No:17; 5♂,1 ♀
Feke		Sp.No:5; 1♂,5 ♀; Sp.No:6; 1♂,2 ♀; Sp.No:12; 1♂,2 ♀; Sp.No:10; 1♂,2 ♀; Sp.No:8; 1♂,2 ♀; Sp.No:17; 1♂,2 ♀; Sp.No:7; 1♂,2 ♀; Sp.No:4; 3♂,3 ♀; Sp.No:2; 1♂,2 ♀
İmamoğlu		Sp.No:1; 10♂,12 ♀; Sp.No:5; 6♂,12 ♀; S.No:10; 1♂,2 ♀; Sp.No:11; 1♂, 2 ♀; Sp.No:14; 13♂,3 ♀; Sp.No:3; 1♂,2 ♀; Sp.No:9; 12♂,2 ♀; Sp.No:7; 11♂,21 ♀; Sp.No:18; 2♂,9 ♀; Sp.No:6; 18♂,9 ♀
Karaisalı		Sp.No:6; 2♂,2 ♀; Sp.No:11; 1♂,5 ♀; Sp.No:3; 14♂,2 ♀; Sp.No:17; 2♂,4 ♀; Sp.No:8; 1♂,5 ♀; Sp.No:15; 13♂,6 ♀; Sp.No:16; 4♂,4 ♀
Pozantı		Sp.No:1; 4♂,2 ♀; Sp.No:5; 3♂,2 ♀; Sp.No:3; 7♂,6 ♀; Sp.No:4; 2♂,3 ♀; Sp.No:7; 3♂,3 ♀; Sp.No:8; 10♂,3 ♀; Sp.No:16; 7♂,8 ♀
Saimbeyli		Sp.No:7; 4♂,2 ♀; Sp.No:18; 3♂,3 ♀; Sp.No:6;5♂,6 ♀; Sp.No:9; 3♂,3 ♀; Sp.No:11; 5♂,4 ♀; Sp.No:12; 5♂,6 ♀
Seyhan		Sp.No:7; 4♂,2 ♀; Sp.No:10; 4♂,2 ♀; Sp.No:11; 5♂,2 ♀; Sp.No:15; 2♂,3 ♀; Sp.No:16; 1♂,4 ♀; Sp.No:17; 6♂,2 ♀; Sp.No:18; 2♂,2 ♀
Tufanbeyli		Sp.No:4; 8♂,5 ♀; Sp.No:5; 3♂,2 ♀; Sp.No:6; 4♂,2 ♀; Sp.No:8; 5♂,2 ♀; Sp.No:10; 4♂,5 ♀; Sp.No:17; 4♂,5 ♀;

