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## **Overview of the Distribution and Biogeography of Tiphidae (Hymenoptera: Aculeata) in Turkey**

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**A b s t r a c t :** Faunistic and systematic studies on Tiphidae of Turkey are reviewed and the distribution and biogeography of the Turkish tiphid wasp fauna is analyzed. In this study, one species of one genus of Methocinae, 10 species of three genera of Myzinae and nine species of three genera of Tiphinae are recorded. In total, 20 species belonging to seven genera of Tiphidae are recorded from Turkey. Among them, the type localities of one genus and six species of Tiphidae are located in Turkey. Furthermore, one genus and six species comprising 30% of Turkish tiphids are endemic. Species composition, diversity and proportion of endemism varies considerably between the biogeographic subregions of the country.

**K e y w o r d s :** Hymenoptera, Tiphidae, distribution, biogeography, Turkey.

### **Introduction**

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 (Figure 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).

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 Tiphidae fauna (YILDIRIM & BONI BARTALUCCI 2009). Tiphidae 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 Tiphidae have been conducted by both foreign and native researchers in Turkey. However, no attempt has been undertaken to evaluate the distribution and biogeography of Tiphidae in Turkey. Yet, such a study is essential for

researchers who are interested in Tiphiiidae in West Palaearctic region including Turkey.

In this paper, the publications on the Tiphiiidae in Turkey were reviewed (ARGAMAN & ÖZBEK (1992, 1996), MADL (1997), BONI BARTALUCCI (2004, 2008, 2010), YILDIRIM & BONI BARTALUCCI (2009), JAPOSHVILI & KARACA (2010) and ELÇİN et al. (2013) and the biogeography of the Turkish fauna of Tiphiiidae have been analyzed.

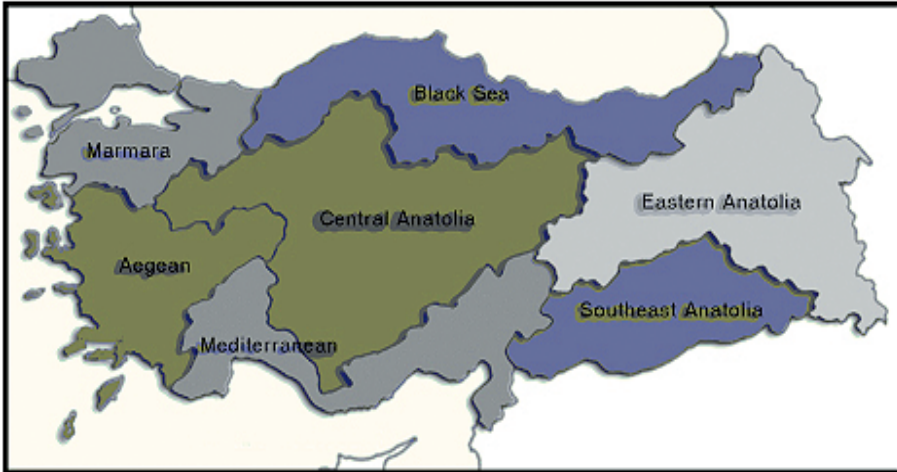


Fig. 1: Biogeographical map of Turkey (1/3.200.000) (from: YILDIRIM & LELEJ 2012).

### Materials and Methods

In this paper, the previous publications on the Tiphiiidae of Turkey are reviewed and the distribution and biogeography of the Turkish fauna of Tiphiiidae 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 of one genus of Methocinae, 10 species of three genera of Myzinae and nine species of three genera of Tiphiiinae are recorded. In total, 20 species belonging to seven genera of Tiphiiidae are recorded from Turkey. Among them, the type localities of one genus and six species of Tiphiiidae are located in Turkey. Furthermore, one genus and six species comprising 30% of Turkish tiphiiids are endemic (Table 1, 2, 3).

