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New Data on Large Carpenter-bees of Turkey with Considerations About Their Importance as Pollinators

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ABSTRACT

This study is formed on the basis of original data and published records on approximately 210 bee samples that have been collected almost all areas of the country, since the 1960s, which is presented based on the current knowledge of the *Xylocopa* Latreille 1802 fauna of Turkey. Ten species have been recognized as occurring in Turkey. Of these, three species, *X. valga* Gerstaecker, 1872, *X. violacea* (Linnaeus, 1758), and *X. iris* (Christ, 1791) were common and abundant. *Xylocopa olivieri* Lepeletier, 1841 and *X. (Koptortosoma) pubescens* Spinola, 1838 were moderately common, those of *X. (Copoxyla) armeniaca* Warncke, 1982, *X. (Ancylocopa) parviceps* Morawitz 1895, *X. (Xylocopa) varentzowi* Morawitz, 1895, *X. (Ctenoxylocopa) fenestrata* (Fabricius, 1798), and *X. (Proxylocopa) rufa* Friese, 1901 occur in restricted areas within Anatolia and could be accepted as rare species. Update floral associations and geographical distribution were included for each species. Field studies revealed that *Xylocopa* species, particularly *X. valga, X. violacea, X. iris* and *X. olivieri* are valuable pollinators of some cultivated plants, such as apple (*Malus domestica* Borkh), pear (*Pyrus communis* L.), plum (*Prunus domestica* L.), alfalfa (*Medicago sativa* L.), sainfoin, (*Onobrychis viciifolia* Scop), red clover (*Trifolium pratence* L.), soybean (*Glycine max* L.), beans (*Phaseolus* spp.), pea (*Pisium sativum* L.), chickpeas (*Cicer arietium* L.), peanut (*Arachis hypogaea* L.), licorice (*Giycyrrhiza glabra* L.), sunflower (*Helianthus annuus* L.), and *Canthamus tinctorius* L. Furthermore, *X. pubescens* has a potential in using pollination of certain plants in enclosures.

Key words: *Apidae, Xylocopini, Xylocopa, fauna, floral associations, Turkey.*

INTRODUCTION

The subfamily Xylocopinae commonly referred to as the “carpenter bees”, comprise four tribes, Xylocopini, Ceratinini, Manuelini, and Allodapini in the family Apidae, which is one of the seven currently recognised families of bees (Engel, 2005; Michener, 2007; Michez *et al*., 2009). The first two tribes are fairly common in Turkey, although

Manuelini is not present; Allodapini is represented only by *Exoneuridia (Exoneuridia) hakkariensis* (Warncke 1983) (*Allodape libanensis* ssp. *hakkariensis)*, which was described by Warncke (1983) from Hakkari, South-East Anatolia. Terzo (1999) revised the genus *Exoneuridia* and he recognized three species, among them only *E. hakkariensis* occurs in Turkey. Terzo (1999) listed following provinces as distribution of this species: Hakkari (type locality), Bitlis, Kahramanmaraş, Mardin, Siirt, and Sivas. Xylocopini has world-wide distribution and is represented by a single genus, *Xylocopa* Latreille, 1802, the "large carpenter bees". *Xylocopa* species are common robust bees, 13 to 30 mm long, with coloration black, blue or green, ferruginous or yellow, with approximately 470 species worldwide (Michener, 2007; Terzo, 2007). Most are tropical and subtropical, though some are found further north (O'Toole and Raw, 1991). The genus *Xylocopa* is easily recognized by the large size, to which other important characteristics since to be associated with: loss of the stigma in the front wing, while the prestigma and marginal cell is particularly long (Michener, 2007). The rather short proboscis is distinctive, the parts being strongly sclerotized, the postpalpal part of the galea blade like and presumably used to cut into the corollas of tubular flowers to rob the nectar. Mandibles are powerful, although arolia is not present, the densely hairy plate projects somewhat between the claws (Michener, 2007; Terzo, 2007). In general, carpenter bees construct their nest in dead trees, branches or stems, except those that use ground as nidification substrate (species of subgenera *Proxylocopa and Ancylocopa*) (Hurd and Moure, 1963). The females excavate their own nest tunnels in wood rather than using preexisting cavities using both sound and rotten timber, preferring soft woods. Generally, a female excavates a tunnel in solid wood, usually a dead branch. The entrance tunnel may be at right angles to the grain of the wood, but the main tunnel runs along the grain. The bee may use the nest of the previous generation, clearing out the remains of cell partitions, dead bees and any remaining pollens. Several species nest in hollow stems or the culms of herbaceous plants (O'Toole and Raw, 1991 and author's personal observations).