Table 3 Site 2. Hatay

Borough(s)	of	Sex of collected species
Hatay		
Altınözü		Sp.No:2; 16♂,7♀; Sp.No:5; 14♂,5♀; Sp.No:9;11♂,22 ♀; Sp.No:10;4♂,3 ♀; Sp.No:12;6♂, 6♀; Sp.No:13; 3♂,3♀; Sp.No:15; 5♂,9♀; Sp.No:17; 8♂,11 ♀; Sp.No:18; 5♂,11♀
Belen		Sp.No:3; 4♂,6♀; Sp.No:7;1♂,7♀; Sp.No:8;4♂,10♀; Sp.No:11; 3♂,3♀; Sp.No:12;3♂,1♀; Sp.No:14; 13♂,7♀; Sp.No:15; 9♂,3♀; Sp.No:16; 5♂,5♀; Sp.No:17; 5♂,3 ♀; Sp.No:18; 3♂,4 ♀
Dörtyol		Sp.No:1;1♂,6♀; Sp.No:2;4♂,4♀; Sp.No:5;5♂,6♀; Sp.No:6;5♂,8♀; Sp.No:10; 4♂,12♀; Sp.No:14; 11♂,7♀
Erzin		Sp.No:1; 1♂,3 ♀; Sp.No:3; 4♂,2 ♀; Sp.No:9; 10♂,10 ♀; Sp.No:10; 5♂,2 ♀; Sp.No:12; 1♂,6 ♀; Sp.No:17; 1♂,2 ♀; Sp.No:18; 3♂,7 ♀
Hassa		Sp.No:3; 3♂,2 ♀; Sp.No:7;4♂,3 ♀; Sp.No:9; 2♂,5 ♀; Sp.No:15; 4♂,3 ♀; Sp.No:16; 5♂,2 ♀; Sp.No:18; 11♂,2 ♀
İskenderun		Sp.No:2; 3♂,5 ♀; Sp.No:3; 1♂,4 ♀; Sp.No:4;1♂,2♀; Sp.5;3♂,2♀; Sp.8; 3♂3♀; Sp.No:14; 9♂,2 ♀; Sp.No:17; 10♂,5 ♀
Kırıkhan		Sp.No:1;1♂,5 ♀; Sp.No:2;1♂,2 ♀; Sp.No:3; 4♂,2 ♀; Sp.No:4; 5♂,2 ♀; Sp.No:5; 1♂,6 ♀; Sp.No:6; 1♂,5 ♀; Sp.No:7; 1♂,7 ♀; Sp.No:8; 4♂,7 ♀; Sp.No:9; 11♂,2 ♀; Sp.No:10; 1♂,2 ♀; Sp.No:12; 1♂,2 ♀; Sp.No:16; 1♂,2 ♀
Reyhanlı		Sp.No:3;10♂,24♀; Sp.No:4;12♂,2♀; Sp.No:5;16♂,12♀; Sp.No:8;8♂,12♀; Sp.No:9;10♂,20 ♀; Sp.No:11; 6♂,8 ♀; Sp.No:12; 8♂,11 ♀; Sp.No:13; 1♂,2 ♀; Sp.No:14; 1♂,2 ♀; Sp.No:15; 1♂,2 ♀; Sp.No:16; 5♂,6 ♀; Sp.No:17; 9♂,7 ♀; Sp.No:18; 11♂,12♀

Table 4 Site3.Mersin

Borough(s)	of	Sex of collected species
Mersin		
Aydıncık		Sp.No:1; 2♂,2♀; Sp.No:4; 4♂,2♀; Sp.No:6; 4♂,4♀; Sp.No:11; 11♂,12♀; Sp.No:13; 3♂,4♀
Bozyazı		Sp.No:15; 11♂,4♀; Sp.No:16; 7♂,5 ♀; Sp.No:17; 6♂,6 ♀
Çamlıyayla		Sp.No:3;3♂,2♀; Sp.No:4; 5♂,7 ♀
Erdemli		Sp.No:1; 2♂,2♀; Sp.No:4; 5♂,2♀; Sp.No:5;1♂,2♀; Sp.No:7; 3♂,2 ♀; Sp.No:10; 1♂,2 ♀; Sp.No:13; 4♂,2 ♀; Sp.No:14; 7♂,2 ♀; Sp.No:17; 5♂,2 ♀; Sp.No:18; 5♂,4 ♀
Gülнар		Sp.No:3; 1♂,2 ♀; Sp.No:13; 11♂,12 ♀; Sp.No:14; 4♂,2♀
Mut		Sp.No:2; 1♂,2 ♀; Sp.No:4; 3♂,2 ♀; Sp.No:7; 9♂,2♀; Sp.No:8; 1♂,2♀; Sp.No:13; 2♂,2♀; Sp.No:14; 1♂,2 ♀; Sp.No:16; 1♂,2♀; Sp.No:17; 1♂,4 ♀
Silifke		Sp.No:5;5♂,2 ♀; Sp.No:6;1♂,2♀; Sp.No:9; 8♂,2 ♀; Sp.No:11; 1♂,2 ♀; Sp.No:14; 3♂,22 ♀; Sp.No:15; 1♂,2♀
Tarsus		Sp.No:10; 1♂,9 ♀; Sp.No:11; 1♂,5 ♀; Sp.No:13; 2♂,2 ♀