**Table 1:** The number of Turkish Tiphidae by genus.

Family	Subfamily	Genus	Number of species	Number of type localities situated in Turkey	Number of endemic species
Tiphidae	Methochinae	<i>Methocha</i>	1	-	-
	Myzinae	<i>Meria</i>	7	2	2
		<i>Mesa</i>	1	-	-
		<i>Poecilotiphia</i>	2	1	1
	Tiphinae	<i>Silifka</i>	1	1	1
		<i>Pseudotiphia</i>	3	-	-
		<i>Tiphia</i>	5	2	2
	Total		7	20	6

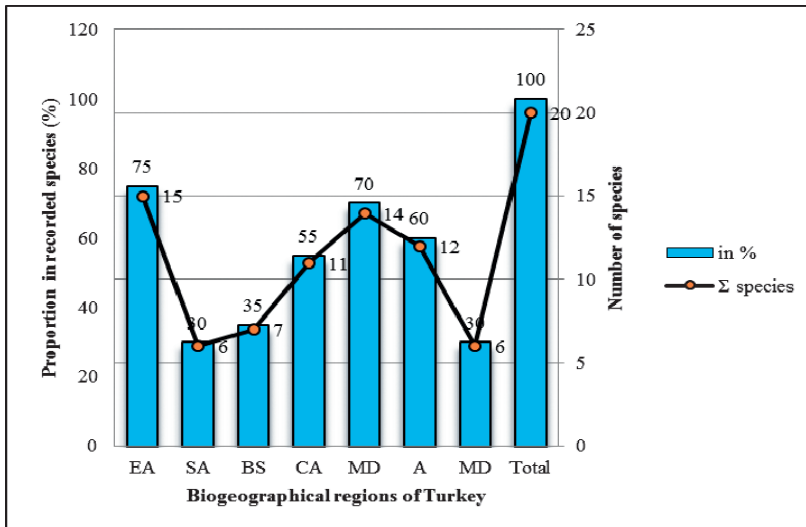
**Table 2:** Distribution of Tiphidae in Biogeographic Regions in Turkey.

Names of taxa	EA	SA	BS	CA	MD	A	M
Subfamily <i>M e t h o c h i n a e</i>							
Genus <i>Methocha</i> LATREILLE, 1804							
<i>Methocha articulata</i> LATREILLE, 1803	+	-	-	-	+	+	-
Subfamily <i>M y z i n a e</i>							
Genus <i>Meria</i> ILLIGER, 1807							
* <i>Meria anatolica</i> BONI BARTALUCCI, 2004	-	-	-	-	+	-	-
<i>Meria askhabadensis</i> (RADOSZKOWSKI, 1886)	+	-	-	+	+	+	-
<i>Meria aurantiaca</i> (GUERIN, 1837)	-	-	-	-	+	+	+
<i>Meria dorsalis</i> (FABRICIUS, 1804)	+	-	+	+	+	+	+
<i>Meria geniculata</i> (BRULLÉ, 1832)	+	-	-	+	+	+	+
<i>Meria nitidula</i> KLUG, 1810	+	-	-	-	+	+	-
* <i>Meria orotaura</i> ELÇIN, BAGRIAÇIK & BONI BARTALUCCI, 2013	-	-	-	+	-	-	-
Genus <i>Mesa</i> SAUSSURE, 1892							
<i>Mesa palestinella</i> GUIGLIA, 1963	+	-	-	-	-	-	-
Genus <i>Poecilotiphia</i> CAMERON, 1902							
* <i>Poecilotiphia melaena</i> BONI BARTALUCCI, 2013	+	-	-	-	-	-	-
<i>Poecilotiphia parvula</i> (SMITH, 1855)	+	+	-	+	-	+	-
Subfamily <i>T i p h i n a e</i>							
Tribe Silifkini							
*Genus <i>Silifka</i> ARGAMAN & ÖZBEK, 1992							
* <i>Silifka fatima</i> ARGAMAN & ÖZBEK, 1992	-	-	-	-	+	-	-
Tribe Tiphini							

