

Two Model Genera to Demonstrate the Pollinator Bee Diversity of Turkey: *Evylaeus* Robertson and *Halictus* Latreille (Halictidae: Hymenoptera)

Fatih DİKMEN*

Istanbul University, Faculty of Science, Department of Biology, Vezneciler, İstanbul, Turkey

*Corresponding author e-mail: fatih.dikmen@istanbul.edu.tr

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A B S T R A C T

Bees (Apiformes: Apoidea: Hymenoptera) are the main pollinator group for many flowering plants. Due to this fact, they are attributed as the keystone group for the ecosystem. However, the studies on the pollinator bee groups of Turkey are underestimated. Neither their taxonomy nor their distributions are well known. The only bee groups in Turkey that were studied well are the members of the family Apidae, such as honeybee, bumblebee, carpenter bee and so on. Nevertheless, these groups are insufficient to display the great picture of the bee diversity of Turkey. For this reason, this study was prepared to report the current situation of some pollinator bee groups, *Evylaeus* Robertson and *Halictus* Latreille, one of the most dominant and most common genera of the family Halictidae, in order to show how diverse they are in Turkey. As a consequence, among 319 members of *Evylaeus* species that distribute in Palaearctic region, 136 of them (42% of total fauna) were reported to be found in Turkey. Moreover, it was reported that *Halictus* species of Turkey (35 species) constitute 47% of the Western Palaearctic fauna. These species accounts alone display the importance of the pollinator bee fauna of Turkey and give us an important clue about the diversity of the region.

Keywords: Bees, Pollinator, Fauna, Biodiversity, Halictidae, Turkey

Introduction

During long periods of glaciations and other geological processes, Anatolia was invaded by different organisms as a refuge [1, 2]. Due to such barriers and the geological events, European, African and Caucasian faunal and floral elements can be found in Anatolia [3, 4]. This diversity can be seen in various ways. According to Karagöz and Sabancı [5], there are about 12.000 plant species that distribute in Turkey. This number is nearly equal to the plant diversity of continental Europe. Besides, it was estimated that the animal species of Turkey is about 80.000 and this number is 1.5 times greater than Europe [3]. Işık [6] reports that while the invertebrate species of the world is about

1.300.000, in Turkey, the number of invertebrate species is about 60.000. Although the number of insect species identified in Turkey is about 30.000, the estimated number is between 60.000 and 80.000. In the light of this data, Turkey holds about 4-5% of the world's invertebrate diversity and this percentage can easily be regarded as high [6]. Different topography of Turkey may have led many species to live together in a relatively small area [3, 6, 7].

The studies underlining and revealing the actual status of the biodiversity of Turkey are still insufficient. In the process of recovering such data, the bee diversity of

Turkey has to be revealed, too. Because they are one of the keystone component of our ecosystem. Their dependence on floral resources such as nectar and pollen let them to take a part in pollination service of flowering plants. And thus, their presence can be attributed as vital for vegetation and agricultural crops [8].

According to Michener [9] there are about 110.000 Hymenoptera species in the world and among nearly 20.000 of them are bees (Apiformes: Apoidea). Moreover they can be evaluated under Apidae (including Anthophoridae), Megachilidae, Colletidae, Andrenidae, Halictidae and Melittidae families [9]. However, their status in Turkey is a little bit controversial.

According to a previous study, Taxonomic Database of Fauna of Turkey [10] which was no longer exist, nearly 200 species from Halictidae, 250 from Andrenidae, 500 from Megachilidae and 50 from Apidae were listed from Turkey. However, Özbek [11] estimated that there should be around 2000 bee species in Turkey. A very recent database that have been listing all living animals in the world, Discover Life [12] reported that Turkey consist of 1662 bee species. In this list Russia was reported to have 1157 and Spain to have 1017 species of bees. Accordingly, there were no any other country very close to the accounts of the species richness of the bee fauna of Turkey. Unfortunately, none of

Materials and Methods

For biogeographical comparison, all known species recorded within the Palearctic region so far were used in the study. A total number of 319 species, for the genus *Evyllaesus*, and a total number of 86 species for the genus *Halictus* were evaluated. These species accounts are the

these accounts have been confirmed very clearly by local studies so far and we are lack of any updated bee list of Turkey. The records that we have about this subject are very limited [13].

