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Orijinal araştırma (Original article)

Contributions on the current knowledge of the diversity of the Megachilidae (Apoidea: Hymenoptera) fauna in the Mediterranean Region of Turkey[1]

Türkiye'nin Akdeniz Bölgesi'ndeki Megachilidae faunası çeşitliliğindeki mevcut bilgilere katkılar

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Summary

The faunal composition and the floral visitation patterns of Megachilidae (Apoidea: Hymenoptera) species in the Mediterranean region of southern Turkey were investigated. Field studies were performed at spring and summer seasons of 2008 and 2009. The study was conducted in fourteen provinces. Four hundred-nine bee specimens were captured from 17 genera and 74 species. Seventy-one plant species were found related with these bees. Sampling date and elevation data were also evaluated to figure out the seasonal activity and altitude choice of bees. *Anthidiellum crassepunctatum* (Popov, 1935) and *Megachile lefebvrei* Lepeletier, 1841 were new records for Turkey. *Coelioxys acanthura* (Illiger, 1806), *M. deceptoria* Perez 1890, *M. pilicrus* Morawitz 1877, *M. willughbiella* (Kirby, 1802) and *Rhodanthidium exsectum* (Pasteels, 1969) were new records for the Mediterranean Turkey.

Keywords: Megachilidae, diversity, new record, plant association, Mediterranean, Turkey

Özet

Türkiye'nin Akdeniz Bölgesindeki Megachilidae (Apoidea: Hymenoptera) türlerinin faunal bileşenleri ve bunların flora ile ilişkileri araştırılmıştır. Arazi çalışmaları, 2008 ve 2009 yıllarının ilkbahar ve yaz sezonunda 14 ilde yürütülmüştür. Onyedi cins ve 74 türe ait 409 arı örneği yakalanmıştır. Yetmişbir bitki türünün bu arılar ile ilişkili olduğu tespit edilmiştir. Arıların mevsimsel aktiviteleri ve yükselti tercihlerini belirlemek için, örnekleme tarihleri ve yükselti verileri de değerlendirmeye alınmıştır. *Anthidiellum crassepunctatum* (Popov, 1935) ve *Megachile lefebvrei* Lepeletier, 1841 Türkiye için, *Coelioxys acanthura* (Illiger, 1806), *M. deceptoria* Perez 1890, *M. pilicrus* Morawitz 1877, *M. willughbiella* (Kirby, 1802) ve *Rhodanthidium exsectum* (Pasteels, 1969) ise Akdeniz Bölgesi için yeni kayıttır.

Anahtar sözcükler: Megachilidae, çeşitlilik, yeni kayıt, bitki ilişkileri, Akdeniz, Türkiye

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Introduction

Bees (Apiformes: Apoidea: Hymenoptera) are known as the most important pollinators of angiosperms. They visit plants for collecting pollen or nectar to provide protein and other nutrients for their progeny (Michener, 2007). Nearly all the bee species, which belong to the seven different families, were involved in this service (Michener, 2007). Megachilidae (leafcutter bees, mason bees, resin bees and carder bees) is one of the most important one throughout these families with its unique pollen collecting adaptation which the scopa (the pollen collecting hairs) of female is located on the ventral side of the metasoma (Banaszak & Romasenko, 1998).

Traditionally, Mediterranean region is characterized by its high plant diversity in the World (Thompson, 2005). Moreover it is one of the most attractive landscapes of the World because of its biological, cultural and geological importance (Blondel et al., 2010). This territory covers the Mediterranean coastal zones of Turkey (Mediterranean Anatolia), Israel and Syria in the east; France, Spain, Portugal, Morocco and Tunisia in the west. It is situated at the meeting point between Eurasia and Africa and so the different zoogeographical territories (Thompson, 2005). Not only its geographical features but also the historical events let this region to be more diverse biologically (Thompson, 2005). Especially because of the glacial and interglacial periods in Pleistocene, there are numerous refuges and genetic reserves formed in this region (Blondel et al., 2010). According to Çıplak (2008), Anatolian topography played a very important role in Pleistocene dispersal changes by providing suitable habitats. Climatic changes during these periods pushed many northern populations to the south and this mobility had enhanced their speciation rates (Çıplak, 2003). Mediterranean Anatolia or in other means Mediterranean Region of southern Turkey is one of the most mountainous districts and contains mountain chains with high elevations (Çıplak, 2008).

Maybe because of these barriers and aforesaid geological events, the region is characterized by high plant diversity (Myers et al., 2000; Türe & Böcük, 2010). Besides, several studies (Zanden, 1980, 1981, 1984, 1987, 1989, 1991, 1992; Warncke, 1985, 1988a, 1988b, 1990, 1991a, 1991b, 1991c, 1991d, 1991e, 1992a, 1992b, 1992c; Özbek & Zanden, 1992a, 1992b, 1993, 1994, 1996; Özbek, 2011, 2013) that have been focused on the Megachilidae fauna of Turkey since sixtees projected a high richness in the region which consists of one hundred and ninety-eight species. Güler & Çağatay (2006) reported that Turkish fauna consist of 461 Megachilidae species. According to these previous data nearly 40% of the Turkish fauna were also distributed in Mediterranean region of Turkey. Henceforth, the richness in the region has to be questioned in relation with the high plant diversity. Our study was aimed to re-discover this richness and to make contribution, if possible. Secondly, in order to understand the factors that affect the vertical distributions of the bees, seasonal activity and altitude preferences were also evaluated in this study. Monitoring the richness and abundances of pollinators and their plant preferences would provide crucial information in developing new ecosystem management models. For this reason some basic diversity analyses were performed to compare the richness of the localities and regions more analytically. Moreover, floral visitation patterns of the bees were analyzed and discussed to figure out main plant categories related with Megachilidae members of the Mediterranean Turkey.

Materials and Methods

The study covered the area of Mediterranean Region of Southern Turkey (Figure 1). The field surveys were conducted in fourteen provinces which are wholly placed (Adana, Antalya, Burdur, Hatay, Isparta, Mersin, Muğla, Osmaniye) and partly placed (Afyon, Denizli, Karaman, Kayseri, Kahramanmaraş, Niğde) at Mediterranean Turkey. The Turkey map (Figure 1.A) that was displaying the provinces at the study area was prepared by Diva-GIS v.7.3 (Hijmans et al., 2005). The map (Figure 1.B) displaying the 85 sampling locations as black circles was prepared with CFF 2.0 (Barbier & Rasmont, 2000: Carto Fauna-Flora). Field studies were performed during the spring and summer seasons of 2008 and 2009. April 24th

was the first, August 09th was the last day for the field studies at 2008; March 20th was the first, August 11th was the last day for the field studies of the second year. Since the area of the field survey was huge (nearly 100.000 km^2), random sampling protocol was used to search and collect as much as it can be. All bee specimens were collected via hand nets and aspirators. Meanwhile, the plants that have been visited by bees also recorded or collected for diagnosis. All captured bee samples and collected plants were properly prepared for collections. All of these specimens were deposited in the Plant Protection Museum of the Plant Protection Central Research Institute and in the Department of Biology, Faculty of Science, Hacettepe University, Ankara, Turkey. GPS coordinates were taken by Garmin Etrex H®. Materials were examined with stereoscopic microscopes for diagnosis. Identification of the bee specimens were made by Y. Güler according to Özbek (1979), Warncke (1980, 1992a), Zanden (1986), Dorn & Weber (1988), Banaszak & Romasenko (1998), Michener (2007), Amiet et al. (2004) and Scheuchl (2006) and by comparing the specimens with the bee collections of Bavarian State Zoology Collection (Zoologische Staatssammlung, Munich, Germany- ZSM), the Upper Austrian Provincial Museum (Oberösterreichisches Landesmuseum- Biologiezentrum, Linz, Austria- OLML). Michener (2007) was followed for the taxonomy of the bee groups. The species are listed below in the alphabetical order within genera and species. Identification of plant specimens were made by D. Töre according to Flora of Turkey and East Aegean Islands (Davis, 1965-1985, 1988; Güner et al., 2000). Brummit & Powell (1999) and The International Plant Names Index (IPNI 2008) were followed for the author names of the plant taxa.

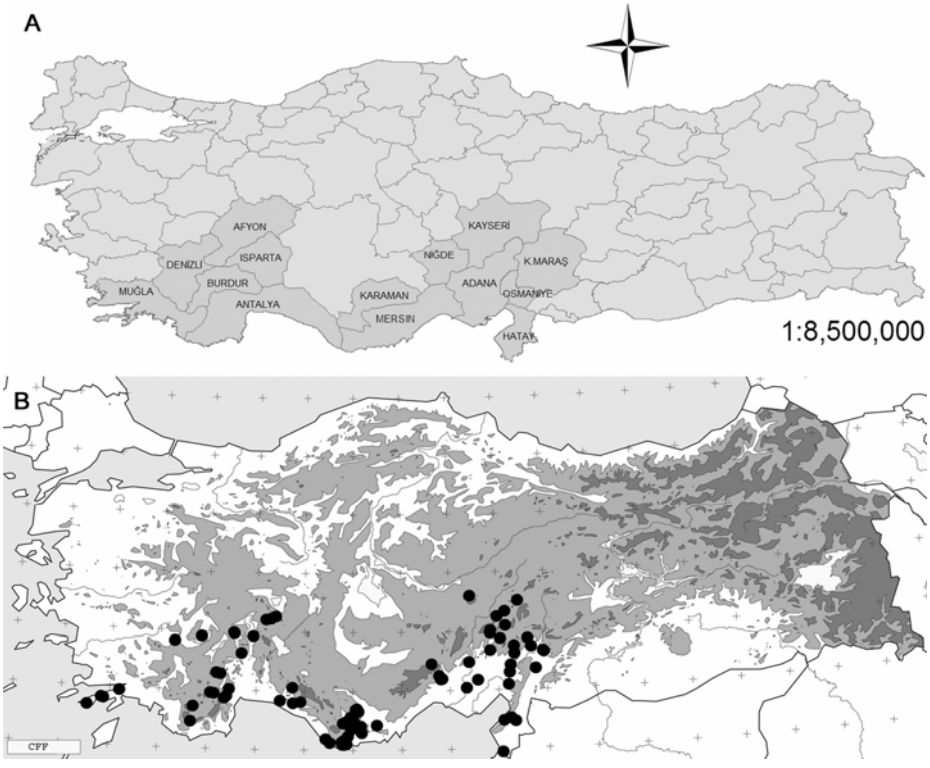

Figure 1. A) Map generated by Diva-GIS displays the provinces of study area. B) Map generated by CFF displays the sampling stations.

