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Overview of the Distribution and Biogeography of Sapygidae (Hymenoptera: Aculeata) in Turkey

Erol YILDIRIM

Abstract

Faunistic and systematic studies on Sapygidae of Turkey are reviewed and the distribution and biogeography of the Turkish sapygid fauna is analyzed. In this study, one species in one genus of Fedtschenkiinae and 14 species in five genera of Sapyginae are recorded. In total, 15 species belonging to six genera of Sapygidae are recorded from Turkey. Among them, the type localities of six species of Sapygidae are located in Turkey. Furthermore, three species comprising 20% of Turkish Sapygidae are endemic. Species composition, diversity and proportion of endemism varies considerably between the biogeographic subregions of the country.

Zusammenfassung

Vorliegende Arbeit gibt den Stand der faunistischen und systematischen Erforschung der Sapygidae (Hymenoptera) der Türkei wieder. Nachgewiesen sind bisher eine Art der Unterfamilie der Fedtschenkiinae sowie 14 Arten der Sapyginae, die sich auf 6 Gattungen verteilen. Unter diesen Arten haben 6 Arten ihren locus typicus in der Türkei, drei Arten (20 %) gelten als endemisch. Verteilung und Häufigkeit variieren entsprechend der reichhaltigen biogeografischen Gliederung des Landes.

Introduction

The small family Sapygidae includes about 30 species of seven genera of subfamilies Fedtschenkiinae and Spyginae from the Palaearctic region (KURZENKO & GUSENLEITNER 1994) and 10 species of four genera of subfamily Sapyginae from Europe (GUSENLEITNER 2013). This family is a widespread family that is absent from the Australian region and contains 66 recent species in 12 genera and two subfamilies (Fedtschenkiinae and Sapyginae) (AGUIAR et al. 2013). Adults are generally predominantly black, often marked with yellow or white. All species are solitary. The larvae are cleptoparasitoids or ectoparasitoids of the larvae of Megachilidae, Anthophoridae and Eumeninae, pupation occurring within the cell constructed by the host (GOULET & HUBER 1993).

Biogeography is the branch of biology that studies the geographical distribution of animals and plants. Biogeographic regions are usually defined separately for floral and faunal communities and are largely restricted to the terrestrial areas of the Earth. Turkey is generally divided into seven geographical regions. These geographical regions were separated according to their climate, location, flora and fauna, human habitat, agricultural diversities, transportation, topography and so on. Four regions were named after the seas bordering them; the Aegean Region, the Black Sea Region, the Marmara Region and the Mediterranean Region. The other three regions were named in accordance with their location in the whole of Anatolia; Central, Eastern and Southeastern Anatolia Regions (Fig. 1). Turkey is a mountainous mass averaging about 1.000 meters in height. The topographic and climatic structure give the country the opportunity to host a rich and diverse fauna. Turkey is one of the most interesting countries from the point of view of Hymenoptera taxonomy and biogeography (YILDIRIM et al. 2014).

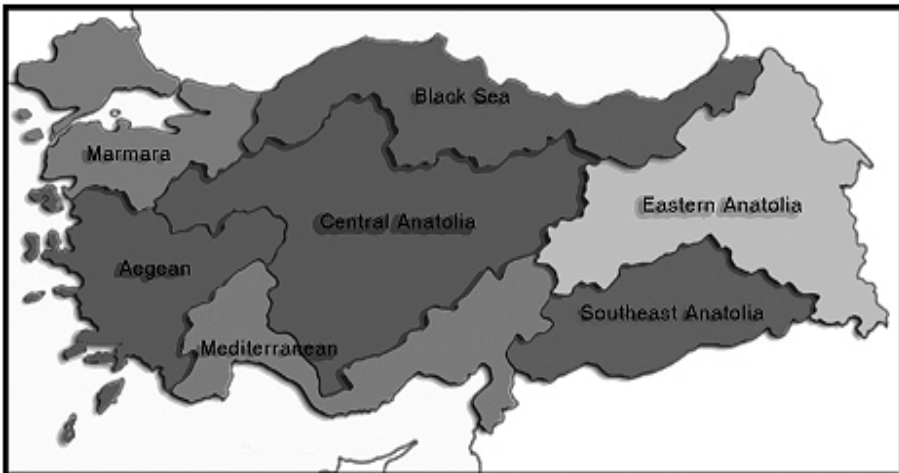


Fig. 1: Biogeographical map of Turkey (1/3.200.000) (from: YILDIRIM & LELEJ 2012).