Studies on *Xylocopa* bees in Turkey are extremely restricted; Warncke (1982) studied the *Xylocopa* bees of eastern countries, Iran, Israel and Turkey. There is no contribution specifically on *Xylocopa* bees of Turkey. However, Özbek (1980, 2008a, 2008b, 2011) and Çalmaşur and Özbek (1999) highlighted the importance of several *Xylocopa* species in the pollinations of various cultivated plants, such as alfalfa, sainfoin, sunflower, and various fruit trees.

The aim of this paper is to present the latest knowledge on Anatolian *Xylocopa* bees, their distribution, floral associations and biogeographical affinities. The present contribution is based on the material that has been collected from Anatolia, mainly the eastern region, by the author, his colleagues and students since the 1960s.

MATERIAL AND METHODS

This paper is based on the materials (a total of 215 *Xylocopa* specimens) that have been collected from almost all over the country, particularly from eastern Anatolia,

since the 1960s by the author and his colleagues in the Plant Protection Department at Atatürk University. Specimens were identified according to the keys by Warncke (1982) and Terzo *et al.* (2007) and by comparison with the preserved specimens in the Entomology Museum, Erzurum, Turkey (EMET), which were previously determined by B. Tkalcu and K. Warncke. Some undetermined specimens were determined by M. Terzo. The visited plants were identified by İ. Çoruh. The material mentioned in this study is deposited in the collection of EMET. Distribution of Xylocopa species is shown in Figs 1, 2), except *X. valga* and *X. violacea* due to being widespread and abundant species all over the country.

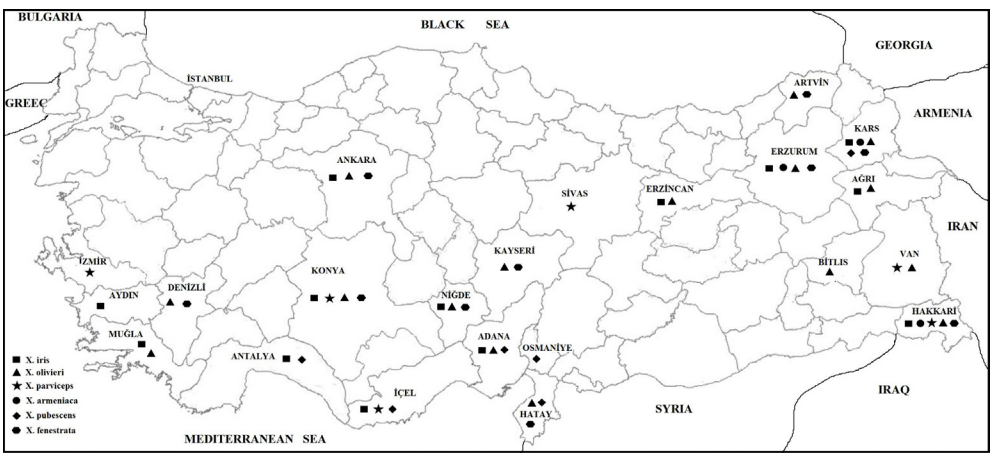

Fig. 1. Distribution of some *Xylocopa* species in Turkey.

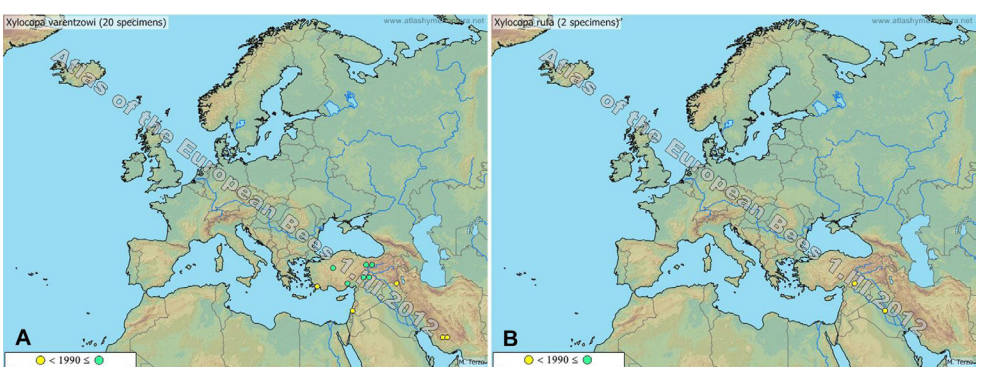

Fig. 2. Distribution of two *Xylocopa*: A. *Xylocopa (Xylocopa) varentzowi* Morawitz, 1895; B. *Xylocopa (Proxylocopa) rufa* Friese, 1901 (Terzo and Rasmont, 2011).

RESULT AND DISCUSSION

Ten species of *Xylocopa* were recognised as occurring in Turkey.