Table 5 Site 4. Osmaniye

Borough(s) of Osmaniye	Sex of collected species
Bahçe	Sp.No:9; 1♂,2♀; Sp.No:10; 2♂,2♀; Sp.No:13; 2♂,2♀; Sp.No:14; 1♂,2♀; Sp.No:15; 5♂,2♀; Sp.No:17; 1♂,3♀; Sp.No:18; 1♂,5 ♀
Düziçi	Sp.No:2; 4♂,4♀; Sp.No:5; 3♂,11♀; Sp.No:8; 9♂,12♀; Sp.No:10; 10♂,1♀; Sp.No:11; 1♂,2♀; Sp.No:16; 1♂,2♀; Sp.No:17; 1♂,2♀; Sp.No:18; 4♂,2♀
Sumbas	Sp.No:3; 1♂,2♀; Sp.No:14; 10♂,6♀
Toprakkale	Sp.No:6; 5♂,2♀; Sp.No:8;10♂,12♀; Sp.No:11; 5♂,5♀; Sp.No:12; 4♂,2♀; Sp.No:15; 7♂,9♀
Kadirli	Sp.No:5; 1♂,2♀; Sp.No:6; 1♂,4♀; Sp.No:7; 2♂,2♀; Sp.No:8; 1♂,2♀; Sp.No:9; 11♂,12♀; Sp.No:10; 1♂,2♀; Sp.No:11; 11♂,12 ♀
Hasanbeyli	Sp.No:13; 6♂,5 ♀; Sp.No:17; 4♂,5♀

