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Checklist of the louse flies or keds (Diptera: Hippoboscidae) of Türkiye

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Abstract

Hippoboscids, known as 'louse flies' or 'keds', are obligate and permanent bloodsucking flies that infest mammals and birds. The Hippoboscidae family includes more than 210 described species worldwide. In studies conducted in Türkiye, a total of eight Hippoboscid species have been reported: five species on mammalian hosts and three species on bird hosts. In this review, a checklist of Hippoboscid flies (Diptera: Hippoboscidae) identified as a result of faunistic studies conducted in Türkiye is given.

Keywords: faunistic review, host-parasite associations, literature review

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Türkiye bit sineklerinin (Diptera: Hippoboscidae) kontrol listesi

Özet

Bit sinekleri olarak da bilinen Hippoboscidler, memeli ve kuşlarda enfestasyona neden olan zorunlu-kalıcı kan emici sineklerdir. Hippoboscidae ailesi dünya genelinde 210'dan fazla tanımlanmış türü içerir. Türkiye'de yapılan çalışmalarda memelilerde beş tür, kuşlarda üç tür olmak üzere toplamda sekiz Hippoboscid türü rapor edilmiştir. Bu derlemede Türkiye'de yapılan faunistik çalışmalar sonucunda tespit edilen Hippoboscid sineklerinin (Diptera: Hippoboscidae) bir kontrol listesi verilmektedir.

Anahtar kelimeler: faunistik inceleme, konak-parazit ilişkileri, literatür taraması

1. Introduction

Members of the Hippoboscidae family, also known as louse flies or keds, are obligate and permanent bloodsucking ectoparasites of avian and mammalian hosts. The average length of these flies is between 2.5-10 mm, and their bodies are generally dorsoventrally flattened [1]. Taxonomically, hippoboscid flies are classified into three subfamilies: Hippoboscinae, Lipopteninae, and Ornithomyinae [2]. In addition to their parasitic effects, such as through bloodsucking that harms birds or mammals, hippoboscid species are also important from an epidemiological perspective because they serve as vectors for agents of protozoal (*Anaplasma* spp., *Haemoproteus* spp., *Theileria* spp., and *Trypanossoma* spp.), bacterial (*Acinetobacter* spp., *Arsenophonus* spp., *Bacillus* spp., *Bartonella* spp., *Borrelia* spp., *Corynebacterium* spp., *Enterobacter* spp., *Halomonas* spp., *Rickettsia* spp., *Shewenella* spp., *Staphylococcus* spp., and *Wolbachia* spp.), viral (Blue-tongue virus, Border disease virus, and West Nile virus), and helminthic (*Acanthocheilonema* spp.) diseases [3,4]. Occasional human cases caused by *Hippobosca* spp., *Lipoptena* spp., *Melophagus* spp., and *Pseudolynchia canariensis* increase these species' importance in both veterinary and medical parasitology [5-8]. In the present review, it has been provided an updated checklist of Hippoboscid fly species reported from Türkiye so far, with their also geographical locations and host-parasite associations.

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2. Materials and methods

Throughout the study, academic search engines such as ResearchGate, PubMed, DergiPark and Google Scholar and a published book containing checklists of ectoparasites detected in Türkiye [9] were used to access studies on louse flies or keds in Türkiye [9-11,14,19,21-27,30,31]. As a result of the literature research, notifications of Hippoboscid flies were detected in 14 academic studies conducted in Türkiye. Original photographs of 5 of the 8 Hippoboscid species reported in Türkiye were taken by me using the integrated camera under a stereo microscope (Nikon SMZ1500, Nikon, Tokyo, Japan) using museum specimens of the relevant species in the Laboratory of the Department of Veterinary Parasitology, Faculty of Veterinary Medicine, Ondokuz Mayıs University (Samsun, Türkiye).

3. Results

Order Diptera Linnaeus, 1758

Family Hippoboscidae Samouelle, 1819

Subfamily Hippoboscinae Samouelle, 1819

Genus *Hippobosca* Linnaeus, 1758

***Hippobosca equina* Linnaeus, 1758** (Figure 1.A)

Hosts: Domestic cattle *Bos taurus* Linnaeus, 1758 (Artiodactyla: Bovidae), domestic donkey *Equus asinus* Linnaeus, 1758 (Perissodactyla: Equidae), domestic horses *Equus ferus caballus* Linnaeus, 1758 (Perissodactyla: Equidae).

Reported locations. It is widely seen throughout Türkiye [9]. Karaman and Konya [10].

***Hippobosca longipennis* Fabricius, 1805**

Host: Domestic dog *Canis familiaris* Linnaeus, 1758 (Carnivora: Canidae) and the red fox *Vulpes vulpes* (Linnaeus, 1758) (Carnivora: Canidae).

Reported locations. Iğdır and Marmara region [9], Hatay [11].

***Hippobosca rufipes* von Olfers, 1816**

Hosts: Domestic cattle *Bos taurus* Linnaeus, 1758 (Artiodactyla: Bovidae), camel *Camelus bactrianus* or *Camelus dromedarius* (Artiodactyla: Camelidae), and domestic horses *Equus ferus caballus* Linnaeus, 1758 (Perissodactyla: Equidae).

Reported location. Antalya [9].

Remarks. The genus *Hippobosca* consists of 7 currently described species that cause infestation on mammal species in the orders Artiodactyla (even-toed ungulates), Perissodactyla (odd-toed ungulates) and Carnivora [1,2]. Many studies have shown that *Hippobosca* species generally show low host specificity. For example, although the primary hosts of *Hippobosca equina* are equids such as horses, donkeys and mules, it has also been reported in camels, deer, dogs, rabbits, hares, goats, roe deer (*Capreolus capreolus*), grey heron (*Ardea cinerea*), northern goshawks, pigeons, and even humans [8,12]. Similarly, *Hippobosca rufipes* has been reported from many hosts, including hartebeest (*Alcelaphus buselaphus*), springbuck (*Antidorcas marsupialis*), white-tailed gnu (*Connochaetes gnou*), corrigum (*Damaliscus korrigum*), Gemsbok (*Oryx gazella*), Steinbok (*Raphicerus campestris*), common eland (*Taurotragus oryx*), giraffes (*Giraffa camelopardalis*), plains zebra (*Equus quagga*), cattle, horses, donkeys, dogs and even humans [8]. *Hippobosca longipennis*, whose primary host is domestic and wild carnivores, has been reported in many hosts from the order Carnivora (Canidae, Viverridae, Hyaenidae, and Felidae) and incidentally in antelopes, birds, and even humans [6,13]. *Hippobosca* notifications and host diversity in Türkiye also support the low host specificity of these species.

Subfamily Ornithomyinae

Genus *Ornithomya* Latreille, 1802

***Ornithomya avicularia* (Linnaeus, 1758)** (Figure 1.D)

Hosts: The rock dove *Columba livia* Gmelin, 1789 (Columbiformes: Columbidae) and the long-eared owl *Asio otus* (Linnaeus, 1758) (Strigiformes: Strigidae).

Reported locations. İstanbul [9] and Samsun [14].

Remarks. The genus *Ornithomya* consists of 29 currently described species that cause infestation on bird species belonging to orders Accipitriformes, Anseriformes, Columbiformes, Coraciformes, Piciformes, Falconiformes, Passeriformes, Pelecaniformes, and Strigiformes [15-17]. *Ornithomya avicularia* is a polyxenous parasitic louse fly that infests birds in the orders Passeriformes, Accipitriformes, Anseriformes, Falconiformes, and Strigiformes, distributed in the Palaearctic, Oriental, and Afrotropical regions [8,18].

Genus *Ornithophila* Rondoni, 1879

***Ornithophila metallica* (Schiner, 1864)**

Host: The Eurasian magpie *Pica pica* (Linnaeus, 1758) (Passeriformes: Corvidae).

Reported location. Bursa [19].

Remarks. The genus *Ornithophila* includes two described species that are distributed in Europe, Asia and Africa and have a wide host diversity [2]. *Ornithophila metallica* has been reported to infest birds in the orders Accipitriformes, Apodiformes, Bucerotiformes, Charadriiformes, Coliiformes, Coraciiformes, Cuculiformes, Galliformes, Falconiformes, Passeriformes, Pelecaniformes, Piciformes, Psittaciformes, Strigiformes and Trogoniformes, distributed in warm and temperate countries of Europe, Asia, Africa, and Australia [8,20].

Genus *Pseudolynchia* Bequaert, 1926

***Pseudolynchia canariensis* (Macquart, 1840)** (Figure 1.E)

Hosts: The rock dove *Columba livia* Gmelin, 1789 (Columbiformes: Columbidae), The Eurasian eagle-owl *Bubo bubo* (Linnaeus, 1758) (Strigiformes: Strigidae), and *Rodentia* sp (Mammalia) (?).

Reported locations. Ankara [9,21], Bursa [19], Elazığ [22], Hatay [23,24], İstanbul [9,25], Konya [26], and Van [27].

Remarks. The genus *Pseudolynchia* consists of five currently described species that cause infestation, on bird species belonging to orders Accipitriformes, Columbiformes, Falconiformes, as well as many other orders (Caprimulgiformes Cuculiformes, Galliformes, Piciformes, and Passeriformes) [1,2,28]. Although *P. canariensis* primarily infests birds in the order Columbiformes, it has been reported in many bird orders, including Accipitriformes, Coraciiformes, Ciconiiformes, Cuculiformes, Falconiformes, Galliformes, Passeriformes and Strigiformes in the continents of Europe, Asia, Africa, and America [29].

Subfamily Lipopteninae

Genus *Lipoptena* Nitzsch, 1818

***Lipoptena cervi* (Linnaeus, 1758)** (Figure 1.B)

Hosts: Domestic goat *Capra hircus* Linnaeus, 1758 (Artiodactyla: Bovidae), the roe deer *Capreolus capreolus* (Linnaeus, 1758) (Artiodactyla: Cervidae), and the red deer *Cervus elaphus* Linnaeus, 1758 (Artiodactyla: Cervidae).

Reported locations. It is widely seen throughout Türkiye [9]. Bursa [30] and Samsun [31].

Remarks. The genus *Lipoptena* comprises 30 currently described species that cause infestation as blood-sucking on mammal species in the order Artiodactyla (families Cervidae and Bovidae), and may accidentally infest humans

[1,2,32]. *Lipoptena cervi* is distributed in Europe, the Middle and Far East, North Africa and North America, and infestations have been reported so far from the species *Alces alces*, *Capreolus capreolus*, *Cervus elaphus*, *C. canadensis*, *Dama dama*, *Odocoileus virginianus* and *Rangifer tarandus* in the order Artiodactyla, and also as accidental on humans [8,32].

Genus *Melophagus* Latreille, 1802

***Melophagus ovinus* (Linnaeus, 1758)** (Figure 1.C)

Host. Domestic sheep (*Ovis aries* Linnaeus, 1758) (Artiodactyla: Bovidae)

Reported locations. It is widely seen throughout Türkiye [9].

Remarks. The genus *Melophagus* comprises three currently described species that cause infestation as blood-sucking on mammal species in the order Artiodactyla (Bovidae) [1,2]. Unlike the other two species, *M. ovinus* is also distributed in Europe, North America, South Africa and Australia. Apart from the sheep, which are the definitive host, it has been reported on domesticated and wild goats, European bison (*Bison bonasus*), rabbit (*Oryctolagus cuniculus*), red fox (*Vulpes vulpes*), dogs (*Canis lupus familiaris*), and humans [5].

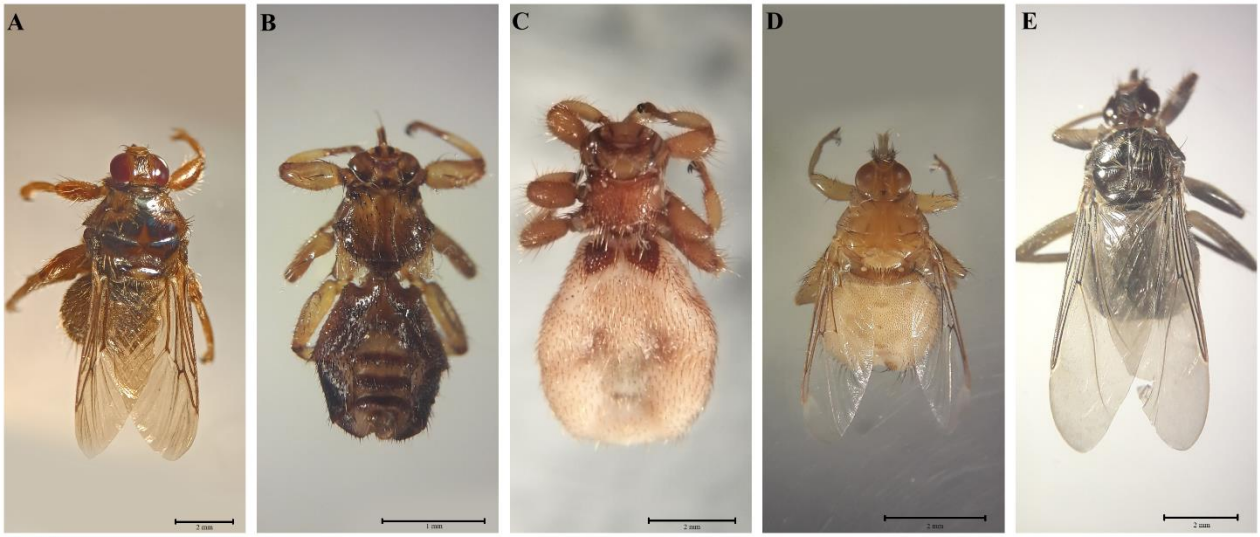

Figure 1. Original photographs of some Hippoboscid species reported in Türkiye: *Hippobosca equina* (A); *Lipoptena cervi* (B); *Melaphagius ovinus* (C); *Ornithomya avicularia* (D); *Pseudolynchia canariensis* (E)

4. Conclusions and discussion

It stands out in literature reviews that scientists working in the parasitology field in Türkiye have focused on ectoparasites of wild mammals and birds in recent years. However, these studies mainly focus on ectoparasites such as fleas, lice, ticks or feather mites [33,34,35], while Hippoboscid species are often ignored. In fact, Türkiye has a diverse and rich wildlife, including both mammals and birds. In countries like Türkiye, where wildlife diversity is richness, Hippoboscid flies are intensively investigated in parasitological studies [16,17,32]. On the other hand, in Türkiye, Hippoboscid fauna has not been adequately revealed due to the narrow scope of ectoparasitic studies and the fact that louse flies or keds were ignored in the studies.

This paper aims to draw attention to this parasitic fly group by preparing an updated checklist of louse flies or keds (Diptera: Hippoboscidae) of Türkiye.

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Distribution of some Ephemeroptera species to the north and south from a gateway in Anatolia: With contributions to the Ephemeroptera fauna of Hatay province

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Abstract

The Hatay-Amanos line is one of the most important migration routes through which African and Eremial fauna elements entered Anatolia during glacial and post-glacial periods. Therefore, the fauna of Hatay province has a very important place in terms of zoogeographical studies. Despite this, faunistic studies on this region, which affects the Ephemeroptera species diversity in Anatolia, are quite outdated and limited. This study, conducted to contribute to the knowledge of Ephemeroptera fauna in Hatay province, examined mayfly larvae (nymphs) collected from four different localities along Ballıöz creek. As a result, six taxa belonging to five genera from three families were identified out of 229 examined specimens. Three of the identified species (*Baetis (Baetis) vernus* Curtis, 1834; *B. (Nigrobaetis) digitatus* Bengtsson, 1912 and *Epeorus (Epeorus) zaitzevi* Tshernova, 1981) were reported for the first time from Hatay province.

Keywords: Ballıöz creek, species distribution, Levant, mayflies

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Anadolu'da bir geçiş kapısından kuzeye ve güneye doğru bazı Ephemeroptera türlerinin dağılımı: Hatay ili Ephemeroptera faunasına katkılar

Özet

Hatay-Amanos hattı buzul ve buzul sonrası dönemlerde Afrika ve Eremiyal fauna elemanlarının Anadolu'ya giriş yaptığı en önemli göç yollarından birisidir. Bu nedenle Hatay ilinin faunası zoocoğrafik çalışmalar bakımından oldukça önemli bir yere sahiptir. Buna rağmen Anadolu'daki Ephemeroptera tür çeşitliliğine etki eden bu bölge ile ilgili çalışmalar oldukça eski ve sınırlı kalmıştır.

Hatay ili Ephemeroptera faunasına katkı sağlamak amacıyla gerçekleştirilen bu çalışmada Ballıöz deresinden toplanan Ephemeroptera larvaları (nimf) incelenmiştir. Sonuç olarak 229 örnek incelenmiş ve üç familya, beş cinse ait altı tür teşhis edilmiştir. Teşhis edilen türlerden üç tanesi (*Baetis* (*Baetis*) *vernus* Curtis, 1834, *B.* (*Nigrobaetis*) *digitatus* Bengtsson, 1912 ve *Epeorus* (*Epeorus*) *zaitzevi* Tshernova, 1981) Hatay ilinden ilk defa tespit edilmiştir.

Anahtar kelimeler: Ballıöz deresi, tür yayılışı, Levant, mayıs sinekleri

1. Introduction

The Middle East, including Anatolia, is zoogeographically recognized as a transitional region containing elements of the Western and Eastern Palearctic fauna. Twenty million years ago, with the Arabian plate compressing the base of the Tethys Sea, the ground rose above sea level and the Levant region began to emerge. Thus, the Levant region, including Hatay province, became a terrestrial crossroad between Eurasia and Africa, and European fauna elements from the north and African fauna elements from the south entered this region [1].

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When the Ephemeroptera fauna of Türkiye is analyzed biogeographically, it appears that most of the species are European (West Palaearctic) species. While the Middle Eastern species constitute the second-largest group [2]. Hatay province has a very important position, especially in the spread of Middle Eastern and African species to Anatolia [1].

To date, three studies [3, 4, 5] have included Hatay province in their analysis of the Ephemeroptera fauna of Türkiye. In these studies, 12 species were reported from Hatay province. All but one of these species were reported from the Asi River and there are no records from other aquatic habitats in the region. The Asi River, one of the 26 water basins in Türkiye and the most important stream of Hatay, is joined by many streams and creeks into the Mediterranean Sea. [6]. This study carried out in Ballıöz creek, one of the important tributaries of the Asi River, aims to contribute to the knowledge of the Ephemeroptera fauna of Hatay province.

2. Material and method

This study was conducted in four localities within Hatay province between 10-13 July 2018 (Fig.1). During field studies, sampling was performed from habitats with diverse ecological characteristics in each locality and utilizing a 1 mm mesh sieve and water hand net to collect larval specimens. The samples were taken into sampling bottles with ethyl alcohol (96%) and labeled, then transported to the laboratory for further examination and identification. Information regarding the sampling stations is provided in Table 1.

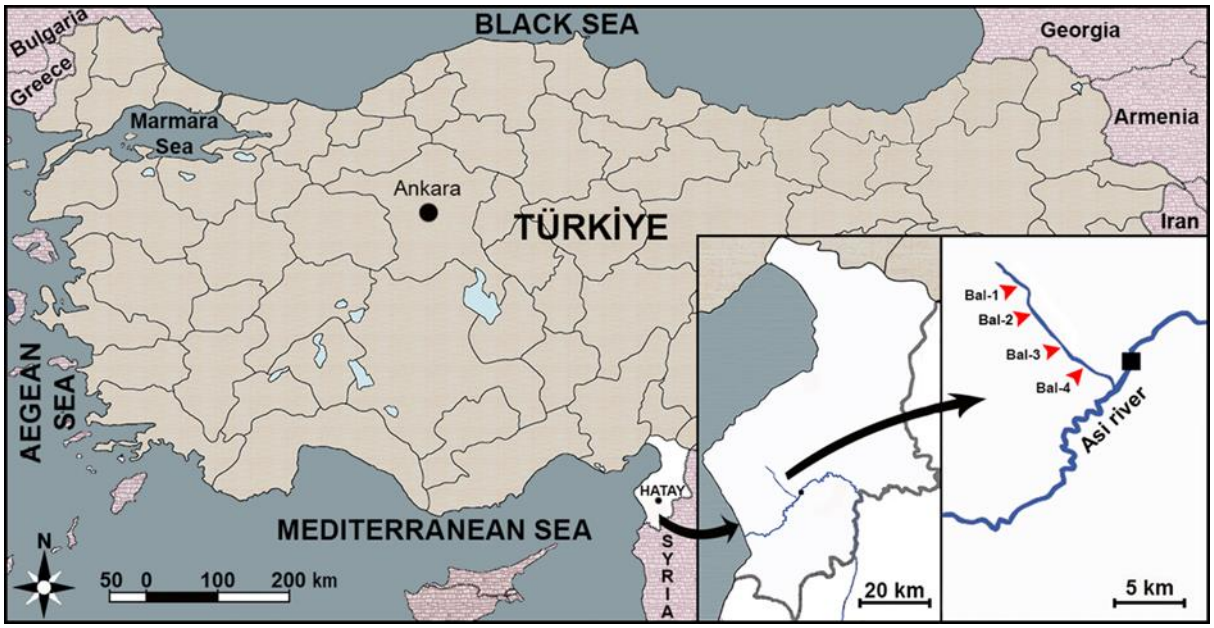

Figure 1. The study area and the sampling sites.

Table 1. General information on the collecting localities.

Locality code	Habitat types	Current speed	Latitude (N)	Longitude (E)	Above sea level (m)
Bal-1	Bld, AV	+++	36°15'01.64"	36°03'41.40"	340
Bal-2	Cb, AV	+++	36°14'01.40"	36°04'47.56"	256
Bal-3	Cb, Sd, AV	++	36°13'24.73"	36°05'41.72"	192
Bal-4	Pb, M, FA	+	36°12'36.15"	36°06'56.94"	132

AV: Aquatic vegetation, FA: Filamentous algae; Bld: Boulders, Cb: Cobbles, Pb: Pubbles; M: Mud, Sd: Sand; +++: High, ++: Moderate, +: Low.

The morphological and taxonomic features of the collected larvae were examined, and microscope slides of taxonomic characters were prepared for identification. Species identification was conducted using references including: Grandi (1960), Müller-Liebenau (1969), Demoulin (1973), Belfiore (1983), Malzacher (1984), Elliott et al. (1988), Sartori (1992), Studemann et al. (1992), Kluge (1997), and Eiseler (2005) [7-16].

The specimens and microscope slides were examined using Leica MZ12.5 stereomicroscope and Leica DM LS2 light microscope. The examined larvae were labeled and kept in Eskişehir Technical University, Faculty of Science, Department of Biology.

Maps (Fig. 1 and Fig. 2) were created using QGIS version 3.34. The distribution of species is marked on the map according to Salur et al. [17].

3. Results

In this study, 229 specimens (Leg. C. Aydınlı) belonging to six species, five genera and three families were identified from four collecting sites. The list of taxa and sampling data of each species (including station name, date, and number of individual numbers of collected samples, respectively) provided below:

List of Taxa
Baetidae Leach, 1815
***Baetis* Leach, 1815**
Baetis (Baetis) vernus Curtis, 1834
Material examined: Bal-1, 10.07.2018, 19 larvae; Bal-2, 11.07.2018, 24 larvae; Bal-3, 12.07.2018, 7 larvae; Bal-4, 13.07.2018, 3 larvae.

Baetis (Nigrobaetis) digitatus Bengtsson, 1912
Material examined: Bal-1, 10.07.2018, 2 larvae; Bal-2, 11.07.2018, 4 larvae; Bal-3, 12.07.2018, 1 larva.

***Procloeon* Bengtsson, 1915**
Procloeon pennulatum (Eaton, 1870)
Material examined: Bal-1, 10.07.2018, 14 larvae; Bal-2, 11.07.2018, 11 larvae; Bal-3, 12.07.2018, 9 larvae; Bal-4, 13.07.2018, 2 larvae.

Heptageniidae Needham in Needham & Betten, 1901
***Anapos* Demoulin, 1973**
Anapos kugleri Demoulin, 1973
Material examined: Bal-1, 10.07.2018, 17 larvae; Bal-2, 11.07.2018, 26 larvae; Bal-3, 12.07.2018, 4 larvae.

***Epeorus* Eaton, 1881**
Epeorus (Epeorus) zaitzevi Tshernova, 1981
Material examined: Bal-1, 10.07.2018, 5 larvae; Bal-2, 11.07.2018, 8 larvae.

Caenidae Newman, 1853
***Caenis* Stephens, 1835**
Caenis macrura Stephens, 1836
Material examined: Bal-1, 10.07.2018, 15 larvae; Bal-2, 11.07.2018, 27 larvae; Bal-3, 12.07.2018, 21 larvae; Bal-4, 13.07.2018, 10 larvae.

4. Conclusions and discussion

The first study on the Ephemeroptera fauna of Hatay province was carried out by Verrier in 1955 [3]. *Baetis (Baetis) fuscatus* (Linnaeus, 1761), which was reported as the only species from the relevant region in this study (as *Baetis bioculatus* Linnaeus, 1758), was found in a freshwater habitat close to the district center of Iskenderun. In another study conducted by Koch in 1980 (Asi River, Samandağ district), *Oligoneuriopsis orontensis* Koch, 1980 (as *Oligoneuriella orontensis*) was reported as a new species [4]. The last faunistic study in the region was again carried out by Koch in 1988 [5]. In this study carried out in the Asi River, eight of the nine identified species were given as new records for the region. As a result, a total of 12 species were reported in these three studies including Hatay province.

Three of the six species identified in this study (*B. (B.) vernus*, *B. (N.) digitatus*, and *E. (E.) zaitzevi*) are new records for Hatay province. *B. (B.) vernus*, which has a Trans-Palearctic distribution [18]; is probably polycentric in Europe and Siberian faunistic origin [19], and is considered to represent the Eurosiberian faunistic element [20]. Although *B. (B.) vernus* has been reported from many provinces in Türkiye (especially in the Northern and Western parts of Anatolia), the fact that there is no record from the southern part of Anatolia (Mediterranean and Southeastern Anatolia regions) supports that the species has spread towards Anatolia via Europe and the Caucasus. When Fig. 2 is examined, it is seen that this species is spread from Europe to the Western Black Sea and Northern Aegean, and from the Caucasus to the Eastern Black Sea and side southward along the Anatolian Diagonal line. In this case, it can be said that this species spread from the Caucasus to the south along the Anatolian Diagonal line to Hatay, and from there to the Middle East.

Although *B. (N.) digitatus* has a polycentric distribution in Europe, this species of unknown origin is considered a Central Asian or Eurosiberian fauna member according to Haybach [19]. It is undisputed that this species, which is widely distributed in the Western Black Sea region of our country (Fig. 2), entered this region via Europe. However, the

presence of this species in Sivas, Muş (Eastern Anatolia Region), and Hatay (Mediterranean Region) provinces, which are too far from each other, is quite interesting. In this case, it can be said that the most probable possibility is that this species spread southward through the Caucasus, but over time, it could only survive in these areas. On the other hand, a different scenario will likely emerge in studies to be carried out in the southeast of Türkiye and neighboring countries such as Iran and Iraq. This species was reported from Syria (from the southern part of Hatay) in a study conducted by Koch in 1988 [5] in the Levant region, including Hatay province. The fact that the species was reported only from this region in this study conducted in a wide area indicates that the species has spread to this region via Hatay.

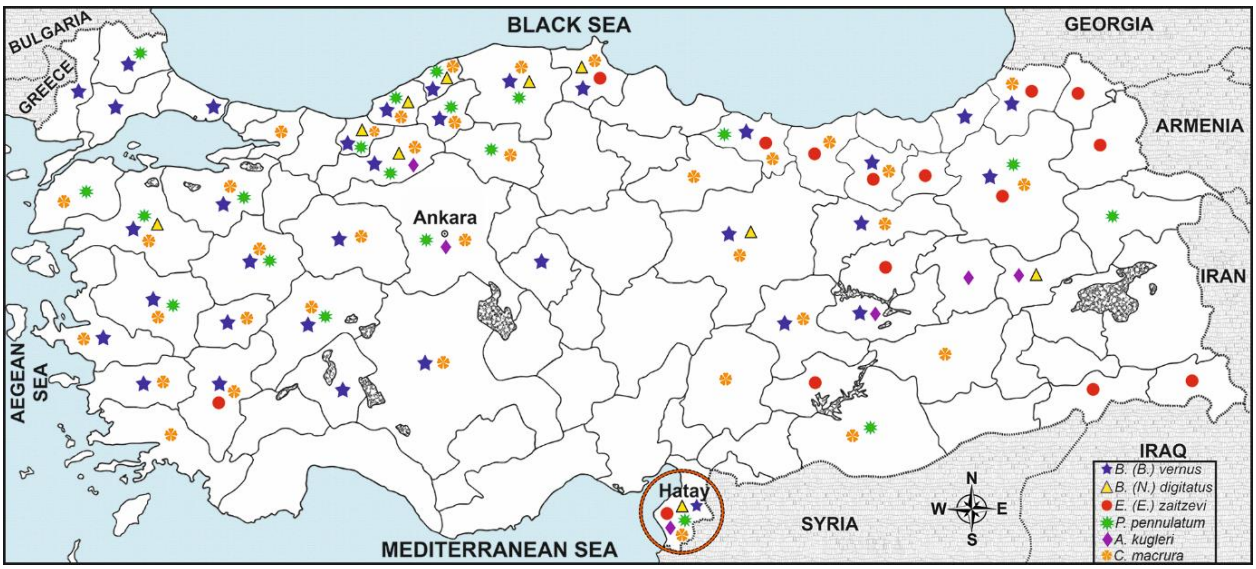

Figure 2. A map showing the distribution of the identified species in Türkiye (The marks were placed randomly within the provincial borders where the species was reported).

Sartori, in his study stating that *E. (E.) zaitzevi* is a Caucasian-Levantine species, stated that this species of Caucasian origin dispersed from the foothills of the Caucasus towards the south through Türkiye, Syria, and Lebanon and reached Jordan [13]. According to its distribution in Türkiye (Fig. 2), it is seen that this species is distributed in the Eastern Black Sea and the area east of the Anatolian Diagonal. However, Aydınlı & Ertorun reported this species unexpectedly from Western Anatolia (Denizli province) [21]. It is assumed that this species, which was thought to have come to this region through the inland freshwaters of central Anatolia in the past, can be found in Southern and Southwestern Anatolia, where it has been little studied.

Among the other species identified in the study, *P. pennulatum* is known as a member of the Holarctic region (includes Western Palearctic, Eastern Palearctic and Nearctic regions) and is thought to represent a Mediterranean fauna element with a wide distribution in Europe or a Siberian fauna element with a meridional distribution [18]. When its distribution in our country is examined (according to Salur et al. [17]), it can be said that this species has a distribution that represents all regions of Türkiye.

According to Yanai et al., *A. kugleri*, reported from various localities in Türkiye, Syria, Iraq, Israel, and Lebanon, is endemic to the northwestern Levant region. In this case, it is possible that this species spread to Central Anatolia (Ankara and Bolu) through Hatay, and to Eastern Anatolia via Iraq [22].

C. macrura has a wide distribution in Türkiye as well as in the Palearctic region. In origin, this species is considered to represent an expansionary type of the holo-Mediterranean faunal element or possibly a Caspian or Pontocaspian faunistic element [18].

Anatolia is a very important both ecologically and geographically due to its location. Consequently, many habitats with different characteristics can be found in the region. This habitat diversity has enabled various fauna elements to inhabit Anatolia and has increased biodiversity. The fact that there are 165 species in Türkiye (Aydınlı & Ertorun [21] mistakenly reported the number of species as 166) that originate from different regions also supports this. In this context, Hatay is one of the most important transition points for the spread of European, Siberian-Caucasian, Eremial, and (albeit limited) African fauna elements. For this reason, Hatay fauna has an importance that can be considered as a reference for zoogeographic and faunistic studies. It is thought that carrying out zoogeographic and faunistic studies at such important transition points as Hatay will contribute to understanding the value and importance of biodiversity.

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Fish fauna of the Dibru River- a tributary of the Brahmaputra River, Dibrugarh District, Assam, Northeastern India, with a new range extension record of *Pseudolaguvia vespa*

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Abstract

This study is an attempt to explore the fish diversity of the Dibru River, a vital waterway that supports both the local economy and the ecological integrity of the Dibru-Saikhowa National Park (India), conducted during October 2023 to May 2024. A total of 414 specimens were collected and, there are 20 species in Cypriniformes, 8 in Siluriformes, 5 in Perciformes, 2 in Synbranchiformes and 1 species each in the other 5 orders in the study. Of these, 37 photographs of different fish species, mostly of ornamental value, are presented to emphasize the potential of the fish resources of this river. Notably, the study records a new range extension for *Pseudolaguvia vespa*, documenting its presence in the Dibru River within the Brahmaputra Basin.

Keywords: fish fauna, ornamental fish, Dibru river, Cyprinidae, Brahmaputra River system

1. Introduction

The northeastern region of India, recognized globally as a biodiversity hotspot for freshwater fish [1], plays a pivotal role in sustaining ecological balance. Freshwater fish are not only crucial components of aquatic ecosystems but also serve as significant protein sources for local communities and also as bioindicators, which can reflect the health and quality of water bodies. However, the rich biodiversity of freshwater fish in India has been declining steadily, primarily due to various anthropogenic pressures and environmental changes. Habitat modification, pollution, overfishing, and unsustainable development have accelerated this trend, while climate change further exacerbates the challenges, posing severe threats to aquatic species and the ecosystems they inhabit. Predictions suggest that, in the future, the impacts of biodiversity loss may be more pronounced in aquatic ecosystems than in terrestrial ones [2]. The potential loss of fish species risks disrupting food webs, altering nutrient cycles, and diminishing ecosystem resilience of the system. Thus, conservation of fish fauna in this region is essential not only for ecological stability but also for the well-being of local communities that rely on these resources for their livelihoods. The Brahmaputra and Barak River systems in Assam, India, are home to 216 documented fish species spanning 36 families, with the Cyprinidae family exhibiting the greatest species diversity [3]. In contrast, neighboring Bangladesh, endowed with extensive and productive freshwater ecosystems rich in diverse aquatic flora and fauna, supports a higher count of 260 freshwater fish species [4]. Considering the challenges facing aquatic biodiversity in the modern era, assessing fish diversity in the Dibru River, Assam, is critically important for maintaining and evaluating ecological balance and supporting the livelihoods of local communities through fishing and related activities. Although numerous studies have explored fish diversity in Assam [5], [6], [7], [8] [9], [10], [11], and assessed protected areas [12], [13] [14], [15], [16], the fish fauna of the Dibru River itself remains under-researched. Therefore, this study aims to assess the diversity of fish and the status of fish species in the Dibru River. The findings could provide valuable insights into the biodiversity of the river, supporting conservation efforts and sustainable management practices.

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2. Materials and methods

Study Area: The Dibru River originates in the low hills near Bordumsa village in Arunachal Pradesh, flows down into the plains, meets with the Doomdooma River, and continues westward. The river forms the Maguri Beel wetland in the Tinsukia district of Assam, then debouches into the Lohit River at the south of Dibru-Saikhowa National Park, and eventually merges with the Brahmaputra River. The study was conducted at four sampling stations covering a distance of approximately 8.0 km starting from near the small township of Dinjan to the vicinity of Bogoritolia village in Dibrugarh District (Figure 1).

The sampling of fish was carried out using a cast net of 3.0 m diameter and 9.50 mm meshes in the study site (Dibru River) covering a distance of approximately 8.0 km. Fish specimens were collected from four sampling stations i.e., Station-1 (27°55'80.36"N; 95°26'73.01"E), Station-2 (27°55'12.31"N; 95°18'54.11"E), Station-3 (27°55'18.30"N; 95°16'64.70"E) and Station-4 (27°55'18.89"N; 95°14'75.46"E). The fish samples that were collected were taken to the laboratory of Zoological Survey of India (ZSI), Arunachal Pradesh Regional Centre (APRC), Itanagar for identification and stored in 70% alcohol. The standard literature that was available in the ZSI library, viz., [17] [18] [19], [20], were consulted and identified the fish specimens except for two that belong to the genera *Amblyceps* and *Paracanthocobitis*. The percentage of relative abundance of the fish was calculated dividing the total number of each species by total number of all species multiplied by 100 and categorized into four categories, viz., abundant (15.1-20.0%), common (10.1-15.0%), moderate (5.1-10.0 %) and rare (0.1-5.0 %). The IUCN conservation status was confirmed following the IUCN Red List of Threatened species version 2024-1 [21]. All the fish species are registered with the registration number at the Department of Zoology, Patkai Christian College (Autonomous), Nagaland.

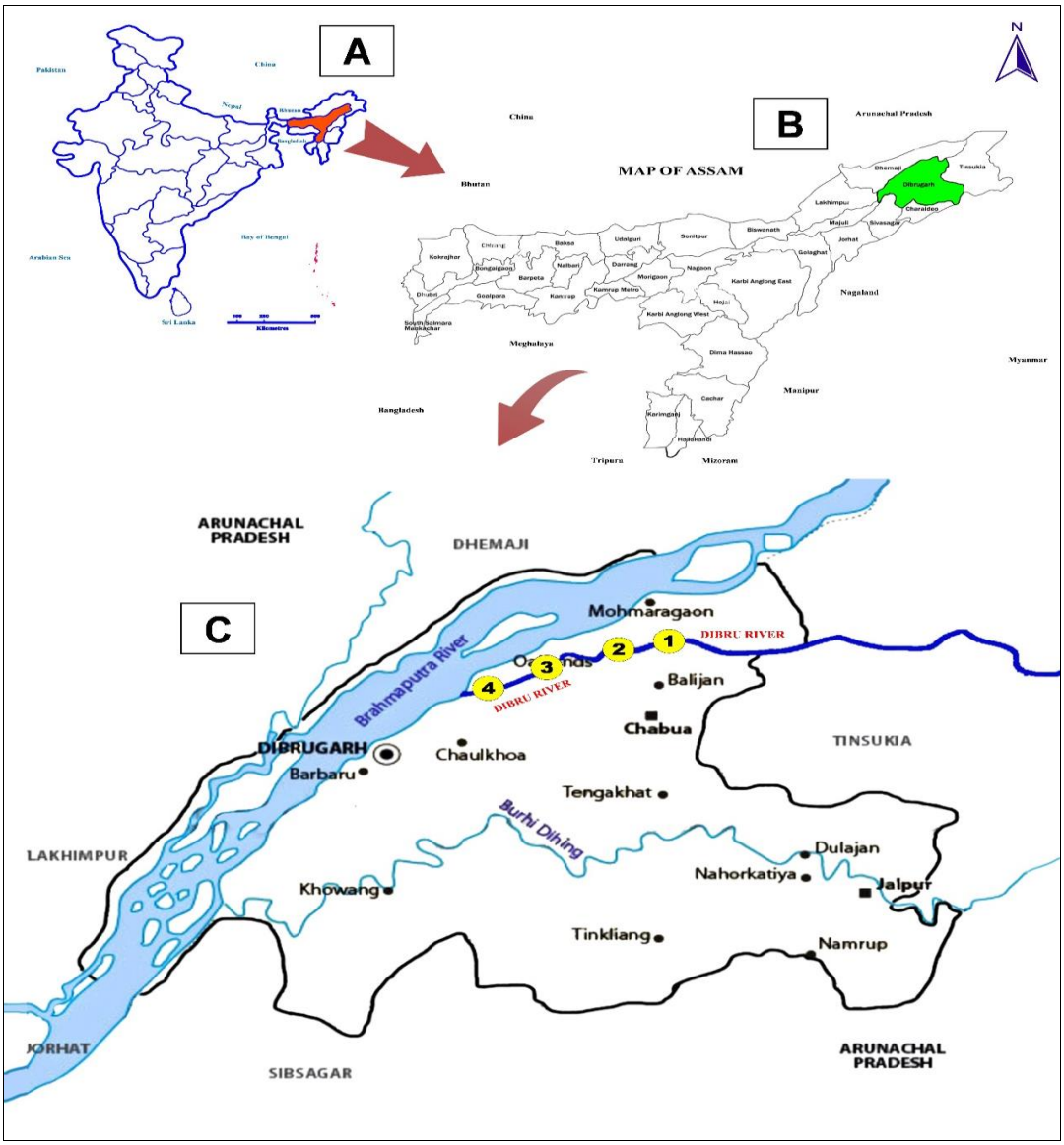


Figure 1. (A) Map of India indicating the State of Assam; (B) Map of Assam indicating Dibrugarh district; (C) Map of Dibrugarh District indicating the Dibru River and four sampling sites

3. Results

The study in the Dibru River documented a total of 414 specimens of fish fauna, comprising 40 species distributed across 34 genera, 18 families, and 9 orders (Table 1 and Figure 2). The fish species accessed primarily consisted of potential ornamental fish, as illustrated in Figure 4. During the survey the highest number of fish species (richness) were recorded during the third survey in March 2024 with 28 species, followed 20, 17, and 13 species in the fourth, first, and second survey respectively (Table 2). The peak in species richness in March may be attributed to reduced water volume during that period, which likely facilitated easier catches.

Further analysis showed that 40% of the species were recorded only once across the surveys, 30% of the species were recorded in at least two surveys, and 25% were observed in three surveys. Only two species (5%), *Paracanthocobitis botia* and *Pethia ticto*, were recorded at all sampling stations throughout the four-month temporal variation period, as presented in Table 2, which also includes catch frequencies for other species. The highest abundance was observed in *Trichogaster fasciata*, accounting for 16.9% of the total specimens, classified as abundant. This was followed by *Xenentodon cancila* at 9.7% (moderate), *Devario devario* at 7.2% (moderate), and *Acanthocobitis pavonacea* at 6.3% (moderate). Other species exhibited lower abundances ranging from 0.5% to 4.3%, categorizing them as rare. No fish species was found under “common" category, which would fall between the abundant and moderate categories. This absence may be attributed to the limited duration of the sampling period.