Names of taxa	EA	SA	BS	CA	MD	A	M
Genus <i>Pseudotiphia</i> ASHMEAD, 1903							
<i>Pseudotiphia caucasica</i> (MOCSARY, 1883)	+	-	+	+	+	+	-
<i>Pseudotiphia fulvipennis</i> (SMITH, 1879)	+	+	+	+	+	+	+
<i>Pseudotiphia villosa</i> (FABRICIUS, 1793)	+	-	+	+	+	+	+
Genus <i>Tiphia</i> FABRICIUS, 1775							
* <i>Tiphia bahattini</i> YILDIRIM & BONI BARATLUCCI, 2009	-	+	-	-	-	-	-
* <i>Tiphia bituberculata</i> YILDIRIM & BONI BARATLUCCI, 2009	+	-	-	-	-	-	-
<i>Tiphia femorata</i> FABRICIUS, 1775	+	+	+	+	+	+	+
<i>Tiphia minuta</i> LINDEN, 1827	+	+	+	+	+	+	-
<i>Tiphia persica</i> TURNER, 1908	+	+	+	+	+	-	-
<b>Total species</b>	<b>15</b>	<b>6</b>	<b>7</b>	<b>11</b>	<b>14</b>	<b>12</b>	<b>6</b>

**Remarks:** 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, 15 species of the Tiphidae have been recorded from Eastern Anatolia (75% of the recorded species), 14 species from Mediterranean (70%), 12 species from the Aegean (60%), 11 species from Central Anatolia (55%), seven species from Black Sea (35%), six species from Marmara region (30%), and six species from Southeastern Anatolia (30%). The diversity of species (15) and genera (six) is highest in the Eastern Anatolia region.



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

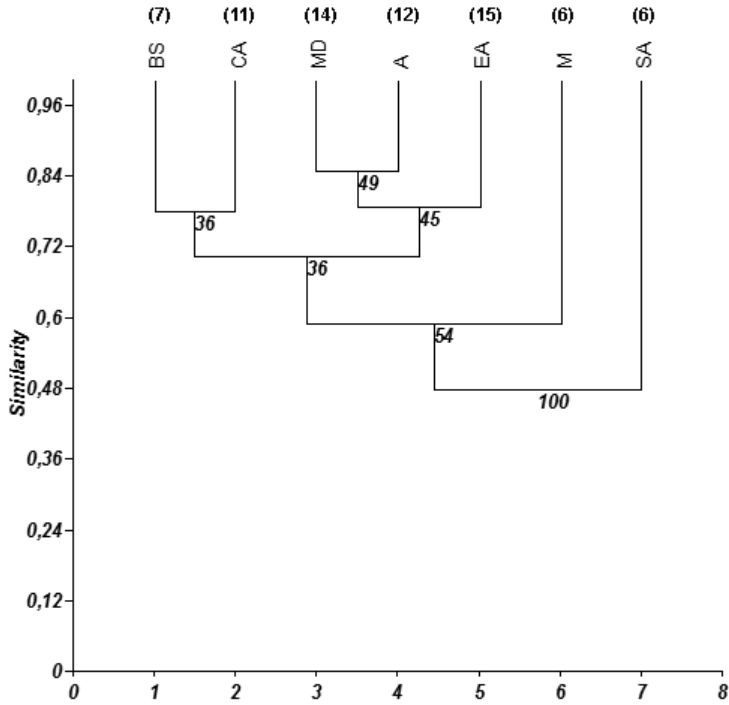
**Remarks:** EA- Eastern Anatolia, SA- Southeastern Anatolia, BS- Black Sea, CA- Central Anatolia, MD- Mediterranean, A- Aegean, M- Marmara.

The cluster analysis of faunal similarities on Tiphidae among seven biogeographical regions of Turkey produce two major clusters (Fig. 3): Black Sea and Central Anatolia (similarity 0.76, bootstrap probability 36% and Eastern Anatolia, Mediterranean and Aegean (similarity 0.77, bootstrap probability 45%) which united with Marmara branch (similarity 0.60, bootstrap probability 54%). This united large cluster belongs to East Mediterranean province of Palaearctic (the division of Palaearctic follows SEMENOV-TIAN-SHANSKIJ 1935). Southeast Anatolia demonstrates minimal similarity (0.48) with other Turkish fauna and belongs 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, Mediterranean and Aegean faunas have highest similarity (0.77) and include most of the Tiphidae species occurring in Turkey. The ordination of the seven biogeographical regions of Turkey in the reduced space of the first two principal coordinates for 20 species of Tiphidae see Figure 4.