Species accounts

1. *Xylocopa (Xylocopa) valga* Gerstaecker, 1872

Distribution: Almost whole Europe, North Afrika and Asia (from Belgium and France to Mongolia and China) (Popov, 1947; Warncke, 1982; Terzo *et al.* (2007). In Turkey: Artvin, Erzincan, Erzurum, Hakkâri, Isparta, Kars, Konya, and Van (Warncke, 1982).

Material examined: Ankara, Şereflikoçhisar, Kayalıboğaz, 1 ♀, leg. Ş. Güçlü. Artvin, Yusufeli, Kınalıçam, 04.6.1978, 1 ♀; Sebzeciler, 14.08.1991, 1 ♀, leg. H. Özbek. Bingöl, 13.06.1974, 1 ♀, leg. M. Doğanlar. Erzincan, Merkez, 09.05.1982, 1 ♀, leg. Y. Kütük, 25.07.1976, 1 ♀, leg. H. Yüksel; Cevizli, 04.06.1990, 5 ♀♀, leg. H. Özbek; 19.06.1992, 1 ♀, leg. E. Yıldırım, 29.08.1991, 1 ♀, leg. R. Hayat; Pöskedağı, 31.07.1980, 1 ♀, leg. H. Özışık; Üzümlü, 23.06.1980, 5 ♀♀. Erzurum, Merkez, 06.06.1970, 1 ♀; 07.06.1971, 1 ♀; 09.06.1981, 1 ♀; 11.06.1966, 1 ♀, 11.06.1971, 2 ♀♀; 14.06.1974, 1 ♀, 14.06.1994, 1 ♀, 18.06.1966, 1 ♀, 21.06.1966, 3 ♀♀, leg. H. Özbek, 24.06.1968, 1 ♀, leg. O. Ecevit, 29.06.1972, 1 ♀, 02.07.1972, 1 ♀, 03.07.1966, 1 ♀, 03.07.1970, 1 ♀, 06.07.1968, 1 ♀, 15.07.1966, 1 ♀, leg. H. Özbek, 14.08.1971, 1 ♀, leg. M. Doğanlar, 18.09.1966, 1 ♀, 18.09.1977, 1 ♀, leg H. Özbek, 18.10.1980, 1 ♀, leg. H. Özışık; Horasan, 06.07.1972, 3 ♀♀; leg. H. Özbek; İspir, 15.06.1971, 2 ♀♀, leg. H. Özbek, 30.07.1990, 1 ♀, leg. E. Yıldırım; Oltu, 14.09.1978, 2 ♀♀; Başaklı, 20.05.1972, 1 ♂, 22.06.1977, 2 ♂♂, 01.09.1978, 1 ♂, leg. H. Özbek; Kaleboğazı, 25.06.1990, 1 ♂, 28.07.1990, 1 ♀, leg. E. Yıldırım; Pasinler, Karakoç, 06.07.1972, 1 ♀, leg. H. Özbek; Şenkaya, Turnalı, 01.07.1990, 2 ♂♂; 09.09.1990, 1 ♀, leg. E. Yıldırım; Tortum, 25.05.1972, 2 ♂♂; Bağbaşı, 22.06.1971, 1 ♀, 16.09.1972, 20.09.1977, 1 ♀, leg. H. Özbek. Eskişehir, Mihalgazi, Alpagut, 27.07.1992, 1 ♀, leg. Z. Suna. Gümüşhane, Torul, Zigana, 1800 m, 14.06.1990, 1 ♀, leg. H. Özbek. Hatay, İskenderun, Derman, 07.07.1990, 3 ♀♀, leg. H. Yılmaz. Iğdır, Merkez, 23.06.1990, 1 ♀, E. Yıldırım; Devlet Üretme Çiftliği, 25.06.1971, 1 ♀, leg. H. Özbek. İçel: Silifke, 22.06.1978, 6 ♀♀; 20.08.1987, 1 ♀, leg. H. Özbek. İzmir, Bornova, 13.04.1992, 1 ♀, leg. H. Özbek. Kars, Merkez, 10.07.1990, 1 ♀, leg. H. Taşçı. Samsun, Merkez, 15.07.1981, 1 ♂.

New localities: Ankara, Bingöl, Eskişehir, Gümüşhane, and Hatay.

Remark: The data on the material collected from Erzurum Province reveal that *X. valga* is active from May until the middle of October.

2. *Xylocopa (Xylocopa) violacea* (L. 1758)

Distribution: Almost the whole Europe, North Africa, and western Asia (Popov, 1947; Warncke, 1982; Terzo *et al*., 2007). In Turkey: Antalya, Bursa, Hakkâri, Isparta, Konya, Niğde (Warncke, 1982).