The family Cyprinidae was the most dominant, comprising 26.3% of the fish species, followed by Bagridae and Nemacheilidae with 10.5% each, Cobitidae and Danionidae with 7.9% each (Figure 3). According to the IUCN Red List of Threatened Species [9], the majority of species (92.1%) are categorized as Least Concern (LC), indicating that most of the fish species collected in the present study in Dibru River is not currently at-risk category. Among the 40 species recorded, two- *Acanthocobitis pavonacea* and *Pseudolaguvia vespa*- are listed as Not Evaluated (NE), while *Badis assamensis* is classified as Data Deficient (DD) on the IUCN Red List. Insufficient data or rarity in field observations may contribute to the "Not Evaluated" status of *Acanthocobitis pavonacea*, while *Pseudolaguvia vespa*, only recently described in 2021, has not yet been assessed by the IUCN. *Badis assamensis* has a limited geographic distribution within the Brahmaputra basin, but information on its population, range, and structure remains minimal; hence, it is placed under the Data Deficient category due to the scarcity of data.

4. Conclusions and discussion

A longer study period, extending up to one year with increased sampling efforts, is expected to reveal a greater diversity of fish species in the Dibru River. Such an extended study would likely provide a more comprehensive understanding of fish fauna of this river, potentially uncovering additional species and their population dynamics. The current collection includes not only food fishes but also several ornamental species, such as *Trichogaster fasciata*, *Parambassis ranga*, *Badis assamensis*, *Acanthocobitis pavonacea*, *Paracanthocobitis botia*, and *Leiodon cutcutia etc*. This diversity highlights the significant potential of fish resources for the economic upliftment of the local population. The study highlighted that many fisher folks residing nearby villages depend heavily on the fish resources of the Dibru River for their livelihoods. This dependence indicates the importance of fishery not only for biodiversity but also for the economic upliftment of local communities. However, dependency on wild collection only is not a permanent solution for sustainability. So, it is necessary to adopt sustainable approaches to fishery management and sustainable utilization such as preventing overfishing, promoting community-based management strategies that minimize habitat degradation and ensure the long-term fish production as well as the health of fish.

Detailed examinations of morphological and meristic data of the specimens (no. of specimens) confirm the presence of *Pseudolaguvia vespa* in the Dibru River of Assam. *Pseudolaguvia vespa*, originally known from its type locality in the Tsücha River (26°27.59′N; 94°29.63′E) in Mokokchung District, Nagaland, India [22]. This range extension reveals the ecological connectivity of northeastern river systems and warrants further ichthyological surveys in these areas.

The study emphasizes the need for a long-term management strategy and technological interventions to promote entrepreneurship in the aquarium trade, particularly for minnows and loaches. To address the challenges posed by anthropogenic pressures and declining health of the river systems, captive breeding, propagation, and seed production are essential. Hence, the government, ichthyologists, NGOs, local communities, and the public should work together to protect illegal trading and promote awareness among fishermen to protect both food and ornamental fish species through innovative and sustainable approaches.

Table 1. Fish species collected from the Dibru River, Assam, according to percentage Abundance [Abundant (15.1-20.0%)- (A), Common (10.1-15.0%) –(C), Moderate (5.1-10.0 %) (M) and Rare (0.1-5.0 %)-(R)]

SN	O	F	NoS	%	R	IS	Reg. No.
1.	Anabantiformes	Osphronemidae	*Trichogaster fasciata*	16.9	A	LC	PCC/ZOO/FISH/00001
2.	Beloniformes	Belonidae	*Xenentodon cancila*	9.7	M	LC	PCC/ZOO/FISH/00002
3.	Cypriniformes	Danionidae	*Devario devario*	7.2	M	LC	PCC/ZOO/FISH/00016
4.	Cypriniformes	Nemacheilidae	*Acanthocobitis pavonacea*	6.3	M	NA	PCC/ZOO/FISH/00019
5.	Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	4.3	R	LC	PCC/ZOO/FISH/00006
6.	Cypriniformes	Cyprinidae	*Bangana dero*	3.9	R	LC	PCC/ZOO/FISH/00007
7.	Cypriniformes	Danionidae	*Barilius barila*	3.9	R	LC	PCC/ZOO/FISH/00017
8.	Cypriniformes	Cyprinidae	*Cabdio morar*	3.4	R	LC	PCC/ZOO/FISH/00008
9.	Cypriniformes	Cobitidae	*Lepidocephalichthys annandalei*	2.9	R	LC	PCC/ZOO/FISH/00003
10.	Cypriniformes	Cobitidae	*Lepidocephalichthys goalparensis*	2.9	R	LC	PCC/ZOO/FISH/00004
11.	Cypriniformes	Cobitidae	*Lepidocephalichthys guntea*	2.4	R	LC	PCC/ZOO/FISH/00005
12.	Cypriniformes	Cyprinidae	*Oreichthys cosuatis*	2.4	R	LC	PCC/ZOO/FISH/00009
13.	Cypriniformes	Cyprinidae	*Osteobrama cotio*	2.4	R	LC	PCC/ZOO/FISH/00010
14.	Cypriniformes	Nemacheilidae	*Paracanthocobitis* sp.	0.5	R	-	PCC/ZOO/FISH/00039
15.	Cypriniformes	Cyprinidae	*Pethia gelius*	2.4	R	LC	PCC/ZOO/FISH/00011
16.	Cypriniformes	Danionidae	*Opsarius bendelisis*	2.4	R	LC	PCC/ZOO/FISH/00018
17.	Cypriniformes	Nemacheilidae	*Paracanthocobitis botia*	2.4	R	LC	PCC/ZOO/FISH/00020
18.	Cypriniformes	Cyprinidae	*Pethia ticto*	1.9	R	LC	PCC/ZOO/FISH/00012
19.	Cypriniformes	Cyprinidae	*Puntius sophore*	1.9	R	LC	PCC/ZOO/FISH/00013
20.	Cypriniformes	Cyprinidae	*Tariqilabeo latius*	1.4	R	LC	PCC/ZOO/FISH/00014
21.	Gobiiformes	Gobiidae	*Glossogobius giuris*	1.4	R	LC	PCC/ZOO/FISH/00021
22.	Perciformes	Ambassidae	*Chanda nama*	1.4	R	LC	PCC/ZOO/FISH/00022
23.	Perciformes	Badidae	*Badis assamensis*	1.4	R	DD	PCC/ZOO/FISH/00024
24.	Perciformes	Badidae	*Badis badis*	1.4	R	LC	PCC/ZOO/FISH/00025
25.	Perciformes	Ambassidae	*Parambassis ranga*	1.0	R	LC	PCC/ZOO/FISH/00023
26.	Perciformes	Channidae	*Channa punctata*	1.0	R	LC	PCC/ZOO/FISH/00026
27.	Siluriformes	Amblycipitidae	*Amblyceps* sp.	1.0	R	-	PCC/ZOO/FISH/00027
28.	Siluriformes	Sisoridae	*Gagata cenia*	1.0	R	LC	PCC/ZOO/FISH/00028
29.	Siluriformes	Heteropneustidae	*Heteropneustes fossilis*	1.0	R	LC	PCC/ZOO/FISH/00029
30.	Siluriformes	Bagridae	*Mystus cavasius*	1.0	R	LC	PCC/ZOO/FISH/00030
31.	Siluriformes	Bagridae	*Mystus dibrugarensis*	1.0	R	LC	PCC/ZOO/FISH/00031
32.	Siluriformes	Bagridae	*Olyra longicaudata*	1.0	R	LC	PCC/ZOO/FISH/00032
33.	Siluriformes	Sisoridae	*Pseudolaguvia vespa*	1.0	R	NA	PCC/ZOO/FISH/00033
34.	Cypriniformes	Nemacheilidae	*Schistura scaturigina*	0.5	R	LC	PCC/ZOO/FISH/00040
35.	Cypriniformes	Cyprinidae	*Labeo gonius*	0.5	R	LC	PCC/ZOO/FISH/00015
36.	Siluriformes	Bagridae	*Rama chandramara*	0.5	R	LC	PCC/ZOO/FISH/00034
37.	Synbranchiformes	Mastacembelidae	*Macrognathus pancalus*	0.5	R	LC	PCC/ZOO/FISH/00035
38.	Synbranchiformes	Synbranchidae	*Ophichthys cuchia*	0.5	R	LC	PCC/ZOO/FISH/00036
39.	Tetraodontiformes	Tetraodontidae	*Leiodon cutcutia*	0.5	R	LC	PCC/ZOO/FISH/00037
40.	Osteoglossiformes	Notopteridae	*Notopterus notopterus*	0.5	R	LC	PCC/ZOO/FISH/00038

SN- Serial No.; **O-** Order; **F-** Family; **NoS-** Name of species; **%-** Percentage; **R-** Remarks; **IS-** IUCN Status; **Reg. No-** Registration No.

Table 2. Temporal variation of fish species in the Dibru River, Assam, (Surveys I – October 2023, II – January 2024, III – March 2024, IV – May 2024)

Sl. No.	Order	Family	Name of species	I	II	III	IV
1.	Anabantiformes	Osphronemidae	*Trichogaster fasciata*				+
2.	Beloniformes	Belonidae	*Xenentodon cancila*	+		+	
3.	Cypriniformes	Danionidae	*Devario devario*	+	+	+	
4.	Cypriniformes	Nemacheilidae	*Acanthocobitis pavonacea*				+
5.	Cypriniformes	Cyprinidae	*Amblypharyngodon mola*			+	+
6.	Cypriniformes	Cyprinidae	*Bangana dero*	+		+	
7.	Cypriniformes	Danionidae	*Barilius barila*	+	+		
8.	Cypriniformes	Cyprinidae	*Cabdio morar*			+	
9.	Cypriniformes	Cobitidae	*Lepidocephalichthys annandalei*			+	
10.	Cypriniformes	Cobitidae	*Lepidocephalichthys goalparensis*			+	+
11.	Cypriniformes	Cobitidae	*Lepidocephalichthys guntea*			+	+
12.	Cypriniformes	Cyprinidae	*Oreichthys cosuatis*			+	
13.	Cypriniformes	Cyprinidae	*Osteobrama cotio*	+	+	+	
14.	Cypriniformes	Cyprinidae	*Pethia gelius*			+	+
15.	Cypriniformes	Danionidae	*Opsarius bendelisis*	+			+
16.	Cypriniformes	Nemacheilidae	*Paracanthocobitis botia*	+	+	+	+
17.	Cypriniformes	Cyprinidae	*Pethia ticto*	+	+	+	+
18.	Cypriniformes	Cyprinidae	*Puntius sophore*			+	
19.	Cypriniformes	Cyprinidae	*Tariqilabeo latius*	+			
20.	Gobiiformes	Gobiidae	*Glossogobius giuris*	+	+	+	
21.	Perciformes	Ambassidae	*Chanda nama*		+	+	+
22.	Perciformes	Badidae	*Badis assamensis*			+	
23.	Perciformes	Badidae	*Badis badis*		+	+	+
24.	Perciformes	Ambassidae	*Parambassis ranga*	+	+	+	
25.	Perciformes	Channidae	*Channa punctata*		+	+	+
26.	Cypriniformes	Nemacheilidae	*Paracanthocobitis* sp.	+	+		
27.	Siluriformes	Amblycipitidae	*Amblyceps* sp.			+	
28.	Siluriformes	Sisoridae	*Gagata cenia*	+			
29.	Siluriformes	Heteropneustidae	*Heteropneustes fossilis*			+	+
30.	Siluriformes	Bagridae	*Mystus cavasius*	+	+		+
31.	Siluriformes	Bagridae	*Mystus dibrugarensis*			+	+
32.	Siluriformes	Bagridae	*Olyra longicaudata*			+	
33.	Siluriformes	Sisoridae	*Pseudolaguvia vespa*			+	
34.	Cypriniformes	Nemacheilidae	*Schistura scaturigina*			+	
35.	Cypriniformes	Cyprinidae	*Labeo gonius*	+	+		+
36.	Siluriformes	Bagridae	*Rama chandramara*	+		+	+
37.	Synbranchiformes	Mastacembelidae	*Macrognathus pancalus*				+
38.	Synbranchiformes	Synbranchidae	*Ophichthys cuchia*			+	
39.	Tetraodontiformes	Tetraodontidae	*Leiodon cutcutia*	+			+
40.	Osteoglossiformes	Notopteridae	*Notopterus notopterus*				+

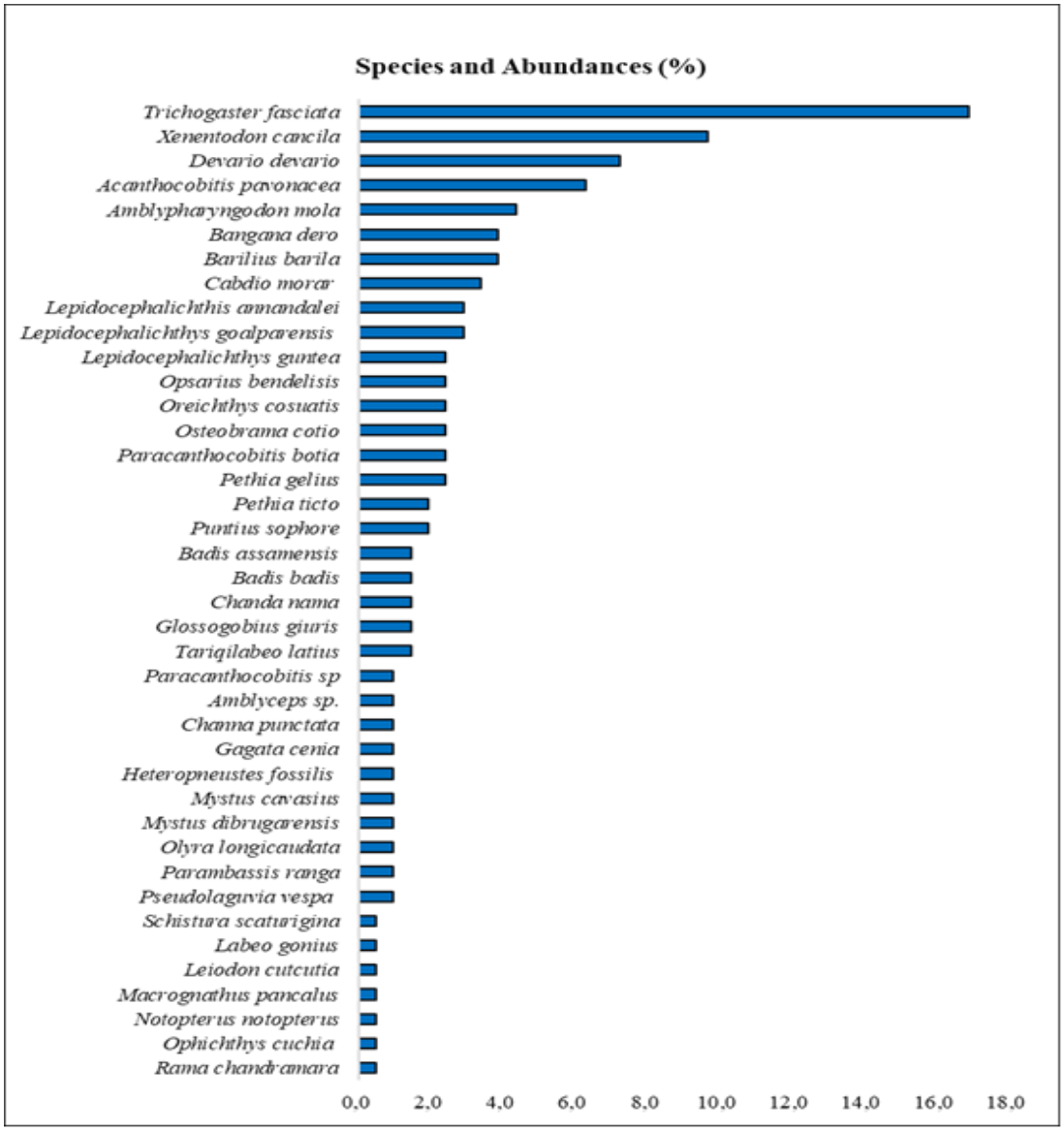


Figure 2. Number of species with percentage of abundances

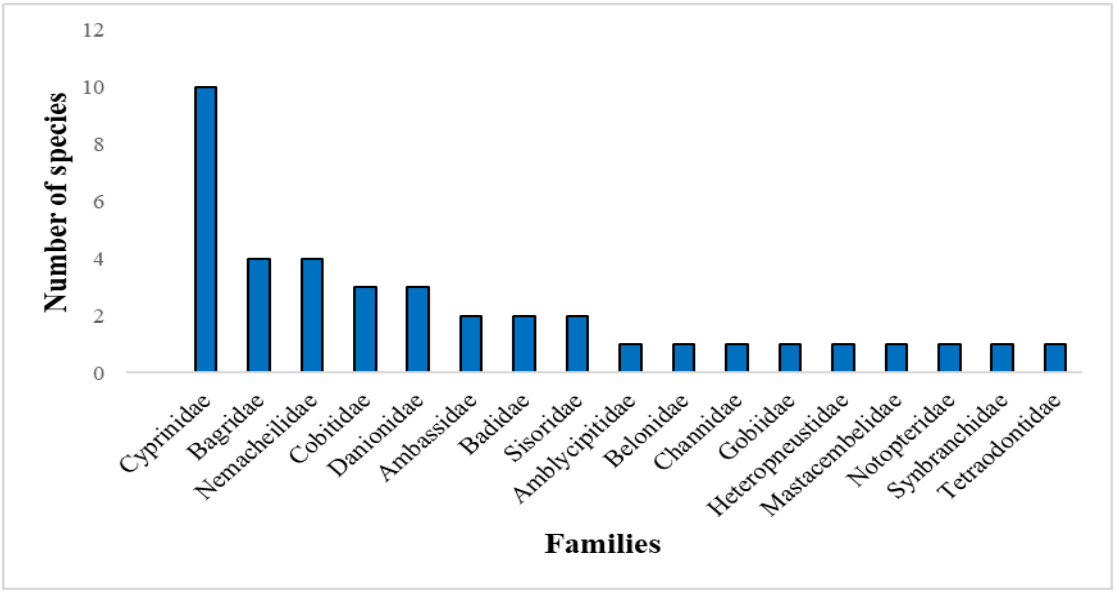
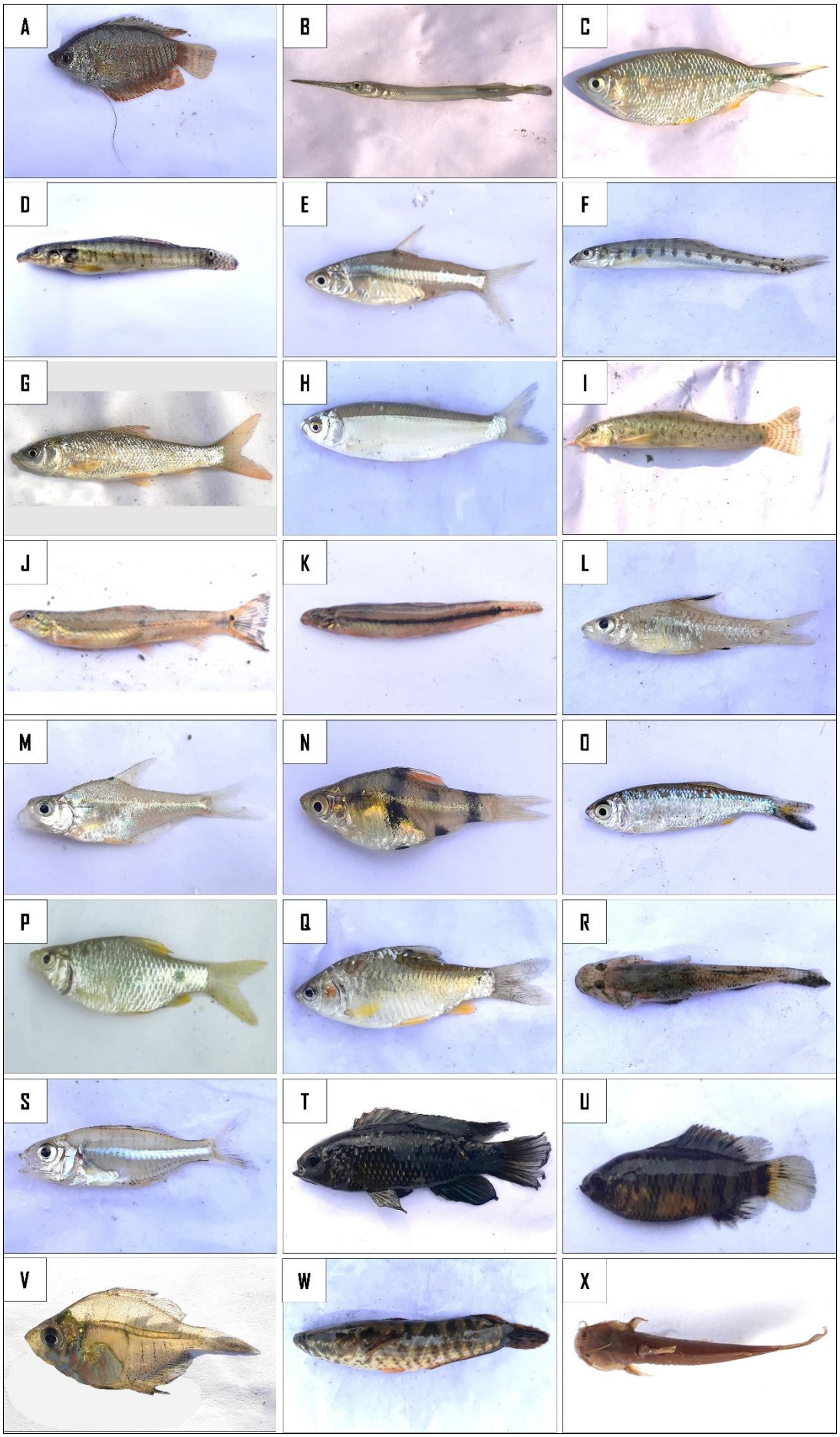


Figure 3. Species abundances within each family



Fish fauna of the Dibru River- a tributary of the Brahmaputra River, Dibrugarh District, Assam, Northeastern India, with a new range extension record of Pseudolaguvia vespa
Kensibo PAMAI, Shantabala Devi GURUMAYUM, Bitu RAI

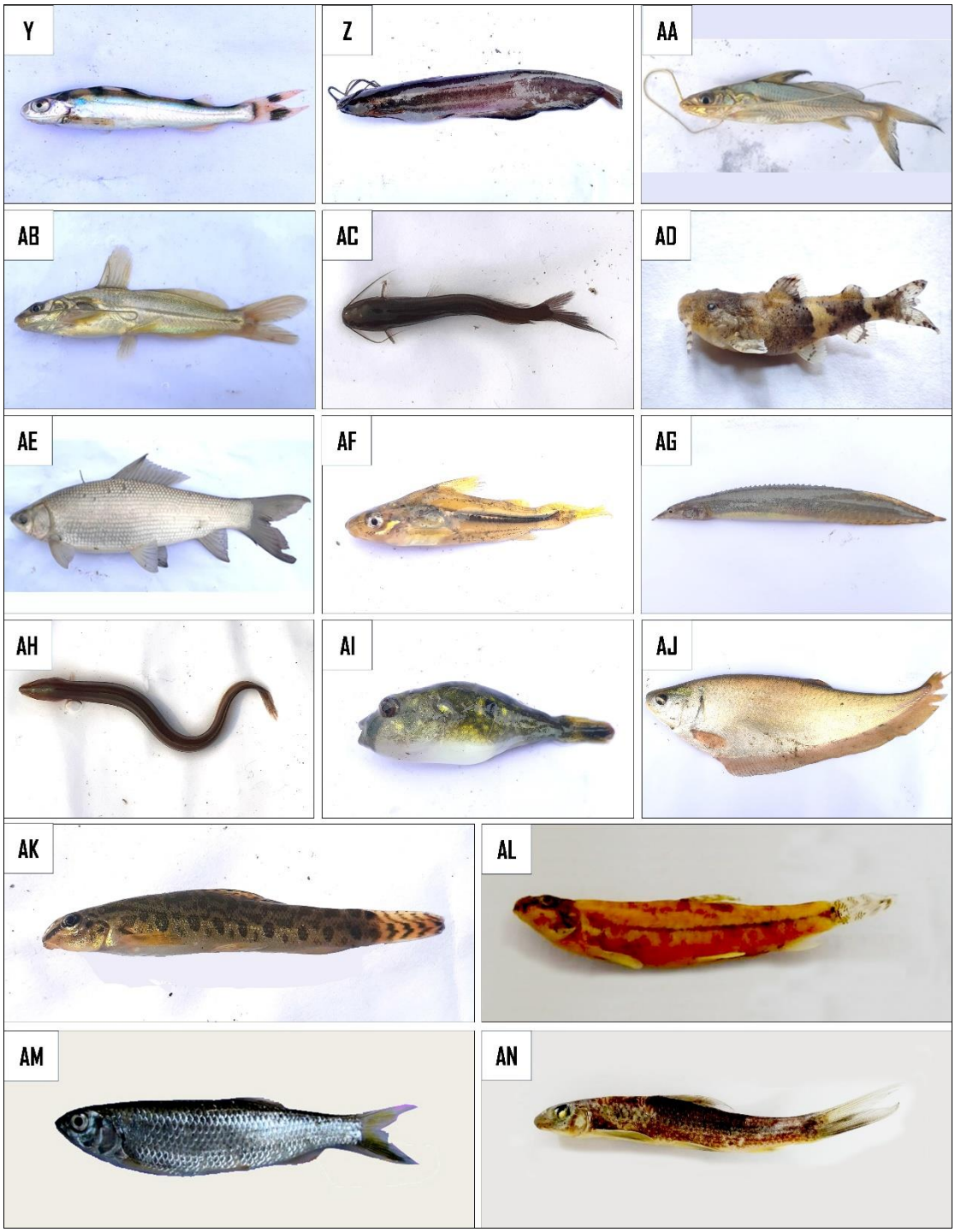


Figure 4. Fish species of Dibru River, Assam: (A) *Trichogaster fasciata*; (B) *Xenentodon cancila*; (C) *Devario devario*; (D) *Acanthocobitis pavonacea*; (E) *Amblypharyngodon mola*; (F) *Schistura scaturigina*; (G) *Bangana dero*; (H) *Cabdio morar*; (I) *Paracanthocobitis* sp.; (J) *Lepidocephalichthys goalparensis*; (K) *Lepidocephalichthys guntea*; (L) *Oreichthys cosuatis*; (M) *Osteobrama cotio*; (N) *Pethia gelius*; (O) *Opsarius bendelisis*; (P) *Pethia ticto*; (Q) *Puntius sophore*; (R) *Glossogobius giuris*; (S) *Chanda nama*; (T) *Badis assamensis*; (U) *Badis badis*; (V) *Parambassis ranga*; (W) *Channa punctata*; (X) *Amblyceps* sp.; (Y) *Gagata cenia*; (Z) *Heteropneustes fossilis*; (AA) *Mystus cavasius*; (AB) *Mystus dibrugarensis*; (AC) *Olyra longicaudata*; (AD) *Pseudolaguvia vespa*; (AE) *Labeo gonius*; (AF) *Rama chandramara*; (AG) *Macrognathus pancalus*; (AH) *Ophichthys cuchia*; (AI) *Leiodon cutcutia*; (AJ) *Notopterus notopterus*; and (AK) *Paracanthocobitis botia;* (AL) *Lepidocephalichthys annandalei*; (AM) *Barilius barila*; (AN) *Tariqilabeo latius.*

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A preliminary study on the investigation of Hemiptera (Pentatomidae, Scutelleridae, Coreidae, Alydidae, Pyrrhocoridae, Lygaeidae, Stenocephalidae, Rhopalidae) fauna in Eskişehir, Türkiye

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Abstract

A preliminary study was carried out to determine the species of Hemiptera pests of wheat in Eskişehir province. It was aimed to determine the existing pests in order to develop appropriate control methods with the possible damages that may occur in the region. The study was carried out in 19 different localities determined especially around wheat, barley, lucerne fields and roadsides in Eskişehir. As a result of the study, 26 genera and 41 species belonging to 8 families were identified. Of the species identified; *Aelia cognata* Fieber, 1868, *Aelia virgata* (Herrich-Schaeffer, 1841), *Aelia acuminata* (Linnaeus, 1758), *Eurydema blanda* Horváth, 1903, *Pausias martini* (Puton, 1890), *Carpocoris mediterraneus* Tamanini, 1958, *Rhaphigaster nebulosa* (Poda, 1761), *Ventocoris trigonus* (Krynicki, 1871), *Ventocoris fischeri* (Herrich & Schaeffer, 1851), *Ancyrosoma leucogrammes* (Gmelin, 1789), *Eurygaster dilaticollis* Dohrn, 1860, *Odontotarsus robustus* Jakovlev, 1884, *Odontotarsus purpureolineatus* (Rossi, 1790), *Psacasta tuberculata* (Fabricius, 1781), *Enoplops disciger* (Kolenati, 1845), *Psacasta exanthematica* (Scopoli, 1763), *Coreus marginatus* (Linnaeus, 1758), *Dicranocephalus albipes* (Fabricius, 1781), *Centrocoris spiniger* (Fabricius, 1781), *Lygaeus pandurus* (Scopoli, 1763), *Lygaeus equestris* (Linnaeus, 1758), *Brachycarenus tigrinus* (Schilling, 1829) and *Corizus hyoscyami* (Linnaeus, 1758) were reported for the first time from the research area. As a result of this study, the distribution of the Hemiptera pest fauna in the region was determined. Since most of the detected species are phytophagous, the damages that they may cause to plants such as wheat can be estimated with the data obtained.

Keywords: Hemiptera, fauna, pest, phytophagous, Eskişehir

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Eskişehir (Türkiye) ili Hemiptera (Pentatomidae, Scutelleridae, Coreidae, Alydidae, Pyrrhocoridae, Lygaeidae, Stenocephalidae, Rhopalidae) faunasının araştırılmasına yönelik bir ön çalışma

Özet

Eskişehir ilinde buğday zararlısı Hemiptera türlerinin belirlenmesi amacıyla bir ön çalışma gerçekleştirilmiştir. Bu ön çalışma ile bölgede oluşabilecek olası zararlar ile uygun mücadele yöntemlerinin geliştirilebilmesi için mevcut zararlıların belirlenmesi amaçlanmıştır. Çalışma Eskişehir'de özellikle buğday, arpa, yonca tarlaları çevresinde belirlenen 19 farklı lokalitede gerçekleştirilmiştir. Çalışma sonucunda 8 familyaya ait 26 cins ve 41 tür tespit edilmiştir. Tespit edilen türlerden, *Aelia cognata* Fieber, 1868, *Aelia virgata* (Herrich-Schaeffer, 1841), *Aelia acuminata* (Linnaeus, 1758), *Eurydema blanda* Horváth, 1903, *Eurygaster dilaticollis* Dohrn, 1860, *Carpocoris mediterraneus* Tamanini, 1958, *Pausias martini* (Puton, 1890), *Rhaphigaster nebulosa* (Poda, 1761), *Ventocoris trigonus* (Krynicki, 1871), *Ventocoris fischeri* (Herrich & Schaeffer, 1851), *Ancyrosoma leucogrammes* (Gmelin, 1789), *Odontotarsus robustus* Jakovlev, 1884, *Odontotarsus purpureolineatus* (Rossi, 1790), *Pcacasta tuberculata* (Fabricius, 1781), *Enoplops disciger* (Kolenati, 1845), *Psacasta exanthematica* (Scopoli, 1763), *Coreus marginatus* (Linnaeus, 1758), *Dicranocephalus albipes* (Fabricius, 1781), *Centrocoris spiniger* (Fabricius, 1781), *Lygaeus equestris* (Linnaeus, 1758), *Brachycarenus tigrinus* (Schilling, 1829), *Lygaeus pandurus* (Scopoli, 1763) ve *Corizus hyoscyami* (Linnaeus, 1758)

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araştırma alanından ilk kez rapor edilmiştir. Tespit edilen türlerin çoğu fitofag olduğu için buğday gibi bitkilere verebilecekleri zararlar bu çalışmadan elde edilen verilerle tahmin edilebilmektedir. Bir ön çalışma olan bu araştırma ile bölgedeki zararlı Hemiptera faunasının dağılımı belirlenmiştir.

Anahtar kelimeler: Hemiptera, fauna, zararlı böcek, fitofag, Eskişehir

1. Introduction

Agriculture is one of the most important sources of the Turkish economy. Cereals, mainly wheat, are grown on 75% of the agricultural areas. Cereals are also the main product in human nutrition. Wheat is an annual crop and can be produced in large areas because it has many varieties that can grow in different climatic and soil conditions and is highly adaptable. In Türkiye, especially in the Central Anatolian region, wheat production is quite common due to the cool and dry climatic conditions [14].

Cereals especially wheat, which has such a large area under cultivation in Türkiye, have very important pests that affect production. Cereal pests mostly cause damage by sucking the leaves and seeds of the plants. On the one hand, they cause a decrease in yield and on the other hand, they cause a significant decrease in the germination power of the grains and the quality of the flour obtained from such grains. The most important pests of wheat and the most widespread species in cultivated areas are the *Aelia* spp. and *Eurygaster* spp.. The population of these species increased in the 1980s in the Thracian region and very serious damage was reported in 1987 [14]. Studies on agricultural pest species in Türkiye started in the 1930s and continued with the identification, distribution and damage of the species [14, 15, 22, 25].

There are important families within the Hemiptera order. Among these families; Coreidae includes 2200 species belonging to 500 genera worldwide, and has a very wide distribution. Belonging to this family in Türkiye; 17 species of 12 genera were distributed in Thrace and 47 species of 19 genera distributed in Anatolia [4]. Another Hemiptera family Alydidae is represented by 4 genera and 7 species [6]. Again, two species from the family Pyrrhocoridae have been reported [17, 19]. 227 Lygaeidae species from the Hemiptera are known in Türkiye [23].

So far, there are not enough studies on the identification and distribution of cereal pests for Eskişehir province in the literature. The aim of this study was to contribute to the determination of the damage caused by these species in the Central Anatolian region by investigating the Hemiptera species harmful to cereals distributed in Eskişehir province.

2. Materials and methods

The examined specimens were collected from 19 different localities within the borders of Eskisehir province in 2005 and 2006, during the months of June-August, when adult activity was observed. The number of collected specimens was 3395. Specimens were collected by hand or with forceps from short plants, roadsides, cultivated fields and harvested crops. The captured specimens were killed in ethyl acetate jars and then taken to the laboratory. [16] was used to identify the specimens brought to the laboratory.

Male genitalia specimens were prepared for species identification of the genera *Eurygaster* and *Carpocoris*, using the aedeagus and paramere structure in the pygophore for diagnosis, as morphological characteristics were not sufficient for species identification. The methods used were those of [1] for the identification of *Eurygaster* species and [3] for the identification of *Carpocoris* species. During the identification of the material, the collections of Gazi University, Faculty of Science, Department of Biology, Zoological Museum were used as comparison material.

The localities, altitudes, habitats and survey dates are given in the Table 1 and the localities are shown on a map (Figure 1). The specimens of the studied species, which constitute the research material, preparaed and labelled according to standard methods, are kept in the Zoological Museum of Eskisehir Technical University.

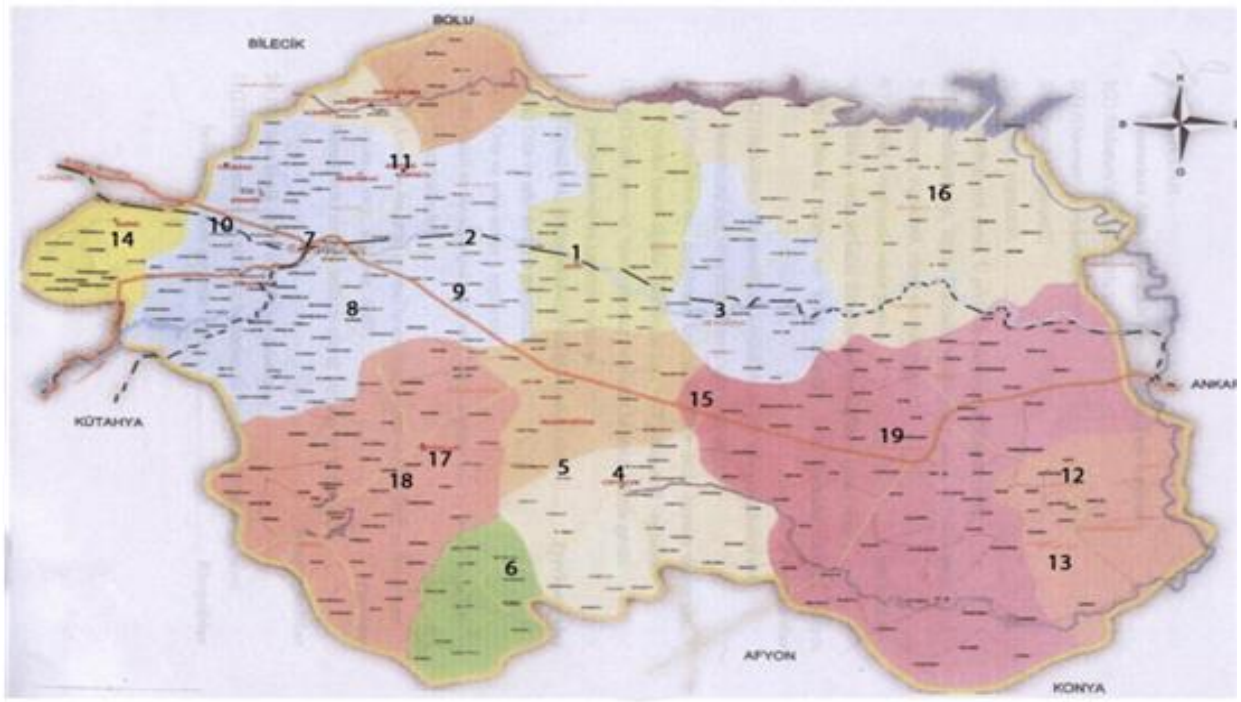

Figure 1. Localities researched in Eskisehir province (numbers refer to the sequence numbers of the localities shown in Table 1)

Table 1. Locations, altitudes, habitats and survey dates in Eskişehir region

Locality no	Locality	Altitude (m.)	Habitat	Date
1	Alpu	768	wheat field	14.07.2006 17.07.2006
2	Alpu-Çavlum	768	wheat field	29.07.2005
3	Beylikova	766	wheat field	29.07.2005 14.07.2006
4	Çifteler	869	wheat field, meadow, barley field, lucerne	31.07.2005 27.07.2005 25.07.2006
5	Çifteler-Hayriye	901	wheat field	05.08.2005
6	Han-İskankuyu	1081	wheat field	10.07.2005
7	Eskişehir	818	Roadside herbaceous plants	12.07. 2006
8	Eskişehir-Akpınar	978	wheat field	11.07.2006
9	Eskişehir-İmişehir	956	wheat field	11.07.2006
10	Eskişehir-Satılmışoğlu	804	wheat field	11.07.2006
11	Eskişehir-Yarımca	1248	Woodland, fruit trees, field edges	11.07.2006 13.07.2006
12	Günyüzü	904	wheat field, barley field, meadow	11.07.2006 15.07.2006
13	Günyüzü- Kayakent	1002	wheat field	13.07.2005
14	İnönü	1008	wheat field	27.07.2006
15	Kaymaz	970	wheat field	10.07.2006 15.07.2006
16	Mihalıççık	1222	Herbaceous plants in harvested wheat field	14.07.2006
17	Seyitgazi	1030	wheat field, meadow	01.08.2005 11.07.2006 17.07.2006
18	Seyitgazi	1030	Harvested wheat heap	01.08.2005
19	Sivrihisar	1039	wheat field	12.07.2006

3. Results

A total of 3395 adult specimens were collected from 19 different localities in present study which is conducted in Eskişehir. 14 genera 22 species belonging to family Pentatomidae; 3 genera and 8 species from Scutelleridae; 3 genera and 3 species belonging to family Coreidae; 1 genus and 1 species from Alydidae; 1 genus and 1 species belonging to Pyrrhocoridae; 1 genus and 3 species belonging to Lygaeidae; 1 genus and 1 species belonging to Stenocephalidae; 2 genera and 2 species belonging to Rhopalidae were collected and identified. According to the results, Hemiptera is represented by 26 genera and 41 species belonging to 8 families in the study area.

Family: Pentatomidae

Genus: *Mustha* Amyot and Serville, 1843

Mustha spinosula (Lefebvre, 1831)

Material examined: Eskişehir, Yarımca (1248 m.): 11.07.2006, 2♀♀

General geographical distribution: Serbia, Albania, Bulgaria, Bulgaria, South Russia, Iran, Israel, Northern Iraq, Cyprus, Caucasus, Egypt, Syria, Turkmenistan, Türkiye, Transcaucasia, Greece [8].

Distribution from Türkiye: Kars [11]; Bursa [23]; Kahramanmaraş, Gaziantep, Eskişehir, Mardin [7]; Muş, Artvin (Çoruh) [7]; İstanbul [7, 9]; Edirne [5, 18]; Ankara [6, 13, 19]; Mersin [15]; İzmir, Aydın, Isparta, Çanakkale, Manisa, Uşak, Muğla [18]; Adana, Antalya [19]; Elazığ [11]; Konya [17]; Karaman [19]; Çorum, Ordu, Samsun, Tokat [7].