Biodiversity analyses

In order to make multivariate analyses on the biodiversity parameters, a data matrix including GPS coordinates, habitat properties, abundances of bee species and related plants was generated. Krebs (1999) and Magurran (2004) were used for biodiversity analyses. Sample size and sampling efforts were different for some stations. For this reason we calculated both Shannon-Weiner index (H_{SW}) and Brillouin index (H_B) scores according to the formulas given by Krebs (1999) and Magurran (2004).

Plant preference term used in here is nearly the same meaning with the term “niche breadth” of Krebs (1999). All the observations on the plant visits of female bees are coded as presence-absence data. Only the visitation records were involved to the study. Pollen provisions could not be included. Delimitations of the plant taxa categories for the analyses would be more helpful in understanding the preferences of females regard to plant genera and species. Because of that both categories were analyzed according to the occurrence of bees on those plants. Calculations were made via Shannon-Weiner index (H_{SW}) scores according to the methodologies proposed by Krebs (1999) and Cane & Sipes (2006).

Results

Taxonomic results

Afranthidium carduele (Morawitz, 1876)

Material: Isparta: Bahtiyar Village, 38°11’81”N, 31°11’01”E, 1060 m, 17.VII.2008, ♀, Senirkent, 38°19’59”N, 31°06’44”E, 1179 m, 17.VII.2008, ♂; 37°59’06”N, 30°30’59”E, 1346m, 04.VIII.2009, ♂.

Recorded Plants: *Centaurea solstitialis* L. subsp. solstitialis, *C. iberica* Trevir. ex Spreng., *C. virgata* Lam. (Asteraceae).

Anthidiellum crassepunctatum (Popov, 1935)

Material: Mersin: Mut, 30.V.1967, ♂, leg. J. Gusenleitner, det.? (in OLML), Anamur, 36°13’62”N, 32°53’40”E, 1167 m, 22.VII.2008, 2♀♀; Urfa, 31.V.1968, 1♀, 4♂♂, leg. J. Gusenleitner, det. J. Pasteels, 1970 (in OLML). New record for Turkey.

Recorded Plants: *Rhus coriaria* L. (Anacardiaceae).

Anthidiellum strigatum (Panzer, 1805)

Material: Antalya: Güçlüköy, 36°47’48”N, 31°45’52”E, 374 m, 09.VI.2009, ♀, Research Forest, 37°00’92”N, 30°26’37”E, 655 m, 10.VI.2009, ♀, 6♂♂, 36°48’63”N, 31°55’05”E, 998 m, 06.VIII.2009, 2♀♀, 1♂; Isparta: 37°59’06”N, 30°30’59”E, 1346m, 04.VIII.2009, ♂; Karaman: Kazancı, 36°33’50”N, 32°56’52”E, 529 m, 24.VII.2008, ♀; Mersin: Anamur, 36°13’62”N, 32°53’40”E, 1167 m, 22.VII.2008, 3♀♀, 36°07’69”N, 32°45’67”E, 120 m, 06.VI.2009, ♀.

Recorded Plants: *Centaurea virgata* Lam., *Crepis foetida* L., *C. micrantha* Czerep. (Asteraceae), *Heliotropium hirsutissimum* Grauer (Boraginaceae), *Lythrum salicaria* L., (Lythraceae) *Rhus coriaria* L. (Anacardiaceae), *Scabiosa atropurpurea* L. subsp. *maritima* (L.) Arcang. (Dipsacaceae), *Stachys cretica* L. subsp. *anatolica* Rech. f. (Lamiaceae).

Anthidium cingulatum Latreille, 1809

Material: Antalya: Korkuteli-Finike road, 36°56’58”N, 30°07’52”E, 1346 m, 10.VI.2009, ♀, Yeşilbayır plateau, 36°57’22”N, 30°03’29”E, 1438 m, 10.VI.2009, ♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°40’35”N, 33°03’43”E, 1786 m, 25.VII.2008, ♂.

Recorded Plants: *Lotus corniculatus* L., *Ononis spinosa* L. subsp. *leiosperma* (Boiss.) Sirj. (Fabaceae).

Anthidium eremicum Alfken, 1938

Material: Antalya: Çomaklı, 37°17’06”N, 30°15’41”E, 914 m, 18.VII.2008, 3♀♀; Burdur: Ağlasun, 37°38’09”N, 30°40’68”E, 983 m, 05.VIII.2009, ♀.

Recorded Plants: *Centaurea solstitialis* subsp. *carneola* (Boiss.) Wagenitz, *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum* (Asteraceae).

Anthidium florentinum (Fabricius, 1775)

Material: Kahramanmaraş: Andırın, 37°36’55”N, 36°20’37”E, 1069 m, 10.VII.2008, ♂; Kayseri: 38°36’05”N, 35°25’87”E, 1890 m, 09.VIII.2009, ♂.

Recorded Plants: *Anchusa leptophylla* Roem. & Schult. subsp. *incana* (Ledeb.) D. F. Chamb. (Boraginaceae), *Centaurea solstitialis* L. subsp. *carneola* (Boiss.) Wagenitz (Asteraceae).

Anthidium loti Perris, 1852

Material: Adana: Saimbeyli, Avcıpınar, 38°03’89”N, 36°10’15”E, 1516 m, 17.VII.2009, ♂; Isparta: 38°15’37”N, 31°22’73”E, 1555 m, 03.VIII.2009, 2♀♀, ♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°40’35”N, 33°03’43”E, 1786 m, 25.VII.2008, ♂.

Recorded Plants: *Echium italicum* L. (Boraginaceae), *Phlomis rigida* Labill., *Stachys byzantina* K. Koch., *Teucrium orientale* L. var. *orientale* (Lamiaceae).

Anthidium manicatum (Linnaeus, 1758)

Material: Karaman: Ermenek, 36°27’98”N, 32°50’46”E, 1464 m, 22.VII.2008, ♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°40’32”N, 33°04’45”E, 1719 m, 25.VII.2008, ♀; 25.VII.2008, 36°40’35”N, 33°03’43”E, 1786 m, ♀, ♂.

Recorded Plants: *Ballota saxatilis* Sieber *ex.* C. Presl subsp. *brachyodonta* (Boiss.) P. H. Davis & Doroszenko, *Sideritis libanotica* Labill. subsp. *violascens* (P. H. Davis) P. H. Davis (Lamiaceae), *Onopordum bracteatum* Boiss. & Heldr. var. *arachnoideum* Erik & Sümbül (Asteraceae).

Anthidium spiniventre Friese, 1899

Material: Isparta: Gönen, 37°58’36”N, 30°30’95”E, 1180 m, 04.VIII.2009, ♀.

Recorded Plants: *Centaurea solstitialis* L. subsp. *solstitialis* (Asteraceae).

Anthidium taeniatum Latreille, 1809

Material: Kahramanmaraş: Göksun, 37°59’30”N, 36°29’79”E, 1347 m, 02.VII.2009, ♂.

Recorded Plants: *Medicago* x *varia* Martyn (Fabaceae).

Anthidium undulatiforme Friese, 1917

Material: Mersin: Anamur, Abanoz, 36°20’69”N, 32°57’24”E, 1329 m, 22.VII.2008, ♂.

Recorded Plants: *Phlomis nissolii* L. (Lamiaceae).

Anthidium undulatum Dours, 1873

Material: Mersin: Mut, Akpınar-Güzlek plateau, 36°40’25”N, 33°04’70”E, 1645 m, 25.VII.2008, ♀.

Recorded Plants: *Cousinia ermenekensis* Hub.-Mor. (Asteraceae).

Anthidium wustneii Mocsary, 1887

Material: Isparta: 37°58’36”N, 30°30’95”E, 1180 m, 04.VIII.2009, 6♀♀.

Recorded Plants: *Pulicaria dysenterica* (L.) Bernh. (Asteraceae).

Chelostoma emarginatum (Nylander, 1856)

Material: Afyonkarahisar: Dinar, (no GPS record), 1048 m, 27.V.2009, 6♀♀, 2♂♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°39’98”N, 33°04’04”E, 1772 m, 04.VI.2009, 4♀♀; 36°39’98”N, 33°04’04”E, 1881 m, 04.VI.2009, 2♂♂.

Recorded Plants: *Ranunculus fenzlii* Boiss. (Ranunculaceae).

Chelostoma rapunculi (Lepeletier, 1841)

Material: Afyonkarahisar: Dinar, Cumhuriyet, (no GPS record), 1119 m, 27.V.2009, ♀.

Recorded Plants: *Anthemis* sp. (Asteraceae).

Coelioxys acanthura (Illiger, 1806)

Material: Kahramanmaraş: Göksun, 37°43'30"N, 36°41'49"E, 939 m, 18.VII.2009, ♀. New record for the region.

Recorded Plants: *Echinops orientalis* Trautv. (Asteraceae).

Coelioxys caudata Spinola, 1838

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, ♀.

Recorded Plants: *Centaurea iberica* Trevir. ex Spreng. (Asteraceae).

Coelioxys haemorrhoa Förster, 1853

Material: Afyonkarahisar: Dazkırı, 37°54'52"N, 29°50'66"E, 891 m, 12.VI.2009, ♀; Hatay: İskenderun, Arsuz, 36°32'84"N, 36°04"77"E, 7 m, 29.VI.2009, ♀, Kırıkhan, 36°27'52"N, 36°19'48"E, 93 m, 01.VII.2009, ♀; Karaman: Kazancı, 36°33'50"N, 32°56'52"E, 529 m, 24.VII.2008, ♂.

Recorded Plants: *Eryngium campestre* L. var. *virens* Link (Apiaceae), *Echinops* spp. (Asteraceae), *Peganum harmala* L. (Zygophyllaceae).

Coelioxys rufescens Lepeletier, 1825

Material: Afyonkarahisar: Dinar, Cumhuriyet, 1119 m, 27.V.2009, 2♂♂.

Recorded Plants: *Anthemis* sp. (Asteraceae).