Turkey occupies Asia Minor between the Mediterranean Sea and the Black Sea and stretches into continental Europe. It has been known to possess a rich fauna of Sapygidae (YILDIRIM & GUSENLEITNER 2001). Sapygid fauna in Turkey is very rich also in comparison to others countries of the Mediterranean region. Thus, some faunistic and systematic studies about the family Sapygidae have been conducted by both foreign and native researchers in Turkey. However, no attempt has been undertaken to evaluate the distribution and biogeography of Sapygidae in Turkey. Yet, such a study is essential for researchers who are interested in Sapygidae in West Palaearctic region including Turkey.

In this paper, the publications on the Sapygidae in Turkey were reviewed (KURZENKO & GUSENLEITNER (1994), GUSENLEITNER (1996, 1997) and YILDIRIM & GUSENLEITNER (2001, 2004)) and the biogeography of the Turkish fauna of Sapygidae have been analyzed.

Materials and Methods

In this paper, the previous publications on the Sapygidae of Turkey are reviewed and the distribution and biogeography of the Turkish fauna of Sapygidae has been analyzed. In the following text, the species whose type localities are in Turkey are marked with an asterisk (*), and the endemic species are indicated as such. Faunal similarities between biogeographical regions of Turkey were evaluated, without regard to differences in region area by using Sorensen's coefficient of similarity (see LEGENDRE & LEGENDRE 1998). The similarity matrix resulting from pair-wise calculations was then subjected to unweighted arithmetic average clustering (UPGMA; PAST program, version 1.57, HAMMER et al. 2006).

Result and Discussion

As a result, one species in one genus of Fedtschenkiinae and 14 species in five genera of Sapyginae are recorded. In total, 15 species in six genera of Sapygidae are recorded from Turkey. Among them, the type localities of six species of Sapygidae are located in Turkey. Furthermore, three species comprising 20% of Turkish Sapygidae are endemic (Table 1, 2, 3).

Table 1. The number of Turkish Sapygidae by genera

Family	Subfamily	Genus	Number of species	Number of type localities situated in Turkey	Number of endemic species
Sapygidae	Fedtschenkiinae	<i>Fedtschenkia</i>	1	-	-
	Sapyginae	<i>Asmisapyga</i>	1	1	-
		<i>Monosapyga</i>	1	-	-
		<i>Sapyga</i>	8	3	1
		<i>Sapygina</i>	3	2	2
		<i>Polochrum</i>	1	-	-
	Total	6	15	6	3

Table 2: Distribution of Sapygidae in Biogeographic Regions of Turkey.

Names of taxa	EA	SA	BS	CA	MD	A	M
<i>Fedtschenkia</i> ANDRE, 1903							
<i>Fedtschenkia</i> SAUSSURE, 1880							
<i>Fedtschenkia grossa</i> SAUSSURE, 1880	-	-	-	-	+	-	-
<i>Sapygina</i> PATE, 1947							
<i>Asmisapyga</i> KURZENKO, 1994							
* <i>Asmisapyga warnckei warnckei</i> KURZENKO, 1994	+	-	-	+	-	-	-
<i>Monosapyga</i> PIC, 1920							
<i>Monosapyga clavicornis</i> (LINNAEUS, 1758)	+	-	+	-	+	-	-
<i>Sapyga</i> LATREILLE, 1796							
* <i>Sapyga (Polosapyga) singla</i> KURZENKO, 1994	+	-	-	-	-	-	-
<i>Sapyga (Sapyga) caucasica schevyrevi</i> MORAWITZ, 1889	+	-	+	-	-	-	-
* <i>Sapyga (Sapyga) gusenleitneri</i> KURZENKO, 1994	+	+	+	-	+	-	-
<i>Sapyga (Sapyga) morawitzi</i> TURNER, 1911	+	+	-	+	+	-	+
* <i>Sapyga (Sapyga) mutica</i> KURZENKO, 1994	-	-	-	+	+	-	-
<i>Sapyga (Sapyga) pulcherrima</i> MORAWITZ, 1894	+	-	+	+	+	-	-
<i>Sapyga (Sapyga) quinquepunctata</i> (FABRICIUS, 1781)	+	+	+	+	+	-	+
<i>Sapyga (Sapyga) similis</i> (FABRICIUS, 1793)	+	-	-	-	-	-	-
<i>Sapygina</i> A. COSTA, 1887							
<i>Sapygina decemguttata</i> (JURINE, 1807)	+	+	+	+	+	-	-
* <i>Sapygina maloasiatica</i> KURZENKO, 1994	-	-	-	-	+	-	-
* <i>Sapygina schwarzi</i> KURZENKO, 1994	+	-	-	-	-	-	-
<i>Polochrum</i> SPINOLA, 1805							
<i>Polochrum repandum</i> (SPINOLA, 1805)	+	-	+	-	-	-	-
Total species	12	4	7	6	9	0	2