Among such bees, Halictidae is one of the most common, most diverse and most abundant group. It contains nearly 4500 species in the world [12]. *Evyllaesus* Robertson is among the well diversified genera of Halictidae. It contains 319 species in Palaeartic region [14]. In addition, *Halictus* Latreille is also one of the largest genera. It includes 86 species in Palaeartic region [15]. Moreover, it was reported that Halictidae fauna of Turkey contains 293 species [12].

From this perspective, our study aimed to display such important data deficiency and point out a model group in realizing “how diverse can be the bee species in Turkey”. The genera *Evyllaesus* and *Halictus* bear such potential because they are both very common in Turkey. Besides, the number of species they have are relatively high. Since bees are an important group for our ecosystem and agriculture, data on their presence and distribution are important and vital for both ecosystem management and agricultural practices [8, 13, 16]. Due to these facts, in this study a biogeographical comparison has been made to conclude high richness of bee fauna of Turkey.

latest actual records for the Palaeartic region. Pesenko [14] and Dikmen et al. [15] were evaluated to obtain the species lists for the genera *Evyllaesus* and *Halictus*. The presence/occurrence data were acquired from Dikmen et al. [15], and from the websites of Fauna Europae [17],

Atlas Hymenoptera [18, 19] and Discover Life [12]. To compare the species diversities between the subregions of Palearctic realm, S (species richness) values were calculated as a total sum of their presence. Since the data based on the presence only data, we did not prefer to calculate the diversity indices to compare species diversities among subregions. For

delimiting the subregions, Palearctic realm was divided into two part as west and east firstly, then western Palearctic part divided into subregions such as South Europe, North Europe, North Africa, Caucasia, Mediterranean and Turkey, in a similar way as defined by Skuhrová & Skuhrový [20].

Results and Discussion

The analysis on the list of the genus *Evyllaesus* of Palearctic region reveals many comparisons among subregions (Table 1). Similarly, the Palearctic list of the genus *Halictus* were also summarized (Table 2).

According to these results, the species richness of the genus *Evyllaesus* of Western Palearctic fauna consist of 216 species. In addition, 136 of these were listed as fauna of Turkey.

The occurrence records for 63 species were found in both Western and Eastern Palearctic regions. Besides, 153 species were found to be distributed only in Western Palearctic region, and 103 species were only in Eastern Palearctic region. On the other hand, it is recorded that *Evyllaesus* fauna of Turkey constitutes 42% of total Palearctic fauna and 63% of Western Palearctic fauna.

Table 1. Relative species richness (S) of the genus *Evyllaesus* among Palearctic realm

Region	Sub-regions		
Palearctic S: 319	Western S: 216	Europe S: 114	North S: 61
			South S: 110
		North Africa S: 64	
		Middle East S: 173	Caucasia S:114
	Turkey S: 136		
	Eastern S: 166	Middle Asia S: 96	
East Asia S: 92			

Among Palearctic species of the genus *Halictus*, 74 of them were reported to be distributed in the West Palearctic region and 12 species at east. According to the

comparison of the subregions within Palearctic realm, it was revealed that Western Palearctic members of the genus *Halictus* are distributed mainly around

Mediterranean basin (S: 52, Table 2). Besides there are 35 species recorded from Turkey which means, 40% of the

Palaeartic and 47% of the Western Palaeartic species can be found in Turkey.

Table 2. Relative species richness (S) of the genus *Halictus* among Palaeartic realm.

Region	Sub-regions	
Palaeartic S: 86	Western S: 74	Europe S: 26
		North Africa S: 15
		Middle East S: 42
		Caucasia S: 26
	Turkey S: 35	
	Mediterranean basin S: 52	
	Eastern S: 22	

It is clear that Anatolia has an enormous biodiversity. However, there are not enough studies exposing this rich fauna [7, 13, 21]. Also the number of researches for establishing bee fauna of Turkey is still insufficient. Therefore, such studies that explore or re-evaluate the current richness of Turkey would be invaluable.