Genus: *Aelia* Fabricius, 1803

Aelia acuminata (Linnaeus, 1758)

Material examined: Seyitgazi (1030 m.): 01.08.2005, 2♀♀, 2♂♂; Seyitgazi (1030 m.): 17.07.2006, 3♀♀, 2♂♂; Mihalıççık (1222 m.): 14.07.2006, 2♀♀, 1♂; Eskişehir- İmişehir (956 m.): 11.07.2006, 1♂; Eskişehir- Akpınar (978 m.): 11.07.2006, 3♀♀, 1♂; Çifteler (869 m.): 27.07.2006, 2♀♀; Çifteler (869 m.): 25.07.2006, 2♀♀; Sivrihisar (1039 m.): 12.07.2006, 1♂; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 1♀; İnönü (1008 m.): 27.07.2006, 5♀♀, 5♂♂.

General geographical distribution: Serbia, Caucasus, Algeria, Austria, Baltic States, Albania, Western Russia, Czech Republic, Balearic Islands, Denmark, Finland, France, Morocco, Netherlands, South Russia, England, Switzerland, Sweden, Spain, Iran, Cyprus, Italy, Hungary, Corsica, Norway, Portugal, Poland, Romania, Slovakia, Sicily, Syria, Siberia, Sardinia, Turkestan, Tunisia, Türkiye, Greece (Crete), Germany, Macedonia, Bulgaria, Croatia. [8].

Distribution from Türkiye: Ankara [10, 16, 24]; Hatay [20, 24]; Adana [10, 24]; Antalya, Zonguldak, Bartın, Kahramanmaraş, Gaziantep, İçel, Bolu , Karabük, Karaman, Niğde, Nevşehir, Sinop, Osmaniye [24]; Kırşehir [17, 24]; Kastamonu, Çankırı [19, 24]; Kocaeli, Sakarya, Artvin, Konya, Rize, Diyarbakır, İzmir, Balıkesir, Afyon, Uşak, Bilecik, Denizli, Aydın, Manisa, Muğla, Bursa [7, 23]; İstanbul, Tekirdağ, Kırklareli, [7, 9, 23]; Edirne [10, 23, 24]; Çanakkale [9, 23]; Ordu, Çorum, Sinop, Tokat, Amasya [5]; Samsun [5, 7, 23].

Aelia cognata Fieber, 1868

Material examined: Alpu- Çavlum (768 m.): 29.07.2005, 1♂; Han- İskankuyu (1081 m.): 10.07.2005, 1♂; Alpu (768 m.): 14.07.2006, 8 ♂♂; Çifteler (869 m.): 27.07.2005, 1♂; Çifteler (869 m.): 25.07.2006, 3♂♂; Seyitgazi (1030 m.): 01.08.2005, 1♂; Mihalıççık (1222 m.): 14.07.2006, 5♂♂; Günyüzü (904 m.): 15.07.2006, 7♂♂; Seyitgazi (1030 m.): 17.07.2006, 7♂♂; Eskişehir- İmişehir (956 m.): 11.07.2006, 5♂♂; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 3♂♂; Sivrihisar- Kaymaz (970 m.): 10.07.2006, 1♂; Beylikova (766 m.): 14.07.2006, 5♂♂.

General geographical distribution: Belgium, Algeria, Morocco, France, Spain, Italy (Sicily), Sardinia, Portugal, Slovenia, Syria, Tunisia, Türkiye [8].

Distribution from Türkiye: İzmir, Manisa, Konya, Kayseri, Ankara, Gaziantep, Yozgat [10, 23, 24]; Kırşehir [17]; Samsun, Çorum, Amasya, Tokat [5]; Tekirdağ, Edirne, Kırklareli, İstanbul [9].

Aelia rostrata Boheman, 1852

Material examined: Eskişehir- Akpınar (978 m.): 11.07.2006, 6♀♀, 5♂♂; Mihalıççık (1222 m.): 14.07.2006, 31♀♀, 21♂♂; Han- İskankuyu (1081 m.): 10.07.2005, 6♀♀, 5♂♂; Eskişehir-İmişehir (956 m.): 11.07.2006, 46♀♀, 29♂♂; Alpu (768 m.): 14.07.2006, 97♀♀, 70♂♂; Alpu- Çavlum (768 m.): 29.07.2005, 3♀♀, 4♂♂; Beylikova (766 m.): 14.07.2006, 32♀♀, 21♂♂; Seyitgazi (1030 m.): 17.07.2006, 32♀♀, 31♂♂; Günyüzü (904 m.):

15.07.2006, 40♀♀, 43♂♂; Eskişehir-Satılmışoğlu (804 m.): 11.07.2006, 3♀♀, 1♂; Sivrihisar (1039 m.): 12.07.2006, 20♀♀, 12♂♂; Eskişehir- Yarımca (1248 m.): 13.07.2006, ♀; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 61♀♀, 39♂♂; Sivrihisar- Kaymaz (970 m.): 10.07.2006, 13♀♀, 8♂♂; Çifteler (869 m.): 25.07.2006, 37♀♀, 35♂♂; Çifteler (869 m.): 27.07.2005, 7♀♀, 1♂; İnönü (1008 m.): 27.07.2006, 52♀♀, 46♂♂; Beylikova (766 m.): 29.07.2005, 11♀♀, 5♂♂; Çifteler- Hayriye (901 m.): 05.08.2005, 4♀♀.

General geographical distribution: Albania, Austria, Bulgaria, Czech Republic, Denmark, France, South and West Russia, Iran, Sweden, Italy (Sicily), Cyprus, Hungary, Portugal, Romania, Poland, Sardinia, Slovakia, Türkiye, Greece, Germany, Macedonia, Croatia, Serbia, Spain, Switzerland [8].

Distribution from Türkiye: Sakarya, Kocaeli, Bilecik [7]; İstanbul [7, 9]; Ankara, Kars [10]; Edirne [2, 9, 10, 23]; Tunceli [10, 23, 24]; Uşak, Bilecik, Manisa, Isparta, Burdur, İzmir, Kütahya, Afyon, Bursa [23]; Kırklareli [9, 23]; Konya, Nevşehir [24]; Çorum, Tokat [5, 24]; Aksaray, Adana, Bolu, Antalya, Eskişehir, Çankırı, Kastamonu, Çorum, Kahramanmaraş, Karabük, Konya, Kayseri, Kırşehir, Nevşehir, Kırıkkale [24]; Çanakkale, Tekirdağ [9]; Samsun, Ordu, Amasya [5].

Aelia virgata (Herrich-Schaeffer, 1841)

Material examined: Günyüzü (904 m.): 15.07.2006, 1♀, 1♂

General geographical distribution: Bulgaria, South Russia, Macedonia, Iraq, Iran, Israel, Israel, Syria, Tunisia, Türkiye, Greece [8].

Distribution from Türkiye: Konya, Ankara [10]; Elazığ, Tunceli [10, 23, 24]; Bilecik, Uşak, Afyon, Kırklareli [23]; Çanakkale, Gaziantep [24]; Edirne [2, 9, 10]; Kahramanmaraş [16, 24]; Tekirdağ [9].

Genus: *Eurydema* Laporte, 1833

Eurydema ornata (Linnaeus, 1758)

Material examined: Günyüzü (904 m.): 15.07.2006, 18♀♀, 14♂♂; Günyüzü-Kayakent (1002 m.): 13.07.2005, 36♀♀, 22♂♂; Seyitgazi (1030 m.): 17.07.2006, 1♀, 1♂; Eskişehir- İmişehir (956 m.): 11.07.2006, 14♀♀, 3♂♂; Alpu (768 m.): 14.07.2006, 2♀♀, 1♂; İnönü (1008 m.): 27.07.2006, 1♀, 3♂♂.

General geographical distribution: Serbia, Afghanistan, Algeria, China, Albania, Germany, Austria, Bosnia and Herzegovina, Balearic Islands, Baltic Region, Belgium, Bulgaria, Croatia, Denmark, Ethiopia, Eritrea, Egypt, Morocco, Hungary, France, Netherlands, India, England, Iraq, Iran, Israel, Spain, Sweden, Switzerland, Italy (Sicily), Czech Republic, Sardinia, Serbia, Caucasus, Canary Islands, Montenegro, Cyprus, Corsica, Libya, Malta, Mongolia, Romania, Poland, Portugal, Western and Southern Russia, Siberia, Slovakia, Slovenia, Transcaucasia, Tunisia, Türkiye, Turkestan, Greece (Crete) [8].

Distribution from Türkiye: Bilecik, Kocaeli [7, 23 Tekirdağ, İzmir, Manisa [23]; Adana, Ankara, Antalya, Eskişehir, Çorum, İçel, Aksaray, Bolu, Kahramanmaraş, Osmaniye, Hatay, Gaziantep, Nevşehir, Karabük, Kastamonu, Karaman, Kilis, Kırıkkale, Konya, Niğde, Nevşehir, Yozgat, Kayseri [24]; Çankırı [19, 24]; Edirne [2, 9, 10, 23]; Bursa, Aydın, Kırklareli, Balıkesir, İstanbul, Afyon, Muğla, Uşak, Sakarya [24]; Artvin, Adıyaman, Bitlis, Batman, Mardin, Erzincan, Elazığ, Iğdır, Hakkari, Malatya, Trabzon, Şanlıurfa, İçel, Kırıkkale [23, 24]; Çorum, Amasya, Ordu, Samsun, Tokat, Sinop [5, 24]; Kırklareli, Çanakkale, Tekirdağ, İstanbul [9].

Eurydema oleracea (Linnaeus, 1758)

Material examined: Günyüzü (904 m.): 15.07.2006, 1♀, 1♂; Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♀; İnönü (1008 m.): 27.07.2006, 2♀♀, 2♂♂

General geographical distribution: Serbia, Norway, Albania, Germany, Austria, Portugal, Baltic Region, Belgium, Bulgaria, Algeria, Czech Republic, Denmark, Morocco, Finland, France, Netherlands, England, Spain, Sweden, Switzerland, Italy (Sicily), Sardinia, Caucasus, Corsica, Hungary, Romania, Poland, Portugal, Western and Southern Russia, Siberia, Slovakia, Tajikistan, Transcaucasia, Türkiye, Turkestan, Greece (Crete) [8].

Distribution from Türkiye: Antalya, Çorum, Kastamonu, Afyon, Bartın, Bolu, Bilecik, Kütahya, Sakarya, Uşak, Kocaeli, Manisa [24]; Ankara, Adapazarı, Adana, Balıkesir, Bursa, Isparta, İzmir, Gümüşhane, Kahramanmaraş, Samsun, Trabzon, Rize, Tunceli, Kars, Yozgat, Zonguldak, Yalova [10, 23, 24]; Kastamonu, Çankırı [19]; Tekirdağ, İstanbul, Kırklareli, Çanakkale [9]; Edirne [2, 9, 10]; Tokat, Ordu, Samsun, Amasya, Çorum, Sinop [5]; Eskişehir [7, 24].

Eurydema blanda Horváth, 1903

Material examined: Eskişehir- İmişehir (956 m.): 11.07.2006, 5♀♀, 3♂♂; Günyüzü-Kayakent (1002 m.): 13.07.2005, 3♀♀; Günyüzü (904 m.): 15.07.2006, 2♀♀, 2♂♂; Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♀; İnönü (1008 m.): 27.07.2006, 3♀♀, 2♂♂

General geographical distribution: Iran, Türkiye [8].

Distribution from Türkiye: Ankara [10, 24]; Antalya, Adana, Niğde, Kahramanmaraş, Kırıkkale [24]; Aydın, Denizli, Afyon, Balıkesir, Bolu, Isparta, Burdur, Bilecik, Erzurum, Uşak, Yalova, Çanakkale, Gümüşhane, Karaman, Kars, Hakkari, İzmir, Kahramanmaraş, Kocaeli, Kırklareli, Kütahya, Kastamonu, Kırıkkale, Malatya, Manisa, Şırnak, Tokat, Ordu [5, 23, 24]; Samsun, Amasya, Çorum [5]; Kırklareli, Tekirdağ, Çanakkale, İstanbul [9].

Genus: *Rhaphigaster* Laporte, 1833

Raphigaster nebulosa (Poda, 1761)

Material examined: Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♀; Eskişehir (818 m.): 12.07.2006, 1♀; Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♀.

General geographical distribution: Algeria, Afghanistan, Austria, Germany, Balkans, Balearic Islands, Baltic Region, Belgium, Bulgaria, Albania, Czech Republic, China, France, Hungary, Morocco, Mongolia, Italy, Italy, Italy, Hungary, Hungary, Mongolia, Mongolia, Portugal, Portugal, Romania, Poland, Poland, Western and Southern Russia, Slovakia, Syria, Turkestan, Türkiye, Cyprus, Greece, Crete Island, Sardinia, Spain, Switzerland [8].

Distribution from Türkiye: Kars [11]; Ankara [10, 18, 22]; Edirne [2]; Afyon, Aydın, Bursa, Çanakkale, İstanbul, İzmir, Denizli, Manisa, Isparta, Burdur, Kırklareli, Kütahya, Uşak, Sakarya, Muğla [23]; Çankırı, Adana, Aksaray, Zonguldak, Antalya, Bolu, Konya, Kayseri, Niğde, Nevşehir, Yozgat, Hatay, Karaman, Gaziantep, Bartın, Karabük, Kahramanmaraş, Kilis, İçel [24]; Kastamonu [19, 24]; Samsun, Sinop, Çorum, Ordu, Tokat [5].

Genus: *Piezodorus* Fieber, 1860

Piezodorus lituratus (Fabricius, 1764)

Material examined: Sivrihisar- Kaymaz (970 m.): 15.07.2006, 1♂

General geographical distribution: Serbia, Germany, Albania, Austria, Balearic Islands, Balearic Islands, Western Russia, Bulgaria, Czech Republic, Cyprus, Egypt, Algeria, Morocco, Morocco, Southern France, Southern Russia, Croatia, Netherlands, England, Ireland, Iran, Scotland, Spain, Israel, Italy, Corsica, Libya, Hungary, Macedonia, Poland, Portugal, Romania, Sicily, Switzerland, Sardinia Island, Syria, Türkiye, Turkestan, Tunisia, Greece, Crete Island [8].

Distribution from Türkiye: Eskişehir, İstanbul [7]; Adana, Elazığ [10, 24]; Mersin [20]; Diyarbakır [10, 23]; Manisa, İzmir, Kütahya, Balıkesir, Bilecik, Afyon, Aydın, Burdur, Bursa, Muğla [23]; Kırklareli, Çanakkale [9, 23]; Nevşehir, Hatay, Karabük, Antalya, Bolu, Çorum, İçel, Sinop [23]; Ankara [18]; Kastamonu, Çankırı [19, 23]; Amasya, Ordu, Sinop, Tokat, Çorum, Samsun [5]; Tekirdağ, Edirne, İstanbul [9]; Kırşehir [17].

Genus: *Pausias* Jakowlew, 1905

Pausias martini (Puton, 1890)

Material examined: Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♂

General geographical distribution: Iraq, Iran, Syria, Türkiye [8].

Distribution from Türkiye: İzmir [23]; Karaman [23, 24]; Konya, Ankara, Erzincan [24]; Çanakkale (Bozcaada) [24].

Genus: *Holcostethus* Fieber, 1860

Holcostethus vernalis (Wolff, 1804)

Material examined: Günyüzü (904 m.): 15.07.2006, 1♀; Çifteler- Hayriye (901 m.): 05.08.2005, 1♂; Han-İskankuyu (1081 m.): 10.07.2005, 1♀, 1♂; Eskişehir- Akpınar (978 m.): 11.07.2006, 1♀.

General geographical distribution: Albania, Germany, Balkans, Western and Southern Russia, Belgium, Baltic Region, Bulgaria, Czech Republic, Algeria, Denmark, England, Finland, Netherlands, Iraq, Iran, Israel, Switzerland, Italy, Sicily, Sweden, Sardinia Island, Spain, Norway, Poland, Portugal, Caucasus, Cyprus, Corsica, Hungary, Siberia, Slovakia, Syria, Türkiye, Turkestan, Tunisia, Transcaucasus, France, Greece, Crete Island, Canary Islands [8].

Distribution from Türkiye: Kahramanmaraş, Gaziantep [24]; Edirne [2, 9, 10, 23]; Adana [1, 10, 24]; Burdur, Bursa, Balıkesir, Aydın, Manisa, Bilecik, Denizli, İzmir, Sakarya, Uşak, Muğla [23]; Tekirdağ, Çanakkale, Kırklareli, [9, 23]; Osmaniye, Hatay, İçel, Ankara, Antalya, Karabük, Karaman, Kahramanmaraş, Kilis [24];

Zonguldak, Konya, Niğde, Çorum, Kayseri [1, 24]; Kastamonu, Çankırı [19, 24]; Eskişehir, Elazığ [1, 16]; Kırşehir [17, 24]; Karaman, Osmaniye, Van, Gümüşhane, Hatay, Malatya [1]; Samsun, Çorum, Ordu, Tokat [5]; İstanbul [9].

Genus: *Carpocoris* Kolenati, 1846

Carpocoris mediterraneus Tamanini, 1958

Material examined: Eskişehir- İmişehir (956 m.): 11.07.2006, 1♀; Seyitgazi (1030 m.): 17.07.2006, 1♀; Beylikova (766m.): 14.07.2006, 1♀.

General geographical distribution: Albania, Germany, Balkans, Bulgaria, Czech Republic, Eritrea, Southern Russia, Greenland, Iraq, Iran, Spain, Italy, Cyprus, Hungary, Egypt, Romania, Slovakia, Syria, Türkiye, Greece, Crete Island [8].

Distribution from Türkiye: Ankara [18, 20, 24]; Karaman, Adana, Çorum, Hatay, İçel, Bartın, Bolu, Karabük, Kastamonu, Antalya [24]; İzmir, Balıkesir, Aydın [23]; Çanakkale [9, 23]; Bursa, Bilecik, Burdur [23]; Elazığ [16]; Edirne [2, 9, 23]; Kahramanmaraş [16, 24]; İstanbul, Tekirdağ, Kırklareli [9, 24]; Sakarya, Isparta, Manisa, Muğla [23]; Yalova, Osmaniye [1]; Sinop, Amasya, Ordu, Samsun, Çorum, Tokat [5]; Çankırı [19].

Carpocoris fuscispinus (Boheman, 1850)

Material examined: Alpu (768 m.): 14.07.2006, 1♀; Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♀; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 1♂

General geographical distribution: Serbia, Afghanistan, Germany, Albania, Austria, Azerbaijan, Baltic Countries, Western Russia, Bulgaria, Czech Republic, China, Denmark, Palestine, Finland, France, Southern Russia, Netherlands, Iraq, Italy, Spain, Sweden, Siberia, Switzerland, Japan, Kazakhstan, Kyrgyzstan, Corsica, Hungary, Mongolia, Poland, Romania, Syria, Slovakia, Türkiye, Tajikistan, Greece [8].

Distribution from Türkiye: Kars-Sarıkamış [11]; Muğla, Isparta [23]; Antalya, Aydın, Ağrı, Amasya, Çorum, Denizli, Diyarbakır, Bitlis, Burdur, Eskişehir, Erzurum, Gaziantep, Yozgat, Hatay, Karaman, Kahramanmaraş, Gümüşhane, Niğde, Hakkari, Kars, Kayseri, Kırşehir, Kırıkkale, Sakaya, Şanlıurfa, Konya, Van [10, 20, 24]; Çankırı, Kastamonu [10, 19, 20, 24]; Ankara [10, 18, 20, 24]; Elazığ [16]; Çorum, Tokat [5].

Carpocoris purpureipennis (DeGeer, 1773)

Material examined: Beylikova (766 m.): 14.07.2006, 2♀♀, 1♂; Alpu (768 m.): 14.07.2006, 2♀♀; Eskişehir- Satılmışoğlu (804 m.): 11.07.2006, 1♀; Çifteler- Hayriye (901 m.): 05.08.2005, 1♂.

General geographical distribution: Serbia [12]; Afghanistan, Germany, Albania, Austria, Bulgaria, Czech Republic, Southern France, Southern Russia, Greenland, Iraq, Iran, Italy, Israel, Caucasus, Corsica, Cyprus, Egypt, Poland, Syria, Slovakia, Switzerland, Türkiye, Turkestan, Transcaucasus, Greece (Crete Island) [8].

Distribution from Türkiye: Kocaeli [7, 10]; Ankara [10, 18]; Elazığ [16]; Edirne [2, 9, 10]; Tunceli, Diyarbakır [10, 23]; Bursa, İstanbul [23]; Bartın, Hatay, Adana, Antalya [24]; Kahramanmaraş [16, 24]; Kastamonu, Karabük, Karaman, Zonguldak, Kayseri, Yozgat [1, 24]; Çankırı [19, 24]; Hakkari, Erzincan, Niğde [1]; Tekirdağ, Kırklareli [9]; Amasya, Çorum, Ordu, Tokat, Samsun, Sinop [5].

Genus: *Codophila* Mulsant and Rey, 1866

Codophila varia (Fabricius, 1787)

Material examined: Eskişehir- İmişehir (956 m.): 11.07.2006, 3♀♀; Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♀; Mihalıççık (1222 m.): 14.07.2006, 1♂; Beylikova (766 m.): 14.07.2006, 2♀♀, 3♂♂; Alpu (768 m.): 14.07.2006, 2♀♀; Günyüzü (904 m.): 15.07.2006, 4♀♀, 4♂♂; Alpu (768 m.): 17.07.2006, 2♂♂; Seyitgazi (1030 m.): 17.07.2006, 1♀; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 1♀.

General geographical distribution: Afghanistan, Algeria, Balearic Islands, Czech Republic, Armenia, Morocco, Greenland, Southern France, Southern Russia, Iraq, Iran, Spain, Israel, Switzerland, Italy, Sicily, Syria, Canary Islands, Caucasus, Cyprus, Corsica, Libya, Hungary, Egypt, Central Asia, Romania, Portugal, Slovakia, Sardinia Island, Türkiye, Bulgaria, Turkestan, Turkmenistan, Transcaucasus, Tajikistan, Albania, Austria, Tunisia, Greece, Crete Island [8].

Distribution from Türkiye: Ankara [10, 18, 24]; Tunceli, Diyarbakır, Mardin [10, 23]; Eskişehir [7]; Elazığ [16]; Aydın, Bilecik, Bursa, Balıkesir, İzmir, Sakarya, Kırıkkale, Muğla [23]; Antalya, Adana, Çorum, İçel, Gaziantep, Kayseri, Karaman, Kırşehir, Nevşehir, Konya, Osmaniye, Kahramanmaraş, Karabük, Hatay [24]; Çankırı [19, 24]; Edirne [9, 10, 23]; Kırklareli, Çanakkale, Tekirdağ, İstanbul [9]; Amasya, Sinop, Çorum, Samsun, Tokat [5].

Genus: *Dolycoris* Mulsant and Rey, 1866

Dolycoris baccarum (Linnaeus, 1758)

Material examined: Eskişehir- Akpınar (978 m.): 11.07.2006, 1♂; Eskişehir- İmişehir (956 m.): 11.07.2006, 1♀; Beylikova (766 m.): 14.07.2006, 4♀♀, 1♂; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 1♀, 1♂; Günyüzü (904 m.): 15.07.2006, 6♀♀, 5♂♂; Seyitgazi (1030 m.): 17.07.2006, 2♀♀; Alpu (768 m.): 17.07.2006, 2♀♀; İnönü (1008 m.): 27.07.2006, 1♀; Çifteler- Hayriye (901 m.): 05.08.2005, 1♂.

General geographical distribution: Serbia, Germany, Albania, Balearic Islands, Belgium, Bulgaria, Canary Islands, China, Denmark, England, France, Hungary, Greenland, Russia, Netherlands, Ireland, Iraq, Iran, India, Spain, Switzerland, Sweden, Italy, Corsica, Cyprus, Japan, Norway, Romania, Portugal, Sardinia, Siberia, Syria, Slovakia, Türkiye, Greece, Crete Island, Czech Republic, Finland [8].

Distribution from Türkiye: The whole Türkiye [1, 2, 3, 5, 7, 9, 10, 16, 23, 24].

Genus: *Ventocoris* Hahn, 1834

Ventocoris trigonus (Krynicki, 1871)

Material examined: Sivrihisar- Kaymaz (970 m.): 10.07.2006, 1♂; İnönü (1008 m.): 27.07.2006, 2♀♀, 1♂; Çifteler (869 m.): 31.07.2005, 2♀♀, 5♂♂; Beylikova (766 m.): 14.07.2006, 1♂.

General geographical distribution: Bulgaria, Czech Republic, Southern Russia, Iran, Israel, Caucasus, Cyprus, Hungary, Romania, Slovakia, Syria, Türkiye, Turkestan, Transcaucasia [8].

Distribution from Türkiye: Bursa [11]; Ankara [10, 18, 22]; Konya, Adana [7]; Aydın [11, 23]; Balıkesir, Afyon [23]; Edirne [2, 10]; Gaziantep, Kahramanmaraş [16, 23]; Çanakkale [24]; Çorum, Amasya [5, 11].

Ventocoris fischeri (Herrich & Schaffer, 1851)

Material examined: Eskişehir- Satılmışoğlu (804 m.): 11.07.2006, 1♀; Sivrihisar (1039 m.): 12.07.2006, 9♀♀, 10♂♂; Beylikova (766 m.): 14.07.2006, 128♀♀, 140♂♂; Alpu (768 m.): 14.07.2006, 6♀♀, 4♂♂; Günyüzü (904 m.): 15.07.2006, 9♀♀, 17♂♂; Çifteler (869 m.): 05.08.2005, 3♀♀, 4♂♂; Çifteler (869 m.): 25.07.2006, 1♀.

General geographical distribution: Afghanistan, Southern Russia, Iran, Corsica, Egypt, Portugal, Sudan, Turkestan, Türkiye, Caucasus, Central Asia, Transcaucasia, Turkmenistan [8].

Distribution from Türkiye: Amasya [10]; Ankara [10, 20]; Burdur [23]; İçel, Antalya [23, 24]; Nevşehir [22]; Konya [10]; Çorum [5].

Genus: *Ancyrosoma* Amyot and Serville, 1843

Ancyrosoma leucogrammes (Gmelin, 1789)

Material examined: Günyüzü (904 m.): 15.07.2006, 18♀, 7♂; Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♀, 1♂.

General geographical distribution: Albania, Austria, Algeria, Morocco, Southern France, Croatia, Iraq, Spain, Israel, Italy, Switzerland, Canary Islands, Caucasus, Corsica, Cyprus, Egypt, Hungary, Malta, Romania, Portugal, Sardinia Island, Slovakia, Slovenia, Syria, Türkiye, Turkestan, Transcaucasus, Tajikistan, Tunisia, Greece, Crete Island, Bulgaria, Czech Republic, Germany [8].

Distribution from Türkiye: Adana [7, 10, 23, 24]; Sakarya, İstanbul [7]; Konya [7, 22]; İzmir, Karaman [23]; Edirne [2, 10, 23]; Ankara [10, 18, 24]; Batman, Diyarbakır, Siirt, Tunceli [10, 24]; Manisa, Tekirdağ, Bursa, Muğla, Aydın, Çanakkale, Bilecik, Burdur, Isparta, Kırklareli, Balıkesir [23]; İçel, Antalya, Kahramanmaraş, Hatay, Gaziantep [23, 24]; Osmaniye [24]; Elazığ [16]; Çorum [5, 23, 24]; Sinop, Amasya, Samsun, Ordu, Tokat [5].

Genus: *Graphosoma* Laporte, 1833

Graphosoma lineatum (Linnaeus, 1758)

Material examined: Eskişehir- Yarımca (1248 m.): 13.07.2006, 2♀♀, 4♂♂; Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♂; Günyüzü (904 m.): 15.07.2006, 2♂♂

General geographical distribution: Bulgaria, Slovenia, Croatia, Southern Europe, Iran, Northern Africa, Central and Western Asia, Southern and Western Russia, Türkiye, Greece (Crete), Austria, Serbia [8].

Distribution from Türkiye: Kars [11, 23]; Kocaeli, Eskişehir, İstanbul [7]; Ankara [10, 18, 24]; Bursa [10, 23]; Edirne [2, 10]; İzmir, Denizli, Aydın, Çanakkale, Balıkesir, Bilecik, Ağrı, Artvin, Isparta, Manisa, Muğla,

Kırklareli, Kütahya, Sakarya [23]; Adana, Antalya, Kahramanmaraş, İçel, Hatay, Zonguldak [24]; Kastamonu, Çankırı [19, 24]; Elazığ [16]; Sinop, Ordu, Samsun, Tokat, Amasya [5]; Çorum [5, 24].

Genus: *Derula* Mulsant and Rey, 1856

Derula flavoguttata Mulsant and Rey, 1856

Material examined: Günyüzü (904 m.): 15.07.2006, 2♀♀, 1♂; İnönü (1008 m.), 1♀; Sivrihisar (1039 m.): 12.07.2006, 1♂; Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♂.

General geographical distribution: Albania, Bulgaria, Southern France, Southern Russia, Spain, Italy, Caucasus, Hungary, Romania, Slovakia, Transcaucasus, Türkiye, Greece, Czech Republic, Croatia, Serbia [8].

Distribution from Türkiye: Eskişehir [7]; Bolu, Sinop, Gaziantep, Adana, İçel, Antalya [24]; Edirne [9, 10]; Kütahya, Kırklareli, Bursa [23]; Elazığ [16]; Ankara [18]; Samsun, Amasya, Tokat [5].

Family: Scutelleridae
Genus: *Eurygaster* Laporte, 1833

Eurygaster maura (Linnaeus, 1758)

Material examined: Sivrihisar- Kaymaz (970 m.): 10.07.2006, 40♀♀, 35♂♂; Eskişehir-Satılmışoğlu (804 m.): 11.07.2006, 2♀♀, 2♂♂; Seyitgazi (1030 m.): 17.07.2006, 68♀♀, 83♂♂; Beylikova (766 m.): 29.07.2005, 4♀♀, 5♂♂; Han- İskankuyu (1081 m.): 10.07.2005, 3♀♀, 2♂♂; Eskişehir- Akpınar (978 m.): 11.07.2006, 4♀♀, 3♂♂; Eskişehir- İmişehir (956 m.): 11.07.2006, 91♀♀, 77♂♂; Mihalıççık (1222 m.): 14.07.2006, 83♀♀, 87♂♂; Beylikova (766 m.): 14.07.2006, 51♀♀, 53♂♂; Çifteler (869 m.): 31.07.2005, 5♀♀, 6♂♂; Çifteler (869 m.): 25.07.2006, 143♀♀, 91♂♂; Alpu- Çavlum (768 m.): 29.07.2005, 4♀♀, 3♂♂; Seyitgazi (1030 m.): 01.08.2005, 6♀♀, 5♂♂; Alpu (768 m.): 17.07.2006, 87♀♀, 76♂♂; Günyüzü (904 m.): 15.07.2006, 24♀♀, 39♂♂; Sivrihisar (1039 m.): 12.07.2006, 45♀♀, 35♂♂; İnönü (1008 m.): 27.07.2006, 133♀♀, 121♂♂; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 90♀♀, 93♂♂; Çifteler- Hayriye (901 m.): 05.08.2005, 4♀♀, 3♂♂.

General geographical distribution: Germany, Albania, Austria, Belgium, Bulgaria, Algeria, China, Czech Republic, England, Denmark, Greece, France, Finland, Hungary, Morocco, Netherlands, Iraq, Iran, India, Italy, Ireland, Israel, Spain, Sweden, Syria, Switzerland, Japan, Norway, Pakistan, Portugal, Poland, Russia, Romania, Siberia, Tunisia, Türkiye, Turkestan, [8].

Distribution from Türkiye: Bolu, Çorum, Adana, Antalya, Hatay, İçel, Eskişehir, Gaziantep, Karaman, Kırıkkale, Nevşehir, Zonguldak, Niğde, Yozgat, Kırşehir [1, 24]; Kahramanmaraş [1, 16, 24]; Ankara [1, 18, 24]; Bartın, Karabük, Osmaniye [24]; Kastamonu, Balıkesir, Mardin, Çankırı, Elazığ [1, 19, 24]; Denizli, Afyon, Aydın, Bilecik, Çanakkale, Bursa, Gümüşhane, Diyarbakır, Erzincan, Edirne, Uşak, Tunceli, İstanbul, Erzurum, Isparta, İzmir, Kırklareli, Kayseri, Konya, Kocaeli, Muğla, Manisa, Kütahya, Ordu, Sinop, Samsun, Tekirdağ, Sivas, Tokat, Ağrı [1]; Edirne [9].

Eurygaster austriaca (Schrank, 1776)

Material examined: Sivrihisar- Kaymaz (970 m.): 10.07.2006, 1♀; Eskişehir- İmişehir (956 m.): 11.07.2006, 7♀♀; 3♂♂; Sivrihisar (1039 m.): 12.07.2006, 2♀♀; Sivrihisar- Kaymaz (970 m.): 15.07.2006, 3♀♀; Mihalıççık (1222 m.): 14.07.2006, 2♀♀, 1♂; Alpu (768 m.): 14.07.2006, 1♀; Alpu (768 m.): 17.07.2006, 2♀♀, 1♂; Seyitgazi (1030 m.): 17.07.2006, 1♀, İnönü (1008 m.): 27.07.2006, 3♀♀;1♂; Çifteler (869 m.): 25.07.2006, 1♀; Seyitgazi (1030 m.): 01.08.2005, 1♀.

General geographical distribution: Germany, Austria, Bulgaria, Algeria, Czech Republic, Morocco, France, Netherlands, England, Spain, Israel, Switzerland, Italy, Hungary, Belgium, Malta, Poland, Portugal, Russia, Türkiye, Tunisia, Albania, Greece, Denmark, Sweden, Romania [8].

Distribution from Türkiye: Antalya, Eskişehir, Adana, İçel, Karaman, Kahramanmaraş [1, 24]; Karabük [24]; Adıyaman, Bilecik, Balıkesir, Bingöl, Bolu, Bitlis, Bursa, Denizli, Erzincan, Çanakkale, İstanbul, Kırklareli, Aydın, İzmir, Kütahya, Sakarya, Manisa, Tekirdağ, Uşak, Tunceli, Van, Zonguldak [1]; Edirne [1, 9].

Eurygaster dilaticollis Dohrn, 1860

Material examined: Eskişehir- İmişehir (956 m.): 11.07.2006, 1♂; Alpu (768 m.): 17.07.2006, 2♂♂

General geographical distribution: Bulgaria, Kazakhstan, Kyrgyzstan, Spain, Italy, Hungary, Southern Russia, Siberia, Türkiye, Ukraine, Greece [8].

Distribution from Türkiye: Lodos [21] reported that this species was found in Türkiye without giving a locality. Abbas & Önder [1] reported a record from Erzincan.

Genus: *Odontotarsus* Laporte, 1832

Odontotarsus robustus Jakovlev, 1884

Material examined: Günyüzü (904 m.): 15.07.2006, 6♀♀, 7♂♂

General geographical distribution: Germany, Albania, Austria, Bulgaria, Algeria, Crete, Southern France, Southern Russia, Iran, Italy, Caucasus, Cyprus, Hungary, Macedonia, Egypt, Sicily, Syria, Turkestan, Turkmenistan, Türkiye, Greece [8].

Distribution from Türkiye: Aydın, Afyon, Batman, Bilecik, Balıkesir, Bursa, Isparta, Denizli, Muğla, Uşak, Sakarya [10, 23, 24]; Adana [10, 24]; İzmir [23]; İstanbul [7, 20]; Mersin [20, 23]; Ankara [18, 22]; Konya [22]; Hatay, Antalya, İçel, Karaman, Kahramanmaraş, Kırıkkale, Osmaniye, Nevşehir [24]; Kırşehir [17, 24]; Kastamonu, Çankırı [19]; Edirne [9, 10, 23]; Kırklareli, Çanakkale, Tekirdağ, İstanbul [9].

Odontotarsus rufescens Fieber, 1861

Material examined: Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♂; Günyüzü (904 m.): 15.07.2006, 6♀♀, 6♂♂; Alpu (768 m.): 29.07.2005, 1♂.

General geographical distribution: Türkiye, Greece [8, 10].

Distribution from Türkiye: Adana [10, 24]; Nevşehir, Kastamonu [22]; Elazığ [16]; Balıkesir, Aydın, Çanakkale, İzmir, Isparta, Muğla, Manisa [23]; Antalya, Ankara, Çankırı, Hatay, Gaziantep, Kırşehir, Kahramanmaraş, Osmaniye, Nevşehir [24]; İstanbul, Çanakkale, Tekirdağ, Kırklareli [9].

Odontotarsus purpureolineatus (Rossi, 1790)

Material examined: Beylikova (766 m.): 14.07.2006, 1♀, 1♂; Günyüzü (904 m.): 15.07.2006, 3♂♂.

General geographical distribution: Germany, Albania, Bulgaria, Czech Republic, France, Crete Island, Southern Russia, Croatia, Iran, Spain, Israel, Switzerland, Italy, Caucasus, Hungary, Macedonia, Malta, Portugal, Romania, Sicily, Turkestan, Türkiye, Greece [8, 10, 23].

Distribution from Türkiye: Kayseri, Konya [12]; Bursa, Diyarbakır [10]; Niğde, İstanbul [20]; Isparta [23]; Edirne [9, 10]; Gaziantep, Adana, Kahramanmaraş, Hatay [24]; Kırklareli, Tekirdağ, İstanbul [9].

Genus: *Psacasta* Germar, 1839

Psacasta exanthematica (Scopoli, 1763)

Material examined: Alpu (768m.): 14.07.2006, 1♂

General geographical distribution: Albania, Bulgaria, Cyprus, Czech Republic, Dalmatia, Morocco, France, Crete Island, Southern Russia, Croatia, Iran, Italy, Spain, Switzerland, Caucasus, Hungary, Macedonia, Mader Island, Poland, Portugal, Sardinia Island, Syria, Sicily, Tunisia, Turkestan, Türkiye, Greece [8, 19].

Distribution from Türkiye: Diyarbakır [10, 24]; Elazığ [16]; İzmir, Bursa [23]; Adana [7, 24]; İçel, Antalya, Gaziantep, Osmaniye, Kahramanmaraş [24]; Çorum, Kayseri, Çankırı [23, 24]; Kırklareli, Edirne, Tekirdağ [9].

Pcacasta tuberculata (Fabricius, 1781)

Material examined: Eskişehir- Yarımca (1248m.): 13.07.2006, 1♂; Sivrihisar (1039m.): 12.07.2006, 1♂.

General geographical distribution: Bulgaria, Algeria, Czech Republic, Morocco, Crete Island, Southern France, Southern Russia, Spain, Italy, Cyprus, Hungary, Macedonia, Portugal, Sicily, Syria, Türkiye, Greece [8, 10].

Distribution from Türkiye: Kahramanmaraş [24]; Edirne [9].

Family: Coreidae

Genus: *Enoplops* Amyot and Serville, 1843

Enoplops disciger (Kolenati, 1845)

Material examined: Günyüzü (904 m.): 15.07.2006, 1♀; Çifteler (869 m.): 25.07.2006, 3♀♀, Çifteler (869 m.): 31.07.2005, 19♀♀, 16♂♂.

General geographical distribution: Anatolia, Balkans, Bulgaria, Armenia, Iraq, Iran, Israel, Southern Russia, Caucasus, Syria, Turkestan, Türkiye, Greece [8, 10].

Distribution from Türkiye: Mediterranean, Marmara, Eastern Anatolia, Central Anatolia, Southeastern Anatolia Regions [10]; Kayseri [16]; Ankara [18]; Kırşehir [17].

Genus: *Coreus* Fabricius, 1794

Coreus marginatus (Linnaeus, 1758)

Material examined: Eskişehir- Yarımca (1248m.): 11.07.2006, 1♀; Çifteler (869m.): 31.07.2005, 1♂.

General geographical distribution: Germany, Arabia, Albania, Austria, Azerbaijan, Balkans, Belgium, Algeria, Czech Republic, China, Finland, France, Crete Island, Southern Russia, Georgia, Iraq, Israel, Iran, Italy, Ireland, Spain, Sweden, Japan, Caucasus, Kazakhstan, Hungary, Norway, Poland, Portugal, Siberia, Slovakia, Syria, Tajikistan, Turkestan, Türkiye, Ukraine, Greece [8, 10, 16].

Distribution from Türkiye: Ankara [10, 16, 18]; Eastern Anatolia, Central Anatolia, Eastern Black Sea Regions and Marmara, Gaziantep, Hatay, Adana, Zonguldak [10, 16]; Kahramanmaraş, Elazığ [16]; Kastamonu, Çankırı [19]; Kırşehir [17].

Genus: *Centrocoris* Kolenati, 1845

Centrocoris spiniger (Fabricius, 1781)

Material examined: Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♀

General geographical distribution: Albania, Austria, Bulgaria, Algeria, Czech Republic, Armenia, Morocco, France, Crete Island, Iraq, Iran, Spain, Israel, Sweden, Switzerland, Italy, Canary Islands, Cyprus, Corsica, Libya, Hungary, Portugal, Romania, Russia, Syria, Tunisia, Turkestan, Türkiye, Turkmenistan, Ukraine, Greece [8, 10, 16].

Distribution from Türkiye: Marmara Region, Aegean Region, Mediterranean Region, Central Anatolia Region, Eastern Anatolia Region, Southeastern Anatolia Region [10, 16]; Ankara [18]; Kırşehir [17].

Family: Alydidae

Genus: *Camptopus* Amyot & Serville, 1843

Camptopus tragacanthae (Kolenati, 1845)

Material examined: Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♂

General geographical distribution: Afghanistan, China, Southern Russia, Iran, Caucasus, Tajikistan, Türkiye [8, 10, 16].