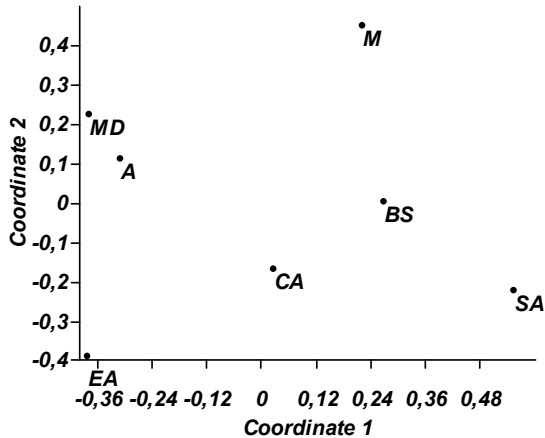
As a result, a total of 20 species of seven genera belonging to three subfamilies (Methochinae, Myzinae and Tiphinae) of Tiphidae were recorded from Turkey. Among them, the type localities of one genus and six species of Tiphidae are located in Turkey. Furthermore, one genus and six species comprising 30% of Turkish tiphids are endemic. The following species have been found to be the most abundant and widespread in all biogeographic regions (Table 2): *Pseudotiphia fulvipennis* (SMITH, 1879), *P. villosa* (FABRICIUS, 1793), and *Tiphia femorata* FABRICIUS, 1775. Moreover, one genus and six species are endemic. They are *Silifka* ARGAMAN & ÖZBEK, 1992, *Meria anatolica* BONI BARTALUCCI, 2004; *M. orotaura* ELÇIN, BAGRIAÇIK & BONI BARTALUCCI, 2013; *Poecilotiphia melaena* BONI BARTALUCCI, 2013; *Silifka fatima* ARGAMAN & ÖZBEK, 1992; *Tiphia bahattini* YILDIRIM & BONI BARATLUCCI, 2009, and *T. bituberculata* YILDIRIM & BONI BARTALUCCI, 2009 (Table 2, 3).

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

Turkish tiphids fauna can be considered as very rich. The fauna of the Tiphidae 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 highest number of species is known from the biogeographical province of Turkey. Turkish tiphids fauna is very rich. The great richness and diversity of the Turkish tiphids 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.



**Fig. 3:** Similarity of 20 species of Tiphiidae from seven biogeographical regions of Turkey. (Dice,  $r = 0.86$ ). Bootstrap probabilities (10000 replies, expressed in percentages) are indicated at node of each cluster. Names of regions: A – Aegean, 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.



**Fig. 4:** Ordination of the seven biogeographical regions of Turkey in the reduced space of the first two principal coordinates for 20 species of Tiphiidae. (Dice,  $r = 0.86$ ). For names of regions see Figure 3.

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

Names of taxa	EA	SA	BS	CA	MD	A	M
<i>Meria anatolica</i> BONI BARTALUCCI, 2004	-	-	-	-	+	-	-
<i>Meria orotaura</i> ELÇIN, BAGRIAÇIK & BONI BARTALUCCI, 2013	-	-	-	+	-	-	-
<i>Poecilotiphia melaena</i> BONI BARTALUCCI, 2013	+	-	-	-	-	-	-
<i>Silişka fatima</i> ARGAMAN & ÖZBEK, 1992	-	-	-	-	+	-	-
<i>Tiphia bahattini</i> YILDIRIM & BONI BARATLUCCI, 2009	-	+	-	-	-	-	-
<i>Tiphia bituberculata</i> YILDIRIM & BONI BARATLUCCI, 2009	+	-	-	-	-	-	-
Total species	2	1	-	1	2	-	-

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

### Zusammenfassung

Vorliegende Arbeit behandelt die Systematik und das Vorkommen der Familie Tiphidae (Hymenoptera) in der Türkei. Insgesamt konnten die drei Unterfamilien Methocinae (1 Gattung, 1 Art), Myzinae (3 Gattungen, 10 Arten) sowie Tiphidae (3 Gattungen, 9 Arten) im Untersuchungsgebiet nachgewiesen werden, darunter Taxa (1 Gattung, 6 Arten), deren locus typicus in der Türkei liegt. Ca 30 % der Arten erwiesen sich als endemisch.

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