Eoanthidium judaeense (Mavromoustakis, 1945)

Material: Kahramanmaraş, Göksun, 37°43'40"N, 36°41'37"E, 901 m, 02.VII.2009, ♀.

Recorded Plants: *Echinops orientalis* Trautv (Asteraceae)

Heriades crenulatus Nylander, 1856

Material: Adana: Aladağ, 37°28'47"N, 35°24'19"E, 864 m, 09.VII.2008, 2♀♀, 1♂; Burdur: 37°38'09"N, 30°40'68"E, 983 m, 05.VIII.2009, ♀; Kahramanmaraş: Göksun 37°51'55"N, 36°37'48"E, 973 m, 02.VII.2009, ♀; Karaman: Kazancı, 36°33'50", 32°56'52", 529 m, 24.VII.2008, ♀; Mersin: Çamalan, 37°12'29"N, 34°48'27"E, 816 m, 08.VII.2008, ♀, 37°11'43"N, 34°48'27"E, 703 m, 08.VII.2008, 5♀♀, 3♂♂, Anamur, 36°04'93"N, 32°48'30"E, 21 m, 06.VI.2009, 2♀♀, Gülnar, 36°24'83"N, 33°29'17"E, 993 m, 22.VII.2009, ♀; Muğla: Marmaris, 36°56'40"N, 28°11'25"E, 1 m, 19.VI.2009, ♀; Osmaniye: Karatepe-Kadirli road, 37°17'46"N, 36°14'05"E, 160 m, 08.VIII.2008, 8♀♀.

Recorded Plants: *Centaurea solstitialis* L. subsp. *solstitialis*, *C. solstitialis* L. subsp. *carneola* (Boiss.) Wagenitz, *C. iberica* Trevir. ex Spreng., *Crepis foetida* L., *Onopordum carduchorum* Bornm. & Beauverd, *Pulicaria arabica* (L.) Cass. (Asteraceae).

Hoplitis acuticornis (Dufour & Perris, 1840)

Material: Antalya: Saklıkent, 36°51'75"N, 30°20'36"E, 1757 m, 11.VI.2009, ♀; Mersin: Mut, Akpınar-Güzlek plateau, 36°39'15"N, 33°06'27"E, 1414 m, 04.VI.2009, ♂.

Recorded Plants: *Vicia cracca* L. subsp. *stenophylla* Velen. (Fabaceae).

Hoplitis praestans (Morawitz, 1894)

Material: Mersin: Mut, Akpınar-Güzlek plateau, 36°39'98"N, 33°04'04"E, 1772 m, 04.VI.2009, ♂.

Recorded Plants: *Crepis sancta* (L.) Babcock (Asteraceae).

Icteranthidium cimbiciforme (Smith, 1854)

Material: Adana: İmamoğlu, 37°10'41"N, 35°33'86"E, 195 m, 15.VII.2009, 2♂♂; Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 2♀♀.

Recorded Plants: *Centaurea iberica* Trevir. ex Spreng., *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum* (Asteraceae).

Icteranthidium grohmanni (Spinola, 1838)

Material: Isparta: 38°54'96"N, 30°54'87"E, 957 m, 03.VIII.2009, ♀, Eğirdir, 38°15'37"N, 31°22'73"E, 957 m, 03.VIII.2009, ♂; Mersin: Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, ♂, Söğüt plateau, 36°17'35"N, 33°10'20"E, 1278 m, 23.VII.2008, ♀.

Recorded Plants: *Eryngium campestre* L. var. *virens* Link (Apiaceae).

Icteranthidium limbiferum (Morawitz, 1875)

Material: Mersin: Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, ♀.

Recorded Plants: *Eryngium campestre* L. var. *virens* Link (Apiaceae).

Lithurgus chrysurus Fonscolombe, 1834

Material: Adana: Aladağ, 37°28'47"N, 35°24'19"E, 864 m, 09.VII.2008, ♂, Feke, Sarıpınar Village, 37°59'88"N, 35°50'80"E, 1099 m, 16.VII.2009, ♀, ♂, Tufanbeyli, 38°19'48"N, 36°10'02"E, 1569 m, 17.VII.2009, 2♂♂; Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 6♀♀, 2♂♂, Söbüce plateau, 37°18'02"N, 30°09'91"E, 1589 m, 18.VII.2008, ♀, 3♂♂, 36°42'75"N, 29°42'21"E, 1455 m, 05.VIII.2009, ♀, 5♂♂, 36°48'63"N, 31°55'05"E, 998 m, 06.VIII.2009, 2♀♀; Burdur: 37°38'09"N, 30°40'68"E, 983 m, 05.VIII.2009, ♀, ♂; Hatay: Kırıkhan, 36°27'52"N, 36°19'48"E, 93 m, 01.VII.2009, ♀; Isparta: Bağkonak, 38°13'20"N, 31°17'24"E, 1243 m, 17.VII.2008, 2♀♀, Bahtiyar, 38°11'81"N, 31°11'01"E, 1060 m, 17.VII.2008, ♀, Gönen, 37°58'36"N, 30°30'95"E, 1582 m, 04.VIII.2009, ♂; Kahramanmaraş: Andırın, 37°44'39"N, 36°20'37"E, 1281 m, 10.VII.2008, 4♂♂, Pehlivan plateau, 37°38'67"N, 36°55'95"E, 1616 m, 01.VII.2009, ♀, 2♂♂, 37°38'56"N, 36°55'97"E, 1624 m, 18.VII.2009, ♀, ♂, Göksun, 37°51'55"N, 36°37'48"E, 973 m, 02.VII.2009, 2♀♀, ♂; Karaman: Ermenek, 36°27'98"N, 32°50'46"E, 1464 m, 22.VII.2008, ♀, 36°28'26"N, 33°00'92"E, 1109 m, 22.VII.2009, ♀, 3♂♂, Anamur-Ermenek road, 36°26'84"N, 32°47'30"E, 1752 m, 23.VII.2009, 2♀♀, 3♂♂; Mersin: Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, 5♀♀, 4♂♂, Çataloluk, 36°08'66"N, 32°47'25"E, 423 m, 06.VI.2009, ♂, Gülek, 37°15'21"N, 34°46'43"E, 1036 m, 15.VII.2009, ♀, ♂; Osmaniye: Andırın-Kadirli road, 37°25'22"N, 36°15'39"E, 187 m, 19.VII.2009, 2♀♀.

Recorded Plants: *Carduus nutans* L. *nutans* sensu lato, *Centaurea iberica* Trevir. ex Spreng., *C. solstitialis* L. subsp. *solstitialis*, *Centaurea solstitialis* subsp. *carneola* (Boiss.) Wagenitz, *Echinops* spp. (Asteraceae), *Eryngium campestre* L. var. *virens* Link, *E. creticum* Lam. (Apiaceae), *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum*, *O. carduchorum* Bornm. & Beauverd, *O. sibthorpianum* Boiss. & Heldr., *Picnomon acarna* (L.) Cass. (Asteraceae).

Lithurgus cornutus (Fabricius, 1787)

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 5♀♀, Söbüce plateau, 37°18'02"N, 30°09'91"E, 1589 m, 18.VII.2008, ♀; Burdur: 37°38'09"N, 30°40'68"E, 983 m, 05.VIII.2009, ♀; Isparta: 37°58'36"N, 30°30'95"E, 1180 m, 04.VIII.2009, 3♀♀; Kahramanmaraş: Andırın, 37°44'39"N, 36°20'37"E, 1281 m, 10.VII.2008, ♀; Karaman: Ermenek, 36°27'98"N, 32°50'46"E, 1464 m, 22.VII.2008, ♀, Ermenek,36°28'26"N, 33°00'92"E, 1109 m, 22.VII.2009, ♀; Kayseri: Dokuzdolambaç pass., 38°30'25"N, 36°26'40"E, 1705 m, 11.VIII.2009, ♀.

Recorded Plants: *Carduus* sp., *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum*, *O. bracteatum* Boiss. & Heldr. var. *arachnoideum* Erik & Sümbül, *O. carduchorum* Bornm. & Beauverd, *O. sibthorpianum* Boiss. & Heldr (Asteraceae).

Lithurgus tibialis Morawitz, 1875

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 7♂♂; Kahramanmaraş: Türkoğlu, Ceceli, 37°20'71"N, 36°46'23"E, 603 m, 07.VIII.2008, ♂; Osmaniye: Andırın-Kadirli road, 37°25'22"N, 36°15'39"E, 187 m, 19.VII.2009, 3♀♀.

Recorded Plants: *Centaurea iberica* Trevir. ex Spreng. (Asteraceae), *Eryngium creticum* Lam. (Apiaceae), *Vitex agnus-castus* L. (Verbenaceae).

Megachile albisecta (Klug, 1817)

Material: Adana: Aladağ, Ibrişim, 37°33'35"N, 35°20'33"E, 682 m, 09.VII.2008, ♂, Feke, Sarıpınar village, 38°01'00"N, 35°50'52"E, 1149 m, 16.VII.2009, ♀, Tufanbeyli, 38°19'48"N, 36°10'02"E, 1569 m, 17.VII.2009, ♀; Isparta: 37°59'06"N, 30°30'59"E, 1346 m, 04.VIII.2009, ♀; Kahramanmaraş: Göksun, 37°43'40"N, 36°41'37"E, 901 m, 02.VII.2009,♀; Mersin: Mut, Güzlek village, 36°39'00"N, 33°06'27"E, 1419 m, 25.VII.2008, ♀.

Recorded Plants: *Centaurea solstitialis* L. subsp. *solstitialis*, *Echinops orientalis* Trautv., *E. ritro* L., *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum* (Asteraceae).

Megachile analis Nylander, 1852

Material: Kayseri: Aksu Plateau, 38°34'57"N, 35°25'14"E, 2196 m, 09.VIII.2009, ♀.

Recorded Plants: From vegetation.

Megachile apicalis Spinola, 1808

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 4♀♀, 36°48'63"N, 31°55'05"E, 998 m, 06.VIII.2009, ♀; Burdur: 37°38'09"N, 30°40'68"E, 983 m, 05.VIII.2009, ♀; Kahramanmaraş: Göksun, 37°51'55"N, 36°37'48"E, 973 m, 02.VII.2009, ♀; Karaman: Ermenek, 36°28'26"N, 33°00'92"E, 1109 m, 22.VII.2009, ♀; Mersin: Anamur, 36°05'74"N, 32°51'67"E, 19 m, 21.VII.2008, ♀; Muğla: Datça, 36°67'87"N, 27°53'87"E, 13 m, 19.VI.2009, ♀; Osmaniye: Karatepe-Kadirli road, 37°17'46"N, 36°14'05"E, 160 m, 08.VIII.2008, 2♀♀.