Distribution from Türkiye: Aegean Region, Marmara Region, Central Anatolia Region, Eastern Anatolia Region, Ankara [10, 16, 18]; Elazığ, Bursa, İzmir, Eskişehir, Kars [10, 16]; Elazığ [21]; Kahramanmaraş, Kayseri [16]; Kastamonu [19]; Kırşehir [17].

Family: Pyrrhocoridae

Genus: *Pyrrhocoris* Fallen, 1814

Pyrrhocoris apterus (Linnaeus, 1758)

Material examined: İnönü (1008 m.): 27.07.2006, 1♀

General geographical distribution: Germany, Algeria, Arabia, Albania, Austria, Azerbaijan, Belgium, Bulgaria, Czech Republic, Cyprus, China, Morocco, France, Finland, Hungary, India, Iraq, Iran, Italy, England, Spain, Israel, Sweden, Canary Islands, Kazakhstan, Lebanon, Egypt, Poland, Portugal, Slovakia, Tunisia, Türkiye, Turkestan, Greece, Crete Island, Asia, Europe, Balkans, North Africa, Middle East [8, 10].

Distribution from Türkiye: Aegean, Central Anatolia, Western Black Sea, Eastern Anatolia and Marmara Regions [10, 16]; Kayseri, Elazığ [16]; Ankara [18]; Çankırı [19]; Kırşehir [17].

Family: Lygaeidae

Genus: *Lygaeus* Fabricius, 1794

Lygaeus saxatilis (Scopoli, 1763)

Material examined: Sivrihisar (1039 m.): 12.07.2006, 1♀; Alpu (768 m.): 14.07.2006, 1♂; Günyüzü-Kayakent (1002 m.): 13.07.2006, 1♂.

General geographical distribution: Germany, Afghanistan, Algeria, Albania, Europe, Austria, Bulgaria, Balkans, Belgium, Cyprus, North Africa, Czech Republic, Egypt, Morocco, France, India, Netherlands, Iraq, Iran, Spain, Israel, Switzerland, Italy, Kashmir, Corsica, Lebanon, Hungary, Macedonia, Portugal, Romania, Russia, Syria, Tunisia, Türkiye, Turkestan, Greece, Crete Island, Caucasus [8].

Distribution from Türkiye: Central Anatolia and Southeastern Anatolia Regions, Kahramanmaraş, Eskişehir, Erzincan, Ağrı, Kırşehir, İstanbul, Gaziantep, Isparta, Kayseri, Çankırı, Niğde, Nevşehir, Konya, Çorum, Yozgat [10, 16]; Elazığ, Kahramanmaraş [16]; Kastamonu [19]; Ankara [10, 16, 18].

Lygaeus pandurus (Scopoli, 1763)

Material examined: Eskişehir- Yarımca (1248 m.): 13.07.2006, 1♀

General geographical distribution: Europe, Australia, Balkans, Philippines, Southern Russia, India, Cyprus, North Africa, Middle East, Turkestan, Türkiye [8, 10].

Distribution from Türkiye: Kahramanmaraş, Elazığ [16]; Ankara [18].

Lygaeus equestris (Linnaeus, 1758)

Material examined: Alpu (768 m.): 14.07.2006, 1♀, 1♂

General geographical distribution: Albania, Europe, Balkans, Finland, Norway, Western Russia, Russia, Algeria, China, Egypt, Italy, Morocco, India, Iraq, Iran, Spain, Israel, Sweden, Japan, Caucasus, Cyprus, Crimea, Corsica, Poland, Portugal, Siberia, Sicily, Syria, Tunisia, Türkiye, Turkestan, Crete Island [8, 10].

Distribution from Türkiye: Aegean Region, Central Anatolia Region, Marmara, Eastern Black Sea Region, Eastern Anatolia Region, Western Black Sea Region, Gaziantep, Diyarbakır [10, 16, 23]; Ankara [18]; Elazığ, Kahramanmaraş [16]; Kastamonu [19]; Kırşehir [17].

Family: Stenocephalidae
Genus: *Dicranocephalus* Hahn, 1826

Dicranocephalus albipes (Fabricius, 1781)

Material examined: Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♂

General geographical distribution: Germany, Albania, Austria, Azerbaijan, Balkans, Bulgaria, Algeria, Czech Republic, Morocco, France, Crete Island, Georgia, Iraq, Iran, England, Spain, Israel, Sweden, Italy, Caucasus, Cyprus, North Africa, Hungary, Malta, Portugal, Romania, Russia, Slovakia, Syria, Türkiye, Ukraine, Greece [8].

Distribution from Türkiye: Aegean Region, Western Black Sea Region, Marmara Region, Western Central Anatolia, Southeastern Anatolia Region, Eastern Anatolia Region [10, 16]; Kahramanmaraş [16]; Çankırı, Kastamonu [19]; Kırşehir [17].

Family: Rhopalidae
Genus: *Corizus* Fallen, 1814

Corizus hyosciami (Linnaeus, 1758)

Material examined: Eskişehir- Yarımca (1248 m.): 11.07.2006, 1♂

General geographical distribution: Afghanistan, Germany, Albania, Europe, Austria, Balkans, Belgium, Bulgaria, China, Czech Republic, Armenia, Finland, France, Crete Island, Southern Russia, Iraq, Iran, England, Ireland, Spain, Israel, Sweden, Switzerland, Italy, Caucasus, Kazakhstan, Cyprus, North Africa, Libya, Lebanon, Hungary, Egypt, Poland, Portugal, Romania, Siberia, Slovakia, Syria, Tajikistan, Transcaucasus, Turkestan, Türkiye, Turkmenistan, Ukraine, Greece [8, 10].

Distribution from Türkiye: Western Mediterranean, Aegean Region, Central Anatolia Region, Marmara, Southeastern Anatolia Regions, Eastern Anatolia, Artvin, Amasya, Bursa, Ankara, Diyarbakır, Konya, Edirne [10, 16]; Elazığ, Kahramanmaraş, Kayseri [16]; Ankara [18]; Kastamonu, Çankırı [19]; Kırşehir [17].

Genus: *Brachycarenus* Fieber, 1860

Brachycarenus tigrinus (Schilling, 1829)

Material examined: Alpu (768 m.): 14.07.2006, 3♂♂

General geographical distribution: Northwest Africa, Europe, Cyprus, Anatolia, South and West Russia, Syria, Iran, Israel, Turkestan, Mongolia, Kashmir, China, Türkiye [8].

Distribution from Türkiye: Kırşehir [17].

4. Conclusion and discussion

As a result of this study carried out to determine the harmful Hemiptera species in Eskişehir and its surroundings; 27 genera and 42 species belonging to 8 families were identified. Among the detected species, *A. acuminata*, *A. cognata*, *A. virgata*, *A. leucogrammes*, *E. blanda*, *R. nebulosa*, *P. martini*, *C. mediterraneus*, *C. purpureipennis*, *V. trigonus*, *V. fischeri*, *E. dilaticollis*, *O. rufescens*; *O. purpureolineatus*, *O. robustus*, *P. exanthematica*, *P. tuberculata*, *E. disciger*, *C. spiniger*, *L. equestris*, *L. pandurus*, *D. albipes*, *C. hyosciami*, *C. marginatus*, and *B. tigrinus* are reported for the first time from the research area.

E. maura, *A. rostrata*, *E. ornatum* and *V. fischeri* were the most frequently observed and collected species during the study period. *Aelia* spp. species are known to inflict harm primarily on wheat crops, with both adult insects and young ones beginning to consume by sucking when the grains are in the milky stage, causing the grains to progressively diminish in size, resulting in a low-quality product that cannot germinate [4]. A total of 954 adults belonging to the genus *Aelia* spp. were collected from almost all localities in the study area. It was determined that the most widely distributed species belonging to the genus *Aelia* spp. was *A. rostrata* and the most rarely distributed species was *A. virgata*.

Adults and nymphs of *Eurygaster* spp. species damage wheatgrasses in various periods and have a negative effect on the drying of the plant, grain formation and the quality of flour obtained from the grains [14, 21]. A total of 1739 adults belonging to the genus *Eurygaster* spp. were collected from almost all localities in the present study area. The most widely distributed species belonging to the genus *Eurygaster* was found to be *E. maura*, and the most rarely distributed species was found to be *E. dilaticollis*.

Almost all the species found are phytophagous. They have been collected from plants with high nutritional value that are also used as food by humans. Considering the damage caused by the species of the identified families to economically important plants, it is important to know the habitats, biology and densities of these species. In this study, we tried to determine the fauna of harmful Hemiptera species in Eskişehir province. However, it is hoped that by knowing the biology and density of harmful species in this area, it can contribute to the biodiversity of our country in terms of preserving the existing natural balance between harmful and beneficial species.

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Identification of some lichenized fungi species around Akkuyu Nuclear Power Plant (Gülnar, İçel)

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Abstract

In this study, several lichenized fungi species near the Akkuyu Nuclear Power Plant located in the Gulnar district of Mersin province in Türkiye have been identified. Detailed descriptions, photographs, and phylogenetic analyses of the nine lichenized fungi species collected by the second author are provided: *Kuettlingeria erythrocarpa* (Pers.) I.V. Frolov, Vondrák & Arup, *Circinaria calcarea* (L.) A. Nordin, Savić & Tibell, *Flavoplaca communis* (Vondrák, Říha, Arup & Søchting) Arup, Søchting & Frödén, *Flavoplaca havaasii* (H. Magn.) Arup, Frödén & Søchting, *Lecania rabenhorstii* (Hepp) Arnold, *Lobothallia radiosa* (Hoffm.) Hafellner, *Megaspora verrucosa* (Ach.) Arcadia & A. Nordin, *Physcia stellaris* (L.) Nyl. and *Xanthocarpia marmorata* (Bagl.) Frödén, Arup & Søchting.
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Keywords: Akkuyu Nuclear Power Plant, biodiversity, *nrITS*, lichenized fungi

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Akkuyu Nükleer Santrali (Gülnar, İçel) civarında yayılış gösteren bazı likenleşmiş mantar türlerinin tanımlanması

Özet

Bu çalışmada Türkiye'nin İçel ili Gülnar ilçesi'nde yer alan Akkuyu Nükleer Santrali civarında yayılış gösteren bazı likenleşmiş mantar türlerinin tanımlanması yapılmıştır. İkinci yazar tarafından toplanan şu dokuz likenleşmiş mantar türüne ait detaylı deskripsiyonlar, fotoğraflar ve filogenetik analizler paylaşılmıştır: *Kuettlingeria erythrocarpa* (Pers.) I.V. Frolov, Vondrák & Arup, *Circinaria calcarea* (L.) A. Nordin, Savić & Tibell, *Flavoplaca communis* (Vondrák, Říha, Arup & Søchting) Arup, Søchting & Frödén, *Flavoplaca havaasii* (H. Magn.) Arup, Frödén & Søchting, *Lecania rabenhorstii* (Hepp) Arnold, *Lobothallia radiosa* (Hoffm.) Hafellner, *Megaspora verrucosa* (Ach.) Arcadia & A. Nordin, *Physcia stellaris* (L.) Nyl. ve *Xanthocarpia marmorata* (Bagl.) Frödén, Arup & Søchting.

Anahtar kelimeler: Akkuyu Nükleer Santrali, biyoçeşitlilik, *nrITS*, likenleşmiş mantar

1. Introduction

Research on the lichen biodiversity of Türkiye commenced nearly a century ago, primarily through travel accounts documented by foreign explorers. Consequently, the number of species identified in these early studies was quite limited. Since the 1980s, Turkish lichenologists have been actively engaged in research, focusing on the revision of specific species, the regional diversity of lichens, and the biological functions of lichen metabolites [1]. The most extensive compilation of lichenized fungi found in Türkiye was published as a list in 2017 [2], identifying 1,898 species of lichenized and lichenicolous fungi in the country. An update by John and Güvenç [3] added 689 additional species, bringing the estimated total of lichen species in Türkiye to approximately 3,150.

The Akkuyu Nuclear Power Plant, currently under construction, is Türkiye's inaugural nuclear power plant in the Gülnar District of Mersin Province. Research indicates that 116 lichen species have been documented in Mersin

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Province [3]. Notably, only 2 lichenized fungi species have been recorded from the Akkuyu area: *Psora taurensis* Timdal, Bendiksby, Kahraman & Halıcı identified from Akkuyu by Timdal et al. [4] and *Roccella elisabethae* Tehler reported for the first time from Akkuyu by Halıcı and Kahraman [5].

In this study, lichen samples were collected from the Akkuyu region by the second author, and these samples were subsequently identified using anatomical, morphological, and molecular techniques to determine lichen biodiversity in Akkuyu. Also, lichens have been reported as effective collectors of atmospheric trace element pollution due to their relatively high accumulation capacity for heavy metals and radionuclides and their dependence on atmospheric nutrients because they do not have a root system or cuticles like vascular plants. Energy is provided by heat in nuclear power plants. To provide heat, uranium atoms are put into a chain reaction. In this process, heavy metals and radionuclides are also released into nature. Lichens are used as the first bioindicators of this effect created by nuclear power plants, as they are the first step of succession and are considered effective collectors of atmospheric trace element pollution. Therefore, this study will serve as a starting point for future lichen biodiversity studies in the same area and shed light on future studies [6].

2. Materials and methods

2.1. Lichen material

The specimens were collected from Akkuyu and nearby regions (Figure 1) by the second author. The lichen samples were morphologically and anatomically identified by authors using various flora books and identification keys [7-12]. The lichen samples are stored in the Department of Biology, Herbarium of Erciyes University (ERCH), Kayseri, Türkiye.

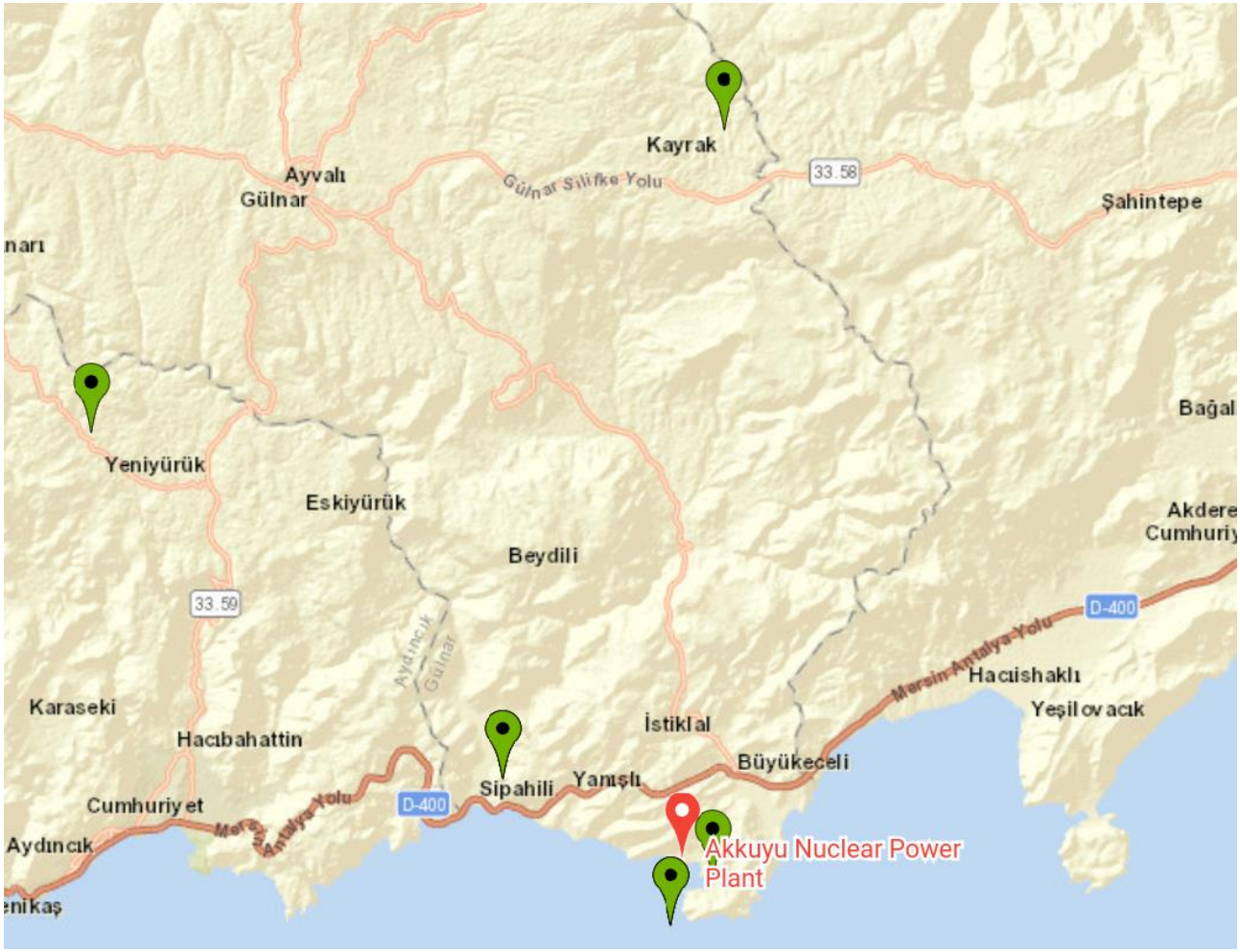

Figure 1. Locations where samples were collected from Akkuyu and nearby regions. The red spot indicates Akkuyu Nuclear Power Plant and the green spots indicate the locations where samples were collected. The map was made with the Map Marker App using Here Technologies Location Services (https://www.mapmarker.app/)

2.2. DNA isolation and PCR amplification

In the process of DNA isolation, samples from lichenized fungi, particularly the apothecium sections, were collected into Eppendorf tubes and labeled accordingly. These labeled samples were subsequently processed at the Biochemistry and Molecular Laboratory within the Faculty of Science at Erciyes University. The DNeasy Plant DNA Kit (Catalog No: 69104) was used to isolate DNA.

nrITS (*ITSF1-5' CTT GGT CAT TTA GAG GAA GTA A 3', ITS4-5' TCC TCC GCT TAT TGA TAT GC 3'*) primers used for PCR analysis [13, 14]. PCR analysis was carried out in 50 µl reaction volumes using, 4 µl of 10 x reaction buffer, 4 µl $MgCl_2$ (50 mM), 0.5 µl each primer, 2 µl dNTP (10 mM), 0.1 µl Taq DNA polymerase, 3 µl of genomic DNA and 35.9 µl dH2O on a thermal cycler equipped with a heated lid for both primers. The PCR was performed for *nrITS* under the following conditions: An initial denaturation of 5 min at 91 °C; 1 cycle with 1 min at 94 °C, 1 min at 56-50 °C, and 2 min at 72 °C; and 20 cycles with 1 min at 94 °C, 1 min at 55 °C, and 2 min at 72 °C; a final extension step of 1 min at 72 °C was added after the samples were kept at 4 °C. The PCR products were analyzed via agarose gel electrophoresis, and sequence analysis was performed on ten lichen samples from which DNA bands were obtained. PCR products run on 1% agarose gel with 0.6 µl /ml ethidium bromide. The loading buffer was prepared by diluting 1X with a concentration of 50X of stock prepared using 40 mM tris acetate and 2 mM $Na_2EDTA.2H_2O$. Thermo SM0321 was used as a DNA ladder. Electrophoresis was conducted at 90 volts for a duration of 60 minutes. Sequence analysis was subsequently performed on the lichenized fungi samples from which DNA bands were obtained [15].

2.3. Phylogenetic analysis

The "ABI PRISM Big Dye Version II" reaction kit was used for DNA sequence analysis. Bidirectional sequences were obtained after DNA sequence analysis. The sequences obtained in bidirectional (forward and reverse) sequence analysis were compared with the "Bioedit" program, edited, and aligned with the DNA sequences of other taxa to be selected as outgroups. Data analysis was performed using Maximum Likelihood analysis with the "MEGA XI" software [16, 17].

Table 1. The specimens' herbarium numbers and GenBank accession numbers

Specimen	***nrITS* GenBank Number**
Circinaria calcarea (ERCH AMEKA 0.111)	PQ167719
Flavoplaca communis (ERCH AMEKA 0.110)	PQ167720
Flavoplaca havaasii (ERCH AMEKA 0.105)	PQ167721
Kuettlingeria erythrocarpa (ERCH AMEKA 0.041)	PQ167718
Lecania rabenhorstii (ERCH AMEKA 0.109)	PQ167722
Lobothallia radiosa (ERCH AMEKA 0.051)	PQ167723
Megaspora verrucosa (ERCH AMEKA 0.091)	PQ167724
Physcia stellaris (ERCH AMEKA 0.020)	PQ167725
Xanthocarpia marmorata (ERCH AMEKA 0.099)	PQ167726

3. Results

Taxonomic descriptions, photographs, habitat records, and molecular positions of lichenized fungi species studied for this paper are given below.

3.1. Circinaria calcarea (L.) A. Nordin, Savić & Tibell

Thallus usually large, to 30 cm diam or more, forming circular patches, thick, finely cracked-areolate. Areoles radially orientated especially at outer edge of thallus, concave to plane when old, matt, chalk white to pale grey, rarely stained rust-coloured, cortex smooth; prothallus usually delimiting, dark grey. Apothecia aspicilioid, (0.3–)0.35–*0.45*–0.55(–0.65) mm diam and immersed. The thalline margin of apothecia was slightly raised. Apothecial disc black, usually not pruinose. Epihymenium 54 µm, black-green. Hymenium 72 µm and hyaline. Hypothecium 72 µm and brown. Ascus 4-spored and ascospores are broadly ellipsoid, hyaline, simple, 20–23.5 × 13.5–21 µm, and with a thin epispore. Cortex and medulla Pd- and K- (Figure 2).

Ecology and distribution: On hard limestones and memorials, intolerant of nutrient enrichment; common. Widely distributed in Europe, Macaronesia, South America, Asia, Africa, Australia, Eurasia, the Arctic [16], and Türkiye [2].

Specimens examined: Türkiye, Mersin, Gülnar-Akkuyu, East sides of the port, on calcareous rock, Station 5, 36°08'15.9"N 33°32'54.5" E alt., 10 m., ERCH AMEKA 0.111, leg. M. G. Halıcı.

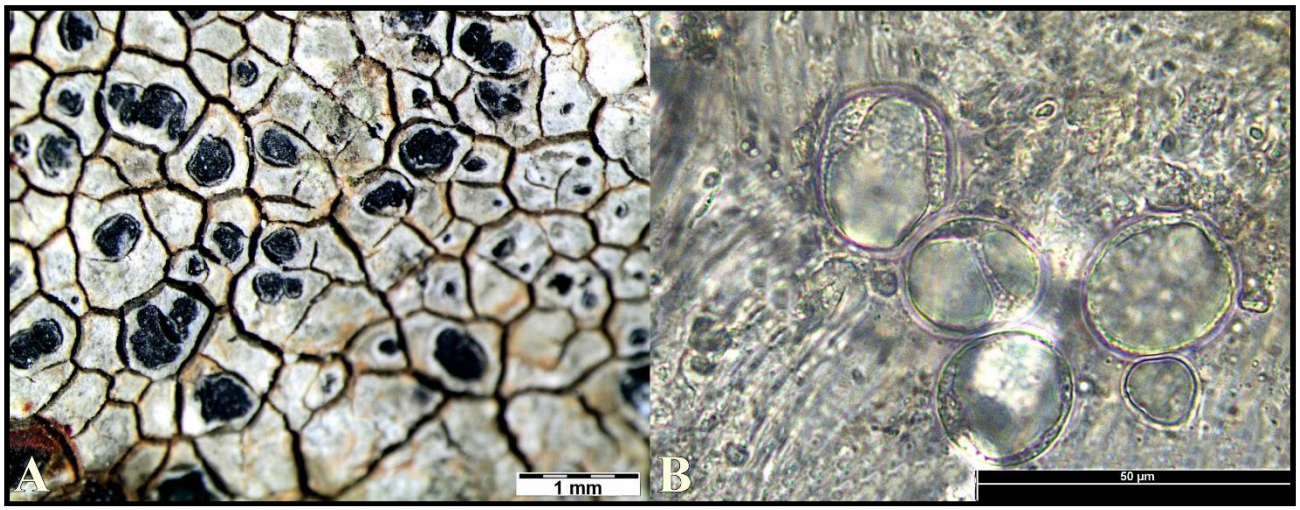

Figure 2. *Circinaria calcarea* A. Habitus, B. Ascospores

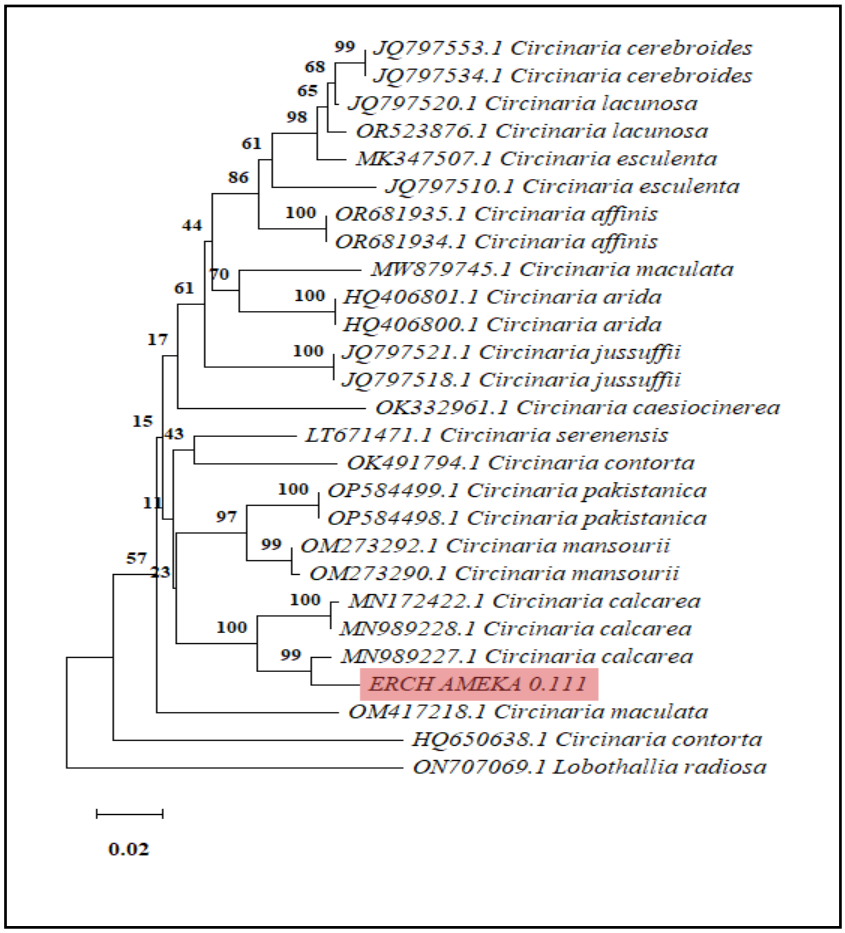

Figure 3. *nrITS* ML dendrogram of *Circinaria calcarea*

3.2. Flavoplaca communis (Vondrák, Říha, Arup & Søchting) Arup, Søchting & Frödén

Thallus crustose, yellow-orange, areolate. Areoles swollen, sometimes weakly squamulose, when thallus well developed surface of thallus has coarse granules—Apothecia common and (0,25─)0.3─*0.5*─0.7(─0,85) mm diam. Apothecia disc is slightly concave at mature ones and margin usually crenulate. Hymenium 78 µm, epihymenium 63 µm and brown. Ascus 8-spored and ascospores hyaline, polaribilocular 10─11.5 × 5.5─7 µm. Septa 4─5 µm. Apothecia K+ red, C- and Pd- (Figure 4).

Ecology and distribution: On hard siliceous rocks, especially near seashore. Distributed in Marmara Region, East Mediterranean Region, Bulgaria, Greece, Ukraine and Türkiye (İstanbul, Kastamonu, Kırklareli, Ordu, Yalova, Zongulgak) [18].

Specimens examined: Türkiye, Mersin, Gülnar-Akkuyu, East sides of the port, on calcareous rock, Station 4, 36°08'15.9"N 33°32'54.5" E alt., 10 m., ERCH AMEKA 0.110, leg. M. G. Halıcı.

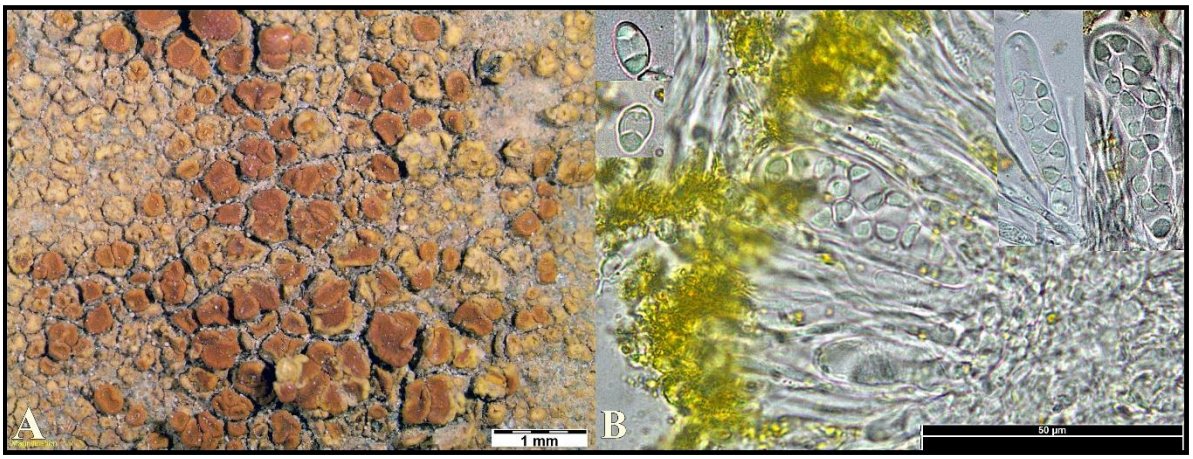

Figure 4. *Flavoplaca communis* A. Habitus, B. Ascospores

3.3. Flavoplaca havaasii (H. Magn.) Arup, Frödén & Søchting

Tallus crustose, verruculose, orange yellow to yellowish orange, 0.1─0.4 mm diam and 0.15─0.4 mm thick. Thallus has 2.5 cm patches in the form of areoles or squamules. Prothallus present or absent. Apothecia abundant and (0.25─)0.3─*0.4*─0.5(─0.6) mm diam, K+ purple, C-, Pd-. Apothecial disc zeorine, shades of orange, plane or convex. Epihymenium 48-52 µm. Hymenium 110 µm and brown. Hypothecium 150-230 µm, K-, N-. Ascus 8-spored, ascospores hyaline, polaribilocular, 11,5─)11,85─*14,1*─16,4(─17) µm length, (6,5─)6,58─*6,65*─6,88(─7) µm width and septa (4─)4.5─*5.5*─6.5(─7) µm. Paraphyses simple and 2─2.5 µm (Figure 5).

Ecology and distribution: Usually occurs on calcareous rocks near the seashore. Distributed in Norway, Holland, Türkiye (Çanakkale, Giresun, Mersin) [18].

Specimens examined: Türkiye, Mersin, Gülnar-Akkuyu, East sides of the port, on calcareous rock, Station 4, 36°08'15.9"N 33°32'54.5" E alt., 10 m., AMEKA 0.105, leg. M. G. Halıcı.

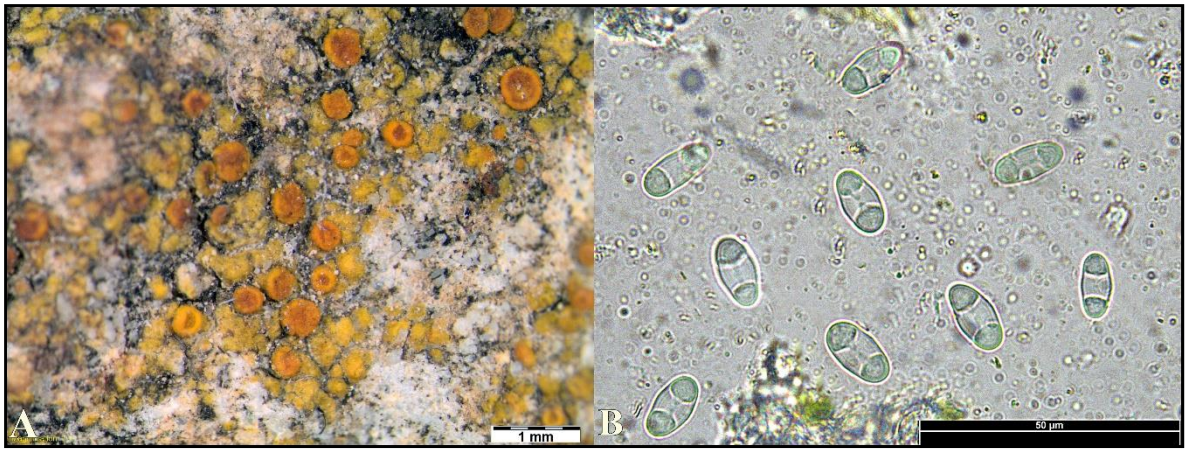

Figure 5. *Flavoplaca havaasii*. A. Habitus, B. Ascospores.

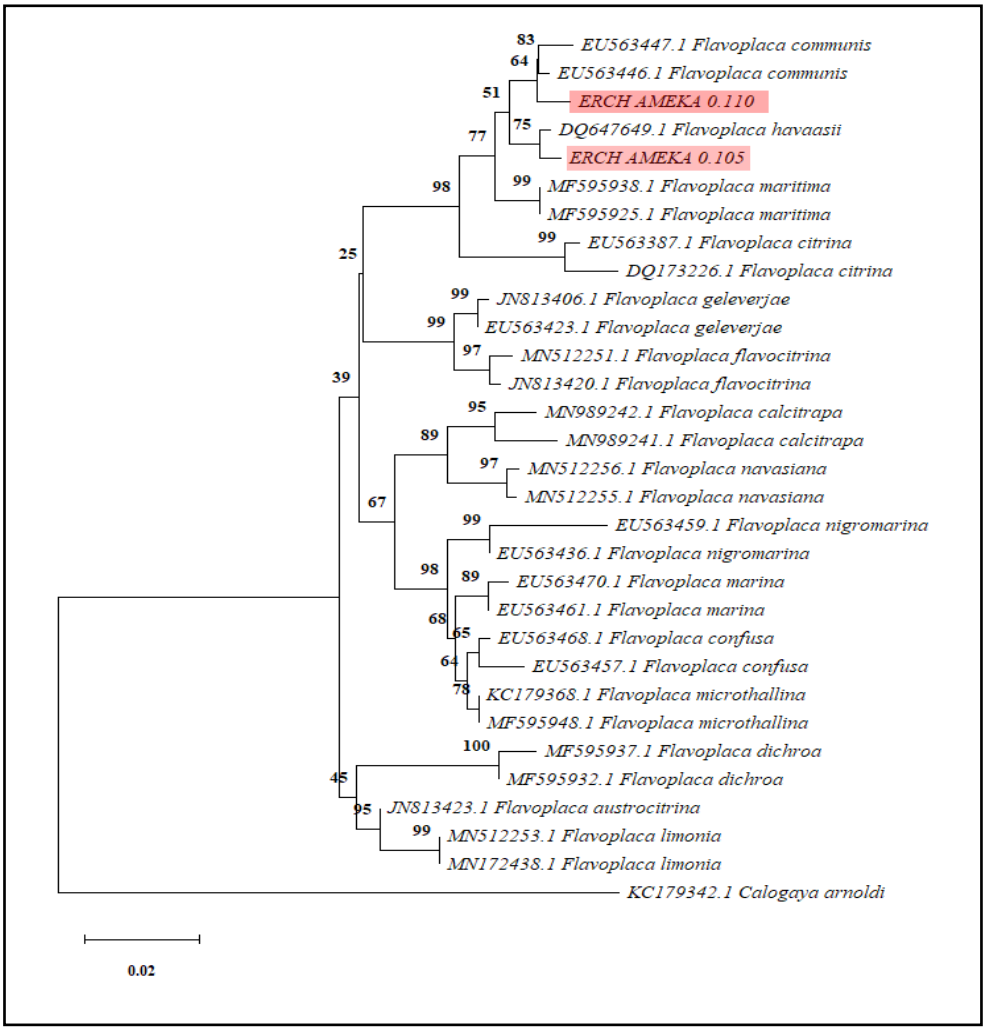

Figure 6. *nrITS* ML dendrogram of *F. communis* and *F. Havaasii*

3.4. Kuettlingeria erythrocarpa (Pers.) I.V. Frolov, Vondrák & Arup

Thallus crustose, rimose-areolate, white. Apothecia red, shiny, smooth, and sessile, 0.2–0.5 mm, C+ red. Ascus 8-spored, 65 × 20 µm. Ascospores characteristically polaribilocular and hyaline, ascospores (13.5–)14.5–*15*–15.5–(16) × (5.5–)7.5–*8.5*–9.5(–10) µm and septa (3–)–*3.5*–(–4.5) µm (n=15). Epihymenium brown, 33–49 µm, hymenium hyaline 80–90 µm, hypothecium hyaline, 60–88 µm (Figure 7).

Ecology and distribution: Mostly on limestone, calcareous schist, and weak calcareous rocks. It has been known in Middle Europe and the Mediterranean region and is widely distributed in Türkiye [2].

Specimens examined: Türkiye, Mersin, Gülnar, upper Sipahi river, on calcareous rock, 36°10'01.5"N 33°28'20.5" E alt., 185–195 m., ERC AMEKA 0.041, leg. M. G. Halıcı.

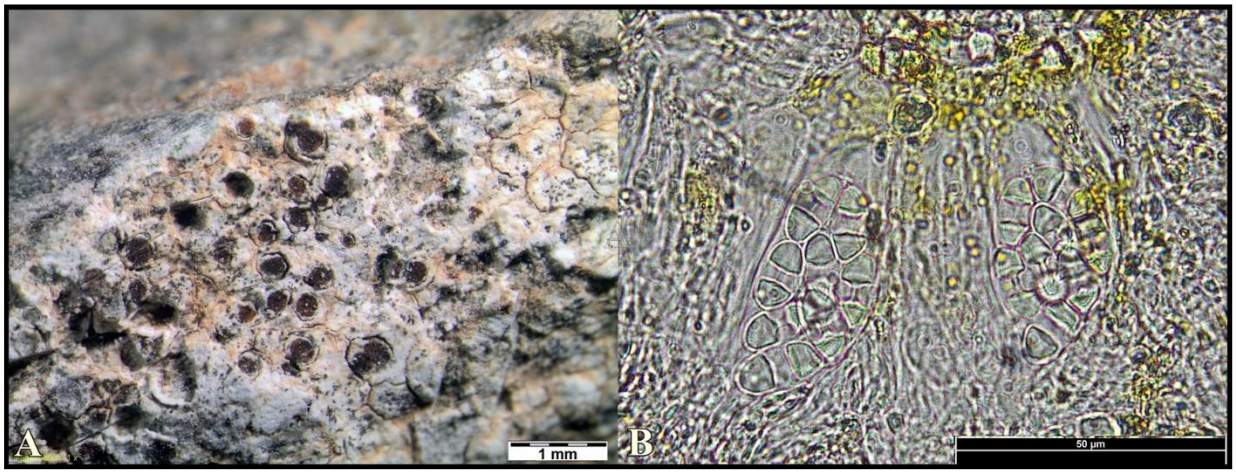

Figure 7. *Kuettlingeria erythrocarpa* A. Habitus, B. Ascospores inside asci.

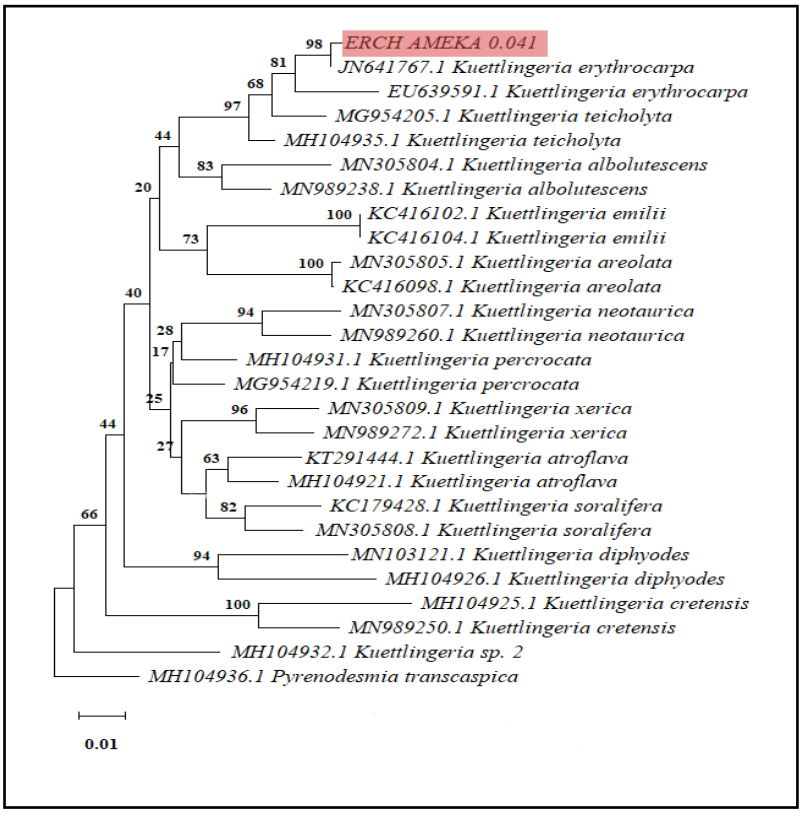

Figure 8. *nrITS* ML dendrogram of *Kuettlingeria erythrocarpa.*

3.5. Lecania rabenhorstii (Hepp) Arnold

Thallus usually in orbicular patches, thick, continuous, angular areoles, the edges often curling upwards. Surface of thallus dark, yellow-grey-brown, sometimes with small, scattered angular or lobe-like fragments. Apothecia usually wide, abundant and covers areoles' surface, (0.35─)0.4─*0.5*─0,6(─0.65) mm diam, brownish black. Epihymenium brown, 78 µm, hymenium hyaline, and 100 µm. Ascus 8 spored, *Bacidia*-type, 45.5 × 105.5 µm diam. Ascospores 12─13.5 × 5 µm, hyaline. Pycnidia rare. All spot tests are negative (Figure 9).