Material examined: Adana, Balcalı, 17.05.1982, 1 ♀, leg. M. Kara; Merkez, 10.09.1974, 1 ♀, leg. M. Doğanlar. Ağrı, Eleşkirt, Tahir, 25.06.1978, 1 ♀, leg. H. Özbek. Artvin, Yusufeli, Kınalıçam, 04.05.1978, 5 ♀♀; Cinnar, 900 m, 15.07.1992, 1 ♂, leg. H. Özbek. Aydın, Davutlar Milli Park, 30.06.1992, 1 ♀, 3 ♂♂, leg. H. Özbek. Bitlis, Kokarsu, 27.07.1978, 1 ♀, leg. H. Özbek. Erzincan, Cevizli, 1480 m, 04.06.1990, 2 ♀♀, leg. H. Özbek, 25.06.1978, 1 ♀, leg. R. Hayat; Kemaliye, 14.05.1981, 1 ♀, leg. H. Özışık; Sandıklı, 21.07.1984, 1 ♀, leg. H. Özışık; Tercan, Yazıören, 29.06.1980, 1 ♀, leg. H. Özbek; Muti Köprüsü, 24.09.1979, 1 ♀, leg. H. Özbek. Erzurum, merkez, 31.05.1972, 1 ♀, 06.06.1968, 1 ♀, 14.06.1971, 1 ♀, 17.06.1970, 1 ♂, 23.06.1977, 1 ♀, 26.07.1966, 1 ♀, 23.06.1977, 1 ♀, leg. H. Özbek; Atatürk Üniv., Kampus, 28.05.1990, 1 ♀, 06.06.1990, 1 ♀, leg. E. Yıldırım; İspir, 15.06.1971, 1 ♂, leg. H. Özbek; İspir Geçidi, 07.06.1980, 1 ♀; Maden Köprübaşı, 17.07.1972, 1 ♀, leg. R. Hayat; Narman, 05.07.1980, 1 ♀, Oltu, 14.09.1978, 1 ♀; Başaklı, 22.05.1972, 1 ♀; 28.05.1974, 1 ♀, leg. H. Özbek; Kaleboğazı, 28.07.1990, 1 ♂, leg. E. Yıldırım; Uzunoluk, 29.06.1980, 1 ♂, leg. H. Özbek; Olur, Süngübayır, 03.06.1991, 1 ♂, İ. Aslan; Palandöken, 2500-2800 m, 21.06.1981, 1 ♀; 5.07.1980, 2 ♀♀; Pasinler, Karaçuha, 06.07.1972, 1 ♀, leg. H. Özbek; Şenkaya, Turnalı, 25.06.1991, 1 ♂, leg. E. Yıldırım. Gümüşhane, Merkez, 19.06.1976, 2 ♀♀; Torul, Zigana, 14.06.1990, 1 ♀, leg. H. Özbek. İçel, Anamur, 03.07.1978, 1 ♀, leg. H. Özbek. İzmir, Kovancık, 18.06.1999, 1 ♀, leg. O. Ulu. Kars, Sarıkamış, 28.05.1972, 1 ♂, leg. H. Özbek. Konya,

Güneysınır, Gürağaç, 11.VIII.1997, 1 ♀, leg. M. Kesdek. Samsun, merkez, 14.VII.1981, 4 ♀♀, leg. O. Ecevit; Lâdik, Akdağ, 1550 m, 04.VII.1990, 1 ♂, leg. Ü. Avcı. Sinop, Ayancık, 23.VII.1977, 2 ♀♀, leg. H. Özbek. Trabzon, Yeşilova, 150 m, 17.VII.1995, 1 ♀, leg. M. Mazlum. Van, Kuzgunkıran, 28.VII.1975, 1 ♀, leg. H. Özbek.

New localities: Adana, Ağrı, Artvin, Aydın, Bitlis, Erzincan, Erzurum, Gümüşhane, İçel, Kars, Samsun, Sinop, Trabzon, and Van.

3. *Xylocopa (Copoxyla) iris* (Christ, 1791)

Distribution: North Africa, Albania, Austria, Belgium, Bulgaria, Croatica, Cyprus, European Rusia, France, Germany, Greece, Hungary, Italy, Macedonia, Moravia, Slovakia, Slovenia, Spain, Switzerland, Ukraine, Afghanistan, Armenia, Georgia, Kazakhstan, Iran, Israel, Tajikistan, Turkmenistan, and Turkey (Warncke, 1982; Terzo *et al*., 2007; Ascher and Pickering, 1912). In Turkey: Adana, Ağrı, Ankara, Antalya, Erzurum, Hakkâri, İçel, Kars, Konya, Muğla, Niğde (Warncke, 1982).