Recorded Plants: *Centaurea iberica* Trevir. ex Spreng., *C. solstitialis* L. subsp. *solstitialis*, *C. solstitialis subsp. carneola* (Boiss.) Wagenitz, *Circium* sp., *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum*, *O. carduchorum* Bornm. & Beauverd, *O. majori* Beauverd (Asteraceae).

Megachile deceptoria Perez, 1890

Material: Adana: Aladağ, 37°28'47"N, 35°24'19"E, 864 m, 09.VII.2008, 3♀♀, Tufanbeyli, Damızlık, 38°19'48"N, 36°10'02"E, 1569 m, 17.VII.2009, 2♂♂; Isparta: Bağkonak, 38°13'20"N, 31°17'24"E, 1243 m, 17.VII.2008, ♀, Eğirdir, 38°15'37"N, 31°22'73"E, 957 m, 03.VIII.2009, ♀, Gönen, 37°58'36"N, 30°30'95"E, 1180 m, 04.VIII.2009, ♂; Kahramanmaraş: Göksun, 37°43'40"N, 36°41'37"E, 901 m, 02.VII.2009, ♂; Mersin: Gülnar, 36°24'83"N, 33°29'17"E, 993 m, 22.VII.2009, ♀. New record for the region.

Recorded Plants: *Centaurea solstitialis* L. subsp. *solstitialis*, *C. solstitialis* L. subsp. *carneola* (Boiss.) Wagenitz, *Echinops pungens* Trautv. var. *pungens*, *E. orientalis* Trautv (Asteraceae), *Phlomis sieheana* Rech.f. (Lamiaceae), *Pterocephalus plumosus* (L.) Coulter (Dipsacaceae), *Stachys byzantina* C.Koch (Lamiaceae).

Megachile ericetorum (Lepeletier, 1841)

Material: Adana: Çamlıplateau cross, Gülek, 37°12'29"N, 34°48'27"E, 816 m, 08.VII.2008, ♂,37°09'42"N, 34°48'47"E, 580m, 08.VII.2008, ♂; Kahramanmaraş: Göksun, Tekir, 37°51'55"N, 36°37'48"E, 973 m, 02.VII.2009, ♂; Niğde: Altunhisar, (no GPS record), 1192 m, 21.V.2008, ♀.

Recorded Plants: *Centaurea iberica* Trev. ex Sprengel, *Echinops viscosus* subsp. *bithynicus* (Boiss.) Rech. (Asteraceae), *Echium italicum* L. (Boraginaceae), *Scolymus hispanicus* L. (Asteraceae).

Megachile fertoni Pérez, 1896

Material: Karaman: Kazancı, 36°33'50"N, 32°56'52"E, 529 m, 24.VII.2008, 2♀♀.

Recorded Plants: *Eryngium campestre* L. var. virens Link (Apiaceae).

Megachile giraudi Gerstaecker, 1869

Material: Karaman: Kazancı, 36°33'50"N, 32°56'52"E, 529 m, 24.VII.2008, 2♀♀.

Recorded Plants: *Eryngium campestre* L. var. *virens* Link (Apiaceae).

Megachile hungarica Mocsary, 1877

Material: Adana: Çamlıplateau cross, 37°09'42"N, 34°48'47"E, 580 m, 08.VII.2008, 2♂♂; Kahramanmaraş: Göksun, Tekir, 37°51'55"N, 36°37'48"E, 973 m, 02.VII.2009, ♂; Karaman: Ermenek, 36°27'98"N, 32°50'46"E, 1464 m, 22.VII.2008, 4♀♀; Mersin: Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, ♀, Gülek, 37°15'21"N, 34°46'43"E, 1036 m, 15.VII.2009, ♂, Mut, Akpınar-Güzlek plateau, 36°40'35"N, 33°03'43"E, 1786 m, 25.VII.2008, ♀, Söğüt plateau, 36°17'35"N, 33°10'20"E, 1278 m, 23.VII.2008, ♀; Muğla: Datça, Karaköy, 138 m, 19.VI.2009, 2♀♀, Marmaris, Karacasöğüt, 36°56'40"N, 28°11'25"E, 1 m, 19.VI.2009, ♀.

Recorded Plants: *Anchusa leptophylla* Roem. & Schult. subsp. *leptophylla* (Boraginaceae), *Centaurea iberica* Trev. ex Sprengel (Asteraceae), *Coridothymus capitatus* (L.) Reichb. (Lamiaceae), *Echium angustifolium* Miller (Boraginaceae), *Eryngium campestre* L. var. *virens* Link (Apiaceae), *Onopordum bracteatum* Boiss. & Heldr. var. *arachnoideum* Erik & Sümbül (Asteraceae), *Ononis spinosa* L. subsp. *leiosperma* (Boiss.) Sirj. (Fabaceae), *Phlomis nissolii* L. (Lamiaceae), *Vitex agnus-castus* L. (Verbenaceae).

Megachile lagopoda (Linnaeus, 1761)

Material: Adana: Feke, Gürümze, 37°57'73"N, 35°50'41"E, 971 m, 16.VII.2009, ♀, Feke, Sarıpınar village, 37°59'88"N, 35°50'80"E, 1099 m, 16.VII.2009, ♀; Antalya: Söbüce plateau, 37°18'02"N, 30°09'91"E, 1589 m, 18.VII.2008, ♀, ♂; Kahramanmaraş: Andırın, 37°34'50"N, 36°35'09"E, 1268 m, 18.VII.2009, ♀; Isparta: Gönen, 37°58'36"N, 30°30'95"E, 1582 m, 04.VIII.2009, ♀.

Recorded Plants: *Echium italicum* L. (Boraginaceae) *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum*, *O. sibthorpianum* Boiss. & Heldr (Asteraceae), *Pterocephalus plumosus* (L.) Coulter (Dipsacaceae).

Megachile leachella Curtis, 1828

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, ♀; Mersin: Anamur, 36°05'74"N, 32°51'67"E, 12 m, 21.VII.2008, 2♀♀, Mut, 36°40'35"N, 33°03'43"E, 1786 m, 25.VII.2008, ♀.

Recorded Plants: *Onopordum sibthorpianum* Boiss. & Heldr. (Asteraceae), *Ononis spinosa* L. subsp. *leiosperma* (Boiss.) Sirj. (Fabaceae), *Vitex agnus-castus* L. (Verbenaceae).

Megachile lefebvrei Lepeletier, 1841

Material: Antalya: Saklıkent, 36°53'76"N, 30°22'76"E, 1148 m, 11.VI.2009, ♀; Mersin: Mut, Güzlek plateau, 36°40'35"N, 33°03'43"E, 1786 m, 21.VII.2009, 2♀♀. New record for Turkey.

Recorded Plants: *Lotus aegaeus* (Gris.) Boiss., *Trifolium* sp. (Fabaceae).

Megachile maritima (Kirby, 1802)

Material: Mersin: Mut, 36°40'35"N, 33°03'43"E, 1786 m, 25.VII.2008, ♀.

Recorded Plants: *Ononis spinosa* L. subsp. *leiosperma* (Boiss.) Sirj. (Fabaceae).

Megachile melanopyga Costa, 1863

Material: Mersin: Mut, 36°40'35"N, 33°03'43"E, 1786 m, 12.VI.2009, ♀.

Recorded Plants: *Ononis spinosa* subsp. *leiosperma* (Boiss.) Sirj. (Fabaceae).

Megachile parietina (Geoffroy, 1785)

Material: Antalya: Research Forest, 37°00'92"N, 30°26'37"E, 655 m, 10.VI.2009, ♀; Adana: Feke-Saimbeyli road, 37°51'80"N, 36°02'77"E, 691 m, 16.VII.2009, ♂; Hatay: İskenderun, Belen, 36°31'07"N, 36°14'.36"E, 1124 m, 30.VI.2009, ♀; Kayseri: Develi, Hanyeri, 38°12'52"N, 36°00'08"E, 1880 m, 02.VII.2009, ♀; Muğla: Datça, 36°48'09"N, 27°51'60"E, 1 m, 04.IV.2009, ♀, Datça, Kızlar, 36°48'58"N, 27°48'88"E, 49 m, 04.IV.2009, ♀, Marmaris, 36°58'66"N, 28°13'01"E, 9 m, 02.IV.2009, ♂.

Recorded Plants: *Asphodelus aestivus* Brot. (Asphodelaceae), *Cistus salviifolius* L. (Cistaceae), *Echium* sp. (Boraginaceae), *Stachys cretica* L. subsp. *anatolica* Rech.f. (Lamiaceae), *Vicia villosa* Roth subsp. *eriocarpa* (Hausskn) P.W.Ball. (Fabaceae).

Megachile pilicrus Morawitz, 1877

Material: Adana: Feke-Saimbeyli road, 37°51'80"N, 36°02'77"E, 691 m, 16.VII.2009, ♀, Feke, Sarıpınar, 37°59'88"N, 35°50'80"E, 1099 m, 16.VII.2009, ♂; Hatay: Atik plateau, 36°30'08"N, 36°12'.04"E, 736 m, 30.VI.2009, ♂; Isparta: 37°58'36"N, 30°30'95"E, 1180 m, 04.VIII.2009, ♀; Kahramanmaraş: centrum, Bağevleri, 37°37'65"N, 36°56'87"E, 1288 m, 01.VII.2009, ♀, Pehlivan plateau, 37°38'67"N, 36°55'95"E, 1616 m, 01.VII.2009, 2♂♂, Pehlivan plateau, 37°38'56"N, 36°55'97"E, 1624 m, 18.VII.2009, ♀;. New record for the region.

Recorded Plants: *Centaurea iberica* Trev. ex Sprengel, *C. solstitialis* L. subsp. *solstitialis*, *C. virgata* Lam., *Onopordum bracteatum* Boiss. & Heldr. var. *bracteatum* (Asteraceae).