Ecology and distribution: On base-rich rocks, limestone, etc., particularly in coastal areas, common. Throughout the British Isles, Europe, North Mediterranean, Macaronesia, Africa, North America, and Middle Europe [10] and common in Türkiye [2].

Specimen examined: Türkiye, Mersin, Akkuyu, Beş Parmak Island, on siliceous rock, Station 5, 36°07'27.1"N 33°31'59.6" E alt., 32 m., ERC AMEKA 0.109, leg. M. G. Halıcı.

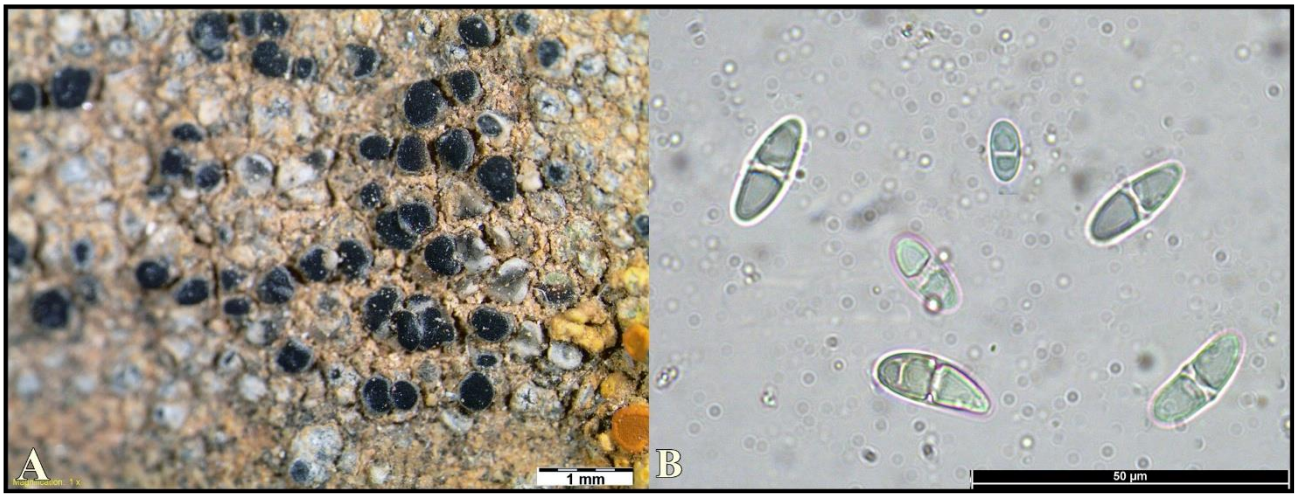

Figure 9. *Lecania rabenhorstii*. A. Habitus, B. Ascospores

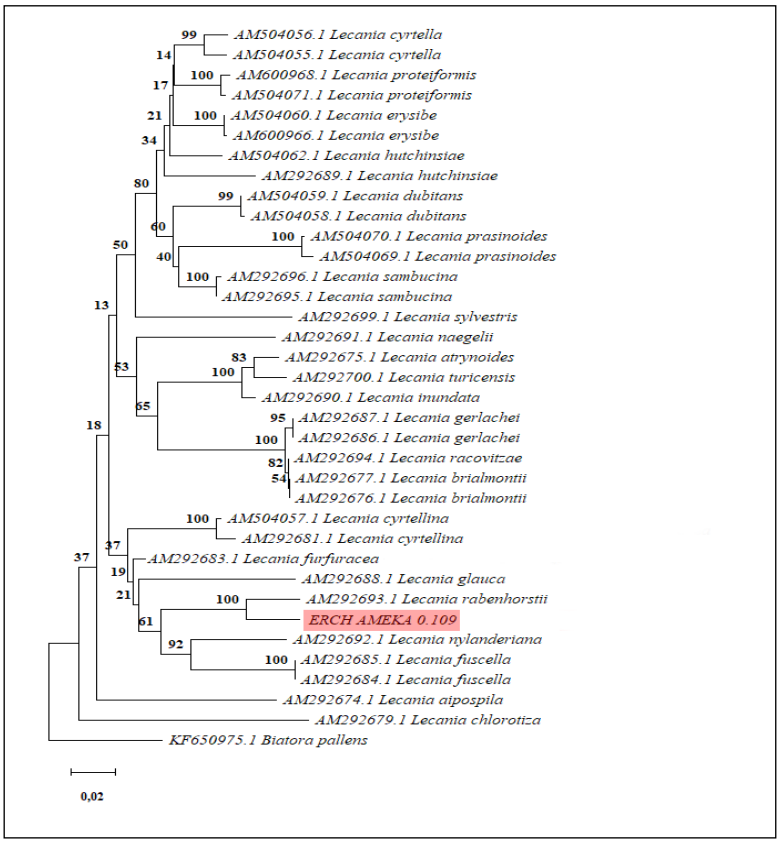

Figure 10. *nrITS* ML dendrogram of *Lecania rabenhorstii*

3.6. Lobothallia radiosa (Hoffm.) Hafellner

Thallus placoid, circular, to 8 cm diam, 0.25─0.5 mm thick, usually angular on main line. Lobes confluent, tightly adnate. Lobe length 2.5─4.5 µm and lobe width 0.8─1 µm. Upper surface usually dark grey, greenish, olive green, greenish gray to greyish brown. Apothecia abundant, centrally dense, sesile and (0.25─)0.35─*0.5*─0.65(─0.7) mm diam. Apothecial disc red-brown to grey-brown, sometimes black to brownish black, at first concave, then plane, and usually not pruinose. Epihymenium 10─15 µm and hyaline, hymenium 70─80 µm and hyaline. Hypothecium 30 µm. Ascus rectangular-elliptic, 8-spored, and 64 × 23 µm. Ascospores hyaline, simple, ellipsoid, (10.5─)11─*12.5*─14(─14.5) µm × (7.5─)8.5─*9*─9.5(─10) µm width. Paraphyses slender, tips clavate, 2─3 µm. Thallus K- or K+ faint brown, C-, KC-, P-, Medulla and cortex P+ yellow and C- (Figure 11).

Ecology and distribution: Occurs on rigid siliceous substrates, including basalt and various organic rocks, granite, and rhyolite, or on silicate-carbonate formations, where the silica content is nearly equal to calcium or magnesium.

Distributed through Europe, Asia, and North America in the World and Türkiye, it is very common on hard siliceous rocks [2, 10].

Species examined: Türkiye, Mersin, Through Aydıncık-Gülnar road to Yassıhan village, on calcareous rock, 36°16'06.5"N 33°19'23.3" E alt., 750–760 m., ERC AMEKA 0.051, leg. M. G. Halıcı.

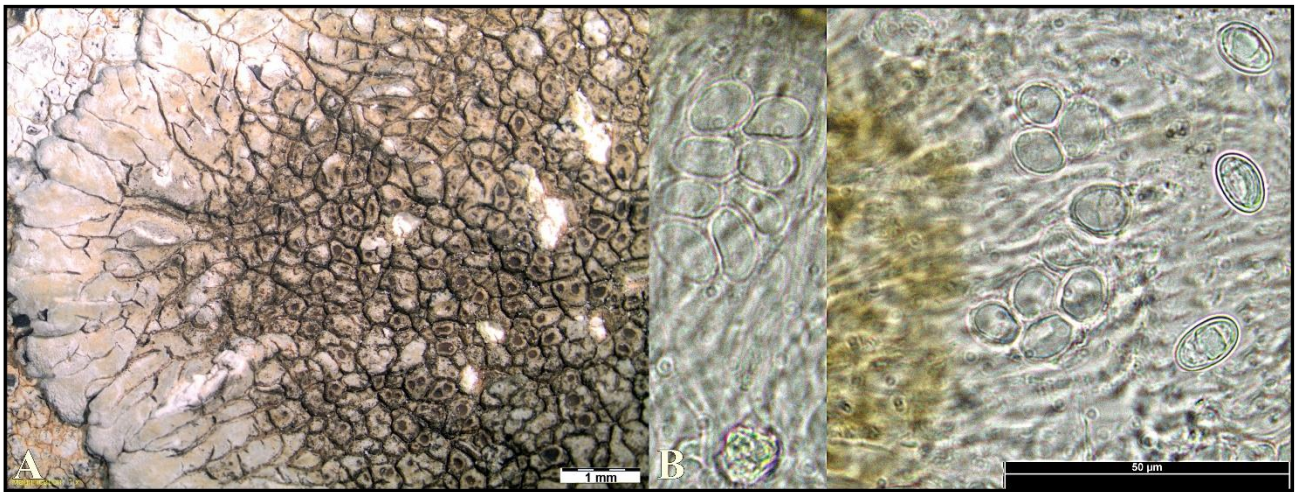

Figure 11. *Lobothallia radiosa* A. Habitus, B. Ascospores

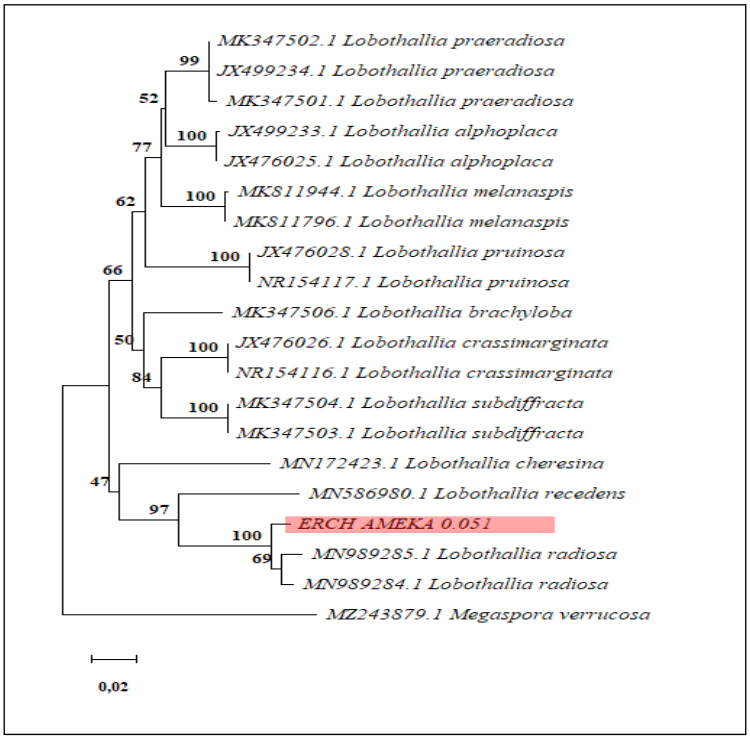

Figure 11. *nrITS* ML dendrogram of *Lobothallia radiosa*

3.7. Megaspora verrucosa (Ach.) Arcadia & A. Nordin

Thallus crustose, olivaceous green-whitish green, partially pruinose, soredia and isidia absent, hypotallus ambiguous. Apotechia immersed to areoles, (0.3–)0.35–*0.5*–0.65(–0,7) mm diam. Apotechial disc black, deeply concave, at first ostiolate then gradually narrowing. Hymenium I+ blue, 200–250 µm and hyaline. Hypothecium pale yellowish to brownish. Ascus clavate, 8-spored, 200–230 × 45–50 µm. Ascospores has thick walls, often has oil drops, and (38–)38.5–*46.5*–54.5(–60) µm × (20.5–)23.5–*26.5*–29.5(–30) µm. All chemical spots test are negative (Figure 13).

Ecology and distribution: Occurs on moss, humus, and soils and can also occur on barks in the Arctic, Europe, Macaronesia, Asia, South America, and North America [19, 20].

Specimen examined: Türkiye, Mersin, Gülnar, Gülnar- Silifke Highway, Kayrak exit, on calcareous rock, 36°21'24.5"N 33°33'08.8"E alt., 1000─1020 m. Corrupted forests and cliffs, ERC AMEKA 0.091**,** leg. M. G. Halıcı.

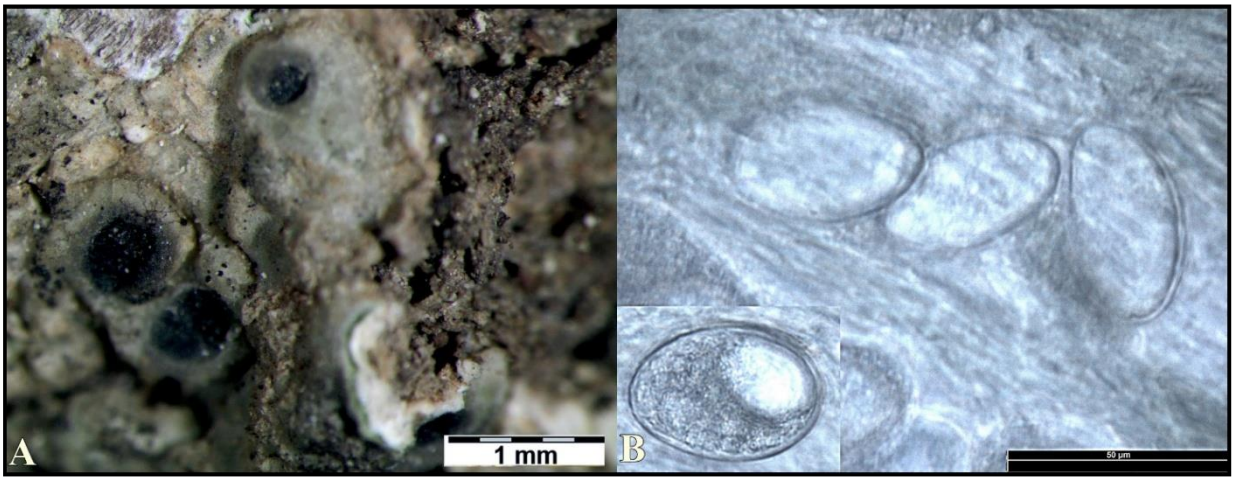

Figure 13. *Megaspora verrucosa* A. Thallus, B. Ascospores

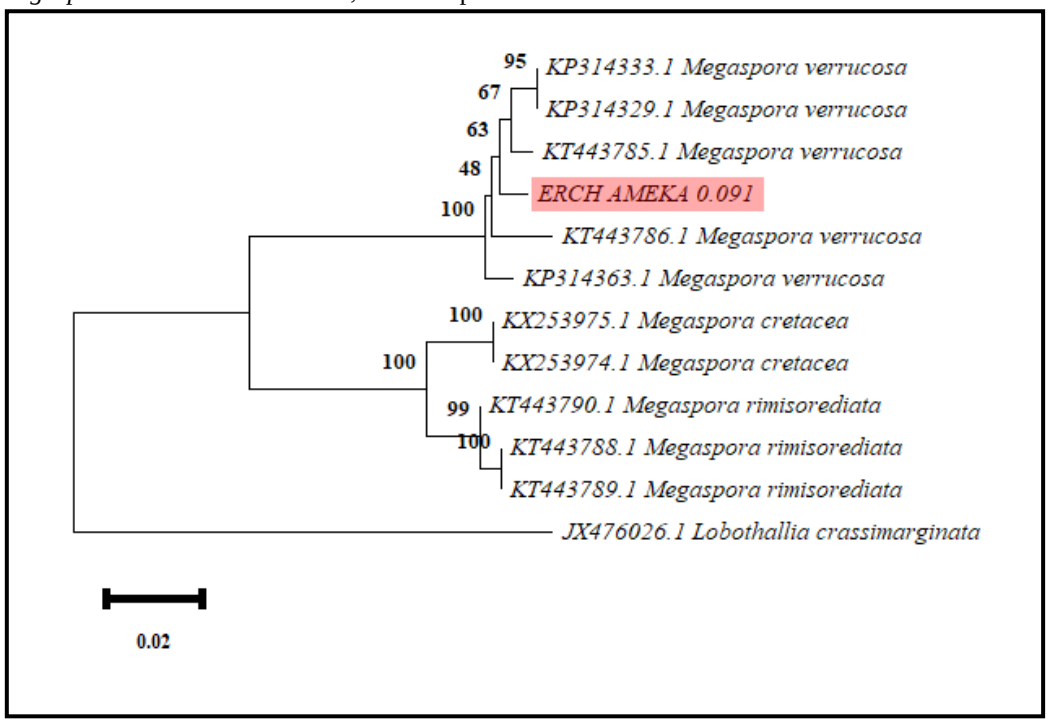

Figure 14. *nrITS* ML dendrogram of *Megaspora verrucosa*

3.8. Physcia stellaris (L.) Nyl.

Thallus up to 3─6 cm diam, usually orbicular, closely adpressed. Lobes 0.5─1.5 mm wide, radiating, white to darkish grey, rarely with a bluish tinge, not indistinctly white-flecked, not pruinose, without soredia or isidia, bullate warts or secondary lobules sometimes at the center of thallus and on apothecia margins. Lowe side of the thallus whitish to pale brown-white or pale grey, with numerous simple or branched, whitish to dark brown or grey rhizines that often protrude beyond the lobe margins. Apothecia usually present, (1─)1.2─*1.5*─1.8(─2.3) mm diam and disc-shaped. Apothecial disc black and often white pruinose. Hymenium 87 µm and hyaline. Ascus 8-spored and 60 × 25 µm. Ascospores brown, 1-septate, (15.5─)17─*17.5*─18(─19) × (8.5─)─*9.0*─(─10) µm. Pycnidia common and immersed. Cortex K+, yellow C-, KC-, Pd+, medulla K-, C-, KC-, P- (Figure 15).

Ecology and distribution: Occurs on bark—Cosmopolitan except Antarctica [10]. Very common on barks in Türkiye [2].

Specimen examined: Türkiye, Mersin, Gülnar, Gülnar- Silifke Highway, Kayrak exit, on calcareous rock, 36°21'24.5"N 33°33'08.8"E alt, 1000–1020 m. Corrupted forests and cliffs, **ERC AMEKA 0.020,** leg. M. G. Halıcı.,

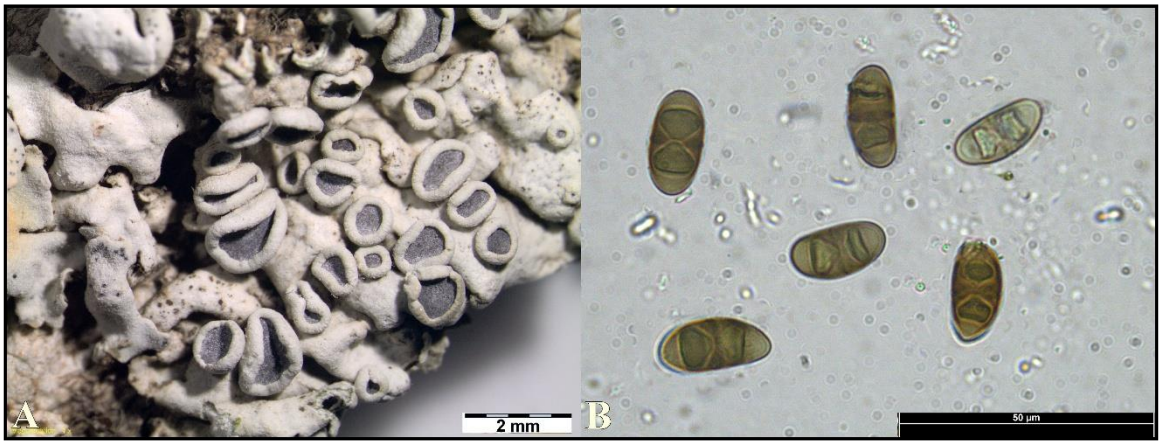

Figure 15. *Physcia stellaris*. A. Thallus, B. Ascospores

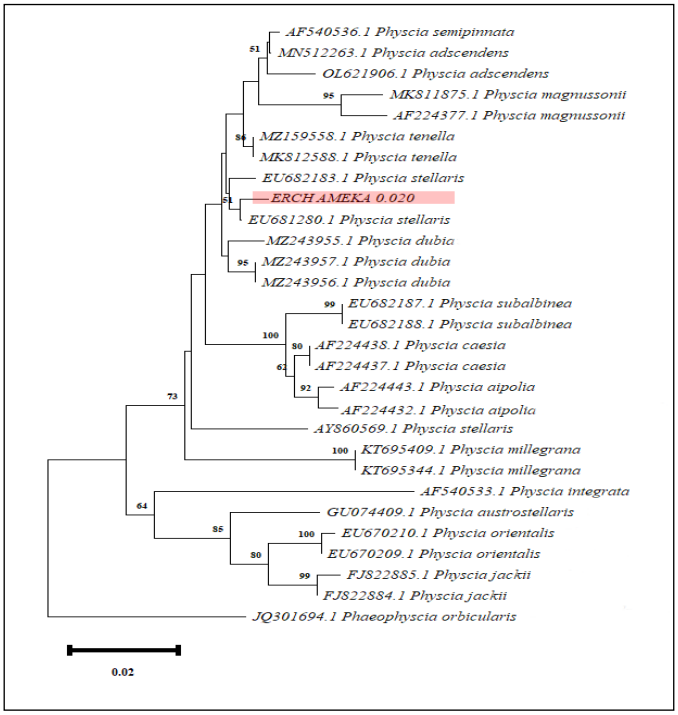

Figure 16. *nrITS* ML dendrogram of of *Physcia stellaris* (ERC AMEKA 0.020)

3.9. Xanthocarpia marmorata (Bagl.) Frödén, Arup & Søchting

Thallus crustose, immersed. Prothallus absent. Apothecia adnate, (0.25─)0.3─*0.4*─0.5(─0.65) mm diam. Apothecial disc reddish brown to dark orange, smooth to convex, not pruinose. Epihymenium goldish, K+ red, and 40 µm. Hymenium 65 µm and hyaline. Paraphyses apically swollen, apices 1-2 µ.. Hypothecium 55 µm. Ascus cylindrical, 8-spored and 65 × 25 µm. Ascospores hyaline, polaribilocular, polaribilocular (12─)13─*14*─15(─16) µm × (5.5─)6.5─*7*─7.5(─8) µm and septa (2─)2.5─*3.5*─4.5(─5) µm (Figure 16).

Ecology and distribution: Occurs on calcareous rocks and soft calcareous sea shells. Throughout Europe and North America [10].

Specimen examined: Türkiye, Mersin, Gülnar, upper Sipahi river, on calcareous rock, 36°10'01.5"N 33°28'20.5" E alt., 185–195 m., ERC AMEKA 0.099, leg. M. G. Halıcı.,

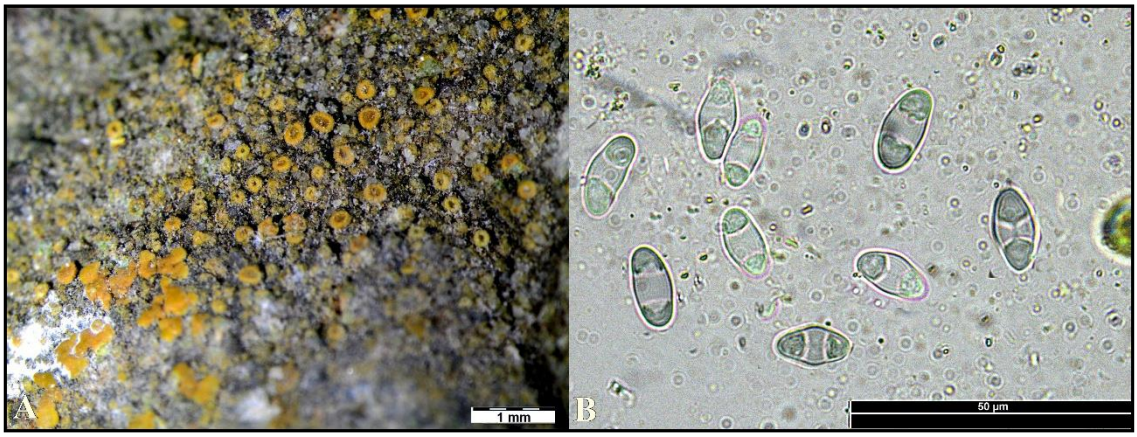

Figure 17**.** *Xanthocarpia marmorata* A. Thallus, B. Ascospores

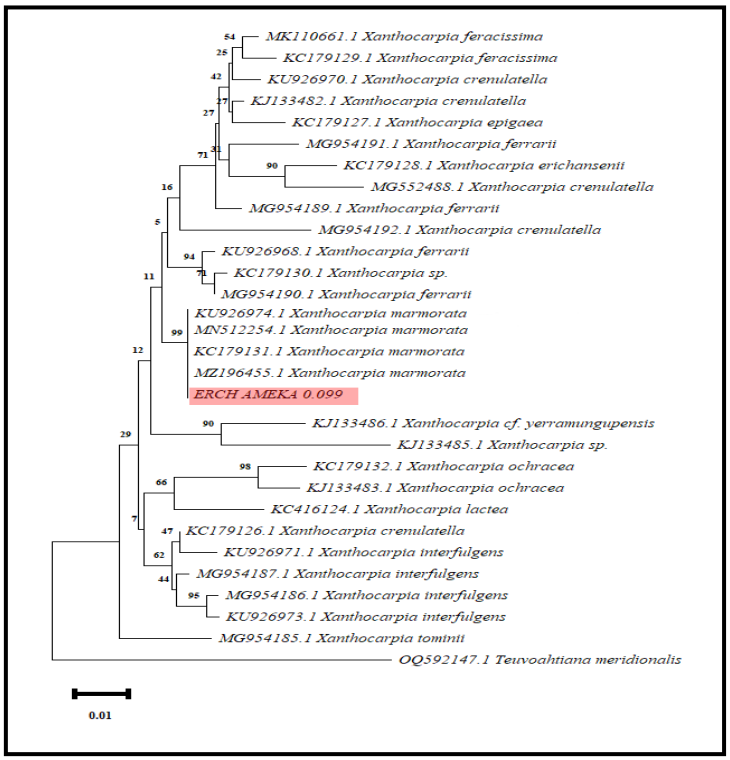

Figure 18. *nrITS* ML dendrogram of *Xanthocarpia marmorata*

4. Conclusions and discussion

As a result of this study, nine species collected from the study area and diagnosed molecularly are *Circinaria calcarea, Flavaploca havaasii, Flavoplaca communis, Kuettlingeria erythrocarpa, Lecania rabenhorstii, Lobothallia radiosa, Megaspora verrucosa, Physcia stellaris* and *Xanthocarpia marmorata*.

In the *nrITS* ML dendrogram of *C. calcarea* (Figure 3), a sample from the Akkuyu region (ERC AMEKA 0.111) matches *Circinaria calcarea*. *Circinaria mansourii* (Sohrabi) Sohrabi is closely related to *C. calcarea*. While *C. calcarea* is a saxiolous lichen which grows on basic, calciferous and calcareous rock, *C. mansourii* is a terricolous species wgich grows on soil or plant debris. Also *C. calcarea* characteristicly have immersed apothecia into its thallus, in contrast, apothecia or pycnidia have rarely been observed in *C. mansourii* [21]. *C. calcarea* exhibits anatomical and morphological similarities to *C. contorta* (Hoffm.) A. Nordin, Savić & Tibell. However, the apothecia of *C. contorta* are characterized by a crater-like shape, and its ascospores are more spherical and narrower than those of *C. calcarea*. Additionally, *Hymenelia cyanocarpa* (Anzi) Lutzoni bears a superficial resemblance but is distinct in its occurrence on siliceous substrates [10].

In the *nrITS* ML dendrogram of *F. communis* and *F. havaasii* (Figure 6), it is clear that samples from the Akkuyu region (ERC AMEKA 0.105 and ERC AMEKA 0.110) match *F. havaasii* and *F. communis*. It isn't easy to distinguish between *F. havaasii* and *F.communis* species morphologically. *F. communis* is typically found on siliceous substrates

along shorelines, whereas *F. havaasii* does not share this habitat preference. Additionally, the thallus of *F. communis* is less developed and lacks the coarse granules that characterize *F. havaasii*. As seen in Figure 5, molecular analysis reveals that *F. maritima* (B. de Lesd.) Arup, Frödén & Søchting, *F. communis,* and *F. havaasii* are grouped within the same clade. *F. communis* grows on siliceous rocks, whereas *F. havaasii* prefers a different habitat. The distribution of *F. maritima* is restricted to coastal areas or rocky shorelines. Furthermore, *F. maritima* exhibits more reddish-orange apothecia and ascospores with more minor septa than *F. havaasii* [23].

In the *nrITS* ML dendrogram of *K. erythrocarpa* (Figure 8), it is clear that the sample from the Akkuyu region (ERC AMEKA 0.041) matches with *Kuettlingeria erythrocarpa*. *Kuettlingeria teicholyta* (Ach.) Trevis is closely related to *K. erythrocarpa*. However, it is differentiated from *K. teicholyta* by its distinctive vegetative propagation [10].

In the *nrITS* ML dendrogram of *L. rabenhorstii* (Figure 10); it is clear that sample from Akkuyu region (ERC AMEKA 0.109) matches *Lecania rabenhorstii. L. rabenhorstii* is anatomically similar to *Lecania inundata* (Hepp ex Körb.) M. Mayrhofer. *L. inundata* has more dense papillate thallus surface than *L. rabenhorstii*. Furthermore, it exhibits morphological similarities with *Lecania turicensis* (Hepp) Müll. Arg., yet can be distinguished by its more whitish-gray thallus [9]. As seen in Figure 9, L. rabenhorstii is closely related to *L. nylanderiana* A. Massal. *L. nylanderiana* has no papillate surface, and also it has 3-septate ascospores, unlike *L. rabenhorstii* [24].

In the *nrITS* ML dendrogram of *L. radiosa* (Figure 12), it is clear that the sample from the Akkuyu region (ERC AMEKA 0.051) matches *Lobothallia radiosa. Lobothallia radiosa* is similar to *Lobothallia praeradiosa* (Nyl.) Hafellner both morphologically and anatomically. However, the *L. radiosa* has thinner adnate tallus and thinner lobes. The absence of hyphal packets in the medulla also differentiates this species from *L. praeradiosa*. *Lobothallia recedens*, the closest relative of *Lobothallia radiosa* according to *nrITS* gene region. It can be differentiated from *L. radiosa* by its thicker thallus, the medulla's K- and Pd- reactions, and its less frequent distribution [25].

In the nrITS ML dendrogram of *M. verrucosa* (Figure 14), it is clear that the sample from the Akkuyu region (ERC AMEKA 0.091) matches *Megaspora verrucosa*. M. verrucosa anatomically resembles *M. rimisorediata* Valadb. & A. Nordin. However, *M. verrucosa* can be distinguished from *M. rimisorediata* by its longer hymenium, which measures between 200─250 µm, as well as its larger ascus dimensions (200─230 × 45─50 µm) and larger ascospores (30─60 × 21─42 µm) [10]. *M. verrucosa* is closely related to M. cretacea Gasparyan, Zakeri & Aptroot, as seen in Figure 13. In contrast, *M. cretacea* is characterized by the presence of soredia, a 4-spored ascus, smaller ascospores, and a habitat restricted to barks, distinguishing it from *M. verrucosa* [26].

In the *nrITS ML* dendrogram (Figure 16), it is clear that the sample from the Akkuyu region (ERC AMEKA 0.020) matches with *P. stellaris.* The closest branch is *P. dubia* (Hoffm.) Lettau. It differs from *P. dubia* by not containing vegetative propagules like soredia or isidia. Notably, *P. stellaris* is distinguished from *P. dubia* by the absence of vegetative propagules such as soredia or isidia. Furthermore, *P. stellaris* is often anatomically and morphologically mistaken for *P. aipolia* (Ehrh. ex Humb.) Fürnr., with which it commonly coexists. However, it can be differentiated by the absence of white-flecked lobes, particularly evident when the specimen is moist, as well as by its medulla reaction K- and the lack of zeorine [10, 11].

In the *nrITS* ML dendrogram (Figure 18), it is clear that our samples from the Akkuyu region (ERC AMEKA 0.081 and ERC AMEKA 0.099) are branching with *Xanthorcarpia marmorata.* This species is phylogeneticly, anatomically and morphologically very similar with *Xanthocarpia diffusa* and *X. crenulatella* species are very similar. However, it is distinguished by the presence of dark red apothecia discs and a very thin whitish tallus [27].

Numerous investigations into the biodiversity of lichenized fungi have been conducted within Türkiye. Due to their distinctive characteristics, Lichens represent unique biological associations, and understanding their biodiversity is poised to make a substantial contribution to existing scholarly literature. This research aims to enhance the body of knowledge regarding lichen biodiversity. Additionally, the significance of the study area adds another layer of importance to this investigation. The research focuses on lichens found in the Akkuyu region, which is slated for the establishment of a nuclear power plant in Mersin Province. Lichens are recognized for their efficacy as bioindicators of atmospheric trace element pollution, attributed to their considerable capacity for accumulating heavy metals and radionuclides and their reliance on atmospheric nutrients. The operation of nuclear power plants is associated with releasing heavy metals and radionuclides into the environment. Consequently, lichens serve as primary bioindicators of the ecological impacts induced by nuclear power facilities, marking the initial phase of environmental succession and acting as effective collectors of atmospheric pollutants. Thus, this study is anticipated to serve as a foundational reference for future research on the region's lichen biodiversity and provide insights for subsequent investigations.

Acknowledgments

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Hohenbuehelia mastrucata, a new basidiomycete record for Türkiye

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Abstract

The pleurotoid species, *Hohenbuehelia mastrucata* (Fr.) Singer (Pleurotaceae, Agaricales) was presented as a new record for Turkish macrofungi, based on the specimens collected from Beypazarı district of Ankara province. It is the ninth member of the genus *Hohenbuehelia* Schulzer in Türkiye. A brief description of the species is provided together with the photographs, related to the macroscopy and microscopy,

Keywords: Biodiversity, new record, Beypazarı, Ankara

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Hohenbuehelia mastrucata, Türkiye için yeni bir bazidiyomiset kaydı

Özet

Pleurotoid bir tür olan *Hohenbuehelia mastrucata* (Fr.) Singer (Pleurotaceae, Agaricales) Ankara'nın Beypazarı ilçesinden toplanan örneklere dayanılarak Türkiye makromantarları için yeni kayıt olarak sunulmuştur. Tür, *Hohenbuehelia* Schulzer cinsinin Türkiye'deki dokuzuncu üyesidir. Türün kısa bir betimlemesi, makroskobi ve mikroskobisine ilişkin fotoğrafları ile birlikte verilmiştir.

Anahtar kelimeler: Biyoçeşitlilik, yeni kayıt, Beypazarı, Ankara

1. Introduction

Hohenbuehelia Schulzer is a genus of the family Pleurotaceae Kühner within the order Agaricales. Members of the genus are cosmopolitan in distribution and are characterized by pleurotoid basidiomata with a reduced or not sharply differentiated stipe, white spore print, hyphae with clamp connections, lecythiform cheilocystidia, thick-walled metuloidal pleurocystidia, smooth, inamyloid, acynophilic basidiospores [1-4].

Index Fungorum lists more than 190 taxon names under *Hohenbuehelia*, but 50 of them are currently accepted as separate species [4-5].

Though eight species of *Hohenbuehelia* Schulzer (*H. atrocoerulea* (Fr.) Singer, *H. cyphelliformis* (Berk.) O.K. Mill., *H. longipes* (Boud.) M.M. Moser, *H. myxotricha* (Lév.) Singer, *H. petaloides* (Bull.) Schulzer, *H. semiinfundibuliformis* (P. Karst.) Singer, *H. tremula* (Schaeff.) Thorn & G.L. Barron and *H. unguicularis* (Fr.) O.K. Mill.) are currently known to exist in Türkiye, the current check-list [6] and the latest contributions [7-13] indicate that *H. mastrucata* (Fr.) Singer hasn't been presented from Türkiye before. The study aims to contribute to the mycobiota of Türkiye.

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2. Material and Method

The specimens of *H. mastrucata* were collected during a routine field trip within the boundaries of Beypazarı district of Ankara province in 2024. The basidiomata were photographed in situ. Related data about the ecology and locality were noted. The specimens were put in paper boxes and brought to the laboratory. Macromorphological descriptions are based exclusively on collected fresh materials. Micromorphological studies were performed on dried material using freehand sections of specimens mounted in 10% KOH. The microcharacters were photographed by using a 20 MP camera with Risingcam Sony imx 1" sensor, connected to a Leica DM 2500 trinocular compound microscope. Identification was performed by comparing the obtained data by Kuo [14], Elborne [15], Henrici [16], Siegel and Schwarz [17], Consiglio et al. [18] and Siegel et al. [19]. The collections are deposited in Biology Department, Science Faculty, Gazi University.

3. Results

Hohenbuehelia mastrucata (Fr.) Singer, Lilloa 22: 255 (1951) [1949]

Syn: *Acanthocystis mastrucata* (Fr.) Konrad & Maubl., *Agaricus echinatus* Sowerby, *Agaricus mastrucatus* Fr., *Calathinus mastrucatus* (Fr.) Quél., *Dendrosarcus echinatus* Kuntze, *Geopetalum mastrucatum* (Fr.) Kühner & Romagn., *Hohenbuehelia atrocoerulea* var. *mastrucata* (Fr.) Krieglst., *Phyllotus mastrucatus* (Fr.) P. Karst., *Pleurotus mastrucatus* (Fr.) Sacc.

Macroscopic and microscopic features: Cap 20-50 mm across, convex to planoconvex with an inrolled margin, circular, semicircular, shell-shaped or fan to kidney-shaped, some becomes wavy and lobed at maturity. Gray, bluish gray, brownish gray to buff, covered with a dense tomentum that forms a reticulate pattern. Flesh thin, gelatinous to rubbery when dry, whitish gray, taste mild, odor not distinct. Gills radiating from the attachment point, subdecurrent to adnate, close to subdistant, whitish to whitish gray. Spore print white. Stem absent or with an indistinct stipe, fruit body laterally attached to the wood. Basidia 26–41 × 7–9 µm, cylindric-clavate, hyaline, 4-spored. Cheilocystidia 30–43 × 4.5–6.7 µm, clavate-capitate to lageniform, with necks 2–2.5 µm across. Pleurocystidia up to 70–100 × 15–19 µm; lanceolate, fusiform, thick-walled metuloid with apical or sheathing encrustations. Basidiospores 6.8–8.7 × 3.5–5.5 µm, ellipsoid to cylindrical, rarely ovoid, smooth, inamyloid.