On the other hand, the important role of the bees in the ecosystem let us to study more on them to expose their current status or current occurrence. Especially some recent studies [8, 12] showed the importance of the bees and their decline in Europe. It was also reported that in Europe, majority of the bee species were defined as “data deficient” which means there is no any data whether their populations in decline or not. Before they become extinct suddenly, we need to evaluate their presence and distribution patterns in order to protect their surviving populations.

Many of the flowering plants need bees for pollination, bees also dependent on plants because they supply the nutrients that bees can survive. This interdependence may have affected their evolutionary history in terms of their distribution and diversification. Many studies have been shown to record examples of such interdependence. Therefore, it is not absurd to expect the diversity of plants and bees to be parallel. In particular, considering the huge plant diversity of Turkey mentioned by Karagöz and Sabancı [5], it should not be surprising to record the high species richness of Anatolian fauna. Due to this, it will not be exaggeration to evaluate these two genus, *Evylaeus* and *Halictus* as a model for the bee diversity of Anatolia. Because, *Evylaeus* fauna of Turkey constitutes 42% of total Palaeartic and 63% of Western Palaeartic species; *Halictus* fauna of Turkey constitutes nearly 40% of the

Palearctic, and 47% of Western Palearctic elements.

As a consequence, these results presented a small fraction of the big picture. When we evaluate both the great plant diversity [22] and great bee diversity in Mediterranean basin of the world (Table 1 and 2) together, we can assume that bee diversity of Turkey is supposed to be much more than previously recorded. Recent databases also suggesting similar results [12]. Rising of the precedent studies would improve our understanding and findings about Anatolian bee diversity and the evolutionary history that lies underneath of it.

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Türkiye'nin Tozlaştırıcı Arı Çeşitliliğini Kanıtlayan İki Örnek Cins: *Evylaeus* Robertson ve *Halictus* Latreille (Halictidae: Hymenoptera)

Öz: Arılar (Apiformes: Apoidea: Hymenoptera), pek çok çiçekli bitki için ana tozlaştırıcıdır. Bu nedenle ekosistem için kilit taşı bir grup olarak değerlendirilirler. Ancak, Türkiye'deki

tozlaştırıcı arılar üzerine çalışmalar biraz ihmal edilmiştir. Ne taksonomileri ne de yayılışları hakkında yeterli bilgi bulunmamaktadır. Bu konuda Türkiye'de varlıkları yeterince araştırma konusu haline gelmiş olan tek arı ailesi Apidae familyasıdır ki, burada da bombus arıları, bal arıları ve marangoz arıları gibi bilindik gruplar yer almaktadır. Bununla birlikte bu gruplar Türkiye arı çeşitliliği konusundaki büyük resmi bizlere gösterebilmekten acizdirler. Bu nedenle çalışmamız, Halictidae familyasına ait en yaygın ve en baskın cinsler olan *Evylaeus* Robertson ve *Halictus* Latreille gibi iki önemli cinsin Türkiye'deki durumlarının rapor edilmesine ve Türkiye'de ne derece çeşitlilik sergilediklerini göstermek üzere hazırlanmıştır. Sonuç olarak, Palearktik'te 319 tür ile temsil edilen *Evylaeus* cinsi üyelerinden 136'sının (yani toplam faunanın %42'sinin) Türkiye'de mevcut olduğu rapor edilmiştir. Dahası, Türkiye'deki *Halictus* türlerinin (35 tür), Batı Palearktik faunasının %47'sini oluşturduğu kaydedilmiştir. Türlerin sayılarına ilişkin sadece bu rakamlar bile Türkiye'deki tozlaştırıcı arı faunasının önemini göstermeye yetmekte ve bölgenin çeşitliliği açısından önemli ipuçları vermektedir.

Anahtar Kelimeler: Arılar, Polinatörler, Fauna, Biyoçeşitlilik, Halictidae, Türkiye

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