Megachile pilidens Alfken, 1924

Material: Antalya: Söbüce plateau, 37°18'02"N, 30°09'91"E, 1589 m, 18.VII.2008, ♀; Hatay: İskenderun, Arsuz, 38°32'84"N, 36°04'77"E, 7 m, 30.VI.2009, ♀; Isparta: 38°15'37"N, 31°22'73"E, 1555 m, , 03.VIII.2009, ♀, 38°54'96"N, 30°54'87"E, 957 m, 03.VIII.2009, ♀, 37°59'06"N, 30°30'59"E, 1346 m, 04.VIII.2009, ♀; Osmaniye: 37°05'38"N, 36°12'32"E, 100 m, 26.IV.2008, 2♂♂.

Recorded Plants: *Centaurea iberica* Trev. ex Sprengel (Asteraceae), *Eryngium campestre* L. var. *virens* Link (Apiaceae), *Ononis spinosa* L. subsp. *antiquorum* (L.) Briq. (Fabaceae), *Onopordum sibthorpianum* Boiss. & Heldr. (Asteraceae), *Salvia viridis* L. (Lamiaceae).

Megachile pyrenaica (Lepeletier, 1841)

Material: Afyonkarahisar: Dinar, Cumhuriyet, 27.V.2009, (no GPS record), 1119 m, ♂; Muğla: Datça, 36°48'58"N, 27°48'88"E, 49 m, 04.IV.2009, 2♂♂.

Recorded Plants: *Asphodelus aestivus* L. (Asphodelaceae), *Anthemis* sp. (Asteraceae).

Megachile rotundata (Fabricius, 1787)

Material: Hatay: Samandağ, 35°56'49"N, 36°02'54"E, 512 m, 20.VII.2009, ♀; Kahramanmaraş: centrum, Bağevleri, 37°37'65"N, 36°56'87"E, 1288 m, 01.VII.2009, ♀; Mersin, Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, ♀.

Recorded Plants: *Centaurea virgata* Lam. (Asteraceae), *Eryngium campestre* L. var. *virens* Link (Apiaceae), *Vitex agnus-castus* L. (Verbenaceae).

Megachile willughbiella (Kirby, 1802)

Material: Isparta: 38°15'37"N, 31°22'73"E, 1555 m, 03.VIII.2009, ♀. New record for the region.

Recorded Plants: *Cirsium arvense* (L.) Scop. subsp. *vestitum* (Wimm. & Grab.) Petr. (Asteraceae).

Osmia bicornis (Linnaeus, 1758)

Material: Mersin: Mut, Akpınar-Güzlek plateau, 36°39'15"N, 33°06'27"E, 1414 m, 04.VI.2009, ♂; Osmaniye: Karatepe National Park road, 37°11'26"N, 36°11'01"E, 104 m, 20-III-2009, 5♂♂.

Recorded Plants: *Asphodelus aestivus* L. (Asphodelaceae), *Carduus nutans* L. *nutans* sensu lato (Asteraceae).

Osmia bidentata Morawitz, 1876

Material: Antalya: Çomaklı, 37°17'06"N, 30°15'41"E, 914 m, 18.VII.2008, 8♀♀, ♂, Söbüce plateau, 37°18'02"N, 30°09'91"E, 1589 m, 18.VII.2008, ♀; Denizli: 37°48'83"N, 29°17'35"E, 429 m, 12.VI.2009, ♂.

Recorded Plants: *Onopordum acanthium* L., *O. bracteatum* Boiss. & Heldr. var. *bracteatum*, *O. sibthorpianum* Boiss. & Heldr. (Asteraceae).

Osmia brevicornis (Fabricius, 1798)

Material: Afyonkarahisar: Dinar, Cumhuriyet, (no GPS record), 1119 m, 27.V.2009, ♂; Antalya: Saklıkent, 36°53'76"N, 30°22'76"E, 1148 m, 11.VI.2009, 3♀♀; Niğde: Karagöl, Bolkar mountains, 37°26'80"N, 34°36'85"E, 1756 m, 22.V.2008, 3♂♂.

Recorded Plants: *Anthemis* sp (Asteraceae), *Cardaria draba* (L.) Desv. subsp. *chalepensis* (L.) O .E. Schulz (Brassicaceae), *Carduus nutans* L. *nutans* sensu lato (Asteraceae), *Melilotus officinalis* (L.) Desr (Fabaceae), *Sisymbrium altissimum* L. (Brassicaceae).

Osmia cephalotes Morawitz, 1870

Material: Mersin: Aydıncık, 36°24'18"N, 33°08'73"E, 1357 m, 07.VI.2009, ♀, Mut, Akpınar-Güzlek plateau, 36°41'57"N, 33°03'98"E, 1699 m, 04.VI.2009, ♀.

Recorded Plants: *Astragalus angustifolius* Lam. subsp. *pungens* (Willd.) Hayek (Fabaceae).

Osmia cerinthidis Morawitz 1876

Material: Afyonkarahisar: Dinar, Cumhuriyet, (no GPS record), 1119 m, 27.V.2009, ♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°41'57"N, 33°03'98"N, 1699 m, 04.VI.2009, 2♀♀.

Recorded Plants: *Cerinthe minor* L. subsp. *auriculata* (Ten.) Domoc. (Boraginaceae), *Medicago* sp. (Fabaceae).

Osmia dimidiata Morawitz 1870

Material: Mersin: Mut, Akpınar-Güzlek plateau, 36°39'15"E, 33°06'27"N, 1414 m, 04.VI.2009, ♂.

Recorded Plants: *Carduus nutans* L. *nutans* sensu lato (Asteraceae).

Osmia gallarum Spinola, 1808

Material: Antalya: Saklıkent, 36°53'76"E, 30°22'76"N, 1148 m, 11.VI.2009, ♀; Mersin: Mut, Akpınar-Güzlek plateau, 36°39'15"E, 33°06'27"N, 1414 m, 04.VI.2009, ♀.

Recorded Plants: *Carduus nutans* L. *nutans* sensu lato (Asteraceae), *Vicia villosa* Roth subsp. *eriocarpa* (Hausskn.) P. W. Ball (Fabaceae).

Osmia ligurica Morawitz, 1868

Material: Isparta: 37°59'06"N, 30°30'59"E, 1346 m, 04.VIII.2009, ♀, Mersin: Gülnar, 36°24'83"N, 33°29'17"E, 993 m, 22.VII.2009, ♀.

Recorded Plants: *Carduus nutans* L. *nutans* sensu lato, *Centaurea solstitialis* L. subsp. *solstitialis* (Asteraceae).

Osmia melanogaster Spinola, 1808

Material: Antalya: Korkuteli-Finike road, 36°56'58"N, 30°07'52"E, 1346 m, 10.VI.2009, ♀.

Recorded Plants: *Erodium cicutarium* (L.) L'Hèr. subsp. *cicutarium* (Geraniaceae).

Osmia melanura Morawitz, 1871

Material: Antalya: Cevizli cross, 37°03'42"N, 31°44'64"E, 1496 m, 09.VI.2009, ♀.

Recorded Plants: *Salvia tomentosa* Mill. (Lamiaceae).

Osmia mustelina Gerstaecker, 1869

Material: Afyonkarahisar: Dinar, Cumhuriyet, 27.V.2009, (no GPS record), 1119 m, 2♂♂.

Recorded Plants: *Anthemis* sp. (Asteraceae).

Osmia niveata (Fabricius, 1804)

Material: Afyonkarahisar: Dazkırı, Yukarı Yenice, 37°54'52"N, 29°50'66"E, 891 m, 12.VI.2009, ♂, Dinar, Cumhuriyet, (no GPS record), 1119 m, 27.V.2009, 9♂♂; Mersin: Mut, Akpınar-Güzlek plateau, 36°39'15"N, 33°06'27"E, 1414 m, 04.VI.2009, 2♂♂, Mut, Akpınar-Güzlek plateau, 36°41'57"N, 33°03'98"E, 1699 m, 04.VI.2009, 3♂♂, Sertavul pass., 36°51'78"N, 33°16'38"E, 1423 m, 03.VI.2009, ♂.

Recorded Plants: *Anthemis* sp., *Carduus nutans* L. *nutans* sensu lato, *Crepis alpina* L. (Asteraceae), *Medicago* sp. (Fabaceae), *Peganum harmala* L. (Zygophyllaceae).

Osmia parietina Curtis, 1828

Material: Muğla: Marmaris, 36°50’88”N, 28°06’97”E, 195 m, 04.IV.2009, 2♀♀.

Recorded Plants: *Hymenocarpus circinnatus* (L.) Savi (Fabaceae), *Ranunculus marginatus* d'Urv var. *trachycarpus* (Fisch. & Mey) Azn.(Ranunculaceae).

Osmia scutellaris (Morawitz, 1868)

Material: Adana: Seyhan, 37°02’47”N, 35°19’86”E, 91 m, 23.V.2009, ♀.

Recorded Plants: *Crepis foetida* L. subsp. *foetida* (Asteraceae).

Osmia submicans Morawitz, 1870

Material: Antalya: Yeşilbayır plateau, 36°57’22”N, 30°03’29”E, 1438 m, 10.VI.2009, ♀; Denizli: 37°48’83”N, 29°17’35”E, 429 m, 12.VI.2009, ♀; Hatay: Yayladağ, 35°55’25”N, 36°02’70”E, 450 m, 27.IV.2008, ♀; Isparta: Gönen, 37°58’36”N, 30°30’95”E, 1180 m, 04.VIII.2009, 4♀♀, 37°59’06”, 30°30’59”, 1346 m, 04.VIII.2009, ♀.

Recorded Plants: *Carduus nutans* L. *nutans* sensu lato, *Onopordum acanthium* L., *O*. *boissieri* Willk., *O*. *bracteatum* Boiss. & Heldr. var. *bracteatum*, *Picnomon acarna* (L.) Cass (Asteraceae).

Osmia viridana Morawitz, 1874

Material: Mersin: Çamalan cross, 37°11’75”N, 34°50’25”E, 810 m, 23.V.2009, ♀.

Recorded Plants: *Trigonella kotschyi* Fenzl (Fabaceae).

Protosmia tiflensis (Morawitz, 1876)

Material: Mersin: Anamur, Abanoz, 22.VII.2008, 36°20’69”N, 32°57’24”E, 1329 m, ♀.