R e m a r k s : EA- Eastern Anatolia, SA- Southeastern Anatolia, BS- Black Sea, CA- Central Anatolia, MD- Mediterranean, A- Aegean, M- Marmara.

There are great differences in species composition and richness between the biogeographic regions of Turkey (Table 2, Fig. 2). In this study, 12 species of the Sapygidae have been recorded from Eastern Anatolia (80% of the recorded species), nine species from Mediterranean (60%), seven species from Black Sea (47%), six species from Central Anatolia (40%), four species from Southeastern Anatolia (27%), two species from Marmara (13%). There are not recorded species from Aegean region. The diversity of species (12) and genera (5) is highest in the Eastern Anatolia region.

The cluster analysis of faunal similarities on Sapygidae among six biogeographical regions of Turkey (there are no recorded species from Aegean region) produce two major clusters (Fig. 3): Black Sea and Eastern Anatolia (similarity 0.74, bootstrap probability 68%) and Central Anatolia and Mediterranean (similarity 0.66, bootstrap probability 37%)

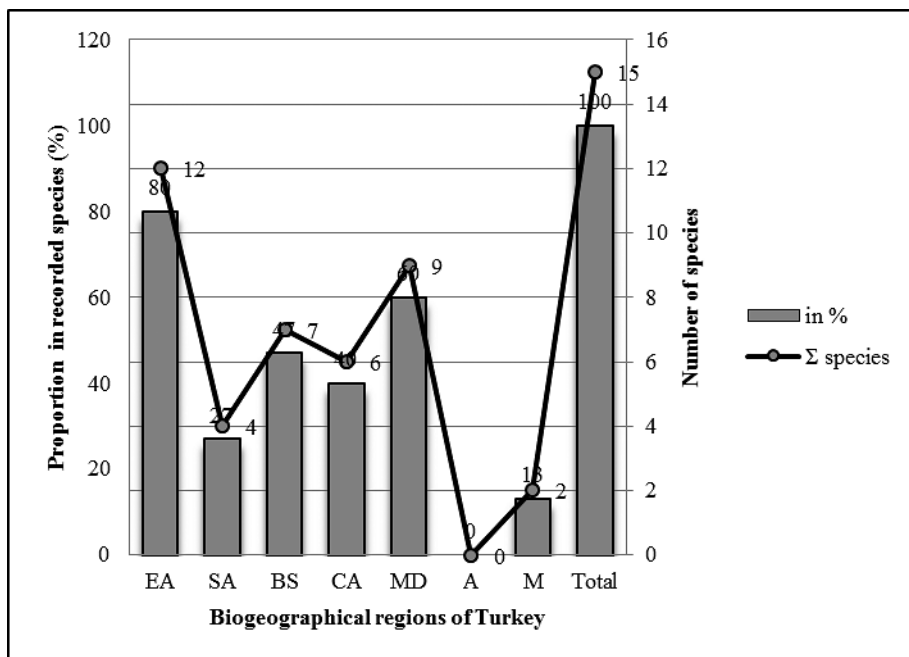


Fig. 2: Number of species of Sapygidae in the biogeographical regions of Turkey.