Figure 1. Basidiocarps of *Hohenbuehelia mastrucata*

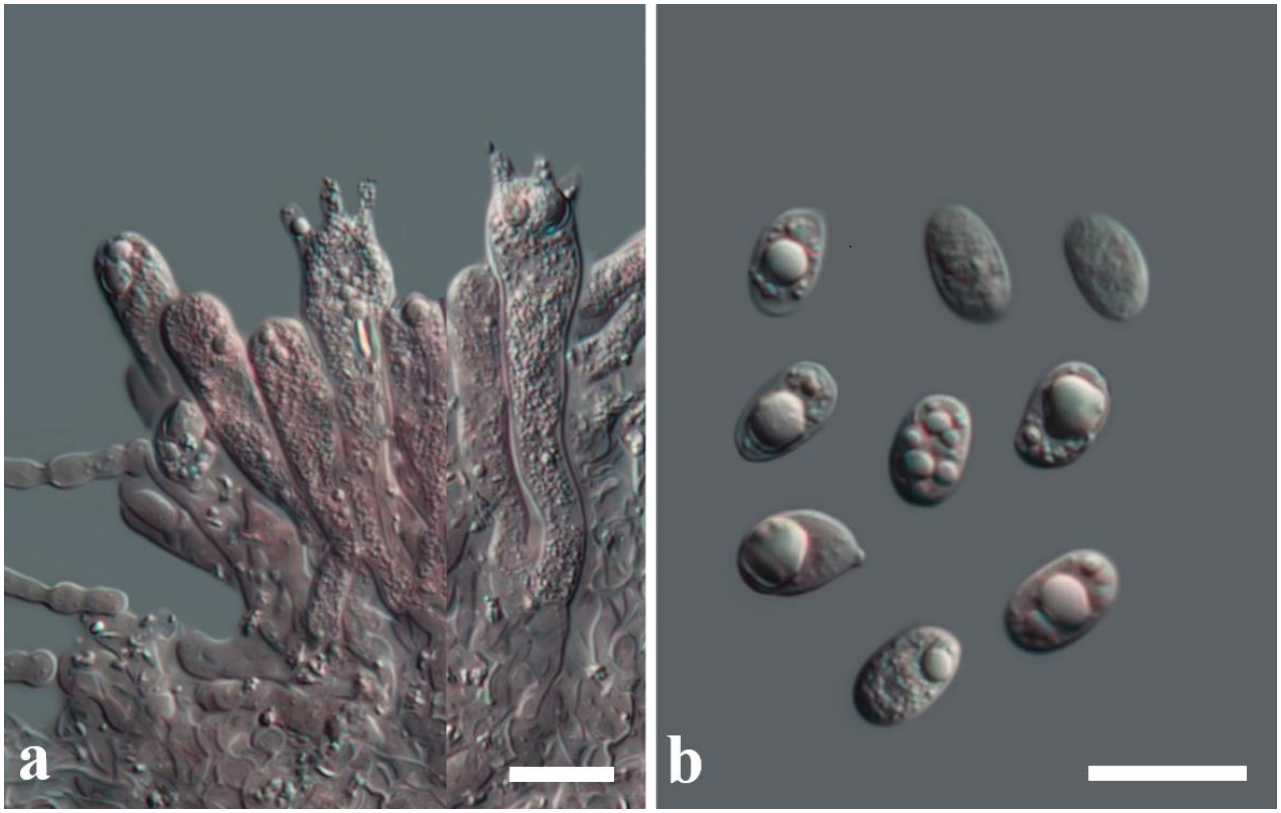

Figure 2. Basidia, basidioles (a) and basidiospores (b) of *Hohenbuehelia mastrucata* (bars: 10 µm)

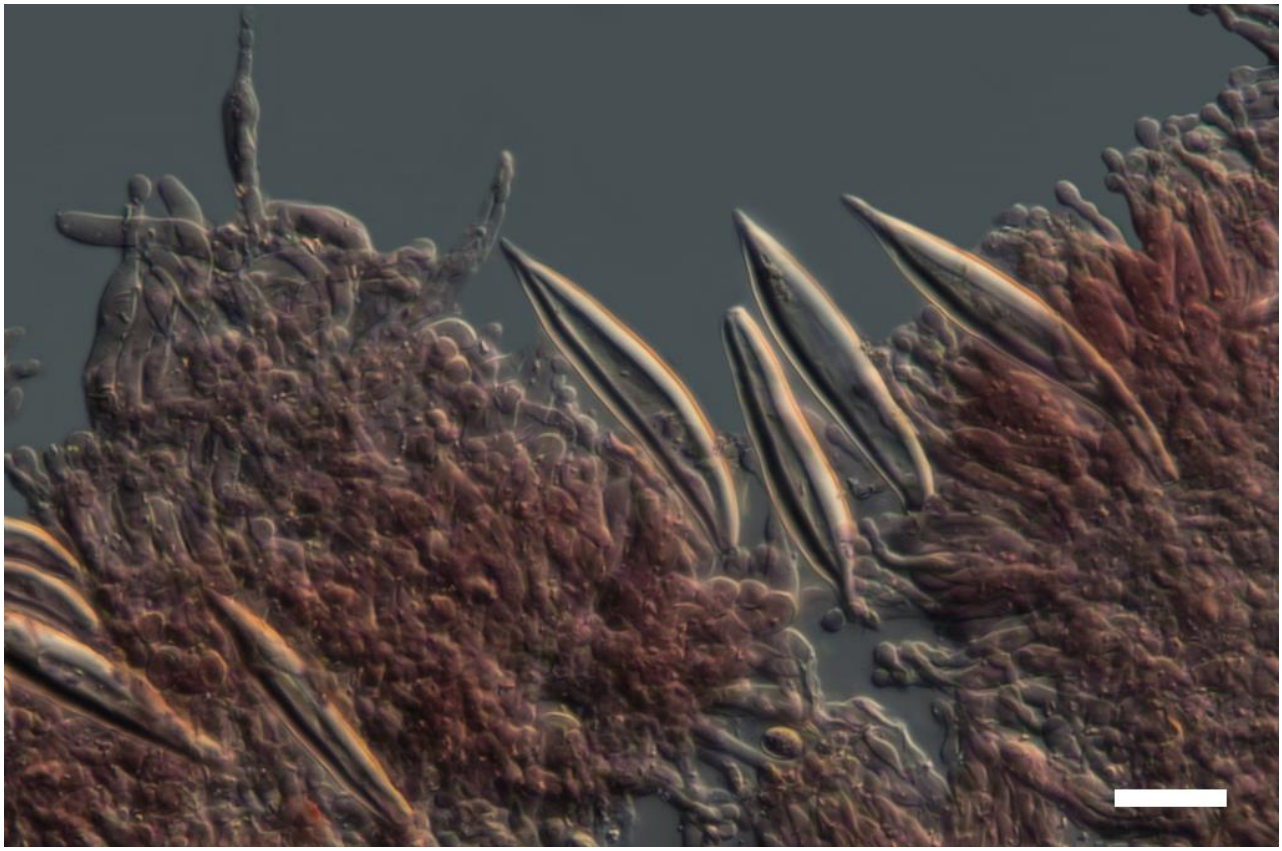

Figure 3. Cheilocystidia and pleurocystidia of *Hohenbuehelia mastrucata* (bar: 20 µm)

Hohenbuehelia mastrucata was reported to grow as solitary to scattered on well-decayed hardwoods such as *Alnus* Mill., *Betula* L., *Notholithocarpus* Manos, Cannon & S.H.Oh, *Populus* L., *Quercus* L. and *Salix* L. species [14, 15, 17, 19]. *Hohenbuehelia mastrucata* currently known from Hungary [2], Italy [4], Britain [16], USA [17, 19], Spain [20], Denmark, Finland, Norway, Sweden [21].

Specimen examined: Ankara, Beypazarı, Karaören village, on decaying *Populus* sp. stump, 40°16′N-31°54′E 1239 m, 19.05.2024, İnci 955.

Suggested Turkish name for this species is "Gümüş dirsekmantarı".

4. Conclusions and discussions

Hohenbuehelia mastrucata was reported as a new record for Turkish mycobiota. General characteristics of the Turkish collection are generally in aggreement with Kuo [14], Elborne [15], Henrici [16], Siegel and Schwarz [17], Consiglio et al. [18] and Siegel et al. [19].

Hohenbuehelia mastrucata is a distinct species by its pleurotoid, gray to brownish-grey cap covered with whitish gray to silky tomentum, a distinct gelatinous layer under the cap cuticle, lecythiform cheilocystidia and pileipellis lacking metuloidal cystidia. As similar members of the *Hohenbuehelia, H. grisea* (Peck) Singer, *H. petaloides* (Bull.: Fr.) Schulz. and *H. odorata* C.K. Pradeep & C. Bijeesh can be compared with *H. mustrucata*. *Hohenbuehelia grisea* is recognized by a smaller (10–25 mm broad), greyish-black to dark grayish-brown cap, and cylindrical-elliptical basidiospores (6.0–9.0 × 3.0–4.0 μm) [19, 22, 23]. *Hohenbuehelia petaloides* has brown and large fruiting body [17]. Smaller and yellowish white to pinkish/grayish orange cap, and subglobose to broadly ellipsoid basidiospores (5.2–7.6 × 4.8–6.4 μm) distinguishes *H. odorata* from *H. mastrucata* [2].

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Rhopalocera (Lepidoptera) diversity in Ranga reserve forest, Lakhimpur, Assam: A seasonal perspective

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Abstract

A detailed study on butterfly diversity was conducted in the Ranga Reserve Forest, Assam, India, between March 2021 and June 2022. Throughout the research, 225 species of butterflies, belonging to 131 genera and six families, are recorded. The family Nymphalidae is the most abundant, with 92 species identified. To assess the influence of seasonal changes on butterfly populations, the study period is categorized into four seasons: summer, monsoon, post-monsoon, and winter. Butterfly diversity showed notable seasonal fluctuations, with the most species observed during the monsoon season and the lowest during winter. A sharp contrast in species count is particularly evident during the monsoon, with Nymphalidae contributing 88 species, while Riodinidae accounted for only 2 species. The conservation assessment revealed that two species are listed as Critically Endangered (CR) such as *Discophora sondaica* and *Lethe europa*; two as Endangered (EN) such as *Papilio clytia* and *Doleschallia bisaltide*; one as Vulnerable (VU) such as *Castalius rosimon*; and six as Least Concern (LC) such as *Eurema andersoni*, *Chersonesia intermedia*, *Junonia almana*, *Junonia hierta*, *Caleta decidia* and *Hypolycaena othona* on the IUCN Red List. The conservation status of 214 species remains unassessed. Additionally, 42 species are protected under the Indian Wildlife (Protection) Act, 1972 (Amendment, 2022). The study emphasizes that the forest's rich diversity of butterflies can be attributed to the abundance of host and nectar plants throughout the year, making it a vital habitat for butterfly breeding.

Keywords: Conservation, diversity, Lakhimpur, Rhopalocera, seasonal diversity

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Rhopalocera (Lepidoptera) çeşitliliği Ranga rezerv ormanı, Lakhimpur, Assam: Mevsimsel bir bakış

Özet

Hindistan'ın Assam kentindeki Ranga Rezerv Ormanı'nda Mart 2021 ile Haziran 2022 tarihleri arasında kelebek çeşitliliğine ilişkin detaylı bir çalışma gerçekleştirildi. Araştırma boyunca 131 cins ve altı familyaya ait 225 kelebek türü kaydedildi. Nymphalidae familyası, tanımlanmış 92 türle en bol bulunan familyadır. Mevsimsel değişikliklerin kelebek popülasyonları üzerindeki etkisini değerlendirmek için çalışma dönemi dört mevsime ayrılmıştır: yaz, muson, muson sonrası ve kış. Kelebek çeşitliliği kayda değer mevsimsel dalgalanmalar gösterdi; türlerin çoğu muson mevsiminde, en düşük türler ise kış mevsiminde gözlemlendi. Tür sayısında keskin bir fark özellikle muson sırasında belirgindir; Nymphalidae 88 türe katkıda bulunurken, Riodinidae yalnızca 2 türe katkıda bulunmuştur. Koruma değerlendirmesi, Discophora sondaica ve Lethe europa gibi iki türün Kritik Tehlike Altında (CR) olarak listelendiğini ortaya çıkardı; Papilio clytia ve Doleschallia bisaltide gibi ikisi Tehlike Altında (EN); Castalius rosimon gibi Savunmasız (VU) bir tanesi; ve IUCN Kırmızı Listesinde yer alan Eurema andersoni, Chersonesia intermedia, Junonia almana, Junonia hierta, Caleta decidia ve Hypolycaena othona gibi altısı En Az Endişe (LC) olarak sıralanıyor. 214 türün koruma durumu henüz değerlendirilmemiştir. Ayrıca 42 tür, 1972 tarihli Hindistan Yaban Hayatı

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(Koruma) Yasası (Değişiklik, 2022) kapsamında korunmaktadır. Çalışma, ormandaki zengin kelebek çeşitliliğinin, yıl boyunca konakçı ve nektar bitkilerinin bolluğuna bağlanabileceğini ve bu durumun burayı kelebek yetiştiriciliği için hayati bir yaşam alanı haline getirdiğini vurguluyor.

Anahtar kelimeler: Koruma, çeşitlilik, Lakhimpur, Rhopalocera, mevsimsel çeşitlilik

1. Introduction

The Ranga Reserve Forest (RF) is a significant protected area situated within the Lakhimpur district of Assam, positioned between the Dikrong and Ranganadi rivers. The reserve's northern boundary is contiguous with that of the Papum Pare district in Arunachal Pradesh. Two additional reserve forests, Kakoi and Dulung, are situated within this district and collectively constitute a contiguous landscape. Ranga RF extends as the southwestern arm of Arunachal Pradesh, running eastward along the interstate border [1]. Despite its ecological significance, there has been no prior research on the butterfly diversity of this reserve. The absence of scientific data on the area's fauna has resulted in the conservation value of the reserve remaining unexplored.

Butterflies are recognized as valuable biological indicators due to their seasonal patterns and habitat specificity [2], as well as their high sensitivity to climate variations [3]. Given their well-documented taxonomy, geographical distribution, and conservation status for many species, butterflies are an ideal subject for biodiversity research [4]. Even minor alterations to the habitat can result in migration or local extinction [5], [6]. In northeastern India, research on butterflies is still in its infancy, lagging behind studies on birds, mammals, and other fauna. Nevertheless, there is a growing interest in the biology and conservation of butterflies across India, particularly in the north-eastern region, as awareness of these issues increases.

This study aims to record the butterfly species found in the Ranga Reserve Forest and the Lakhimpur district of Assam. The paper also aims to document the butterfly species present in the study area, providing valuable insights for future conservation efforts and ecological assessments.It is anticipated that the findings will facilitate a deeper comprehension of the diversity of butterflies in this region that has hitherto been relatively underexplored and will contribute to the conservation of the species.

2. Materials and methods

2.1. Study area

The research was conducted in the Ranga Reserve Forest, located in Assam's Lakhimpur district, India, spanning an area of approximately 85.29 km². The forest is situated between longitudes 93°47'37.48" E and 94°01'12.75" E, and latitudes 27°07'04.50" N and 27°19'21.02" N. The northernmost point of the reserve is at 27°19'21.02" N. (Figure 1). 88.14% of the forest is composed of dense and open woodland [7]. For this study, the following locations were selected as the primary sampling sites: Golajuli, Bogoli, Kachajuli, Dhekiajuli, Rampur, and Kimin.

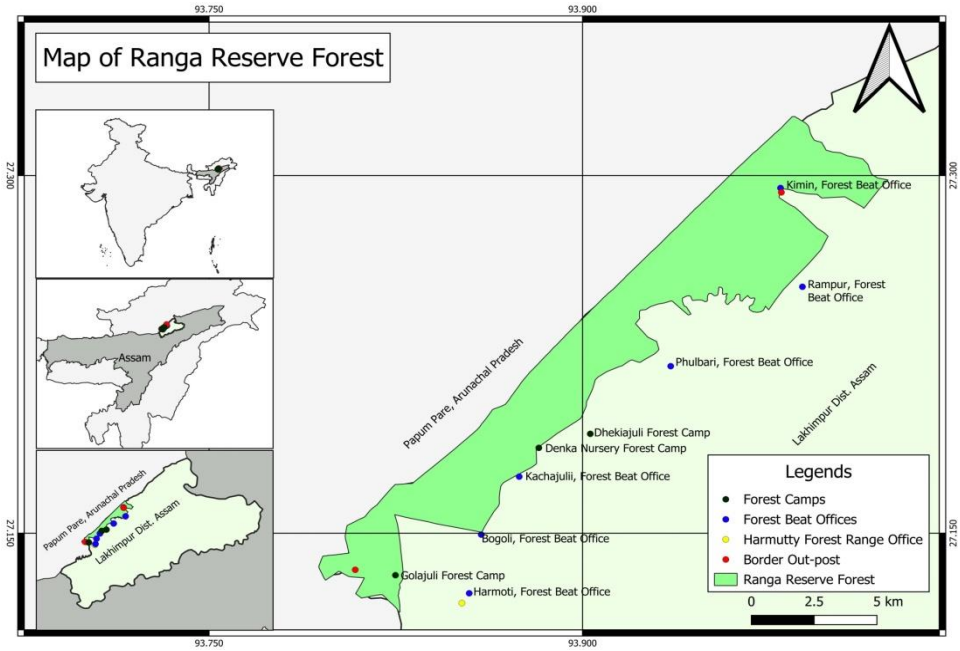

Figure 1. A map illustrating the study area within the Ranga Reserve Forest, located in

Assam, India

This reserve forest is characterized by a predominantly riverine and hilly landscape, with vegetation ranging from riverine grasslands to tropical lowland rainforest [8]. The lowlands extend northward through the Ranga Reserve, gradually giving way to low hills that continue seamlessly into Arunachal Pradesh. The forest is largely composed of semi-deciduous trees typical of the region, including species such as cottonwood (*Bombax ceiba*), beech (*Gmelina arborea*), Indian rosewood (*Dalbergia sissoo*), Chebulic myrobalan (*Terminalia chebula*), Ceylon ironwood (*Mesua ferrea*), and neem tree (*Azadirachta indica*) [9].

2.2. Methods of the study

The purpose of the survey was to develop a comprehensive checklist of butterfly species within the designated study area. The following methods were used during the study: Line Transect Method [10], Randomized Walk [11], and Visual Encounter Survey [12]. These techniques were conducted along stream banks, forest trails, forest edges, and at the boundaries of human-altered environments such as roads and agricultural fields to document butterfly presence in these habitats.

2.3. Study design

Butterfly diversity in the Ranga Reserve Forest was assessed through field surveys conducted from March 2021 to June 2022, covering four distinct seasons: summer (March to May), monsoon (June to August), post-monsoon (September to November), and winter (December to February). Surveys were carried out during favorable weather conditions, avoiding rain and strong winds to ensure reliable data collection. Six different locations within the forest were surveyed, with a total transect length of 30.5 km. Observations were made within a 150 m wide area on both sides of the transect. Total of 11 search paths were selected: three at the Bogoli site, two each at Gulajuli, Kachajuli, and Kimin, and one each at Dhekiajuli and Rampur. Random walks were also conducted to visually record butterfly species. Each trail was surveyed three times per week, depending on weather conditions, with data collected for 9 hours per day (06:00-11:00 and 14:00-18:00). In total, the study covered 180 days and 1,620 hours of observation.

2.4. Data collection and identification

For this study, data were recorded on a field data sheet, which included details such as location, date, time, and habitat for each butterfly observation, along with any reproductive or behavioral information noted. Sampling was conducted randomly along trails, streams, riverbanks, adjacent grasslands, and other locations known to host butterfly species. Photographs were taken using a DSLR camera (Nikon D5600) and a cell phone (Asus Zenfone) to document individuals. By following the ethical guidelines, no samples of butterflies were captured during the study period. Species identification was performed through visual examination and analysis of photographs, relying on reference guides [13] as well as personal observations and expertise. Identification keys from Evans [14], Talbot [15], and resources from the Butterflies of India website (https://www.ifoundbutterflies.org/) were used for classification. Geographical coordinates of survey sites were recorded using the Note Cam app on an Android device. Following conservation ethics, no specimens were collected during the survey. The map of the study area (Figure 1) was created using QGIS software version 3.18, and data analysis was conducted with Microsoft Office Excel 2007.

3. Results

A total of 225 butterfly species from six families within the order Lepidoptera were identified in the Ranga Reserve Forest. Among these, the Nymphalidae family (Plate III) showed the greatest diversity, encompassing 92 species across 46 genera. This was followed by the Lycaenidae family (Plate IV) with 47 species from 32 genera, and the Hesperiidae family (Plate VI), which included 43 species across 34 genera. The Papilionidae family (Plate I) featured 22 species from seven genera, while the Pieridae family (Plate II) contained 19 species across 10 genera. Finally, the Riodinidae family (Plate V) included two species from two genera. This research provided significant insights into the butterfly diversity of the region, highlighting several rare and noteworthy species such as *Hidari bhawani* (de Niceville, 1889), *Burara harisa* (Moore, 1866), *Arhopala perimuta* (Moore, 1858), *Telinga malsarida* (Butler, 1868), and *Mycalesis anaxias* (Hewitson, 1862). Notably, *Hidari bhawani* is regarded as extremely rare in India. Among the recorded species, three are classified under Schedule I and 39 under Schedule II of the Indian Wildlife (Protection) Act, 1972 (Amendment, 2022). According to the IUCN conservation status, two species are categorized as Critically Endangered (CR), two as Endangered (EN), one as Vulnerable (VU), and six as Least Concern (LC), while the conservation status of the remaining 200 species has yet to be assessed.

The butterfly species documented in the Ranga Reserve Forest, Assam, during the study period (March 2021 to June 2022), are as follows:

Family: *Papilionidae*
Lamproptera curius, *Graphium doson*, *Graphium eurypylus* (SC II), *Graphium agamemnon*, *Graphium sarpedon* (SC II), *Graphium antiphates*, *Byasa polyeuctes*, *Atrophaneura varuna*, *Pachliopta aristolochiae*, *Troides helena*, *Troides aecus* (SC II), *Papilio clytia* (SC II, EN), *Papilio paradoxa* (SC II), *Papilio polytes*, *Papilio memnon*, *Papilio castor*, *Papilio helenus*, *Papilio chaon*, *Papilio protenor*, *Papilio demoleus*, *Papilio paris* and *Papilio bianor*.
Family: *Pieridae*

Eurema andersoni (SC II, LC), *Eurema hecabe*, *Eurema blanda*, *Gandaca harina*, *Catopsilia pomona*, *Catopsilia pyranthe*, *Ixias pyrene*, *Hebomoia glaucippe*, *Appias olferna*, *Appias lyncida* (SC II), *Appias indra* (SC II), *Appias lalage*, *Pieris canidia*, *Cepora nerissa*, *Cepora nadina* (SC II), *Delias hyparete*, *Delias descombesi*, *Delias pasithoe*, *Leptosia nina*.
Family: *Nymphalidae*
Parantica aglea, *Parantica melaneus*, *Tirumala limniace*, *Tirumala septentrionis*, *Danaus genutia*, *Danaus chrysippus*, *Euploea core*, *Euploea sylvester*, *Euploea mulciber*, *Euploea klugii*, *Euploea algea* (SC II), *Euploea radamanthus*, *Charaxes bharata* (SC II), *Charaxes eudamippus*, *Charaxes bernardus* (SC II), *Charaxes kahruba* (SC II), *Charaxes marmax* (SC II), *Charaxes solon* (SC II), *Discophora sondaica* (SC I, CR), *Amathuxidia amythaon*, *Thaumantis diores*, *Elymnias hypermnestra*, *Elymnias malelas* (SC II), *Elymnias nesaea*, *Ethope himachala*, *Melanitis leda*, *Melanitis phedima*, *Lethe confusa*, *Lethe europa* (SC I, CR), *Lethe mekara*, *Lethe chandica*, *Lethe sinorix* (SC II), *Telinga malsara*, *Telinga malsarida* (SC II), *Mycalesis perseus*, *Mycalesis visala*, *Mycalesis mineus*, *Mycalesis anaxias* (SC II), *Mycalesis gotama* (SC II), *Orsotriaena medus*, *Ypthima huebneri*, *Ypthima baldus*, *Acraea terpsicore*, *Acraea issoria*, *Cethosia cyane*, *Cethosia biblis* (SC II), *Argynnis hyperbius*, *Phalanta phalantha*, *Vindula erota*, *Cirrochroa aoris*, *Cirrochroa tyche*, *Vagrans egista*, *Moduza procris*, *Athyma perius*, *Athyma inara*, *Athyma asura* (SC II), *Athyma ranga* (SC II), *Athyma selenophora*, *Athyma cama*, *Lebadea martha*, *Pantoporia hordonia*, *Neptis hylas*, *Neptis clinia* (SC II), *Neptis nata*, *Neptis pseudovikasi*, *Euthalia aconthea* (SC II), *Euthalia monina*, *Lexias dirtea* (SC II), *Lexias cyanipardus* (SC II), *Tanaecia julii*, *Tanaecia jahnu*, *Tanaecia lepidea* (SC II), *Cyrestis thyodamas*, *Chersonesia risa*, *Chersonesia intermedia* (SC II, LC), *Stibochiona nicea*, *Ariadne merione*, *Rohana parisatis*, *Euripus nyctelius* (SC II), *Hestinalis nama*, *Symbrenthia lilaea*, *Kaniska canace*, *Vanessa indica*, *Vanessa cardui*, *Junonia atlites*, *Junonia iphita*, *Junonia lemonias*, *Junonia almana* (LC), *Junonia hierta* (LC), *Hypolimnas bolina*, *Kallima inachus*, and *Doleschallia bisaltide* (SC II, EN).
Family: *Lycaenidae*
Curetis acuta dentata, *Curetis bulis*, *Poritia hewitsoni* (SC II), *Taraka hamada*, *Spalgis epius*, *Cigaritis lohita* (SC II), *Cigaritis syama*, *Anthene emolus*, *Anthene lycaenina*, *Prosotas nora*, *Prosotas dubiosa*, *Caleta decidia* (LC), *Caleta roxus* (SC II), *Caleta elna*, *Jamides celeno*, *Jamides bochus*, *Jamides alecto* (SC II), *Jamides elpis*, *Catochrysops strabo*, *Lampides boeticus*, *Chilades lajus*, *Chilades pandava*, *Leptotes plinius*, *Castalius rosimon* (VU), *Taracus spp.*, *Pseudozizeeria maha*, *Zizeeria karsandra*, *Zizina otis*, *Neopithecops zalmora*, *Megisba malaya* (SC II), *Acytolepis puspa*, *Heliophorus epicles*, *Arhopala centaurus*, *Arhopala perimuta*, *Surendra quercetorum*, *Hypolycaena erylus*, *Zeltus amasa*, *Hypolycaena othona* (SC I, LC), *Loxura atymnus*, *Horaga onyx* (SC II), *Cheritra freja*, *Remelana jangala* (SC II), *Rapala manea*, *Rapala nissa*, *Rapala iarbus*, *Rapala pheretima* and *Rapala suffusa*.
Family: *Riodinidae*
Abisara bifasciata and *Zemeros flegyas*.
Family: *Hesperiidae*
Burara harisa, *Burara oedipodea*, *Bibasis sena* (SC II), *Hasora badra*, *Hasora chromus*, *Choaspes benjaminii*, *Seseria sambara*, *Gerosis phisara*, *Tagiades japetus*, *Tagiades gana*, *Tagiades litigiosa*, *Odontoptilum angulata*, *Celaenorrhinus leucocera*, *Celaenorrhinus putra*, *Sarangesa dasahara*, *Pseudocoladenia dan*, *Ampittia dioscorides*, *Astictopterus jama*, *Halpe porus*, *Pithauria stramineipennis*, *Thoressa cerata*, *Iambrix salsala*, *Suastus gremius*, *Psolos fuligo*, *Hyarotis adrastus*, *Ancistroides nigrita*, *Udaspes folus*, *Notocrypta paralysos*, *Hidari bhawani*, *Matapa aria*, *Matapa druna*, *Erionota torus*, *Gangara thyrsis*, *Baoris farri*, *Caltoris kumara*, *Parnara guttata*, *Pelopidas sinensis*, *Pelopidas agna*, *Polytremis eltola*, *Oriens gola*, *Oriens goloides*, *Telicota colon* and *Telicota bambusae*.

Note: Species with conservation statuses are noted: **SC I** indicates inclusion under Schedule I, **SC II** indicates inclusion under Schedule II of the Indian Wildlife (Protection) Act, 1972 (Amendment,2022). **CR** denotes Critically Endangered, **EN** denotes Endangered and **VU** denotes Vulnerable status as per the IUCN Red List.

3.1. Diversity of butterflies in the study area

Throughout the study, the Nymphalidae family exhibited the greatest species richness, representing 41% of the total with 92 species. This was followed by the Lycaenidae family, contributing 21% (47 species), Hesperiidae at 19% (43 species), Papilionidae at 10% (22 species), and Pieridae at 8% (19 species). The family Riodinidae contributed a small fraction of 1% of the total with 2 species. Notably, the Ranga Reserve Forest exhibit a remarkable diversity of butterfly species (Figure 2).

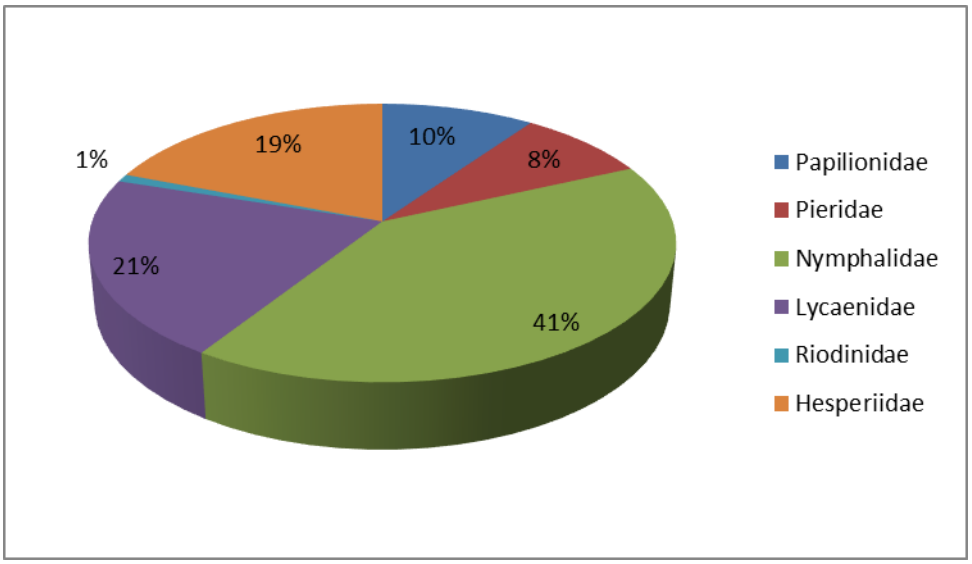

Figure 2. Distribution of butterfly species by family in Ranga Reserve Forest, Assam, India

3.2. Seasonal diversity of butterflies in the study area

The study, conducted from March 2021 to June 2022, was divided into four distinct seasons: summer, monsoon, post-monsoon, and winter. A seasonal analysis revealed considerable variation in the distribution of butterfly species. The highest diversity of 194 species was observed during the monsoon season, followed by 182 species in the summer. The post-monsoon season showed a slight decline in diversity with 130 species recorded, and the winter recorded the lowest number of species with 95. Notably, the family Nymphalidae consistently showed the highest diversity across all seasons. In the monsoon, Nymphalidae dominated with 88 species, while the Riodinidae family had the lowest representation with only two species (Figure 3).

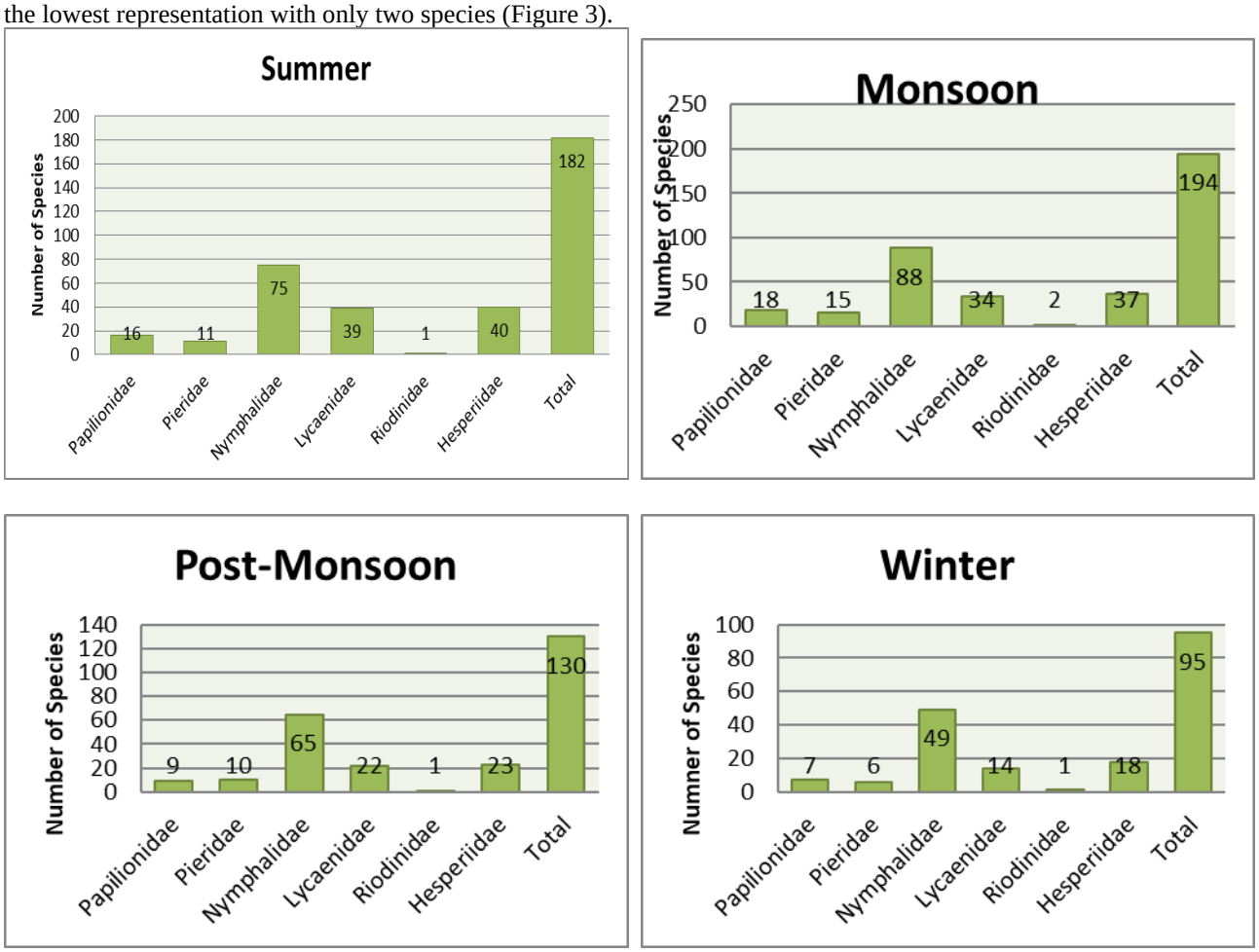

Figure 3. Seasonal distribution of butterflies ofRanga Reserve Forest, Assam, India

4. Conclusions and discussion

The geographic positioning of the study area is of great consequence in the formation of habitats that foster a rich and diverse butterfly population. Our research indicates that Ranga RF is a habitat with abundant resources, which renders it an optimal environment for butterflies. The study on the diversity of butterflies within Ranga Reserve Forest, Assam, India, a total of 225 species were recorded, including several rare and unique species that are exclusively found in this region. During our 16 months of fieldwork in the Ranga Reserve Forest, we documented a significant diversity of butterfly species, reflecting the rich biodiversity of the area. While Assam as a state has an impressive record of 686 butterfly species, our findings from Ranga Reserve Forest represent a large subset of this total, highlighting the importance of the reserve as a key habitat within the state. Compared to the national record of 1,379 butterfly species in India [16], our results from Ranga Reserve Forest underline the region's contribution to the country's overall butterfly diversity. This comparison highlights the importance of Ranga Reserve Forest as an important area for butterfly conservation in the state and national context. It is noteworthy that this marks the inaugural comprehensive butterfly survey for both the reserve forest and the Lakhimpur district of the state. The distribution of butterfly species exhibited distinct patterns across the four seasons, with the family Nymphalidae consistently demonstrating the highest diversity. The study revealed that the butterfly diversity is high during the monsoon season, the reason maybe, due to the region's favorable climatic conditions, such as moderate temperatures, and abundant rainfall. These conditions lead to lush vegetation growth, providing ample nectar sources for adult butterflies and suitable host plants for caterpillars. Additionally, the monsoon season supports the blooming of a diverse variety of flowers, creating microhabitats that are ideal for butterfly survival and proliferation. This observation aligns with previous studies by Eswaran & Pramod [17] and Krishnakumar et al. [18], which also noted the dominance of the Nymphalidae family in tropical regions. Their dominance can be attributed to their polyphagous nature, which allows them to thrive in a range of habitats.The findings of our study indicate that the diverse vegetative cover across the various habitat types within the area provides optimal conditions for the survival of numerous species of butterflies. This finding is consistent with conclusions of Bora and Meitei [4], who suggested that the structural complexity and diversity of vegetation in different habitats may create specific microhabitats that support the persistence of certain butterfly species.there are similar studies also from other states like Jammu and Kasmir by Riyaz [19]. The expansion of human activities along forest edges has resulted in a reduction in forest cover and habitat loss [20]. Factors such as pesticide use, grazing pressure, and alterations in land use patterns have been identified as principal contributors to the decline in butterfly populations [21]. The increasing application of pesticides in proximity to forested areas represents a significant cause for concern. Furthermore, the rate of deforestation is increasing as a result of the expansion of human settlements and the conversion of land for agricultural purposes. Collectively, these issues present a significant challenge to the long-term sustainability of the forest. The presence of rare or uncommon butterfly species serves to illustrate the rich biodiversity potential of this area, thereby underscoring the necessity for the implementation of more robust protection measures. Further surveys in this biologically significant region have the potential to identify additional butterfly species, thereby enhancing its conservation value.

Acknowledgments

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PHOTO PLATES

PLATE I: Photographs of butterfly species from the Papilionidae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

Lamproptera curius

Graphium doson

Graphium eurypylus

Graphium agamemnon

Graphium sarpedon

Graphium antiphates

Byasa polyeuctes

Pachliopta aristolochiae

Troides helena

Troides aecus

Papilio clytia

Papilio paradoxa

Papilio polytes

Papilio memnon

Papilio castor

Papilio helenus

Papilio chaon

Papilio protenor

Papilio demoleus

Papilio paris

PLATE II: Photographs of butterfly species from the Pieridae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

Eurema andersoni

Eurema hecabe

Eurema blanda

Gandaca harina

Catopsilia pomona

Catopsilia pyranthe

Ixias pyrene

Hebomoia glaucippe

Appias olferna

Appias lyncida

Appias indra

Appias lalage

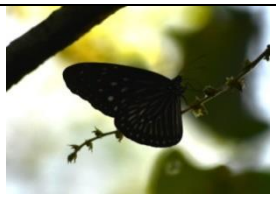
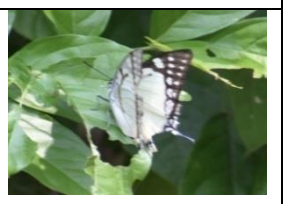
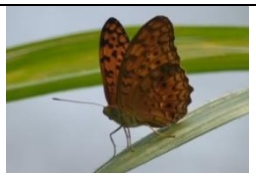
Pieris canidia

Cepora nadina

Delias hyparete

Delias descombesi

PLATE III: Photographs of butterfly species from the Nymphalidae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

			
Parantica aglea	*Tirumala septentrionis*	*Danaus chrysippus*	*Euploea sylvester*
			
Euploea mulciber	*Euploea algae*	*Euploea radamanthus*	*Charaxes eudamippus*
			
Charaxes solon	*Discophora sondaica*	*Thaumantis diores*	*Elymnias hypermnestra*
			
Elymnias malelas	*Ethope himachala*	*Lethe confusa*	*Lethe europa*
			
Lethe mekara	*Lethe chandica*	*Telinga malsara*	*Telinga malsarida*
			
Mycalesis anaxias	*Mycalesis gotama*	*Orsotriaena medus*	*Phalanta phalantha*

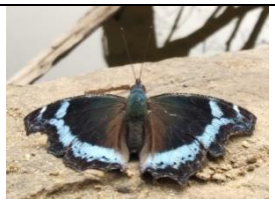
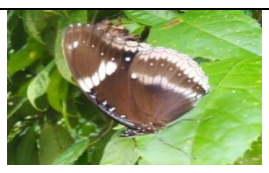
			
Vindula erota	*Cirrochroa aoris*	*Cirrochroa tyche*	*Vagrans egista*
			
Athyma inara	*Athyma asura*	*Athyma ranga*	*Athyma selenophora*
			
Pantoporia hordonia	*Euthalia aconthea*	*Euthalia monina*	*Lexias dirtea*
			
Tanaecia jahnu	*Cyrestis thyodamas*	*Chersonesia intermedia*	*Stibochiona nicea*
			
Rohana parisatis	*Euripus nyctelius*	*Hestinalis nama*	*Symbrenthia lilaea*
			
Kaniska canace	*Vanessa indica*	*Junonia atlites*	*Junonia almana*
			
Junonia hierta	*Hypolimnas bolina*	*Kallima inachus*	*Doleschallia bisaltide*

PLATE IV: Photographs of butterfly species from the Lycaenidae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

Curetis acuta

Poritia hewitsoni

Taraka hamada

Spalgis epius

Cigaritis lohita

Anthene emolus

Anthene lycaenina

Prosotas nora

Caleta decidia

Caleta elna

Jamides celeno

Jamides elpis

Catochrysops strabo

Lampides boeticus

Chilades lajus

Chilades pandava

Leptotes plinius

Castalius rosimon

Taracus spp.

Pseudozizeeria maha

Zizeeria karsandra

Zizina otis

Neopithecops zalmora

Acytolepis puspa

Heliophorus epicles

Arhopala centaurus

Arhopala perimuta

Surendra quercetorum

Hypolycaena erylus

Zeltus amasa

Chliaria othona

Loxura atymnus

Cheritra freja

Remelana jangala

Rapala nissa

Rapala pheretima

PLATE V: Photographs of butterfly species from the Riodinidae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

Abisara bifasciata

Zemeros flegyas

PLATE VI: Photographs of butterfly species from the Hesperiidae family, documented in the Ranga Reserve Forest, Lakhimpur, Assam, India, during the study period from March 2021 to June 2022.

Burara harisa

Burara oedipodea

Bibasis sena

Hasora badra

Hasora chromus

Choaspes benjaminii

Seseria sambara

Gerosis phisara

Tagiades japetus

Tagiades gana

Tagiades litigiosa

Odontoptilum angulata

Celaenorrhinus putra

Sarangesa dasahara

Pseudocoladenia dan

Ampittia dioscorides

Astictopterus jama

Halpe porus

Pithauria stramineipennis

Thoressa cerata

Iambrix salsala

Suastus gremius

Hyarotis adrastus

Ancistroides nigrita

Udaspes folus

Hidari bhawani

Matapa druna

Gangara thyrsis

Baoris farri

Pelopidas agna

Oriens gola

Telicota colon

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Possibilities of using Tenebrionidae species (Insecta: Coleoptera) as biological indicators for habitat description

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Abstract

This study investigated the distribution of eighteen darkling beetles species of (Tenebrionidae) sampled using pitfall traps across six distinct habitats in the Çukurova Delta (Adana, Türkiye), including sand dunes, salt marshes, salt meadows, Pinus spp. forests, *Eucalyptus* spp. afforestation, and beach habitats. The objective was to assess the potential of darkling beetles as indicators for habitat characterization. Beetle abundance was recorded for each habitat, and indicator species analysis identified specific associations: *Zophosis dilatata*, *Erodius oblongus oblongus*, and *Ammobius cyprius* were most abundant in sand dunes; *Phtora reitteri reitteri* in salt marshes; *Gonocephalum rusticum* and *Centorus turcicus* in salt meadows; and *Pimelia bajula solieri* and *Zophosis punctata punctata* in Eucalyptus afforestation areas. The highest indicator values were observed for *C. turcicus* (94.0%) and *P. b. solieri* (84.7%). Although the majority of species were members of the Tenebrionidae family, the results suggest that these beetles are adaptable and can thrive across a range of habitat types within the delta.