Material examined: Adana, Ceylan, 22.V.1992, 1 ♀, 1 ♂, leg. E. Yıldırım. Ankara, Şereflikoçhisar, Koçarlı, 05.VII.1990, 1 ♂, leg. Ş. Güçlü. Antalya, Düzlerçamı, 09.VII.1991, 2 ♀♀; Termessos, 09.VII.1991, 1 ♀, 1 ♂, leg. H. Özbek. Aydın, Davutlar Millipark, 30.VI.1992, 1 ♀, leg. H. Özbek. Erzincan, Işıkpınarı, 27.IX.1979, 1 ♂, leg. H. Özbek. Erzurum, Atatürk Üniv. Kampus, 30.VI.2007, 1 ♀, leg. J.S. Ascher, H. Özbek, J.G. Rozen; Merkez, 31.V.1972, 1 ♀, 04.VI.1970, 1 ♀, 14.VI.1971, 2 ♀♀, 25.VI.1979, 1 ♀, 26.VI.1974, 1 ♀, leg. H. Özbek, 26.VII.1976, 1 ♀, 20.VIII.1966, 1 ♀, 12.IX.1976, 1 ♂, leg. H. Özbek; İspir, 30.VI.1990, 1 ♀; 20.VII.1990, 1 ♀, leg. E. Yıldırım; Oltu, 14.IX.1978, 1 ♀, leg. H. Özbek; Şenkaya, Turnalı, 25.VI.1991, 2♀♀, leg. E. Yıldırım. Hakkâri, Kaval Vadisi, 1300 m, 20.VII.1992, 1 ♀, leg. W. De Prins.

New localities: Aydın and Erzincan.

Remark: Terzo and Rasmont (1997) presented a revision of the carpenter bee of the subgenus *Copoxyla* Maa, 1954 from the circum-mediterranean countries. They concluded that two species of *Copoxyla* occured in this area: *X. armeniaca* Warncke, 1992 and *X. iris* (Christ, 1791). *Xylocola iris* has three subspecies namely, *X. iris iris* (Christ, 1791), *X. uclesiensis* Perez, 1901, and *X. cupripennis* Smith, 1874. Acording to the map they prepared, *X. iris iris* has very large distribution range, from Eorope to western Asian. In Turkey it occurs almost over the country, that of *X. iris uclesiensis* has widespread distribution in Iberian Peninsula, in Turkey it has been recorded only in one or two localities in the costal area of Aegean Region. *Xylocopa iris cupripennis* has not present in Turkey, occurs in North Africa (Terzo and Rasmont, 1997)

4. *Xylocopa (Copoxyla) armeniaca* Warncke, 1982

Distribution: Armenia and Turkey (Warncke, 1982). In Turkey: Hakkari and Kars (Warncke, 1982).

Note: Warncke (1982) described the subspecies, *X. turanica* ssp. *armeniaca* (Holotype: Suvari-Halil Geçidi, Hakkari, Turkey; Paratype: Monastero Gherard, Armenia). Although he collected just two samples (1 ♀, 1 ♂) from only one location in Armenia and, 33 specimens from various localities in Hakkâri, unfortunately, he named as "*armeniaca*". In addition of Hakkâri Warncke collected one 1 ♂ in Karakurt, Kars.

Material examined: Erzurum, Karagöbek, 2200 m, 05.08.1989, 1 ♂, leg. H. Özbek; İspir, Madenköprübaşı, 1700 m, 18.06.1994, 1 ♂, leg. İ. Aslan.

Remark: the data presented reveal that *X. armenica* is not a wide spread species either in Turkey or other parts of the world. Erzurum Province is new record and is westernmost distribution point for this species (Fig. 1). Furthermore, contrary to certain other *Xylocopa* members, it is a mountainous species and lives at higher altitudes, at least above 1500 m elevation.

New locality: Erzurum.

5. *Xylocopa* (*Ancylocopa*) *parviceps* Morawitz, 1895

Distribution: Afghanistan, China, Iran, Kyrgyzstan, Tajikistan, Turkey, Turkmeanstan (Warncke, 1976, 1982; Terzo and Rasmont, 2011; Ascher and Pickering, 2012). In Turkey: Hakkâri, İçel, Konya, Sivas, Van (Warncke, 1976, 1982).

Material examined: Hakkâri, Kaval Vadisi, 1300 m, 20.07.1992, 1 ♀, leg. W. DePrins. İçel, Gülnar, 20.07.1990, 4 ♀♀, leg. H. Kocabey. İzmir, Bornova, 15.06.1983, 1 ♂, leg. H. Özbek.

New locality: İzmir.