Recorded Plants: *Phlomis nissolii* L. (Lamiaceae).

Pseudoanthidium lituratum (Panzer 1801)

Material: Antalya: Çomaklı, 37°17’06”N, 30°15’41”E, 914 m, 18.VII.2008, 3♀♀, Korkuteli, Yeşilbayır plateau, 36°58’34”N, 30°01’75”E, 1691 m, 05.VIII.2009, 2♀♀.

Recorded Plants: *Onopordum acanthium* L., *O. bracteatum* Boiss. & Heldr. var. *bracteatum* (Asteraceae).

Pseudoanthidium melanurum (Klug, 1832)

Material: Antalya: Söbüce plateau, 37°18’02”N, 30°09’91”E, 1589 m, 18.VII.2008, 3♀♀; Isparta: 38°15’37”N, 31°22’73”E, 1555 m, 03.VIII.2009, ♂; Kahramanmaraş: Andırın, 37°44’39”N, 36°20’37”E, 1281 m, 10.VII.2008, ♀.

Recorded Plants: *Cirsium arvense* (L.) Scop. subsp. *vestitum* (Wimm. & Grab.) Petr., *Onopordum carduchorum* Bornm. & Beauverd, *O. sibthorpianum* Boiss. & Heldr. (Asteraceae).

Pseudoanthidium reticulatum (Mocsáry, 1884)

Material: Antalya: Söbüce plateau, 37°18’02”N, 30°09’91”E, 1589 m, 18.VII.2008, ♂.

Recorded Plants: *Onopordum sibthorpianum* Boiss. & Heldr. (Asteraceae).

Rhodanthidium exsectum (Pasteels, 1969)

Material: Kahramanmaraş: Pehlivan plateau, 37°38'56"N, 36°55'97"E, 1624 m, 18.VII.2009, 2♂♂. New record for the region.

Recorded Plants: *Centaurea iberica* Trevir. ex Spreng. (Asteraceae).

Stelis signata (Latreille, 1809)

Material: 06.VIII.2009, 36°48'63"N, 31°55'05"E, 998 m, Antalya, 1♂.

Recorded Plants: *Scabiosa atropurpurea* L. subsp. *maritima* (L.) Arc (Dipsacaceae).

Trachusa dumerlei (Warncke, 1980)

Material: Adana: Aladağ, İbrişim, 37°33'35"N, 35°20'33"E, 682 m, 09.VII.2008, 2♀♀, Feke, 37°36'39"N, 35°50'46"E, 864 m, 09.VII.2008, 2♀♀; Burdur: 37°41'57"N, 30°21'01"E, 1187 m, 18.VII.2008, ♀; Mersin: Çamalan, 37°11'43"N, 34°48'27"E, 703 m, 08.VII.2008, 2♀♀; Osmaniye: Karatepe-Kadirli road, 37°17'46"N, 36°14'05"E, 160 m, 08.VIII.2008, ♀ .

Recorded Plants: *Centaurea solstitialis* L. subsp. *solstitialis*, *C. solstitialis* subsp. *carneola* (Boiss.) Wagenitz. *Onopordum carduchorum* Bornm. & Beauverd, *O. anatolicum* (Boiss.) Eig (Asteraceae).

Trachusa interrupta (Fabricius, 1781)

Material: Antalya: Güçlüköy, 36°47'48"N, 31°45'52"E, 374 m, 09.VI.2009, 3♀♀, ♂, 36°48'63"N, 31°55'05"E, 998 m, 06.VIII.2009, 2♀♀, ♂; Isparta: 37°59'06"N, 30°30'59"E, 1364 m, 04.VIII.2009, ♀; Mersin: Anamur, 36°07'71"N, 32°45'75"E, 128 m, 06.VI.2009, ♀, ♂, Anamur, 36°08'71"N, 32°46'87"E, 458 m, 06.VI.2009, ♀, ♂.

Recorded Plants: *Carduus olympicus* Boiss. subsp. *hypoleucus* (Bornm.) P. H. Davis (Asteraceae), *Pterocephalus plumosus* (L.) Coult *Scabiosa atropurpurea* L. subsp. *maritima* (L.) Arcang, *S. reuteriana* Boiss. (Dipsacaceae).

Trachusa laticeps (Morawitz, 1873)

Material: Mersin: Mut, Akpınar-Güzlek plateau, 25.VII.2008, 36°40'35"N, 33°03'43"E, 1786 m, ♂.

Recorded Plants: *Phlomis rigida* Labill. (Lamiaceae).

Trachusa pubescens (Morawitz, 1872)

Material: Antalya: Kaş, Sütleğen village, 36°27'45"N, 29°39'47"E, 1427 m, 10.VI.2009, ♀; Isparta: Gönen, 37°58'36"N, 30°30'95"E, 1180 m, 04.VIII.2009, ♀; Mersin: Anamur, Abanoz, 36°20'69"N, 32°57'24"E, 1329 m, 22.VII.2008, ♀, ♂.

Recorded Plants: *Phlomis grandiflora* H. S. Thomps., *P. nissolii* L. (Lamiaceae).

Ecological considerations

After a two year survey, 409 bee specimens were sampled (Figure 1.B) and a total number of 74 species belonging to 17 genera were identified (Table 1). Number of caught specimens from different genders and relative abundances of the species were given in Table 1. *Lithurgus chrysurus* seemed to be the most frequently (nearly 17%) encountered species. Moreover *Heriades crenulatus*, *Anthidiellum strigatum*, *Osmia niveata*, *Chelostoma emarginatum*, *L. cornutus* and *Megachile hungarica* have relatively higher abundances, respectively (Table 1). In general, *Megachile* and *Osmia* are the most abundant and richest genera (Table 2).

Table 1. Number of caught specimens (N: abundance) from different genders (F: female; M: male) and relative abundance of the species (N%)

Species	F	M	N%	Species	F	M	N%
Afranthidium carduele	1	2	0.73	*Megachile lagopoda*	5	2	1.71
Anthidiellum crassepunctatum	2	0	0.49	*Megachile leachella*	4	0	0.98
Anthidiellum strigatum	9	8	4.16	*Megachile lefebvrei*	3	0	0.73
Anthidium cingulatum	1	2	0.73	*Megachile maritima*	1	0	0.24
Anthidium eremicum	4	0	0.98	*Megachile melanopyga*	1	0	0.24
Anthidium florentinum	0	2	0.49	*Megachile parietina*	5	2	1.71
Anthidium loti	2	3	1.22	*Megachile pilicrus*	4	4	1.96
Anthidium manicatum	2	2	0.98	*Megachile pilidens*	5	2	1.71
Anthidium spiniventre	1	0	0.24	*Megachile pyrenaica*	0	3	0.73
Anthidium taeniatum	0	1	0.24	*Megachile rotundata*	3	0	0.73
Anthidium undulatiforme	0	1	0.24	*Megachile willughbiella*	1	0	0.24
Anthidium undulatum	1	0	0.24	*Osmia bicornis*	0	6	1.47
Anthidium wustneii	6	0	1.47	*Osmia bidentata*	9	2	2.69
Chelostoma emarginatum	10	4	3.42	*Osmia brevicornis*	3	4	1.71
Chelostoma rapunculi	1	0	0.24	*Osmia cephalotes*	2	0	0.49
Coelioxys acanthura	1	0	0.24	*Osmia cerinthidis*	2	1	0.73
Coelioxys caudata	1	0	0.24	*Osmia dimidiata*	0	1	0.24
Coelioxys haemorrhoa	3	1	0.98	*Osmia gallarum*	2	0	0.49
Coelioxys rufescens	0	2	0.49	*Osmia ligurica*	2	0	0.49
Eoanthidium judaeense	1	0	0.24	*Osmia melanogaster*	1	0	0.24
Heriades crenulatus	23	4	6.60	*Osmia melanura*	1	0	0.24
Hoplitis acuticornis	1	1	0.49	*Osmia mustelina*	0	2	0.49
Hoplitis praestans	0	1	0.24	*Osmia niveata*	0	16	3.91
Icteranthidium cimbiciforme	2	2	0.98	*Osmia parietina*	2	0	0.49
Icteranthidium grohmanni	2	2	0.98	*Osmia scutellaris*	1	0	0.24
Icteranthidium limbiferum	1	0	0.24	*Osmia submicans*	8	0	1.96
Lithurgus chrysurus	32	36	16.63	*Osmia viridana*	1	0	0.24
Lithurgus cornutus	14	0	3.42	*Protosmia tiflensis*	1	0	0.24
Lithurgus tibialis	3	8	2.69	*Pseudoanthidium lituratum*	5	0	1.22
Megachile albisecta	5	1	1.47	*Pseudoanthidium melanurum*	4	1	1.22
Megachile analis	1	0	0.24	*Pseudoanthidium reticulatum*	0	1	0.24
Megachile apicalis	12	0	2.93	*Rhodanthidium exsectum*	0	2	0.49
Megachile deceptoria	6	4	2.44	*Stelis signata*	0	1	0.24
Megachile ericetorum	1	3	0.98	*Trachusa dumerlei*	9	0	2.20
Megachile fertoni	2	0	0.49	*Trachusa interrupta*	8	4	2.93
Megachile giraudi	2	0	0.49	*Trachusa laticeps*	0	1	0.24
Megachile hungarica	10	4	3.42	*Trachusa pubescens*	3	1	0.98

Table 2. Abundance (N) from different genders (F: female; M: male), relative abundance (N%), species richness (S) of the genera

Genera	M	F	N	N%	S
Afranthidium	2	1	3	0.7%	1
Anthidiellum	8	11	19	4.6%	2
Anthidium	11	17	28	6.8%	10
Chelostoma	4	11	15	3.7%	2
Coelioxys	3	5	8	2.0%	4
Eoanthidium	0	1	1	0.2%	1
Heriades	4	23	27	6.6%	1
Hoplitis	2	1	3	0.7%	2
Icteranthidium	4	5	9	2.2%	3
Lithurgus	44	49	93	22.7%	3
Megachile	25	71	96	23.5%	19
Osmia	32	34	66	16.1%	16
Protosmia	0	1	1	0.2%	1
Pseudoanthidium	2	9	11	2.7%	3
Rhodanthidium	2	0	2	0.5%	1
Stelis	1	0	1	0.2%	1
Trachusa	6	20	26	6.4%	4
Total	150	259	409	100%	74

Fourteen provinces and 85 locations from these provinces were investigated at field studies and nearly 55 of these localities were successful in sampling which means Megachilidae species were recorded (Table 3). A total number of 27 species were recorded from Antalya and 35 species recorded from Mersin. The H_{SW} and H_B scores of these provinces were also highlighted in Table 3. Mersin province displayed the highest Shannon-Wiener and Brillouin scores (H_{SW}: 3.18; H_B: 2.69). Antalya (H_{SW}: 2.80; H_B: 2.46), and Isparta (H_{SW}: 2.75; H_B: 2.25) were followed this region, respectively in relation to diversity scores.