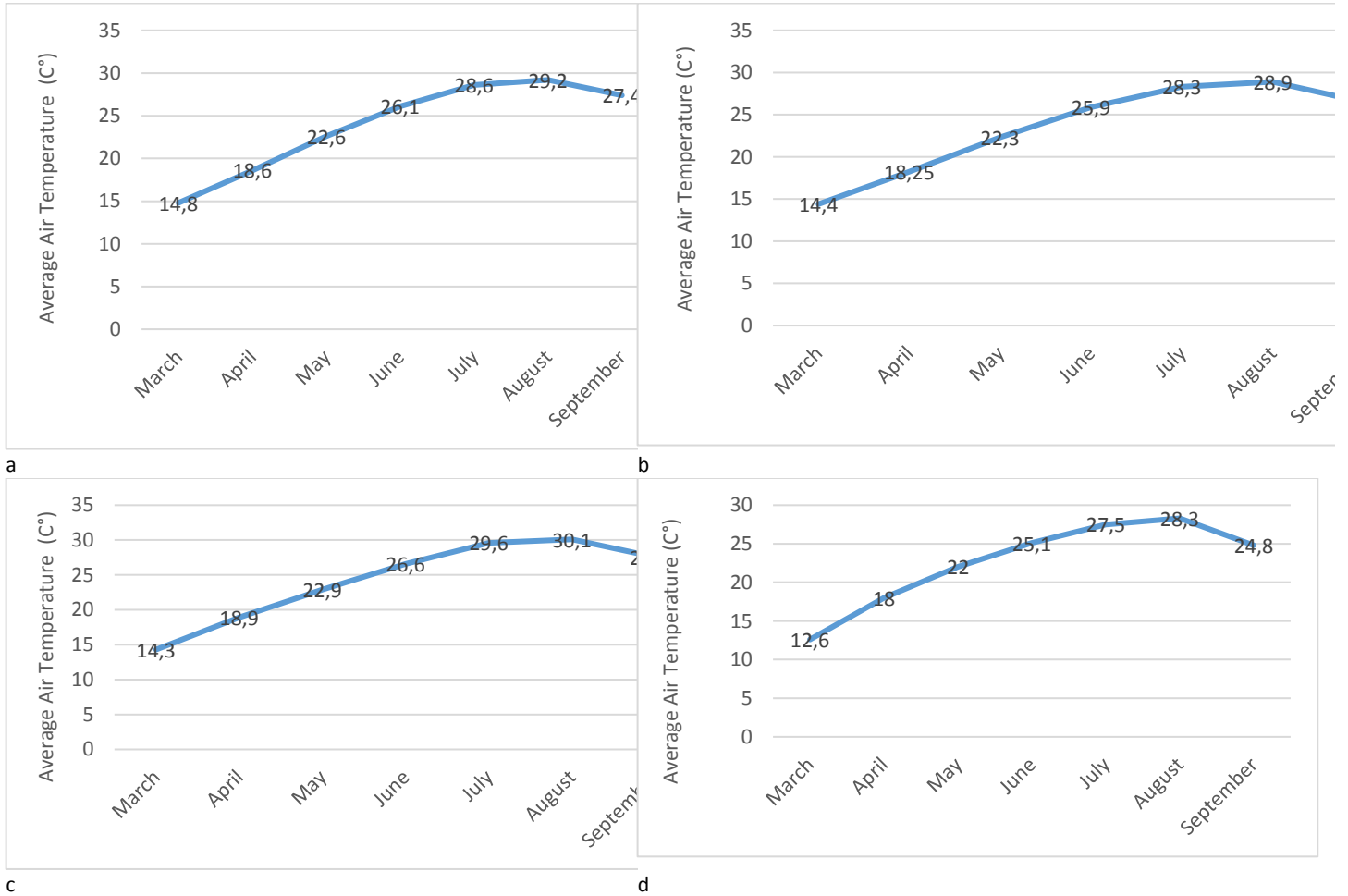


Figure 1 Monthly average recorded temperatures in Adana (a), Hatay (b), Mersin (c) and Osmaniye (d) from March 2012 to September 2013

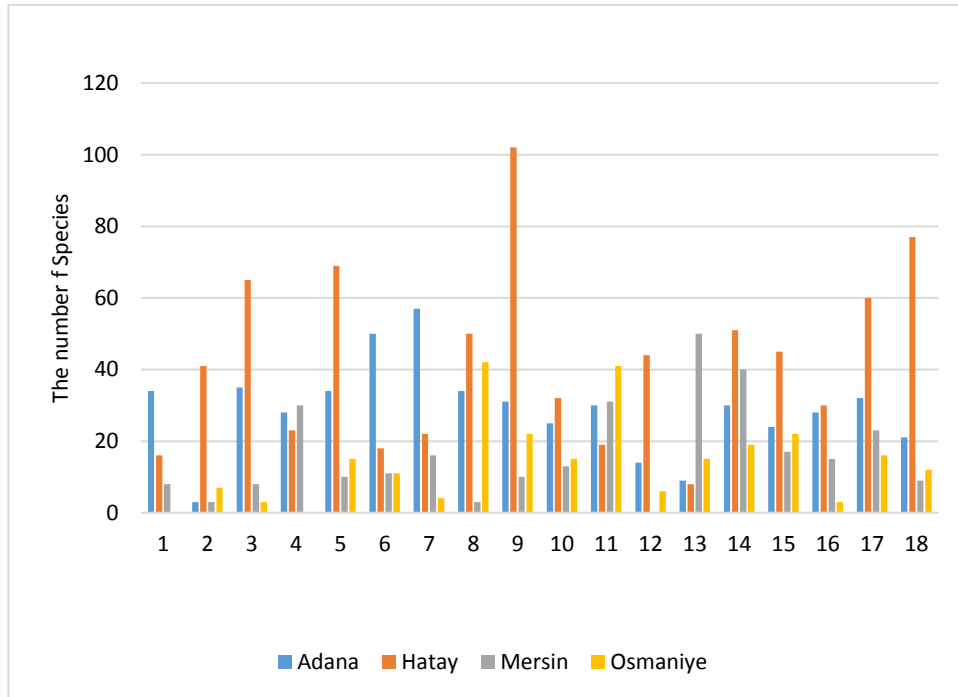


Figure 2 The distribution of species in (Provinces) from March 2012 to September 2013