6. *Xylocopa* (*Proxylocopa*) *olivieri* Lepeletier, 1841

Distribution: Albania, Greece, Cyprus, Macedonia, Crete, Azerbaijan, Iran, Kyrgyzstan, Turkmenistan, Israel, Syria, Iraq, and Turkey (Warncke, 1982; Ascher and Pickering, 2012). In Turkey: Ağrı, Ankara, Artvin, Denizli, Erzurum Hakkari, Hatay, Kars, Kayseri, Konya, Niğde, Van (Warncke, 1982).

Material examined: Adana: merkez, 14.06.1976, 1 ♀, leg. M. Doğanlar. Antalya, merkez, 10.09.2009, 2 ♀♀, leg. H. Özbek. Bitlis, merkez, 27.05.1989, 1 ♀,1 ♂, leg. H. Özbek. Erzincan, merkez, 17.07.1982, 1 ♀, leg. H. Özbek; Tercan, Yazıören, 29.07.1980, 1 ♀, leg. H. Özbek. Erzurum, Oltu, 25.06.1971, 1 ♂, 14.09.1978, Başaklı, 15.07.1989, 1 ♀, leg. H. Özbek; Pasinler, 10.07.2007, 1 ♀, leg. J. S. Ascher, H. Özbek, J. G. Rozen; Tortum, Pehlivanlı, 26.06.1990, 2 ♀♀, leg. E. Yıldırım. Konya, Merkez, 09.07.1995, 1 ♀, leg. A. Dündar. Muğla, merkez, 28.08.1983, 1 ♀, leg. H. Padem. Van, Çatak, 18.08.1992, 1 ♀, leg. Poorten.

New localities: Adana, Antalya, Bitlis, Erzincan, and Muğla.

7. *Xylocopa (Koptortosoma) pubescens* Spinola, 1838

Distribution: Turkey, Afghanistan, India, Iran, Israel, Syria, Pakistan, Nepal, Burma, Weast Bengal, Algeria, Egypt, Ethiopia, Senegal, Sudan, Kenya, Morocco, Mozambique, and Tanzania (Warncke, 1982; Ascher and Pickering, 2012). In Turkey: Hatay (Warncke, 1982).

Material examined: Adana, merkez, 10.09.1974, 1 ♀, 6 ♂♂, leg. M. Doğanlar, 05.11.1987, 1 ♀, leg. A. Timuroğlu; Kozan, 04.8.1996, 1 ♂, leg. N. İlbasmış. Antalya, merkez, 03.10.2005, 1 ♀, leg. H. Özbek. İçel, Silifke, Boğusak, 22.06.1978, 1 ♀; 20.08.1987, 1 ♀; 03.09.1987, 1 ♀, leg. H. Özbek. Kars, Karakurt, 10.08.1990, 1 ♀, 3 ♂♂, leg. H. Taşçı. Osmaniye, Merkez, 22.08.1984, 1 ♀, leg. M. Işık.

New localities: Adana, Antalya, İçel, and Kars.

Remark: *X. pubescens* has distribution in South Asia and Africa, Turkey (Kars) is the northernmost distribution range of it (Fig. 1).

Xylocopa species that material has not been collected but known from Turkey

8. *Xylocopa (Xylocopa) varentzowi* Morawitz, 1895

Distribution: Afghanistan, Iran, Israel, Turkmenistan, and Turkey (Terzo and Rasmont, 2011; Ascher and Pickering, 2012). From the map prepared by Terzo and Rasmont (2011) reveals that *X. varentzowi* has moderately distributed in Turkey and mostly recorded from eastern part of the Central Anatolia. They noted 20 specimens (Fig. 2).

9. *Xylocopa (Ctenoxylocopa) fenestrata* (Fabricius, 1798)

Ascher and Pickering (2012) listed following countries as distribution areas of this species: Afghanistan, Iraq, Iran, Pakistan, India, Burma, Nepal, Sri-Lanka, Burma, Nepal, China, Madagascar, Maritius, and Reunion. Turkey is not listed among these countries. Additionally, Terzo and Rasmont (2011) quoted following data from Maa, 1970: "widespread in Western Oriental Region and penetrating into part of Palaearctic Region, very common in lowlands in India; at present known from NE Arabia (Muscat), Iraq (Assur), Iran, W. Pakistan, Kashmir, India, Maldive Is., Ceylon, Andaman Is., E. Pakistan and Burma. The western- and northernmost limits of the known range are Iraq: Assur and Kashmir: Srinagar, respectively." However, Warncke (1982) noted that he recorded this species in Ankara, Artvin, Denizli, Erzurum, Hakkari, Hatay, Kars, Kayseri, Konya, and Niğde as *X. lunata* Klug, 1807 (Fig.1), which is a synonym of *X. fenestrata.*

***10. Xylocopa (Proxylocopa) rufa* Friese, 1901**

Distribution: Warncke (1982) listed Kaukasus, Turkestan, Pakistan, Iran, Sudan, and Israel. Ascher and Pickering (2012) added Armenia, Turkmenistan, Kyrgyzstan, Tajikistan, India and China. The map prepared by Terzo and Rasmont (2011) shows that *X. rufa* occurs rarely in the Southeast Anatolia (Fig. 2).