Remarks : EA- Eastern Anatolia, SA- Southeast Anatolia, BS- Black Sea, CA- Central Anatolia, MD- Mediterranean, A- Aegean, M- Marmara.

which form united cluster (similarity 0.54, bootstrap 27%). Aegean (similarity 0.59, bootstrap probability 31%). Marmara, this united large cluster belongs to East Mediterranean province of Palaearctic (the division of Palaearctic follows SEMENOV-TIAN-SHANSKIJ 1935). Third cluster (Southeast Anatolia and Marmara, the latter due to minimal number of species) demonstrates minimal similarity (0.48) with other Turkish fauna. The isolation of Southeast Anatolia is caused by belonging of this region to Sumerian province of Palaearctic (Syrian province of Sethian Region according to EMELJANOV 1974). In other cluster analyses (Mutillidae, Pompilidae, Vespidae) (YILDIRIM & LELEJ 2012) Southeast Anatolia has minimal similarity (0.2, 0.45, and 0.3 respectively) with other Turkish fauna. Eastern Anatolian and Black Sea faunas have highest similarity (0.74) and include most of the Sapygidae species occurring in Turkey. The ordination of the six biogeographical regions of Turkey in the reduced space of the first two principal coordinates for 15 species of Sapygidae see Fig. 4.

As a result, a total of 15 species of six genera belonging to two subfamilies Fedtschenkiinae and Sapyginae of Sapygidae were recorded from Turkey. Among them, the type localities of six species (*Asmisapyga warnckei warnckei* KURZENKO, 1994; *Sapyga gusenleitneri* KURZENKO, 1994; *S. mutica* KURZENKO, 1994; *S. singla* KURZENKO, 1994; *Sapygina maloasiatica* KURZENKO, 1994 and *S. schwarzi* KURZENKO, 1994) in Sapygidae are situated in Turkey. Moreover, three species are endemic. They are *Sapygasingla*, *Sapygina maloasiatica*, and *S. schwarzi* are considered to be endemic (Table 2, 3). Separately, the following species have been found to be the most abundant

and widespread (Table 2): *Sapyga morawitzi* TURNER, 1911; *S. quinquepunctata* (FABRICIUS, 1781) and *Sapygina decemguttata* (JURINE, 1807).

There are great differences in endemic species composition and richness between the biogeographic regions of Turkey (Table 3). In this study, two species Sapygidae have been recorded from Eastern Anatolia, and one species from Mediterranean region.

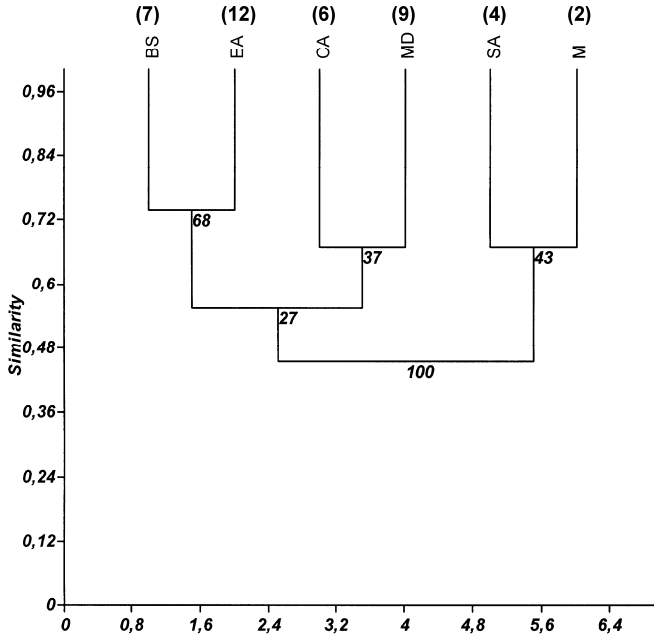


Fig. 3: Similarity of 15 species of Sapygidae from six biogeographical regions of Turkey (there are no recorded species from Aegean region) (Dice, $r = 0.66$). Bootstrap probabilities (10000 replies, expressed in percentages) are indicated at node of each cluster. Names of regions: BS – Black Sea, CA – Central Anatolia, EA – Eastern Anatolia, M – Marmara, MD – Mediterranean, SA – Southeastern Anatolia. Number of the species is given in the brackets above the names of regions.