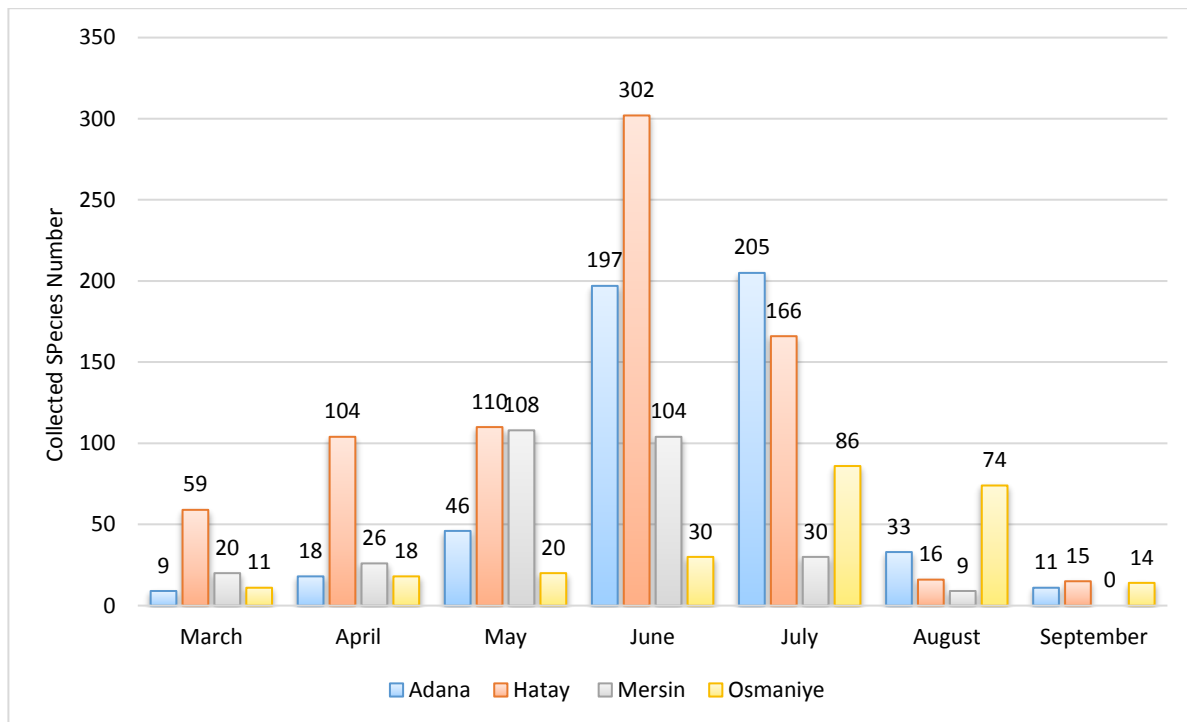


Figure 3. Seasonal abundance of Chrysopidae species from March 2012 to September 2013

DISCUSSION

Climatic conditions in the East Mediterranean Area of Turkey (Adana, Hatay, Osmaniye, Mersin) were extremely cloudy throughout of the year. Chrysopid's avoid sunny weather in various ways such as sheltering on the leaves. Some of the species observed in the sites and hence this

habitats can be considered important in connection with the biological warfare, release and conservation in future. For example; *Ch. formosa* and *Ch. carnea* has been used in so many agricultural areas as predator insects. Considering that dominant species have the potential to be used in biological control programs.

Throughout the study, *Nineta flava* (Scopoli 1763), has been seen in the all sites. Also, the species number of *Chrysopa dorsalis* Burmeister, 1839, *Dichochrysa flavifrons* (Brauer 1850), *Dichochrysa prasina* (Burmeister, 1839) and *Chrysopa commata* Kis ve Ujhelyi, 1841 in the Site 1,2, has been found higher than Site 3,4.

Imamoğlu, Reyhanlı, Erdemli and Düziçi boroughs has a habitat including so many plant diversity (Fagaceae, Ericaceae, Pinaceae, Compositae, Brassicaceae and other broad-leaved trees. On the other hand; Feke, Hassa, Tarsus and Sumbas; has scarce plant flora including a few annual plants. We can conclude that there is an important relationship between the flora of site(s) and Chrysopidae species.

Öztürk et al (2009) stated that, *Scymnus pallipediformis* Günther, *S. rubromaculatus* (Goeze) and *S. quadriguttatus* Fürsch&Kreissl (Coleoptera: Coccinellidae) with *Crysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) species are determined as predators of *A. granati* in the field studies.

Hazır and Ulusoy have been recorded in their study titled Pest, parasitoid and predator species determined in peach and nectarine orchards in Adana and Mersin provinces *Ch. carnea*.

Satar et al. (2017) stated that *C. carnea* is particularly effective to suppress the Aphididae populations.

The study of Chrysopidae's seasonal fluctuations indicated a positive correlation between abundance and seasonal distribution. In July the number of samples were found as maximum. In support of this, Mc Ewen et al. (2001) stated that Chrysopidae's has a large of abundant in Jun and July substantially higher in March and April. Average 25-26°C temperature may give these species a suitable dwelling.

East Mediterranean Area flora were identified with over 100 families, more than 400 genera and approximately 800 species (Akman 1973). Turkey flora comprises about 850 genera. It comprises approximately half of those plant genus in Turkey. Compared with Turkey flora

floristic composition of these features are seen to be quite interesting (Davis 1965; Davis 1988).

Therefore, in implementing suchlike studies, it is imperative to define the survey area in a geographically meaningful manner. It will not only simplify inter-study comparison, but will also increase the precision of development efforts.

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