Present study revealed that material has been collected for seven species of *Xylocopa* occurring in Turkey. From the literature records we recognized that *X. varentzowi, X fenestrata,* and *X. rufa* also present in Turkey. Thus ten species of *Xylocopa occure* in Turkey. Additionally, *X. (Xylocopa) iranica* Maa, 1954 presents in Iran that of *Xylocopa (Proxylocopa) versicolor* Alfken 1930 in Armenia (Terzo and Rasmont, 2011). I believe that these two species theoretically could well be found in Turkey. Of course, Turkey, particularly the eastern part, should be searched more intensively.

***Xylocopa* bees as pollinators of cultivated and wild plants**

Agricultural pollination is the first indispensable step in a process that results in the production of fruit, vegetables, nuts and seeds. Thus agriculture is highly dependent on insect pollination (McGregor, 1976; Free, 1993; Cunningham *et al*., 2002). Wild bees are of enormous ecological and economical importance as pollinators of many cultivated and wild plants, and are thought to account for 75% of crop pollination requirements (Nabhan and Buchmann, 1997) hence they are often termed a keystone species (O'Toole, 1993). Only a dozen bee species are managed for pollination worldwide (Kremen *et al*., 2002); in contrast, somewhere between hundreds and

thousands of the world's more than 20,000 wild bee species contribute to crop pollination as unmanaged populations (McGregor, 1976; Corbet *et al*. 1991, Free, 1993; Roubik, 1995; Nabhan and Buchmann, 1997). However, it has often been observed that alternative bee species are either somewhat greatly more efficient than the most widely-used managed pollinator, *Apis mellifera* L. in a variety of crops (e.g. alfalfa, blueberry, cranberry, sunflower, watermelon, tomayto and many others) (Parker *et al*., 1987; Kevan *et al*., 1990).

The species of the genus *Xylocopa* are shown to be strongly polylectic but show a clear preference for the families: Fabaceae, Lamiaceae, and Asteraceae (Terzo *et al*., 2007). Among the *Xylocopa* bees recorded, *X. valga* (20-28 mm), *X. violacea* (19-24 mm), and *X. iris* (14-16 mm), the first two species are particularly large, abundant and widespread bees. Apart from these, particularly the females are much-longer lived than those of other solitary bees; they usually survive long enough to see their own offspring become adult and some interact socially with their progeny (O'Toole and Raw, 1991). Evidently, these are advantages for *Xylocopa* bees as pollinators. Keasar (2010) noted that their foraging is characterised by a wide range of food plants, a long season activity, tolerance of high temperatures, and activity under low illumination levels. These traits make them attractive candidates for agricultural pollination in hot climates, particularly in greenhouses, and of night-blooming crops. These bees have demonstrated efficient pollination services in passionflowers, blueberries, greenhouse tomatoes and melons. The current challenges to the commercialization of these species lie in the difficulties of mass-rearing *Xylocopa* and in the high levels of nectar robbing exhibited by these bees.

Some plants in the family Fabaceae are important agricultural plants in Turkey including alfalfa (*Medicago sativa* L.), sainfoin (*Onobrychis viciifolia* Scop), red clover (*Trifolium pratence* L.), and other *Trifolium* species, soybean (*Glycine max* L.), beans (*Phaseolus* spp.), pea (*Pisium sativum* L.), chickpeas (*Cicer arietium* L.), peanut (*Arachis hypogaea* L.), and liquorices (*Giycyrrhiza glabra* L.). While a *Xylocopa* bee is collecting nectar from leguminous plants, its weight depressed the keel and released stigma and anthers contacted by its abdomen. In my field works I recognized that *X. valga, X. violacea, X. iris* and *X. olivieri* visited the above mentioned plants frequently and play an important role in their pollination.