Keywords: Insecta, Coleoptera, Çukurova delta, Tenebrionidae, distribution

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Tenebrionidae türlerinin (Insecta: Coleoptera) habitat tanımlamasında biyolojik gösterge olarak kullanılma olanakları

Özet

Bu çalışmada, Çukurova Deltası'nda (Adana, Türkiye) altı farklı habitatta (kumullar, tuzlu bataklıklar, tuzlu çayırlar, *Pinus* spp. ormanları, *Eucalyptus* spp. ağaçlandırma alanları ve plaj habitatları) çukur tuzakları kullanılarak örneklenen on sekiz Tenebrionidae türünün dağılımı incelenmiştir. Çalışmada, tenebrionid böceklerinin habitat karakterizasyonu için gösterge türü olarak kullanılma potansiyeli değerlendirilmmiştir. Her habitat için böcek yoğunluğu kaydedilmiş ve gösterge türü analizi ile belirli ilişkiler tespit edilmiştir: *Zophosis dilatata*, *Erodius oblongus oblongus* ve *Ammobius cyprius* en fazla kumul alanlarında; *Phtora reitteri reitteri* tuzlu bataklıklarda; *Gonocephalum rusticum* ve *Centorus turcicus* tuzlu çayırlarda; *Pimelia bajula solieri* ve *Zophosis punctata punctata Eucalyptus* ağaçlandırma alanlarında en fazla bulunmuştur. En yüksek gösterge değeri *C. turcicus* (94.0%) ve *P. b. solieri* (84.7%) için belirlenmiştir. Örneklenen türlerin yüksek oranda Tenebrionidae familyasına ait olmasına karşın, sonuçlar bu böceklerin delta içindeki çeşitli habitat türlerinde başarılı bir şekilde yaşayabildiklerini göstermiştir.

Anahtar kelimeler: Insecta, Coleoptera, Çukurova deltası, Tebenrionidae, dağılım

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Introduction

Türkiye is home to three global biodiversity hotspots—the Mediterranean, Caucasus, and Irano-Anatolian regions-each exhibiting a higher biodiversity and endemism rate than any other European country [1-2]. However, the populations of many epigean species have experienced significant declines due to factors such as agricultural expansion, pesticide use, and other crop improvement practices [3-10]. Despite these challenges, continues to be a rich source of new species discoveries, particularly within its terrestrial ecosystems and even at depths of up to -1260 meters in its cave ecosystems [11-13].

The Çukurova Delta, located in the southern region of Adana province, covers approximately 5,000 km² and represents the largest lagoon and dune succession in Türkiye, extending 110 km in length. It is considered one of the most important humid biotope systems along the Turkish Mediterranean coast [14]. The delta includes six main biotopes: (i) sand dunes, (ii) salt marshes, (iii) salt meadows, (iv) *Eucalyptus* spp. afforestation, (v) Pinus spp. forests, and (vi) beaches [15]. The Turkish government has proposed designating the delta as the nation's first biosphere reserve. Preliminary studies have highlighted the remarkable diversity of habitats and species present, although habitat classification has predominantly relied on vegetation, a practice commonly adopted in both Çukurova and across the EU (e.g., FFH - Natura 2000). This study seeks to build on this framework by proposing that darkling beetles could serve as valuable indicators for habitat classification in the delta, thus addressing the existing gap in faunal data.

Darkling and ground beetles are widely recognized as key indicator species for biodiversity monitoring and nature conservation [16-17]. However, the Tenebrionidae fauna of southern Anatolia has not been thoroughly studied. In this research, we present data on the darkling beetle species of the Çukurova Delta, obtained through pitfall trap sampling across various habitats within the delta.

A comprehensive and reliable distribution pattern is essential for utilizing darkling beetles in nature conservation efforts or as ecological indicators [18-23]. Therefore, the primary aim of this study is to provide detailed distribution data of Tenebrionidae species in relation to their habitats and to evaluate their potential as indicators for habitat classification within the Çukurova Delta.

2. Materials and methods

The study was conducted in the extended eastern Mediterranean dune and beach regions of the Çukurova Delta. Six main biotopes were investigated: sand dunes, salt marshes, salt meadows, *Eucalyptus* spp. afforestation, *Pinus* spp. forests, and beaches. Sampling was carried out across a total of 18 localities within the delta.

2.1. Sampling method

Darkling beetles were sampled using pitfall traps consisting of plastic cups (15 cm diameter, 20 cm depth) buried into the soil with the upper rim flush with the surface. The traps were spaced approximately 25 meters apart at each sampling site, with a total of 10 traps used in each habitat. Sampling was conducted annually over one-week periods between April and September, coinciding with peak arthropod abundance and diversity. Adult darkling beetles were collected in Falcon tubes (3x10 cm) containing 70% ethyl alcohol and transported to the laboratory for identification. Species identification was performed by Martin Lillig from the Bund für Umwelt und Naturschutz Deutschland Landesverband Saarland, Germany.

2.2. Habitat description

Sand Dune: The sampling areas included four distinct dune types: fore dune, fixed dune, secondary shifting dune, and dune slack. The fore dune, located adjacent to the beach, is less stabilized and sparsely vegetated. The fixed dune is higher, more stable, and exhibits the beginning stages of soil formation, with greater vegetation cover compared to the fore dune. The secondary shifting dune, which is not connected to the beach, is characterized by low vegetation and mobility due to factors such as overgrazing, cutting, and strong winds. The dune slack is a ground depression with distinct vegetation compared to the surrounding dune areas. The vegetation of the sand dune complex was composed of the following species: *Bromus* spp., *Cakile maritima*, *Cyperus capitatus*, *Echinops ritro*, *Echium angustifolium*, *Erica manipuliflora*, *Eryngium maritimum*, *Euphorbia paralias*, *Euphorbia peplis*, *Helianthemum stipulatum*, *Imperata cylindrica*, *Inula viscosa*, *Ipomea stolonifera*, *Juncus acutus*, *Medicago marina* [*Pancratium maritimum*], *Myrtus communis*, *Nerium oleander*, *Pancratium maritimum*, *Pistacia terebinthus* [*Pistacia lentiscus*], *Phragmites australis*, *Polygonum equisetiforme*, *Prunus spinosa*, *Rubus sanctus*, *Thymelaea hirsuta*, *Trachomitum venetum*, *Verbascum sinuatum*, *Vitex agnus-castus*, *Xanthium strumarium* and *Zygophyllum album* [24].

Salt Marsh: The vegetation of marine saline mud predominantly consists of shrub species, which grow on clayey/loamy soils that are periodically inundated and characterized by a consistently high groundwater table. The vegetation cover is generally sparse, with certain areas exhibiting a relatively open structure. This habitat is typified by

the presence of the following plant species: *Arthrocnemum fruticosum*, *Arthrocnemum glaucum*, *Halimione portulacoides*, *Halocnemum strobilaceum*, *Salicornia europaea* and *Tamarix smyrnensis* [24].

Salt Meadow: The vegetation of saline environments along lagoon shorelines is primarily dominated by perennial herbaceous species, which thrive on soils that are subjected to only brief periods of flooding. The vegetation cover is typically dense and clumped, exhibiting a caespitose growth form. This habitat is characterized by the presence of the following species: *Juncus maritimus*, *Juncus acutus*, *Aeluropus littoralis*, *Plantago maritima*, *Limonium gmelinii* and *Tamarix smyrnensis* [24].

Forest (Pinus spp.): These habitats are stable dune ecosystems dominated by *Pinus halepensis* and *Pinus brutia*. In the sampled area, *Pinus halepensis* was found to be the predominant species, although other *Pinus* species may also be present [24].

Afforestation (Eucalyptus spp.): These areas, previously characterized by a sand dune vegetation complex, have been subject to afforestation with *Eucalyptus* species [24].

Beach: This refers to an unvegetated sandy beach area located above the drift line [24].

2.3. Statistic analysis

An indicator species analysis [25] using the PC-ORD software package (Version 4.14) was carried out to establish the species groups that were associated with both major cluster groups derived from the flexible-UPGMA, and with a priori defined habitat groups from Table 1.

(1) The proportional abundance of a specific species within a group was calculated in relation to its abundance across all groups. This value was expressed as a percentage, and the intermediate result was presented.

A = sample unit x species matrix
aijk = abundance of species j in sample unit (SU) i of group k
nk = number of sample units in group k
g = total number of the groups
Firstly, the mean abundance xkj of species j in group k is calculated:

$$\mathrm{xkj} = \sum_{\mathrm{i}=0}^{\mathrm{nk}} \mathrm{aijk} \; / \; \mathrm{nk}$$

Then the relative abundance RAkj of species j in group k is calculated:

$$\mathrm{RAkj} = \mathrm{xkj} \; / \sum_{\mathrm{k}=1}^{\mathrm{g}} \mathrm{xkj}$$

(2) The proportional frequency of species within each group was calculated, representing the percentage of sample units in each group that contained the species. This value was also expressed as a percentage, and the intermediate result was presented.

Initially, A was transformed into a presence-absence matrix B:

$$bij = a_{ij}^{0}$$

Then relative frequency RFkj of species j in group k is calculated:

(3) The two proportions calculated in steps 1 and 2 were combined by multiplying them, and the result was expressed as a percentage, yielding an indicator value (IV_{kj}) for each species (j) in each group (k).

(4) The highest indicator value (IV_max) for a given species across all groups was retained as the overall indicator value for that species.

(5) The statistical significance of IV_max was assessed using the Monte Carlo method for each species. This method involved 1.000 randomizations to evaluate the statistical significance of the maximum indicator value recorded for each species.

The habitats included in the study, from which epigean tenebrionid species could be sampled, were classified into six groups to identify indicator species according to Dufrêne and Legendre (1997) [25]. The presence-absence conditions of the tenebrionids were tested for statistical significance using the Monte Carlo technique.

Distribution maps of the darkling beetles presented in this study were generated using ArcView GIS software.

3. Results

A total of eighteen darkling beetle species were identified in the Çukurova Delta. Among these, *Z. dilatata* ($P < 0.01$), *G. rusticum* ($P < 0.05$), *P. b. solieri* ($P < 0.05$), *E. o. oblongus* ($P < 0.05$), *C. turcicus* ($P < 0.05$), *A. cyprius* ($P < 0.05$), *P. r. reitteri* ($P < 0.05$), and *Z. p. punctata* ($P < 0.05$) exhibited statistically significant indicator values for habitat characterization. In contrast, the indicator values of ten other darkling beetle species did not show statistical significance in the Çukurova Delta (Table 1).

Table 1. The abundance of Tenebrionidae species in selected habitats and their corresponding indicator values (Species highlighted in bold were identified as statistically significant based on the indicator species analysis using the Monte Carlo method)

Species	Group***	InV (%)	P value	1-Sand dune	2-Salt marsh	3-Salt meadow	4-Forest (*Pinus* spp.)	5-Afforestation (*Eucalyptus* spp.)	6-Beach
G. rusticum	**3**	**56.3**	**0.0110***	**18**	**81**	**254**	**33**	**52**	**13**
C. o. oblongiusculus	2	53.5	0.0710	-	122	63	39	4	-
S. p. dlabolai	5	46.0	0.3210	130	-	-	7	306	-
P. b. solieri	**5**	**84.7**	**0.0210***	**-**	**-**	**-**	**53**	**293**	**-**
B. cribrosa	5	58.8	0.2230	17	-	17	174	297	-
D. crenata	5	28.2	0.5510	9	19	20	8	22	-
Z. dilatata	**1**	**74.1**	**0.0080****	**13210**	**19**	**232**	**1260**	**2974**	**133**
E. o. oblongus	**1**	**54.5**	**0.0200***	**2593**	**56**	**36**	**551**	**1497**	**26**
C. turcicus	**3**	**94.0**	**0.0110***	**-**	**9**	**141**	**-**	**-**	**-**
A. cyprius	1	76.9	**0.0200***	**20**	**-**	**-**	**6**	**-**	**-**
S. punctiventris	4	67.9	0.0730	2	4	6	38	6	-
L. p. pumilum	1	58.3	0.1090	7	-	-	-	1	-
O. p. subcylindricus	4	42.1	0.1610	4	3	24	32	13	-
S. humerosum	4	24.2	0.5470	1	-	-	4	6	-
P. r. reitteri	**2**	**72.9**	**0.0190***	**-**	**51**	**4**	**14**	**1**	**-**
P. a. nigriceps	1	33.3	1.0000	1	-	-	-	-	-
Z. p. punctata	**5**	**54.9**	**0.0290***	**22**	**5**	**10**	**373**	**500**	**-**
A.s. sulcatum	5	33.3	1.0000	-	-	-	-	2	-

* $P < 0.05$
** $P < 0.01$
*** The code of habitat names

The data presented in Table 1 and Figs. 1- 4 indicate that certain species, such as *Zophosis dilatata*, *Erodius oblongus oblongus*, *Zophosis punctata punctata*, *Blaps cribrosa*, *Scaurus punctata dlabolai*, *Gonocephalum rusticum*, Pimelia bajula solieri, *Clitobius oblongiusculus oblongiusculus*, and *Centorus turcicus*, were abundant and widespread. In contrast, the species *Leichenum pumilum pumilum*, *Sclerum humerosum*, Ammobius *cyprius*, *Stenosis punctiventris*, *Dailognatha crenata*, *Phtora reitteri reitteri*, *Opatroides unctulatus subcylindricus*, *Phaleria acuminata nigriceps*, and *Adelostoma sulcatum sulcatum* were found to be rare and limited to small areas within the Çukurova Delta. Among the species; *Zophosis dilatata* (Deyrolle, 1867) was the most prevalent species in the Çukurova Delta, occurring in 17 out of 18 sampled locations. A total of 17.828 individuals were collected, with the majority (13.210 individuals, or approximately 74% of the total) obtained from sand dunes. Low numbers of individuals were also collected from other habitats: 2.974 in afforestation areas (*Eucalyptus* spp.), and 1.260, 232, 133, and 19 individuals were found in pine forest, salt meadow, beach, and salt marsh habitats, respectively. *G. rusticum* and *E. oblongus*, along with *Z. dilatata*, were observed in all habitat types across the delta (Table 1 and Figure 1). *Phtora reitteri reitteri* (Seidlitz, 1894) was collected from seven locations within salt marsh, salt meadow, forest (*Pinus* spp.), and afforestation (*Eucalyptus* spp.) habitats, with 51, 4, 14, and 1 individuals recorded, respectively. This species was absent from beach and sand dune habitats (Table 1 and Figure 1). *Gonocephalum rusticum* (Olivier, 1811) was observed across various habitats, including sand dunes, salt marsh, salt meadow, forest (*Pinus* spp.), afforestation (*Eucalyptus* spp.), and beach. A total of 254 individuals were collected from the salt meadow, where this species was most commonly found (Table 1 and Figure 1). *Zophosis punctata punctata* (Brullé, 1832) yielded 910 specimens from nine locations. The highest numbers of individuals were collected from afforestation (*Eucalyptus* spp.) and pine forest habitats, with 500 and 373 specimens,

respectively. This species was also found in salt marsh, salt meadow, and sand dune habitats, with 5, 10, and 22 individuals recorded, respectively (Table 1 and Figure 1).

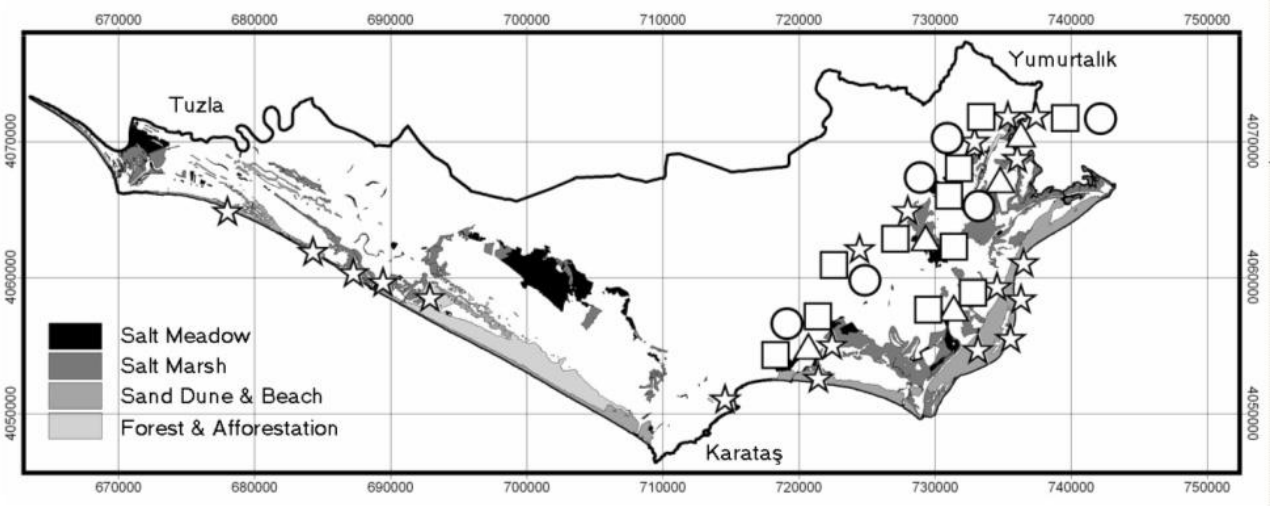

Figure 1. Distribution of *Z. dilatata* (☆), *P. r. reitteri* (△), *G. rusticum* (□) and *Z. p. punctata* (○) in Çukurova Delta in southern Türkiye.

Erodius orientalis oblongus (Solier, 1834) was one of the most widely distributed species, recorded in 16 different locations. A total of 2.593 individuals were collected from sand dune habitats, while 1.497 individuals were found in afforestation areas (*Eucalyptus* spp.) with high sand content. This species was also observed in salt marshes, salt meadows, forests (*Pinus* spp.), and beach habitats, yielding 56, 36, 551, and 26 individuals, respectively (Table 1 and Figure 2). In contrast, *Pimelia bajula solieri* (Mulsant & Wachandru, 1853) was recorded in only four locations, with the highest abundance found in afforestation (*Eucalyptus* spp.) habitats, where 293 individuals were collected. Additionally, 53 individuals were sampled from forest areas. This species was not found in sand dune, salt marsh, salt meadow, or beach habitats (Table 1 and Figure 2). *Clitobius oblongiusculus oblongiusculus* (Fairmaire, 1875) was collected from seven locations across the Çukurova Delta. The majority of individuals were found in salt marsh and salt meadow habitats, with 122 and 63 specimens, respectively. Fewer individuals were collected from forest (*Pinus* spp.) and afforestation (*Eucalyptus* spp.) habitats, with 39 and 4 specimens, respectively (Table 1 and Figure 2). *Opatroides punctulatus subcylindricus* (Ménétriés, 1849) was relatively uncommon in the delta, despite being widespread. This species was recorded in sand dune (4 individuals), salt marsh (3 individuals), salt meadow (24 individuals), forest (*Pinus* spp.) (32 individuals), and afforestation (*Eucalyptus* spp.) (13 individuals) habitats, but it was absent from the beach habitat (Table 1 and Figure 2). *Centorus turcicus* (Kaszab, 1959) was collected from three locations, with 141 individuals sampled from salt marsh habitats and 9 individuals from salt meadow habitats. This species was not observed in sandy habitats, including sand dune, forest (*Pinus* spp.), afforestation (*Eucalyptus* spp.), or beach areas (Table 1 and Figure 2).

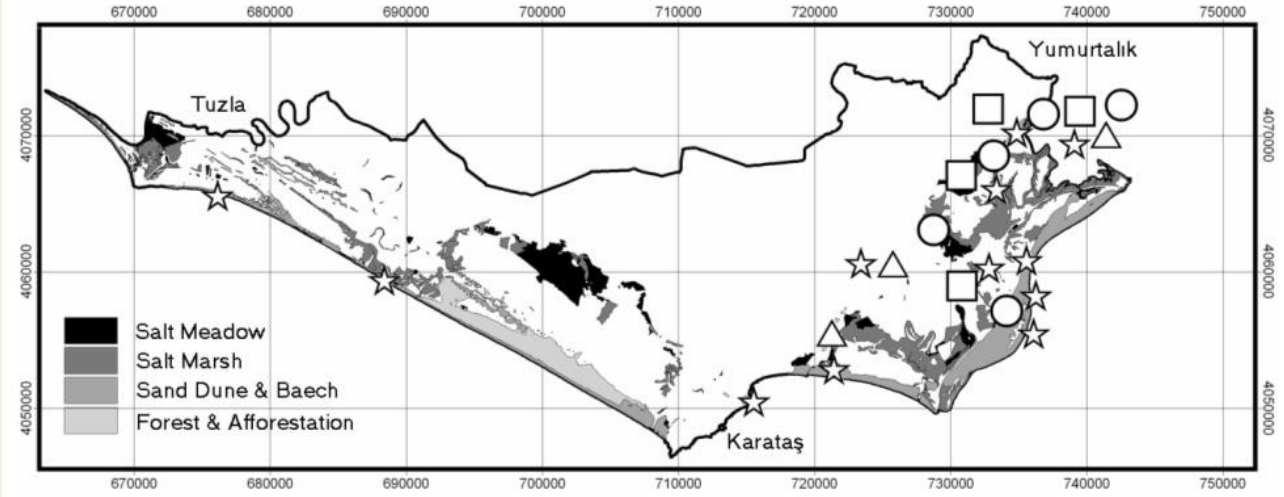

Figure 2. Distribution of *E. o. oblongus* (☆), *P. b. solieri* (△), *C. o. oblongiusculus* (□) and *O. p. subcylindricus* (○) in Çukurova Delta in southern Türkiye

Leichenum pulchellum pumilum (Baudi di Selve, 1876) was identified as a rare species in the delta, occurring in sand dune habitats with 7 specimens and in afforestation (*Eucalyptus* spp.) habitats with a single specimen, both collected from three distinct locations. This species was absent from all other surveyed areas (Table 1 and Figure 3). *Blaps cribrosa* (Solier, 1848) was recorded from 10 different locations, inhabiting all habitat types except salt marsh and beach habitats. It was found in afforestation (*Eucalyptus* spp.) and forest (*Pinus* spp.) habitats with 297 and 174 individuals, respectively. Lower numbers were collected from sand dune and salt meadow habitats, with 17 individuals from each (Table 1 and Figure 3). *Stenosis punctiventris* (Eschscholtz, 1831) was sampled from 10 locations across sand dune, salt marsh, salt meadow, afforestation (*Eucalyptus* spp.), and forest (*Pinus* spp.) habitats, with 2, 4, 6, 6, and 38 individuals recorded, respectively. This species was not found in beach habitats. While its abundance was relatively low, it appears to be an euryoecious species (Table 1 and Figure 3).

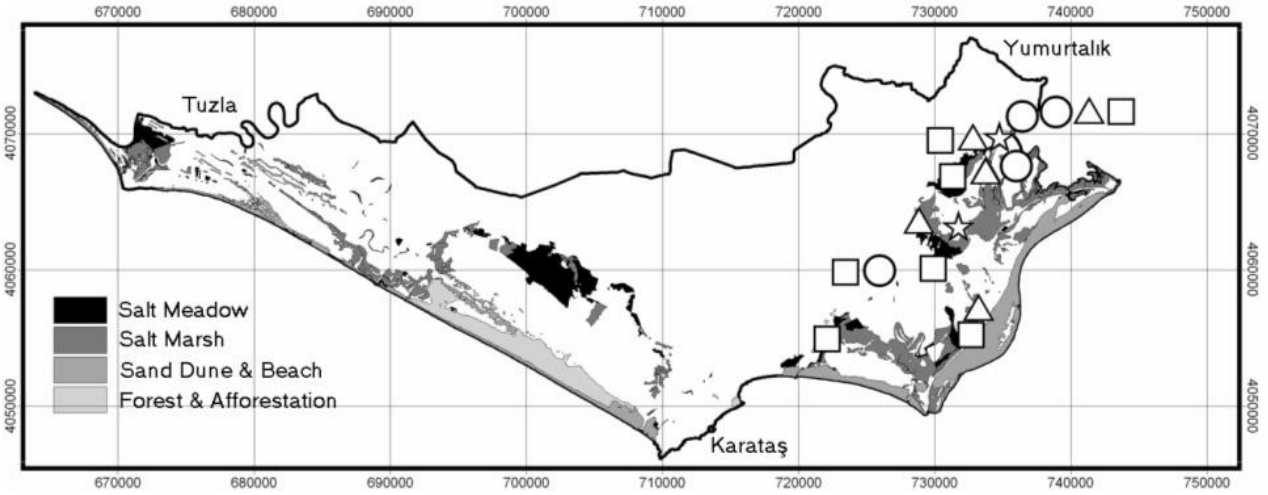

Figure 3. Distribution of *C. turcicus* (☆), *L. p. pumilum* (△), *B. cribrosa* (□) and *S. punctiventris* (○) in Çukurova Delta in southern Türkiye

Ammobius cyprius Grimm, 1991, was recorded in 5 of the 18 selected locations within the Çukurova Delta. The species was found in sand dune and forest (*Pinus* spp.) habitats, with 20 and 6 individuals, respectively. This species was considered rare and confined to small, specific areas within the delta, being absent from other habitats (Table 1 and Figure 4). *Scaurus puncticollis dlabolai* (Kaszab, 1959) was primarily collected in afforestation (*Eucalyptus* spp.) and sand dune habitats, with 306 and 130 individuals, respectively. Seven specimens were found in three separate locations within forest (*Pinus* spp.) habitats. However, this species was not found in salt marsh, salt meadow, or beach habitats, where clay and salt concentrations were high (Table 1 and Figure 4**)**. *Dailognatha crenata* Reiche & Saulcy, 1857, was observed in all habitat types except for beach habitats, although it was infrequently encountered in the delta. The species was sampled from 11 different locations and found in forest (*Pinus* spp.), sand dune, salt marsh, salt meadow, and afforestation (*Eucalyptus* spp.) habitats, with 8, 9, 19, 20, and 22 individuals, respectively. This species may be considered an euryoecious darkling beetle in the delta (Table 1 and Figure 4). *Sclerum humerosum* (Miller, 1861) was found at only four locations: one individual in sand dune habitats, four individuals in forest (*Pinus* spp.) habitats, and six individuals in afforestation (*Eucalyptus* spp.) habitats (Table 1 and Figure 4). *Phaleria acuminata nigriceps* (Mulsant & Wachanru, 1853) was represented by a single individual found in sand dune habitats. *Adelostoma sulcatum sulcatum* Duponchel, 1827, was recorded with only two individuals, both in afforestation (*Eucalyptus* spp.) habitats.

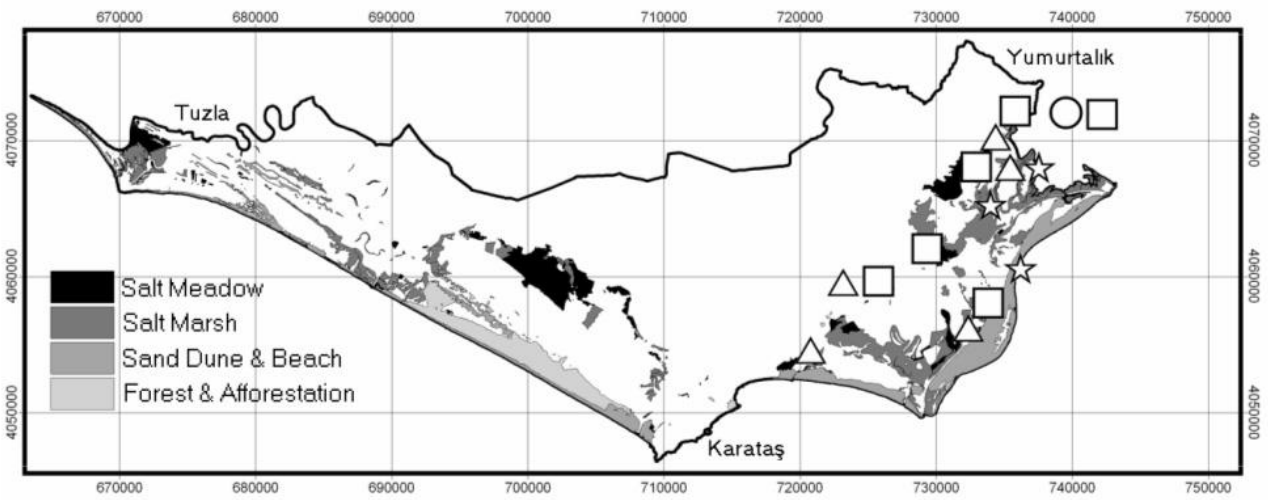

Figure 4. Distribution of A. cyprius (☆), S. p. dlabolai (△), D. crenata (□) and S. humerosum (○) in Çukurova Delta in southern Türkiye

4. Conclusions and discussion

The following species exhibited a significant indicator value for habitat description in the Çukurova Delta: *Zophosis dilatata* (Deyrolle, 1867) (sand dune) (P<0.01), *Gonocephalum rusticum* (Olivier, 1811) (salt meadow) (P<0.05), *Pimelia bajula solieri* (Mulsant & Wachandru, 1853) (afforestation with *Eucalyptus* spp.), *Erodius orientalis oblongus* (Solier, 1834), *Centorus turcicus* (Kaszab, 1959) (salt meadow), *Ammobius cyprius* Grimm, 1991 (sand dune), *Phtora reitteri reitteri* (Seidlitz, 1894) (salt marsh), and *Zophosis punctata punctata* (Brullé, 1832) (afforestation with *Eucalyptus* spp.). These eight species were identified as indicators for sand dune, salt marsh, salt meadow, and afforestation (*Eucalyptus* spp.) habitats (Table 1). The indicator values of five species ranged from 72.9% to 94.0%, while the indicator values for *G. rusticum*, *Z. punctata punctata*, and *E. orientalis oblongus* were determined as 56.3%, 54.9%, and 54.5%, respectively.

Aydın and Kazak (2010) reported that the indicator species value of *Zophosis dilatata* was statistically significant in describing sand dune habitats within the delta [26]. *Phtora reitteri reitteri*, which was undetectable in both sand dune and beach habitats, was identified as an indicator species for salt marsh habitats, exhibiting an indicator value of 78.6% [26]. Similarly, *Gonocephalum rusticum* is known to flourish in a wide range of ecological conditions (euryoecious), akin to *Z. dilatata* and *Erodius orientalis oblongus*, both of which were observed across all habitat types in the delta. The indicator value of *G. rusticum* for salt meadow habitats was recorded at 60.7% [26]. In a study conducted on Davraz Mountain (Isparta), *Gonocephalum granulatum pusillum* was described as a xerophilic, geophilic, and detritivorous subspecies, predominantly found in steppe habitats and areas characterized by reddish-brown Mediterranean soils. This subspecies was deemed uncommon in Mount Davraz, with its presence being more frequent in arid regions compared to moist areas [27]. *Zophosis punctata punctata* has been described as inhabiting open land with sandy soil in the hinterland of the coast [28]. However, Lillig observed this species not only in coastal hinterlands but also in desert areas. Fattorini (2009) noted that *Z. punctata punctata* is commonly found on rocky substrates, while Korkmaz and Gök (2018) characterized it as psammophilic, geophilic, and eurytopic [27]. This species was also reported to be widespread in arid and semi-arid habitats spanning from the Mediterranean region to Western China [28]. Despite an indicator value of 55.1%, *E. orientalis oblongus* was found to be statistically significant indicator for sand dune habitats [26]. The indicator values of *Pimelia bajula solieri* were calculated to be 86.5% and 79.1% for the description of afforestation (*Eucalyptus* spp.) habitats [26]. A subspecies of *Pimelia*, *Pimelia subglobosa polita*, was described as euryecious and geophilic, commonly found in diverse habitats such as steppe, shrubland, and forest. Samples of this subspecies were more frequently collected from moist, sun-exposed areas rather than from dry ones in Davraz Mountain (Isparta), where it was also abundant in areas with brown forest soil [27]. *Opatroides punctulatus* subcylindricus was not found to be statistically significant for habitat identification, yet it has been reported as a pest species affecting pistachios in Gaziantep province, Türkiye [31]. Although the ecological characteristics of *Centorus turcicus* remain poorly understood, members of the *Centorus* genus are known to inhabit saline environments [32]. *Leichenum p.p.*, which did not show statistical significance due to its rarity, has been classified as a stenotopic species by Fattorini (2002) [33]. Soldati (1995) associated the species with valleys between dune crests [34], while Castelfusano noted its presence in a narrow strip of seashore between the eulittoral zone and the first dune [33]. *Ammobius cyprius* is known to inhabit the roots of various plant species within dune systems [35]. In conclusion, the findings of this study align with those of previous research, confirming the ecological roles and habitat preferences of the species examined.

Although the indicator value is crucial for identifying indicator species, there is no definitive threshold or clear demarcation to determine which species are more important indicators. Well-known insect species in biology typically have an advantage in being used as indicators compared to less-studied species. The utilization of insect species as bio-indicators requires detailed data regarding their distribution and population dynamics [9]. Our study represents one of the initial steps in this direction within the Mediterranean region of Türkiye. Based on the findings of this study, the following species can be considered significant indicators for habitat description in the Çukurova Delta: (1) *Zophosis dilatata* and *Ammobius* cyprius, (2) *Pimelia bajula solieri*, and (3) *Centorus turcicus* and *Phtora reitteri reitteri*, which correspond to sand dune, afforestation areas with *Eucalyptus* spp., and saline biotypes, respectively. In relation to *Gonocephalum rusticum*, *Erodius orientalis oblongus*, and *Zophosis punctata* punctata, these species may be categorized as euryoecious. While Schawaller (1996) [28] previously characterized *Z. punctata punctata* as inhabiting open land in the coastal hinterland on sandy soils, our observations and the findings of the current study indicate that this species demonstrates a wide ecological tolerance, thriving in both sandy and saline habitats within the delta. *Z. dilatata*, another euryoecious species, was found abundantly (13.210 individuals) in sand dune habitats across all habitat types in the delta, it was determined to be highly statistically significant in habitat description analysis.

These findings have significant implications for (i) habitat description, (ii) the identification of priority areas, and (iii) decision-making regarding the conservation status of specific habitats. Consequently, the methodology outlined in this study can be replicated to enhance the management of conserved areas and improve environmental management practices. Additionally, this approach can support decision-making processes aimed at identifying critical areas within ecosystems that require conservation efforts. This study is the first to use Tenebrionidae species for habitat type determination through indicator species analysis with the Monte Carlo technique. The method could be applied to other taxa and, when used in protected areas, offers insights into the presence and population dynamics of key species, reflecting the level of protection. Subsequent studies could validate this approach and assess habitat changes over time.

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Wild and cultivated plants used as food in Konak (Kalatya) region

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Abstract

Plants have been used for various purposes throughout human history. Widely used for therapeutic purposes, the usage of plants as food is also of interest. In this study, the usage of wild and cultivated plants as foods was investigated in the Konak Region between May 2015 and November 2016. 102 individuals were interviewed, but valuable and relevant information for the study was obtained from 19 individuals. A total of 79 plant species belonging to 31 families, 53 of which are wild and 26 cultivated plants, have been identified. From these plants; it has been determined that yoghurt meatballs, yoghurt soup, stuffed leaves, pickle, sherbet, jam, fruit leather, marmalade, molasses, compote, stuffed meatballs, plum sour, dolma, soup, tea and pastries were prepared. Of the plants; 34 were used directly as fresh, 32 were used as tea, 33 were used for cooking and three species were firstly determined to be used in stuffed leaves preparation. Further detailed research is required to evaluate the nutritional and health benefits of the plants utilized by the local community.

Keywords: Traditional foods, Local foods, Plant biodiversity, Malatya, Cultural practices.

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Konak (Malatya) Yöresinde Gıda Olarak Kullanılan Yabani ve Kültür Bitkileri

Özet

Bitkiler insanlık tarihi boyunca çeşitli amaçlarla kullanılmıştır. Genellikle tedavi amaçlı kullanılan bitkilerin, gıda olarak kullanımı da ilgi çekmektedir. Bu çalışmada Konak Bölgesi'nde gıda olarak kullanılan yabani ve kültür bitkileri Mayıs 2015 ile Kasım 2016 tarihleri arasında araştırılmıştır. 102 kişiyle görüşülmüş, ancak çalışmaya katkı sağlayacak nitelikli bilgi, 19 kişiden elde edilmiştir. 53'ü yabani, 26'i kültür bitkisi olmak üzere 31 familyaya ait toplam 79 bitki türü tespit edilmiştir. Bu bitkilerden; yoğurtlu köfte, yoğurtlu çorba, yaprak sarması, turşu, şerbet, reçel, pestil, marmelat, pekmez, komposto, içli köfte, erik ekşisi, dolma, çorba, çay ve börek yapıldığı tespit edilmiştir. Bitkilerden 34'ü taze olarak doğrudan, 32'si çay olarak, 33'ü çeşitli işlemlerle yemek yapımında kullanılmış ve üç türün ilk defa yaprak sarmasında kullanıldığı görülmüştür. Yöre halkı tarafından kullanılan bitkilerin beslenme ve sağlık yararlarını değerlendirmek için daha ayrıntılı araştırmalara ihtiyaç vardır.

Anahtar kelimeler: Geleneksel gıdalar, Yöresel gıdalar, Bitki biyoçeşitliliği, Malatya, Kültürel uygulamalar

1. Introduction

Plants have been used for many purposes, especially as a source of food, in every period of history. The information obtained as a result of the use of plants for many purposes was transferred from generation to generation through trial and error, this knowledge developed over time and has survived to the present day [1, 2]. The plants grown in the fields have their origins from the wild, and although they are cultivated, today, with the development of organic

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agriculture, the wild types of some plants are preferred. For this reason, these studies carried out within the scope of ethnobotany are attracting more and more attention [2].

Anatolia has become an important region throughout human history, in terms of its geographical location. Anatolia has been a region where many states lived throughout history, such as the Mesopotamian civilizations, the Byzantines, the Seljuks and the Ottomans. In today's Türkiye, there are approximately 12 thousand plant taxa, of which approximately 35% of the plants are endemic, and this number is increasing day by day with studies conducted [3]. Records on the use of plants as food are also enriched by ethnobotanical studies detailed examinations conducted in local regions.

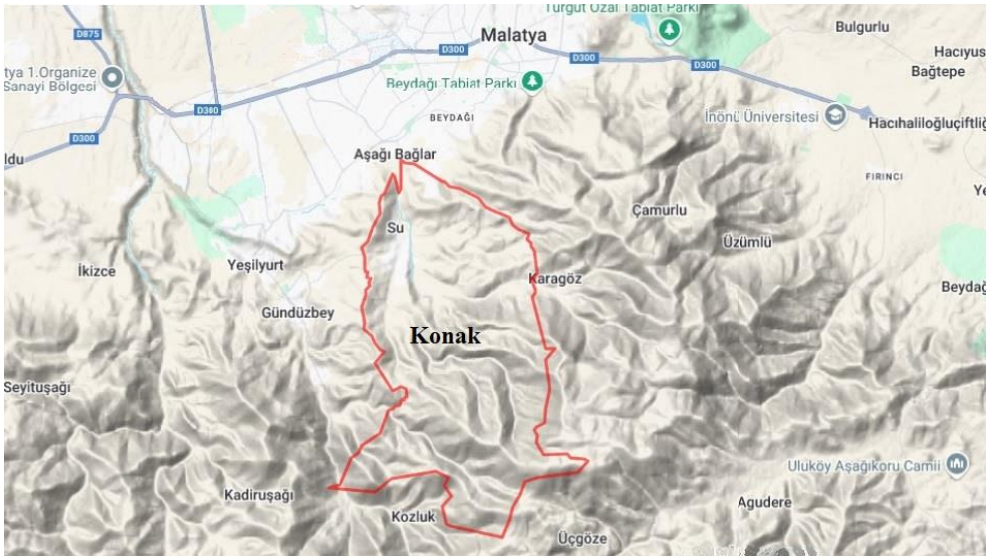

Figure 1. The map of Konak Region

Previously a neighborhood governed by a local headman, Konak transitioned into a town connected to the city center due to population growth. Located three kilometers from Malatya city center, this area was designated as a township under Yeşilyurt District, one of the central districts, after Malatya achieved metropolitan status due to its proximity to the city center.

Konak, which is the subject of the research, is located on the southern foothills of Beydağı. There is Malatya city center in the north, Karagöz Village and Beydağı extension in the east, and Gündüzbey, Yeşilyurt and Tecde in the west (Figure 1). Although it is only 3 kilometers away from the city center, it has managed to preserve its own culture, customs, and traditions. Three neighborhoods in Konak: Yeni, Bahçebaşı and Su have a population of over 6 thousand and they live like a family with strong kinship ties. In addition to being one of the oldest settlements in Malatya, the fact that family elders pass on their experiences to their children makes Konak region worth researching. The experiences of those especially engaged in animal husbandry and hunting continue to be passed on from generation to generation. Those involved in animal husbandry have thought that the herbs eaten by sheep was unsafe and the herbs eaten by goats was safe. It has also been noticed that inexperienced young animals do not eat poisonous plants observing experienced adult animals. Based on this information, people living in the region have tasted the herbs eaten by goats and adult animals and evaluated them as food. It has been reported that those engaged in hunting obtain some information by following the behavior of wild animals. They observed that an injured partridge closed its wound with terebinth gum (*Pistacia terebinthus* L. subsp. *terebinthus*) and that wild animals suffering from indigestion problems ate green fresh herbs. It also has been reported that farmers tried different foods from various plants that grew in their gardens or whose seeds/saplings they bought from the market during periods of famine and abundance. Based on the information highlighted above, the aim of the study is to contribute to the literature in this field by identifying the plants used as food in the Konak region and determining their usage methods.