Table 3: Distribution of endemic species in Biogeographic Regions of Turkey.

Names of taxa	EA	SA	BS	CA	MD	A	M
<i>Sapyga (Polosapyga) singla</i> KURZENKO, 1994	+	-	-	-	-	-	-
<i>Sapygina maloasiatica</i> KURZENKO, 1994	-	-	-	-	+	-	-
<i>Sapygina schwarzi</i> KURZENKO, 1994	+	-	-	-	-	-	-
Total species	2	-	-	-	1	-	-

Remarks: EA- Eastern Anatolia, SA- Southeastern Anatolia, BS- Black Sea, CA- Central Anatolia, MD- Mediterranean, A- Aegean, M- Marmara.

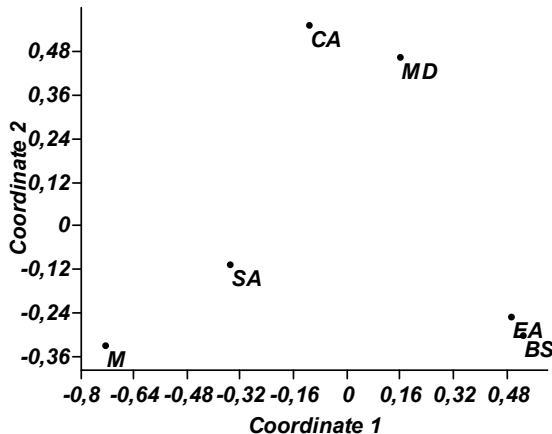


Fig. 4: Ordination of the six biogeographical regions of Turkey (there are no recorded species from Aegean region) in the reduced space of the first two principal coordinates for 15 species of Sapygidae. (Dice, $r = 0.66$). For names of regions see Figure 3.

Turkish sapygid fauna can be considered as very rich. The fauna of the Sapygidae of Turkey contains a large number of species in comparison to others countries of the Mediterranean region, which are well known for their high biodiversity. The sapygid fauna of Turkey is known rather well and currently includes 15 species of six genera of subfamilies Fedtschenkiinae and Sapyginae. Ten species in four genera of subfamily Sapyginae are known from Europe (GUSENLEITNER 2013). The highest number of species is known from the biogeographical province of Turkey. Turkish sapygid fauna is very rich. The great richness and diversity of the Turkish sapygid fauna is the result of the various topographic and climatic structure of the country. In other hand, Turkey is a boundary of East Mediterranean, Sumerian and Irano-Turanian provinces of Palaearctic region that caused the richness of the fauna.

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Author's address:

Prof. Dr. Erol YILDIRIM

Atatürk University, Faculty of Agriculture, Department of Plant Protection

TR-25240 Erzurum, Turkey

E-mail: yildirimerol@hotmail.com

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Maximilian SCHWARZ, Konsulent f. Wissenschaft der Oberösterreichischen Landesregierung, Eibenweg 6, A-4052 Ansfelden, Austria; maximilian.schwarz@liwest.at.

Redaktion: Fritz GUSENLEITNER, Biologiezentrum Linz, f.gusenleitner@landesmuseum.at;
Roland GERSTMEIER, Lehrstuhl f. Zoologie, TU München, gerstmei@wzw.tum.de;
Thomas WITT, Tengstraße 33, D-80796 München, thomas@witt-thomas.com;
Berthold CLEWING, Akademischer Verlag München, avm@druckmedien.de;
Harald SULAK, Museum Witt München, h.sulak@atelier-sulak.de.

Mitarbeiter: Karin TRAXLER, Biologiezentrum Linz, bio.redaktion@landesmuseum.at;
Heike REICHERT, Museum Witt München, heike_reichert66@web.de;
Erich DILLER, Zool. Staatssammlung München, erich.diller@zsm.mwn.de.

Adresse: Entomofauna, Redaktion und Schriftentausch Thomas WITT, c/o Museum Witt München, Tengstr. 33, 80796 München, Deutschland, thomas@witt-thomas.com;
Entomofauna, Redaktion c/o Fritz GUSENLEITNER, Lungitzerstr. 51, 4222 St. Georgen/Gusen, Austria, f.gusenleitner@landesmuseum.at.

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