Furthermore, the climatic conditions and topographical structure of Turkey is extremely suitable for good quality temperate regional fruits: apple (*Malus domestica* Borkh), pear (*Pyrus communis* L.) and plum (*Prunus domestica* L.). Most cultivars of apple, pear, plum, sweet cherry (*Prunus avium* L.), and almond (*Prunus dulcis* (Miller) D.A. Webb are self-unfruitful. Therefore, cross-pollination is usually the most yield-limiting factor in the growing of these plants. *Xylocopa* species are strong and fast flying bees that can fly long distances and mostly visit the flowers on the upper parts of these trees. I observed that *X. valga, X. violacea, X. iris* and *X. olivieri*, particularly the first two species, are usually abundant in the orchards near villages and adjacent to wooded areas. The orchards along the course of the Çoruh River and its branches are good examples for this particular phenomenon; apart from the

abundance of various kinds of trees and bushes in the area, growers mostly used wood, particularly poplar trees, in the constructions of their buildings and fences. I observed that all these are very attractive nesting sites for these bee species. I detected many active nests of *X. valga* and *X. violacea* in this area. Although peach and nectarine (*Prunus persica* L.), apricot (*Prunus armeniaca* L.), and sour cherry (*Prunus cerasus* L.) are largely self-fruitful. *Xylocopa* bees also visit these plants. I assume that even self-fruitful species and cultivars benefit from bee pollination. Additionally, *X. valga, X. violacea, X. iris* and *X. olivieri* visit sunflower (*Helianthus annuus* L.) and safflower (*Canthamus tinctorius* L.), which are commonly cultivated plants in the family Compositae in the country.

Currently, a couple of *Xylocopa* species have potential in the pollination of some plants in enclosures: *X. pubescens* is multivoltine, and may produce four-five generations per year. Females are extremely long lived and may be reproductively active for up to 120 days (Gerling *et al*., 1981). In natural habitats, *X. pubescens* foragers feed on a wide variety of flower species, and remain active at temperatures of up to 40^{o}C (Gerling *et al*., 1989). This heat resilience makes *X. pubescens* an attractive candidate pollinator for greenhouses in hot climates, where temperatures often exceed the thermal window of honeybees and bumblebees (Corbet *et al*., 1993). In an experiment: *X. pubescens* and honeybees were used in the pollination of honeydew melon (*Cucumis melo* L.). Visit durations per flower were shorter for *X. pubescens* than for honeybees. Pollination by both species of bees resulted in similar fruit mass and seed numbers, but *X. pubescens* pollination increased the fruit set threefold as compared to honeybee pollination (Sadeh *et al*., 2007). They concluded that *X. pubescens* can effectively pollinate melons in enclosures.

In the present study, in addition to the cultivated plants, *Xylocopa* species, were recorder visiting many wild plants:

Xylocopa valga and *X violacea*: *Eryngium campestre* L*., E. creticum* Lam., *Arctium minus* (Hill) Bernh., *Carduus acanthoides* L., *C. nutans* L., *Centaurea glastiflia* L., *C. macrocephala* Muss., *Cirsium arvence* (L.) Scop, *Echinops* spp., *Taraxacum* spp., *Tragopogon aureus* M. Bieb., and *T. buphthalmoides* (D.C.) Boiss. (Asteraceae); *Anchusa azurea* Miller, *Cerinthe minor* L. (Boraginaceae); *Cardamine uliginosa* M.Bieb., *Sinapis arvensis* L. (Brassicaceae); *Convolvulus arvensis* L. (Convolvulaceae); *Euphorbia* spp. (Euphorbiaceae); *Astragalus adustus* Bunge, *A. alyssoides* Lam., *A. andrachneifolius* Fenzl, *A. aureus* Wild., *A. baibutensis* Bunge, *A. bicolor* Lam., *A. cylindraceus* DC., *A. idae* Sirj., *A. lagurus* Wild., *A. ponticus* Pallas, *Glycyrrhiza glabra* L.,*Hedsyarum elegans* Boiss.and Huet, *Melilotus alba* Dest., *M. officinalis* (L.), *Onobrychis altissima* Grooh., *O. cana* Boiss., *Trifolium ambiguum* M.Bieb., *T. montanum* L., *T. repens* L., *Vicia canescens* Lab., and *V. cracca* L.(Fabaceae); *Salvia* spp., *Stachys* spp., *Thymus* spp., and *Lavatera punctata* All. (Lamiaceae); *Pedicularis caucasica* M. Bieb., *P. comosa* L. (Scrophulariaceae); *Vitex agnus-castus* (Verbanaceae).

Xylocopa iris: *Anchusa azurea, Astragalus alyssoides, A. bicolor, Glycyrrhiza glabra, Melilotus alba, M. officinalis), Onobrychis altissima, O. cana, Trifolium*

ambiguum, T. montanum, T. repens, Vicia canescens, V. cracca, Vitex agnus-castus, Centaurea solstitialis

Related to this Vicidomini (2007) noted that *X. violacea* is the most widespread Xylocopini species of Italy and Europe, it forages on 742 species and varieties of plants belonging to 85 families.

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