Table 3. Sampling (N: abunance), richness (S) and diversity scores (H_{SW}: Shannon-Wiener; H_B: Brillouin) of provinces. "Succesful Locations" are the locations that bee specimens were sampled

Provinces	N	S	Locations	Successful Locations	H_{SW}	H_B
Adana	45	14	10	5	2.32	1.95
Afyon	27	9	2	2	1.72	1.39
Antalya	99	27	16	8	2.80	2.46
Burdur	8	6	5	2	1.73	1.15
Denizli	2	2	1	1	0.69	0.35
Hatay	8	7	7	4	1.91	1.24
Isparta	43	19	7	4	2.75	2.25
Kahramanmaraş	33	18	9	6	2.38	1.85
Karaman	19	9	4	4	1.76	1.32
Kayseri	4	4	3	2	1.39	0.79
Mersin	82	35	10	8	3.18	2.69
Muğla	12	6	4	3	1.70	1.25
Niğde	4	2	3	2	0.56	0.35
Osmaniye	23	7	4	4	1.74	1.41
Total	409	165	85	55		

Seasonal flight activities of female and male individuals were evaluated separately (Figure 2) but no intense difference were observed. In addition, some species such as *Megachile parietina* and *Osmia submicans* are seem to be active from spring till late summer. Other species are seemed to be active at summer.

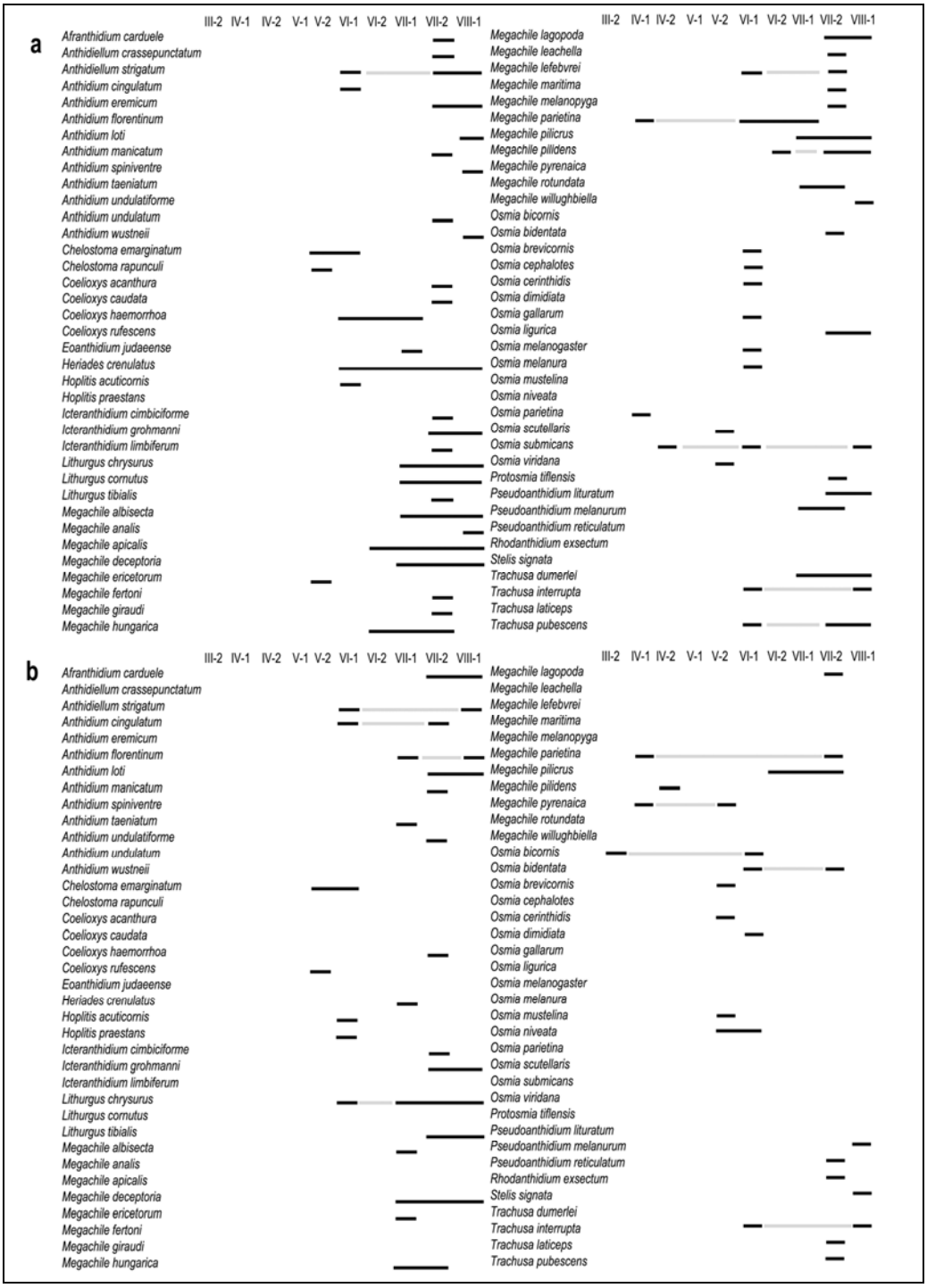

Figure 2. Seasonal activity of Megachilidae species. Each month is divided into two half and the sampling season analyzed according to these periods from second half of March (III-2) to the first part of August (VIII-1). Black line represents the presence of species; gray line represents the potential presence of the species. a: male; b: female.

In order to make more precise assumptions, the altitudes of the sampling localities were classified into 200 meters units. Figure 3 summarizes the altitude choice patterns of Megachilidae species found in the study area. Whereas, 1-200 meters range have the highest scores in respect to numbers of total stations and sampled stations, maximum value of the species richness (S: 26) was observed at 1001-1200 meters range. In general, the elevation value ranging between 800 to 1800 meters displayed high species richness for the members of the family Megachilidae captured from the study area.

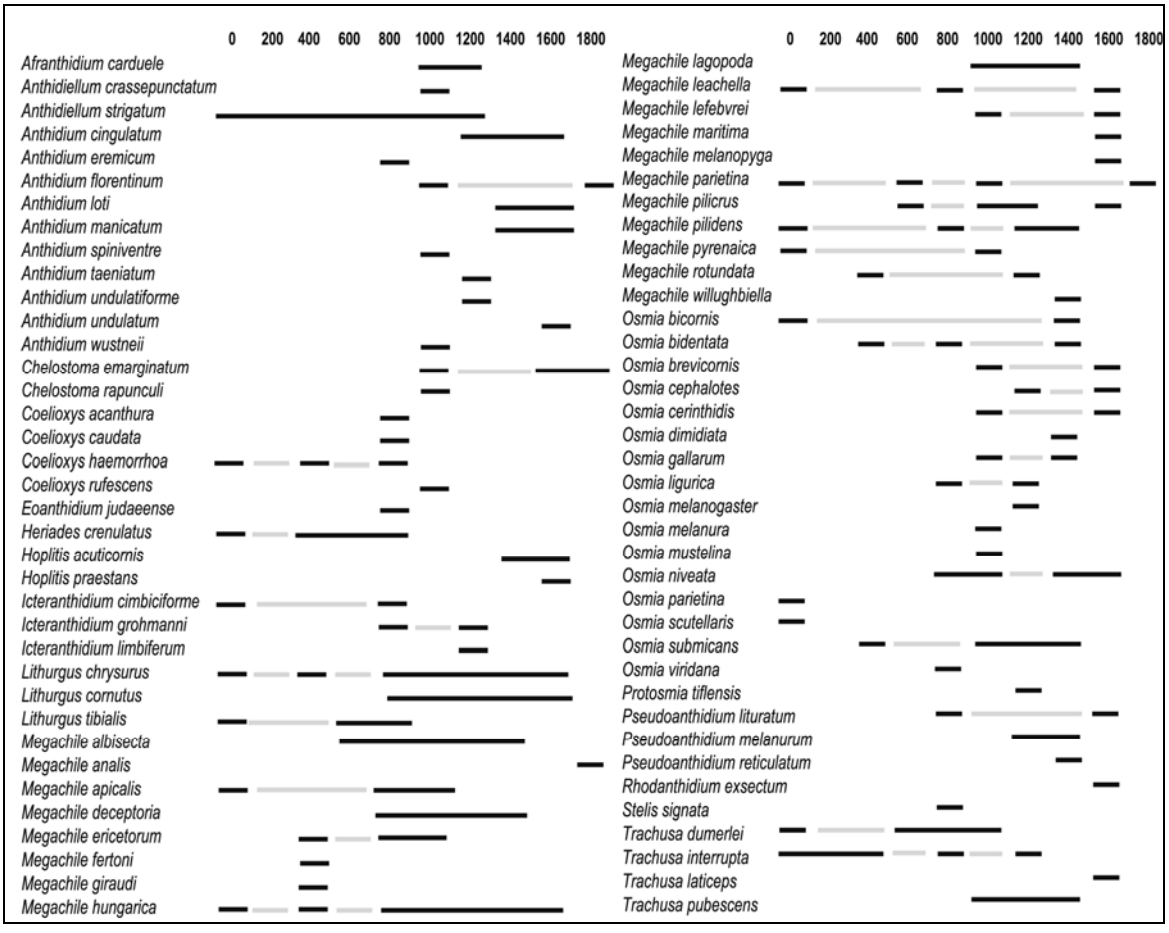

Figure 3. Altitude preference of Megachilidae spp. collected from study area. Black line represents the presence of species; gray line represents the potential presence of the species.

Seventy-one plant species were found related with bee species. Among the 74 bee species recorded in the study, 48 of them were more likely to visit Asteraceae members, 17 of them visited Fabaceae more often and 10 of them were also visited Apiaceae members, as well. Diversity analyses in relation with visitation frequencies of bees on the plant genera and species levels were summarized in Table 4 and 5. Bee species which were represented with one specimen were not included to the analyses. The highest H_{SW} scores for the plant species were recorded from *Eryngium campestre* (Table 4). Moreover *Centaurea* spp. and *Onopordum* spp. displayed higher H_{SW} scores than the other genera (Table 5). Besides, *Eryngium, Carduus, Echinops* and *Ononis* spp. were found as the other mostly visited plants.

Table 4. Brillouin (H_B) and Shannon-Wiener (H_{SW}) scores and collection frequency (Record) for the related plant taxa. The plants that had Records <5, and H_{sw} <1.60 did not added to the table

Plant species	H_{sw}	H_B	Records
Eryngium campestre	2.08	1.33	8
Centaurea iberica	1.95	1.22	7
Onopordum sibthorpianum	1.95	1.22	7
Onopordum bracteatum	1.84	1.36	20
Carduus nutans	1.79	1.10	6
Onopordum carduchorum	1.79	1.10	6
Centaurea solstitialis	1.79	1.33	21
Ononis spinosa	1.61	0.96	5

Table 5. Brillouin (H_B) and Shannon-Wiener (H_{SW}) scores and collection frequency (Record) for the related plant genera. The plants that had H_{sw} <1.60 did not added to the table

Plant genera	H_{SW}	H_B	Records
Onopordum	2.51	1.79	76
Eryngium	2.13	1.43	16
Centaurea	2.10	1.56	54
Carduus	1.83	1.29	14
Echinops	1.67	1.14	8
Ononis	1.61	1.03	5

Discussion

Seventy-four megachilid species were listed as a result of our study. Indeed this account seems to be about 50% of the actual richness of the fauna of the Mediterranean Region. In this study only 9 species were recorded from Afyonkarahisar while Güler (2011) and Güler & Dikmen (2013) reported totally 50 species from Afyonkarahisar province alone. The variability of the species accounts depends on the sampling success of the study. The more local and long term monitoring studies result in more efficient sampling and so the more species accounts. Besides, the study area covered 14 provinces and sampling success was not equal in all of these provinces. Sampling methodology was random and this is one of the most possible reasons for different sampling success. Another reason could be due to the different topologies of the provinces. These factors may effected the sampling efforts and so the number of collected individuals and species. Since, Antalya and Mersin provinces have the largest Mediterranean topography, there were more sampling localities over there and the species diversity scores were also found relatively higher than other provinces. Indeed this study did not reflected the actual megachilid diversity of the Mediterranean Region sufficiently but made contributions to the current knowledge. Two new records for Turkey and five new records for the region were determined. *Anthidiellum crassepunctatum* and *Megachile lefebvrei* were new records for Turkey and, *Coelioxys acanthura* (Illiger, 1806), *M. deceptoria* Perez 1890, *M. pilicrus* Morawitz 1877, *M. willughbiella* (Kirby, 1802) and *Rhodanthidium exsectum* (Pasteels, 1969) were new records for the Mediterranean Turkey. In addition, the distributions of *A. crassepunctatum*, *R. exsectum* and *Trachusa dumerlei* were rather restricted which were recorded from only several countries out of Turkey.

Altitude Preference

Our results do not suggest any strict altitude preferences within the inspected species but we can remark that many of them were found at medium elevations (between 800-1800 meters). Twenty three species are recorded just from one elevation range unit and they are represented with few individuals in the collection. In consideration of the previous records of these species in Turkey, it was showed that *Chelostoma rapunculi*, *Coelioxys caudata*, *C. rufescens*, *Megachile giraudi*, *Osmia mustelia* and *O. parietina* can be found till 2000 meters (Warncke 1992a; Özbek & Zanden, 1992a, 1994; Özbek, 2011, 2013; Zanden, 1989; Güler & Çağatay, 2006; Güler, 2011). *Osmia dimidiata*, *O. melanogaster* and *Trachusa laticeps* can be collected at lower elevations (850- 1251m) than recorded in there (Özbek & Zanden, 1992a; Güler & Çağatay, 2006; Güler, 2011). *Icteranthidium limbiferum*, *Megachile analis*, *M. melanopyga*, *M. willughbiella*, *Osmia viridana* and *Stelis signata* were found between 10 to 3000 meters (Zanden, 1991; Özbek & Zanden, 1992a, 1993, 1994). All of the species mentioned above can also be regarded as wide-ranging bees as well as the spcecies, *Lithurgus chrysurus*, *Megachile hungarica, M. leachella*, *M. parietina*, *M. pilidens*, *Osmia bicornis* and *Trachusa interrupta* found in this study (Figure 3).

Climatic, biological, geographical and historical factors have been suggested as the causes of variation in species richness along elevation gradients (Sanders et al., 2003). Human activity may be the main factor in decreased species richness at the low elevations especially below 800 meters in Mediterranean Anatolia. This region is one of the most important tourism areas of Turkey. Therefore, the habitat destruction, especially in the coastal areas (where elevation is generally between 0-200 m), is rather high. The second factor may be harsh climatic conditions of the region. In general, precipitation does not occur between May and September in this region. Sometimes temperatures reinforced by regional winds blowing from the Sahara can cause a sudden decrease in relative humidity to 20% and temperatures rise up to 40 °C (Atalay et al., 2008). For these reasons, while the distribution of annual mean air temperature is 17.2 °C (Ünal et al., 2003), these values in some of the coastal areas can be 21 °C (Atalay et al., 2008). These factors may limit the vegetation periods and so the suitable habitats for the bees.

The reason of the abrupt decrease of species richness over 1800 meters may be lower temperatures and limited plant diversity in comparison to the lower altitudes. Arroyo et al. (1982) suggested that a greater dependence on endotherm lifestyle of hymenopterans may cause a competitive disadvantage at higher elevations relative to dipterans and lepidopterans. In cold environments, nest building and provisioning may also be disadvantageous for bees in higher altitudes. For all of these reasons above, the altitude range between 800 to 1800 meters were found mostly suitable for Megachilidae in Mediterranean region of southern Turkey.

Seasonal Activity

According to Banaszak & Romasenko (1998), the univoltine megachilid bees are divided into three phenological groups in terms of the flight season: spring, spring - summer and summer species. For the spring species, the flight season is between April to the end of May. The spring - summer species forage from the second half of May to the end of June and the summer species have a flight period between June to the end of August (Banaszak & Romasenko, 1998). This classification is more successful in determining the summer species. When we evaluated our results according to this classification system, members of *Afranthidium*, *Anthidiellum*, *Anthidium*, *Icteranthidium*, *Lithurgus*, *Pseudoanthidium* and *Trachusa* can be considered as summer species (Figure 2). However, seasonal activities may sometimes

be overlapped or shifted due to the local conditions. It is difficult to determine whether some species is a spring or spring – summer species. For these reasons, it is important to take into consideration local conditions and local populations in evaluating such parameters. For example; *Osmia bicornis* is active between the end of March until the end of June in various locations of Turkey (Özbek & Zanden, 1992a; Güler & Dikmen, 2013). In these cases, we can consider such species in spring and spring – summer phenological group.

Plant Preference

Unlike our records, *Anthidiellum strigatum*, *A. manicatum*, *Trachusa pubescens* (Özbek & Zanden, 1993), *Anthidium loti*, *Megachile albisecta* (Özbek, 1979b), *Megachile ericetorum*, *M. giraudi* (Özbek & Zanden, 1994) were recorded from Fabaceae, *Megachile lagopoda* (Özbek, 1979b), *Megachile apicalis* and *Megachile rotundata* were recorded from Fabaceae and Lamiaceae, *Megachile pilicrus* were recorded from Lamiaceae (Özbek & Zanden, 1994), *Osmia cerinthidis* were recorded from Brassicaceae and Rosaceae (Özbek & Zanden, 1992) in Turkey before.

According to recorded plants in there and the previous studies, *Chelostoma emarginatum*, *Heriades crenulatus* and *Osmia bidentata* are oligolectic species, respectively on Ranunculaceae and Asteraceae. *Chelostoma rapunculi* and *Hoplitis praestans* were also mentioned as oligolectic species due to their preference of *Campanula* spp. (Banaszak & Romasenko, 1998; Amiet et al., 2004; Scheuchl, 2006). These species were collected on Asteracea members according to our data. However because of the fact that the sampled numbers of individuals were very few, it could be very difficult to make concrete remarks on the plant choice of these species. If we consider the data from the previously mentioned literature and our data, we can conclude that all other species are polylectics. However, the terminology that explains the relationship between the bees and the flowers sometimes is a little bit confusing according to the literature. For example according to Banaszak & Romasenko (1998) *Anthidiellum strigatum* may be oligolectic. On the contrary Özbek & Zanden (1993), Amiet et al. (2004) and Scheuchl (2006) reported this species as polylectic. Similarly, whereas, Amiet et al. (2004) and Müller (1996) reported *Trachusa interrupta* as oligolectic and forage mainly on Dipsacaceae, Özbek & Zanden (1993) and Banaszak & Romasenko (1998) reported this species as polylectic. According to our results both species are related with a wide range of plant species so they may be either oligolectic or polylectic depending on the evaluation range.

To avoid this kind of confusions we followed recent classification system proposed by Cane & Sipes (2006). In fact, using the pollen load data of bees together with the field observations would be more informative and elucidatory in categorizing the host-plant associations. However in this study we mainly focused on the general flower visitation patterns of female Megachilids of Mediterranean Turkey, and we did not deal with the categorizing the plant visitation ranges of bees.

According to these results *Eryngium campestre, Onopordum bracteatum*, *O. sibthorpianum, Centaurea solstitialis* and *C. iberica* can be regarded as mostly preferred flowers (Table 4). However, these analyzes do not suggest any strict host-plant association between the collected Megachilidae members and related plants. On the other hand, these results let us to conclude that Megachilidae species (females) prefer Asteraceae members and especially *Eryngium* sp., *Centaurea* spp. and *Onopordum* spp. (Table 5) For these reason we may also conclude that many of the Megachilidae species could be mesolectic or polylectic. These findings are also congruent with Müller (1996) and Güler & Sorkun (2007).

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