2. Material and Methods

The plant species studied were collected from Konak (Malatya/Yeşilyurt) and its surroundings between May 2015 and November 2016. The identification of the collected plants was based on the work "Flora of Turkey and the East Aegean Islands" [4]. According to herbarium rules, the collected plants were stored in the Inonu University Faculty of Pharmacy Herbarium after identification. Maximum care was taken to ensure that the data were not based on media or hearsay and the plants were collected by reporters. Additionally, to increase the efficiency of the study, only region-specific information was considered, and unrelated information from various sources was not taken into account. In a region with approximately six thousand inhabitants, instead of conducting individual interviews with all individuals, we targeted those who have the most comprehensive and detailed information about our study among the local population.

Following preliminary consultations with neighborhood headmen and community leaders, a total of 102 individuals were interviewed. However, only 19 participants provided qualified and unique information that significantly contributed to the study. Of these individuals, 2 are male and 17 are female. The interviews were conducted face-to-face, without using a questionnaire. No personal data was collected. The plants mentioned and used as food were collected together with the informants. Whether the plant was wild or cultivated and other details were noted and recorded.

The aim of this study is to record the cultural richness of the local people, contribute local dishes to geographical indication products, add edible wild plants to the literature, and preserve forgotten values [5].

Criteria for including plant samples in the study:
Cultivated plants used in local dishes
Wild plants used in local dishes
Edible wild plants.

3. Results

In the local region Konak, it was determined that a total of 79 plant species which belong to 31 families, 53 of which are wild and 26 cultivated plants, are used as a food source by the local people (Table 1). To the best of our knowledge, this is the only study that exhibited the plant sources used as foods in Konak. In the periods when industrialization, communication, and transportation were not developed, it was common for people to use wild plants as food. When transportation facilities began to develop, plants from different geographies were cultivated. This situation positively affected biodiversity and revealed that the subject is worth researching. Although it is a region close to the city center, the large number of plants used as food attracted attention. This study in the region showed that the development of technology and transportation facilities had a limited impact on the use of plants as food. It is also noteworthy that the number of wild plants used as food is higher than the number of cultivated plants. It is an important result in terms of showing the interest of the people of the region to nature.

Table 1. Wild and cultivated plants used as food in Konak

Family	Species	Local name	Part used	Mode of consumption	Wild/ cultivated	Collector number
Adoxaceae	*Sambucus nigra* L.	Paklanguç, Paklangıç	Flower	As tea Making jam	Wild	TK 1400
Amaranthaceae	*Amaranthus albus* L.	Bozot	Aerial part	Added to pastries Added to meatballs Added to yogurt meatballs Yogurt soup	Wild	TK 1410
Amaryllidaceae	*Allium ampeloprasum* L.	Dağ soğanı	Bulb, leaf	Eaten raw Cooked with meals Roasted	Wild	TK 1429
	Allium cepa L.	Soğan	Bulb, leaf	Eaten raw Cooked with meals Roasted	Cultivated	TK 1443
	Allium sativum L.	Sarımsak	Bulb	Eaten raw Added to yogurt dishes	Cultivated	TK 1442
Anacardiaceae	*Rhus coriaria* L.	Sumak	Fruit	As spice	Wild	TK 1428
Apiaceae	*Anethum graveolens* L.	Dereotu, samıt, tere otu	Aerial part	Eaten raw Added to pastries Pickled	Wild	TK 1396
	Petroselinum crispum (Mill.) A.W. Hill	Maydanoz	Aerial part	Eaten raw Pickled	Cultivated	TK 1444
Asteraceae	*Anthemis armeniaca* Freyn & Sint.	Papatya	Capitulum	As tea	Wild	TK 1470
	Anthemis haussknechtii Boiss. & Reut.	Papatya	Capitulum	As tea	Wild	TK 1469
	Bellis perennis L.	Papatya	Capitulum	As tea	Wild	TK 1471

Table 2. Continued

	Echinops pungens Trautv.	Deve dikeni, topuz dikeni	Receptacle	As tea	Wild	TK 1441
	Gundelia tournefortii L.	Kenger	Latex	Chewing gum	Wild	TK 1404
			Seed	Roasted		
			Aerial part	Added to pastries Cooked with meals Making soup		
	Helichrysum arenarium (L.) Moench	Altın otu, ölmez otu	Capitulum	As tea	Wild	TK 1405
	Helichrysum plicatum DC. subsp. *plicatum*	Altın otu, Ölmez otu	Capitulum	As tea	Wild	TK 1407
	Pulicaria dysenterica (L.) Bernh. subsp. *dysenterica*	-	Aerial part	As tea	Wild	TK 1440
	Taraxacum officinale F.H. Wigg.	Keklik otu	Basal leaves	Cooked with meals Added to pastries	Wild	TK 1419
	Tragopogon buphthalmoides (DC.) Boiss.	Köse sakalı	Aerial part, leaf	Eaten raw Cooked with meals	Wild	TK 1434
	Tragopogon dubius Scop.	Yemlik, Kargacık yemliği	Aerial part, leaf	Eaten raw Cooked with meals	Wild	TK 1395
	Tripleurospermum oreades (Boiss.) Rech.f.	Dağ papatyası	Capitulum	As tea	Wild	TK 1439
Boraginaceae	*Anchusa azurea* Mill. var. *azurea*	Sığır emeceği	Flower	Fresh flower bases are sucked	Wild	TK 1424
Brassicaceae	*Brassica oleracea* L.	Lahana	Leaf	Stuffed leaves Pickled	Cultivated	TK 1445
Chenopodiaceae	*Chenopodium album* L. var. *album*	Tahtik	Aerial part	Added to pastries Added to stuffed meatballs Yogurt soup	Wild	TK 1438
Convolvulaceae	*Convolvulus arvensis L.*	Sarmaşık	Aerial part	Added to pastries Added to stuffed meatballs Yogurt soup	Wild	TK 1433
Cornaceae	*Cornus mas* L.	Kızılcık	Fruit	Eaten raw Making jam Making sherbet Making marmalade	Cultivated	TK 1446
Corylaceae	*Corylus avellana* L. var. *avellana*	Fındık	Fruit	Eaten raw	Cultivated	TK 1447
			Leaf	Stuffed leaves		
Cruciferae	*Capsella bursa-pastoris* L.	Kuş pepeği	Aerial part	Added to pastries	Wild	TK 1423
Cucurbitaceae	*Cucumis sativus* L.	Salatalık, hıyar	Fruit	Eaten raw Salad Stuffed from dried fruit Pickled Stuffed from fresh fruit	Cultivated	TK 1448
	Cucurbita moschata Duchesne	Kabak	Fruit	Stuffed from fresh fruit Cooked with meals	Cultivated	TK 1449

Table 3. Continued

Elaeagnaceae	*Elaeagnus angustifolia* L.	İğde	Fruit	Eaten raw As tea	Wild	TK 1397
Fabaceae	*Anthyllis vulneraria* L. subsp. *boissieri* (Sagorski) Bornm.	Emecek otu	Flower	Fresh flower bases are sucked	Wild	TK 1436
	Astragalus gummifer Labill.	Geven, keven	Latex	As tea	Wild	TK 1437
	Cicer arietinum L.	Nohut	Seed	Cooked with meals Making soup Pickled	Cultivated	TK 1450
	Phaseolus vulgaris L.	Fasülye	Fruit	Cooked with meals Boiled in water	Cultivated	TK 1451
			Leaf	Stuffed leaves		
	Vicia hybrida L.	Bacıt	Seed	Eaten raw	Wild	TK 1399
Geraniaceae	*Geranium tuberosum* L.	Tömlük, kömlük	Tuber	Eaten raw Making soup	Wild	TK 1421
Iridaceae	*Crocus damascenus* Herb.	Çiğdem	Bulb	Eaten raw	Wild	TK 1432
Juglandaceae	*Juglans regia* L.	Ceviz	Seed	Eaten raw Added to Churchkhela Added to dessert	Cultivated	TK 1452
Lamiaceae	*Cyclotrichium niveum* (Boiss.) Manden & Scheng	Erzurum nanesi	Aerial part	As spice	Wild	TK 1414
	Mentha longifolia (L.) L. subsp. *longifolia*	Nane, nerpiz, yarpuz, dağ nanesi	Aerial part	As spice As tea	Wild	TK 1394
	Mentha pulegium L.	Nane, nerpiz, yarpuz, dağ nanesi	Aerial part	As spice As tea	Wild	TK 1412
	Mentha spicata L. subsp. *spicata*	Nane, nerpiz, yarpuz, dağ nanesi	Aerial part	As spice As tea	Wild	TK 1406
	Origanum vulgare L. subsp. *gracile* (K.Koch) Ietsw.	Anıh	Aerial part	As spice As tea	Wild	TK 1413
	Salvia palaestina Benth.	Sığırdili	Leaf	Stuffed leaves As tea	Wild	TK 1411
	Satureja hortensis L.	Kekik	Aerial part	As spice As tea	Wild	TK 1402
	Teucrium polium L. subsp. *polium*	-	Aerial part	As tea	Wild	TK 1408
	Thymus kotschyanus Boiss. & Hohen. var. *kotschyanus*	Kekik	Aerial part	As spice As tea	Wild	TK 1403
	Thymus migricus Klokov & Des.-Shost.	Kekik	Aerial part	As spice As tea	Wild	TK 1453

Table 4. Continued

Malvaceae	*Alcea apterocarpa* (Fenzl) Boiss.	Horoz gülü, ibibik gülü,	Flower	As tea	Wild	TK 1454
	Malva neglecta Wallr.	Ebegümeci, ebemgümeci	Leaf	As tea Added to pastries Stuffed leaves	Wild	TK 1416
	Malva sylvestris L.	Ebegümeci, ebemgümeci	Leaf	As tea Added to pastries Stuffed leaves	Wild	TK 1435
Moraceae	*Ficus carica* L. subsp. *rupestris* (Hausskn.) Browicz	İncir	Fruit	Eaten raw	Wild	TK 1455
	Morus alba L.	Dut	Fruit	Eaten raw Making fruit leather Making molasses Eaten dried Made into helva Churchkhela	Cultivated	TK 1457
			Leaf	Stuffed leaves As tea		
	Morus nigra L.	Karadut	Fruit	Eaten raw Making molasses	Cultivated	TK 1456
Plantaginaceae	*Plantago lanceolata* L.	Damarlı yaprak, hava yaprağı, Damarlı ot	Leaf	Stuffed leaves As tea Added to pastries	Wild	TK 1393
Poaceae	*Hordeum vulgare* L.	Arpa	Seed	Making bread Making soup	Cultivated	TK 1458
	Triticum aestivum L.	Buğday	Seed	Making bread Making soup Making pilav Making tarhana	Cultivated	TK 1459
Polygonaceae	*Polygonum cognatum* Meissn.	Madımak	Aerial part	Added to pastries	Wild	TK 1420
	Rumex crispus L.	Evelik	Leaf	Stuffed leaves Added to pastries	Wild	TK 1422
Portulacaceae	*Portulaca oleracea* L.	Pipirim	Aerial part	Eaten raw Added to pastries Yogurt soup Salad Added to meatballs Added to yogurt meatballs	Wild	TK 1409
Rosaceae	*Amygdalus communis* L.	Acıbadem, pisik payamı	Seed	Eaten after soaking in water Added to fruit leather	Cultivated	TK 1417
	Armeniaca vulgaris Lam.	Kayısı	Fruit	Eaten raw Eaten dried Making jam Making compote	Cultivated	TK 1460
			Seed	Eaten raw Eaten dried		

Table 5. Continued

				Making jam		
	Crataegus monogyna Jacq. var. *monogyna*	Yemişen	Fruit	Eaten raw	Wild	TK 1425
	Crataegus orientalis Pall. ex M.Bieb. subsp. *orientalis*	Alıç	Flower	As tea	Wild	TK 1468
			Fruit	Eaten raw		
	Cydonia oblonga Mill.	Ayva	Leaf	Stuffed leaves As tea	Cultivated	TK 1465
			Seed	As tea		
			Fruit	Making compote Eaten raw Making jam		
	Malus pumila Mill.	Elma	Fruit	Eaten raw Eaten dried Making compote	Cultivated	TK 1467
			Leaf	Stuffed leaves As tea		
	Persica vulgaris Mill.	Şeftali	Fruit	Eaten raw Making compote Making jam	Cultivated	TK 1418
	Prunus avium (L.) L.	Kiraz	Leaf	Stuffed leaves	Cultivated	TK 1466
	Prunus x domestica L.	Erik	Fruit	Eaten raw Making jam Making syrup Making compote Making fruit leather	Cultivated	TK 1464
	Prunus hippophaeoides (Bornm.) Bornm.	Kırmızı Dağ kirazı	Fruit	Eaten raw	Wild	TK 1426
	Prunus microcarpa C.A.Mey.	Sarı dağ kirazı	Fruit	Eaten raw	Wild	TK 1427
	Rosa canina L.	Gül burnu, Gül burcu, kuşburnu	Fruit	Eaten raw Making jam As tea Making marmalade	Wild	TK 1398
Solanaceae	*Capsicum annuum* L.	Biber	Fruit	Eaten raw Salad Added to meals Stuffed from dried fruit Pickled Stuffed from fresh fruit	Cultivated	TK 1463
			Leaf	Stuffed leaves		
	Solanum lycopersicum L.	Domates	Fruit	Eaten raw Salad	Cultivated	TK 1461
				Added to meals		
				Pickled Stuffed from fresh fruit		

Table 6. Continued

	Solanum melongena L.	Patlıcan	Fruit	Stuffed from fresh fruit Stuffed from dried fruit Added to meals	Cultivated	TK 1462
Urticaceae	*Urtica dioica* L. subsp. *dioica*	Isırgan	Leaf	Cooked with meals As tea Added to pastries	Wild	TK 1430
	Urtica urens L.	Isırgan	Leaf	Cooked with meals As tea Added to pastries	Wild	TK 1431
Violaceae	*Viola odorata* L.	Menekşe	Flower	Stuffed leaves	Wild	TK 1415
Vitaceae	*Vitis vinifera* L.	Üzüm, Asma	Fruit	Making molasses Eaten raw Eaten dried Making compote Making fruit leather	Cultivated	TK 1401
			Leaf	Stuffed leaves		

The most common families of plants used as food in the study are as follows; Asteraceae (12), Rosaceae (11), and Lamiaceae (10) (Figure 2). From 79 plant taxa; It has been recorded that 34 are used fresh, 32 are used as tea, 33 are used in cooking through various processes, 15 are used as stuffing in pastries, 14 are used in stuffing leaves and 10 are used in spice making (Table 1). It has been observed that the public generally prefers to stick to traditional methods. Also, as a result of the studies, it was determined that the products of cultural plants such as fruit pulp, molasses, and dried fruits were marketed and traded, but spices, teas, and wild fruits were not traded. Especially due to its leaves used for wrapping/ stuffed; *Vitis vinifera*, *Viola odorata*, *Capsicum annuum*, *Malus pumila*, *Cydonia oblonga*, *Rumex crispus*, *Prunus avium*, *Plantago lanceolata*, *Morus alba*, *Malva sylvestris*, *M. neglecta*, *Salvia palaestina*, *Phaseolus vulgaris*, C*orylus avellana* var. *avellana*, and *Brassica oleracea* are among the plants that have the potential to be included in the list of geographically indicated products (Figure 3). Although the plants are mentioned in the literature as stuffed leaves, making pastries, and adding them to meals, they have not been used in stuffed meatballs or meatballs with yoghurt [5-9]. It was the first time reported that the leaves of *V. odorata*, *S. palaestina* and *M. pumila* were used in stuffing. *Amaranthus albus* all the uses mentioned here were reported for the first time. The use of *Pulicaria dysenterica* subsp. *dysenterica* and *S. palaestina* as tea; *Tragopogon dubius* being added to dishes; *Portulaca oleracea*, *Convolvulus arvensis*, and *Chenopodium album* var. *album* being used in stuffing for meatballs and in yogurt soups; and *Geranium tuberosum* being used in soup were reported for the first time in this study [2, 10-20].

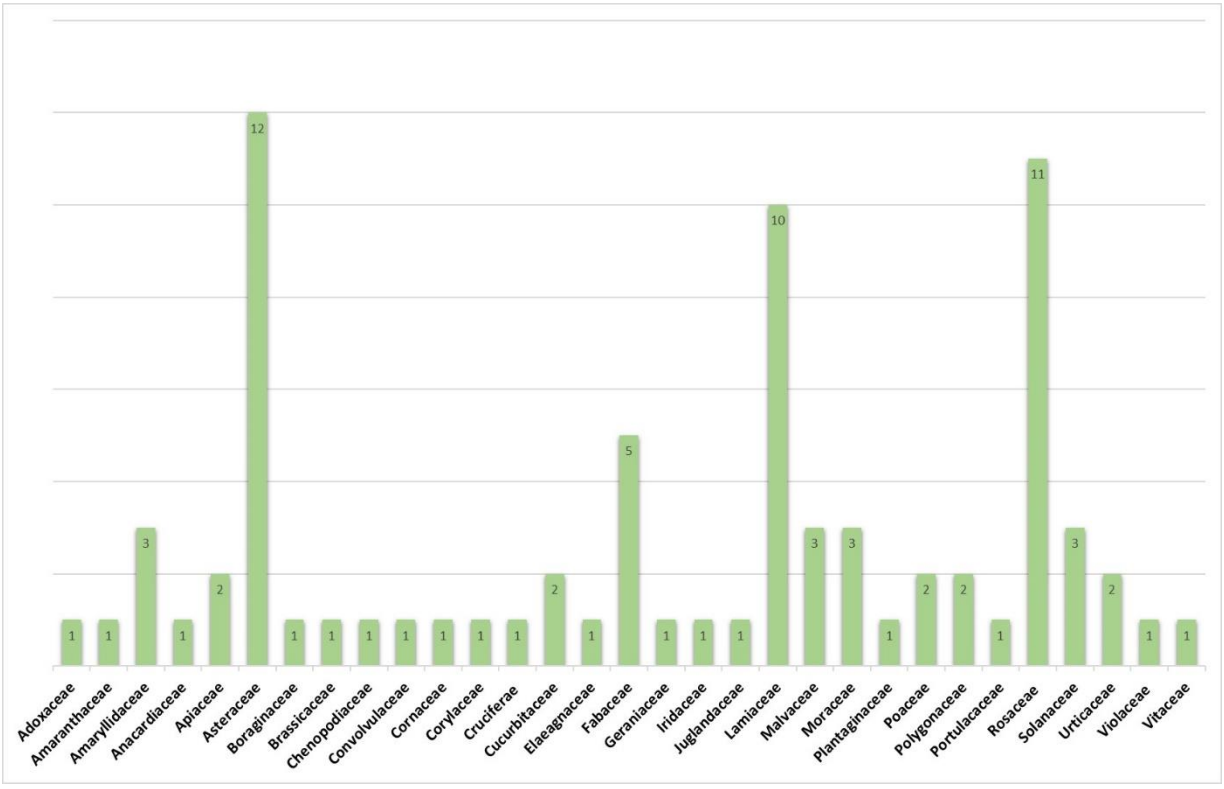

Figure 2. The most frequently encountered plant families

Figure 3. a- Leaves of *Prunus avium*, b- Stuffed leaves of *Prunus avium*, c- Meatballs, d- Stuffed leaves

We know from detailed folk medicine studies that the majority of the plants found to be used as food in our study were also traditionally used for health [21]. Although it is not possible to evaluate the contribution of plants used as food to the health of local people, it is suitable for a holistic approach that they will have a positive impact on the health of people who include these plants in their daily diets and pay attention to a balanced diet [22, 23]. This study is expected to be a pioneer and data provider for health and food studies to be carried out in this region. Detailed research is needed to elucidate the potential of the identified plants.

4. Conclusions and discussion

Reflecting the rich cultural heritage and diverse flora of Western and Central Anatolia, Doğan and his colleagues identified a total of 121 wild edible plant species in their study. These plants were found to be consumable by boiling, frying, eating raw, or as rolled vegetables. They can also be used as pickles, fruits, desserts, spices, and prepared as cold or hot beverages. The study recorded 30 species from the Lamiaceae family, 15 species from the Asteraceae family, 13 species from the Rosaceae family, and 8 species from the Brassicaceae family [24]. In the Konak region, 9 species from Lamiaceae, 12 from Asteraceae, 12 from Rosaceae, and 1 from Brassicaceae were identified. The usage of these plants was summarized as follows: a total of 30 plant species were cooked with meals, while in Konak this number was 16. A total of 21 plant species were used as spices, while in Konak this number was 11. A total of 11 plant species were eaten raw, while in Konak this number was 33. For preparing hot drinks, 23 plant species were recorded in total, while in Konak this number was 32. For stuffing, 11 plant species were used in total, while in Konak this number was 25. The study did not include information about the preparation of molasses, compote, fruit leather, meatballs, or churchkhela. However, it was noted that stuffed leaves and meatballs were prepared using wild or cultivated plants, demonstrating that nearly every plant in the region could be utilized for culinary purposes.

This study conducted in Konak sheds light on the region's rich culinary heritage. The use of both wild and cultivated plants in traditional dishes highlights the deep connection between nature and culture. Furthermore, it suggests the potential for some plants to be included in the list of geographical indication products or to provide commercial

benefits to the local community. Efforts to preserve traditional knowledge of plant use are essential for the protection of cultural heritage, reflecting the local population's strong ties to nature and profound understanding of plant resources. This study makes a significant contribution to the literature by demonstrating how the botanical biodiversity and traditional usage knowledge of Anatolia have been preserved up to the present day.

One of the most important contributions of this research to the literature is the documentation of traditional uses of numerous plants that were not previously reported. For instance, the use of the leaves of *Viola odorata*, *Salvia palaestina*, and *Malus pumila* in making dolma, the inclusion of *Tragopogon dubius* in meals, and the use of *Geranium tuberosum* in soup are reported here for the first time. Such discoveries offer new research opportunities in both botany and ethnobotany. The local population's perception of *Salvia palaestina* as distinct from other sage species, and its culinary use despite the fact that sage tea can be unpleasant when steeped for long periods, suggests that this species may have unique phytochemical properties.

This study not only highlights the plants' value as food sources but also their potential health benefits. The harmful effects of plants used as food are expected to be less severe than those of medicinal plants because much larger quantities are consumed as food compared to the small doses used in medicine. The therapeutic effects of the plants mentioned in this study can be examined with greater confidence.

By documenting the plant diversity and wealth of traditional knowledge in the Konak region, this study makes a significant contribution to the literature. Future detailed research could more comprehensively reveal the health effects and commercial potentials of these plants. Such studies can be important steps towards the preservation of cultural heritage and the sustainable management of biological diversity, both locally and globally.

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First record of Xyphosia laticauda (Meigen, 1826) (Diptera: Tephritidae) in Türkiye

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Abstract

The Tephritidae (Diptera), comprising approximately 5,000 species across 492 genera, holds significant ecological and economic importance. Within the scope of this study aimed at determining the Tephritidae fauna of Karaman Province, Türkiye, new faunistic data on the genus *Xyphosia* have been presented.The study presents the first record of *Xyphosia laticauda* (Meigen, 1826) in Türkiye. Photographs of the examined specimen, updated host plant relationships, and distribution data are provided.

Keywords: biodiversity, Diptera, Karaman, new record, Tephritidae, Türkiye

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Xyphosia laticauda (Meigen, 1826) (Diptera: Tephritidae) türünün Türkiye'den ilk kaydı

Özet

Tephritidae ailesi (Diptera), 492 cinse yayılan yaklaşık 5.000 tür içermekte olup önemli ekolojik ve ekonomik öneme sahiptir. Türkiye'nin Karaman İli'nin Tephritidae faunasını belirlemeye yönelik bu çalışma kapsamında, *Xyphosia* cinsine ait yeni faunistik veriler sunulmuştur. Çalışmada, Türkiye'den ilk defa *Xyphosia laticauda* (Meigen, 1826) kaydedilmektedir. İncelenen örneğin fotoğrafları, güncellenmiş konak bitki ilişkileri ve dağılım verileri sunulmuştur.

Anahtar kelimeler: biyoçeşitlilik, Diptera, Karaman, yeni kayıt, Tephritidae, Türkiye

1. Introduction

The family Tephritidae, commonly known as fruit flies, comprises approximately 5,000 species across 492 genera worldwide, many of which hold significant ecological and economic importance [1]. In Turkey, 177 species of Tephritidae have been documented, underscoring the family's diversity and regional significance [2].

The genus *Xyphosia* currently includes seven recognized species within the Palaearctic Region, predominantly distributed across Europe, the Eastern Palaearctic realm (including parts of Asia), and the Near East, particularly around the eastern Mediterranean [3]. In Turkey, two species have been recorded: *Xyphosia conspicua* (Loew, 1869) and *Xyphosia miliaria* (Schrank, 1781) [4; 5; 6]. However, *Xyphosia laticauda* (Meigen, 1826) has not previously been reported from Turkey.

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This study reports the first record of *Xyphosia laticauda* in Turkey, expanding our knowledge of the distribution and ecological roles of Tephritidae species in the country. It underscores the importance of Turkey's diverse habitats in supporting fruit fly populations and highlights the biogeographical significance of Karaman Province in promoting Tephritidae diversity.

2. Materials and methods

A specimen of *Xyphosia laticauda* was collected in Karaman Province, Türkiye, in June 2023 using insect nets during daylight. Specimen was pinned on card with water-soluble adhesive and preserved for further study. Images were taken using a LEICA EZ4D stereo microscope (Leica Microsystems, Wetzlar, Germany) and processed with Adobe Photoshop CS9 (Adobe Inc., San Jose, CA, USA). Specimen stored in the Entomology Research Laboratory at Selçuk University, Konya, Türkiye, and identified following Evstigneev and Glukhova [7].

3. Results

The genus *Xyphosia* (Tephritinae: Tephritidae) is represented by the newly recorded species *Xyphosia laticauda* in Türkiye's fruit fly fauna, raising the total Tephritidae species count to 178.

3.1. Xyphosia laticauda (Meigen, 1826)

Material examined: Türkiye, Karaman Province, Ayrancı, Kirman Village, 37° 16′ 50″ N, 33° 50″ 46″ E, 1300 m, 08.VI.2023, 1 ♂.

Diagnosis: The thorax and abdomen are shining black with a mesonotum as long as it is wide (Figures 1-2). The scutellum and postpronotal lobe are yellow, with yellow stripes on the anepisternum's upper margin. The scutum is covered with short, adpressed yellow pile, and thoracic setae are long and ochre-yellow. The wings are large and dark brown, with large white spots arranged in a grid-like pattern (Figures 3). These spots are evenly distributed along the wing margin and form a grid pattern at the wing tip. The legs are robust, with the femora predominantly black and thick, while the tibiae and tarsi are yellow. The abdomen is glossy black and densely covered with black setae.

Host Plants: Centaurea cheiranthifolia Willd. [6], *Centaurea nigra* L., *Centaurea montana* L. [8].

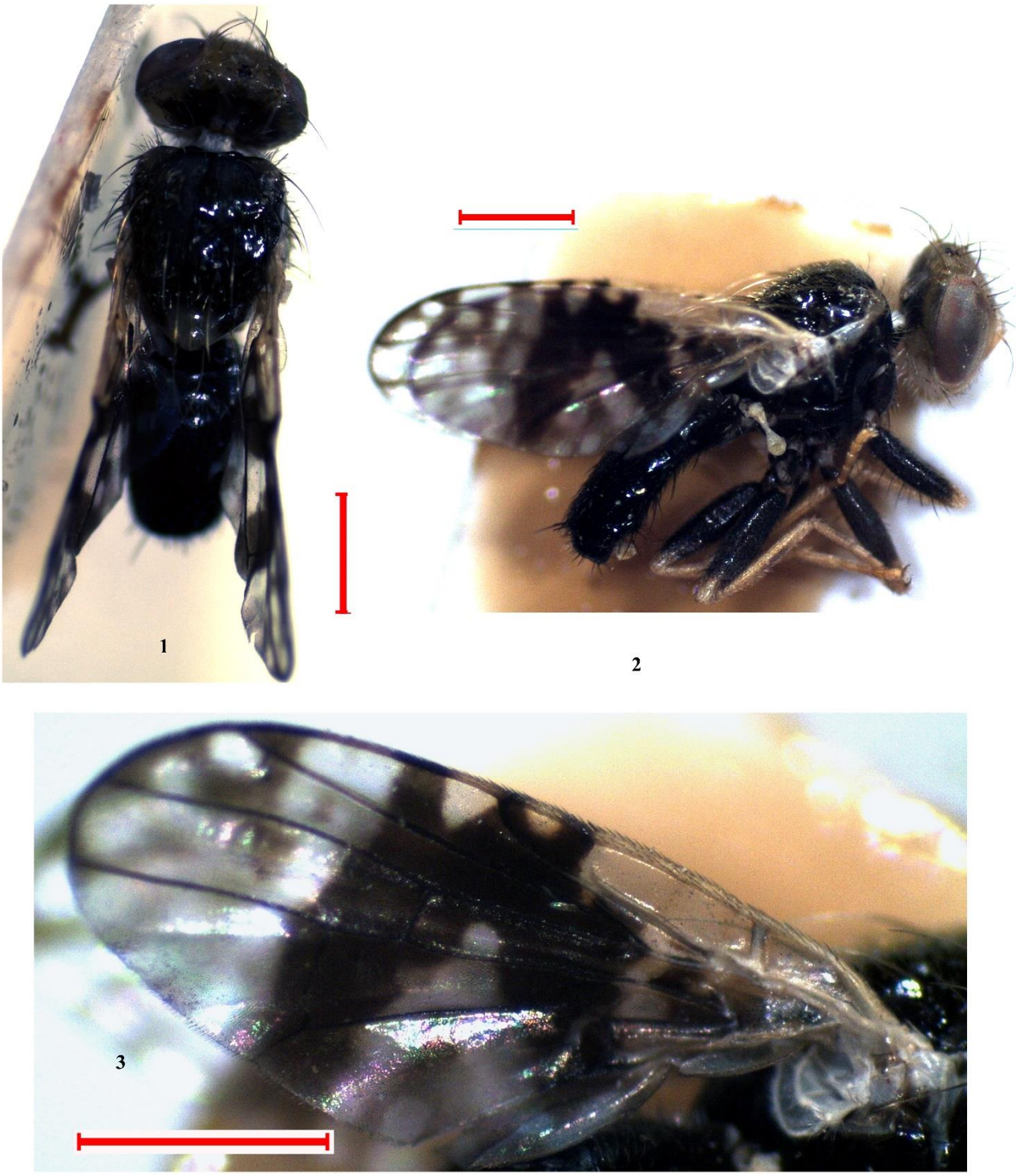
Distribution: Reported across Armenia, Austria, Czechia, France, Hungary, Italy, Russia, Switzerland, Slovakia, and Ukraine [7; 8; 9]. This study records the species for the first time in Türkiye.

Remarks: The specimen was collected from a meadow area using a net, with the food plant undetermined.

4. Conclusions and discussion

This study identifies *Xyphosia laticauda* as the first representative of this species in Türkiye, increasing the country's fruit fly species to 178. This record highlights the significance of Türkiye's unique habitats in supporting diverse Tephritidae species. Future fieldwork and taxonomic studies across Türkiye's relatively unexplored regions are essential for expanding knowledge of Tephritidae diversity.

Acknowledgement: This study is part of doctoral thesis on the Tephritidae fauna and systematics in Karaman Province, Türkiye.



Figures 1–3. Habitus of *Xyphosia laticauda*, male; 1. Dorsal view. 2. Ventral view. 3. Wing. Scale bar: 1 mm

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Bird species in the Arac Stream of Safranbolu in Türkiye

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Abstract

This study was conducted between 2022 and 2023 to identify bird species in the Arac Stream in the Safranbolu district in the province of Karabuk, Türkiye. A total of 54 bird species belonging to 14 orders and 32 families were identified during the survey. Of the species observed, 11 (20.4%) were summer migrants, 1 (1.8%) was a winter migrant and 42 (77.8%) were resident species.

Summer migrants included the white stork (*Ciconia ciconia*), turtle dove (*Streptopelia turtur*), hoopoe (*Upupa epops*), bee-eater (*Merops apiaster*), swift (*Apus apus*), the bullfinch (*Carpodacus erythrinus*), tree pipit (*Anthus trivialis*), black-headed bunting (*Emberiza melanocephala*), red-rumped swallow (*Cecropis daurica*), house martin (*Delichon urbicum*) and crag martin (*Ptyonoprogne rupestris*).

The results of the study show that the forests and wetlands of Karabuk province provide important habitats and food sources for wildlife, especially birds. The wetlands in the region not only provide temporary shelter for migratory birds, but also contribute significantly to the biodiversity of the wetland ecosystem by hosting resident species throughout the year.

These findings emphasize that the protection of the Arac Stream and its surrounding habitats is crucial for the conservation of regional biodiversity.

Keywords: avifauna, biodiversity, migratory birds, Arac Stream, Safranbolu

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Türkiye Safranbolu Araç Çayı'ndaki kuş türleri

Özet

Bu çalışma, Karabük ili Safranbolu ilçesindeki Araç Çayı'nda bulunan kuş türlerini tespit etmek amacıyla 2022-2023 yılları arasında gerçekleştirilmiştir. Araştırma sonucunda, 14 takım ve 32 familyaya ait toplam 54 kuş türü tespit edilmiştir. Tespit edilen türlerden 11 (%20,4) yaz göçmeni, 1 (%1,8) kış göçmeni ve 42 (%77,8) yerli türdür.

Yaz göçmeni türlerden Leylek (*Ciconia ciconia*), Üveyik (*Streptopelia turtur*), İbibik (*Upupa epops*), Arıkuşu (*Merops apiaster*), Ebabil (*Apus apus*), Çütre (*Carpodacus erythrinus*), Ağaç incirkuşu (*Anthus trivialis*), Karabaşlı çinte (*Emberiza melanocephala*), Kızıl kırlangıç (*Cecropis daurica*), Ev kırlangıcı (*Delichon urbicum*) ve Kaya kırlangıcı (*Ptyonoprogne rupestris*)'nın yayılış gösterdiği tespit edilmiştir.

Çalışma sonucunda, Karabük ilinin ormanları ve sulak alanlarının, özellikle kuşlar başta olmak üzere yaban hayatı için kritik öneme sahip habitat ve besin kaynakları sağladığını görülmüştür. Bölgedeki sulak alanların, göçmen kuşlara geçici barınma imkânı sunmasının yanı sıra, yerli türlere yıl boyunca ev sahipliği yaparak sulak alan ekosisteminin biyolojik çeşitliliğine önemli katkıda bulunduğu tespit edilmiştir.

Araç Çayı ve çevresindeki habitatların korunması, bölgesel biyoçeşitliliğin sürdürülmesi açısından kritik önem taşımaktadır.

Anahtar kelimeler: kuş faunası, biyoçeşitlilik, göçmen kuşlar, Araç Çayı, Safranbolu

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1. Introduction

Avifauna is a crucial component of global biodiversity and serves as one of the key indicators of the health and functionality of ecosystems [1]. Birds (Aves) are often used as model organisms in biological monitoring studies due to their taxonomic and ecological diversity, broad habitat range and sensitivity to environmental change [2]. Currently, around 11,000 bird species have been identified worldwide [3, 4]. With their distribution and abundance changing rapidly due to climate change, habitat loss and other anthropogenic factors [5].

Due to its location at the intersection of the zoogeographical regions of the Palaearctic, Ethiopia and the Orient and its diverse ecosystems, Türkiye has a rich avifaunal diversity [6]. The regular observation of around 500 bird species in our country clearly shows this richness [7]. In addition, Türkiye's geographical location within the migration system between Eastern Europeand Africa is of crucial importance [8]. There are many studies conducted on birds in Türkiye [9-12].

The life cycle of birds consists of three basic phases: Breeding, wintering and migration, with each phase presenting different ecological requirements and challenges [13]. Especially during migration periods, birds are exposed to various ecological barriers and anthropogenic threats when traveling long distances [14]. In this context, the protection of resting and feeding areas along migratory routes is of crucial importance for the sustainability of migratory bird populations [15].

The province of Karabuk, especially the Arac Stream and its surroundings, is of great ornithological importance due to its location along the main and secondary bird migration routes leading south from the Black Sea [8]. However, factors such as rapid urbanization, agricultural expansion and deforestation are exerting significant pressure on bird habitats and may affect the composition and dynamics of bird communities in the region.

The lack of a comprehensive study of bird diversity in the Arac Stream and its surroundings in Safranbolu, a UNESCO World Heritage Site, prevents a proper understanding of the ornithological importance of the region. This knowledge gap hinders the development and implementation of effective conservation strategies. Therefore, the systematic identification of bird species in the region and the understanding of their population dynamics are crucial for the conservation of biodiversity.

This study was conducted to determine the bird species occurring in and around the Safranbolu Arac Stream, to assess the seasonal population densities and to calculate the biodiversity of bird species in the region.

2. Materials and methods

The study was conducted in the Arac Stream ecosystem (41°12'37.68 "N, 32°40'9.98 "E) within the boundaries of Safranbolu district in Karabuk province, which is located in the western Black Sea region of Türkiye (Figure 1). Karabuk province is characterized by heterogeneous forest cover, which occupies about 73% of its area. These forested areas have a rich floristic composition of different tree and plant species. The dominant tree species include *Abies* sp. (fir), *Fagus* sp. (beech), *Pinus* sp. (pine), *Platanus* sp. (plane tree), *Juglans* sp. (walnut), *Fraxinus* sp. (ash), *Alnus* sp. (alder), *Quercus* sp. (oak), *Salix* sp. (willow), *Corylus* sp. (hazel), *Taxus* sp. (yew), *Prunus* sp. (cherry), *Tilia* sp. (lime), *Acer* sp. (maple), *Cornus* sp. (dogwood), *Buxus* sp. (boxwood), *Pyrus* sp. (wild pear), *Laurus* sp. (laurel), *Rosa* sp. (rose), and *Rubus* sp. (blackberry). The floristic composition of the region is characterized by elements belonging to the Euro-Siberian phytogeographic region [16, 17].

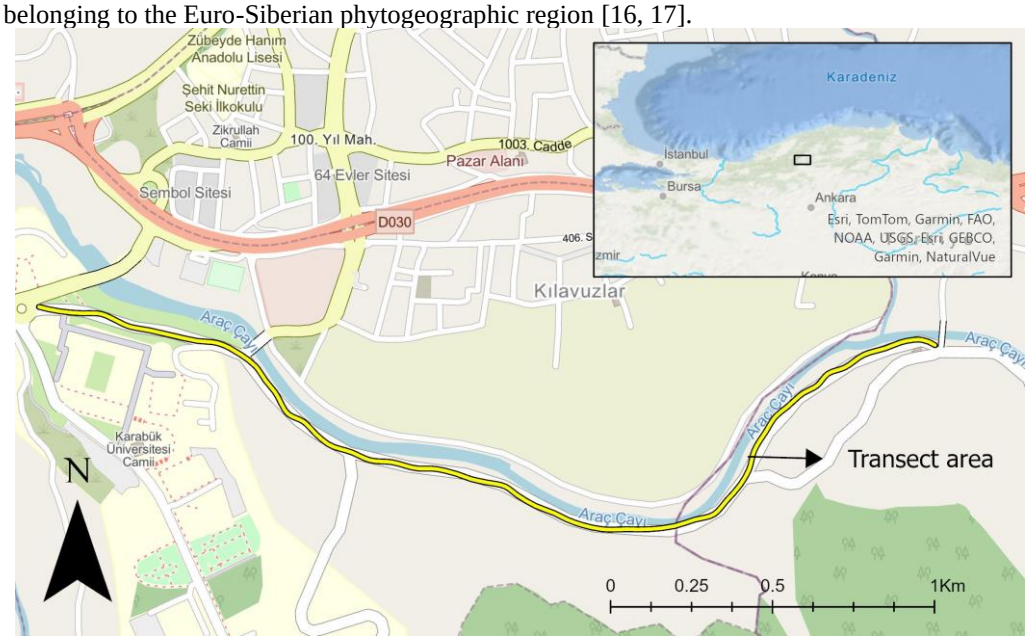

Figure 1. Transect area in the province of Karabuk

The surveys were carried out over a 12-month period between 2022 and 2023. Avifauna observations were conducted twice daily in the first and third week of each month, in the morning (07:30-10:00) and evening (15:30-19:30). These periods cover the main activity times of the birds [18].

The line transect method was used to identify and count bird species [19]. The transect was established along an approximately 5 km stretch of the Arac stream, extending from the iron and steel campus of Karabuk University to the Safranbolu district boundary. During each observation session, the researchers moved along the transect at a constant speed (approx. 2 km/h) and recorded all bird species observed.

Remote observation techniques were used during the observations to avoid disturbing the birds and to observe their natural behaviors. Olympus 10x50 S binoculars were used for this purpose. A Canon EOS R7 mirrorless camera with a Canon RF 800mm f/11 IS STM lens was used for closer examination and photographic documentation. This equipment made it possible to capture high-resolution images of distant and mobile birds.

Appropriate camouflage was used to minimize the potential impact of the researcher's presence on bird behavior [20].

Internationally recognized sources were used for species identification, including Lars Svensson's "Collins Bird Guide" [21] and "Birds of Türkiye", published by the Anonymous Birdwatching Society of Türkiye [22]. The taxonomic classification and nomenclature followed the current International Ornithologists' Union (IOC) World Bird List [4].

Descriptive statistics were used to calculate species percentages based on their migration status (resident, summer migrant, winter migrant).

3. Results

A total of 54 bird species were identified in this study, which was conducted in the Arac Stream ecosystem in Safranbolu between 2022-2023. These species belong to 14 orders and 32 families. The analysis of taxonomic distribution revealed that the order of passerine birds dominated with 32 species (59.3%). The distribution of identified bird species according to the orders and families showed in Figure 2.

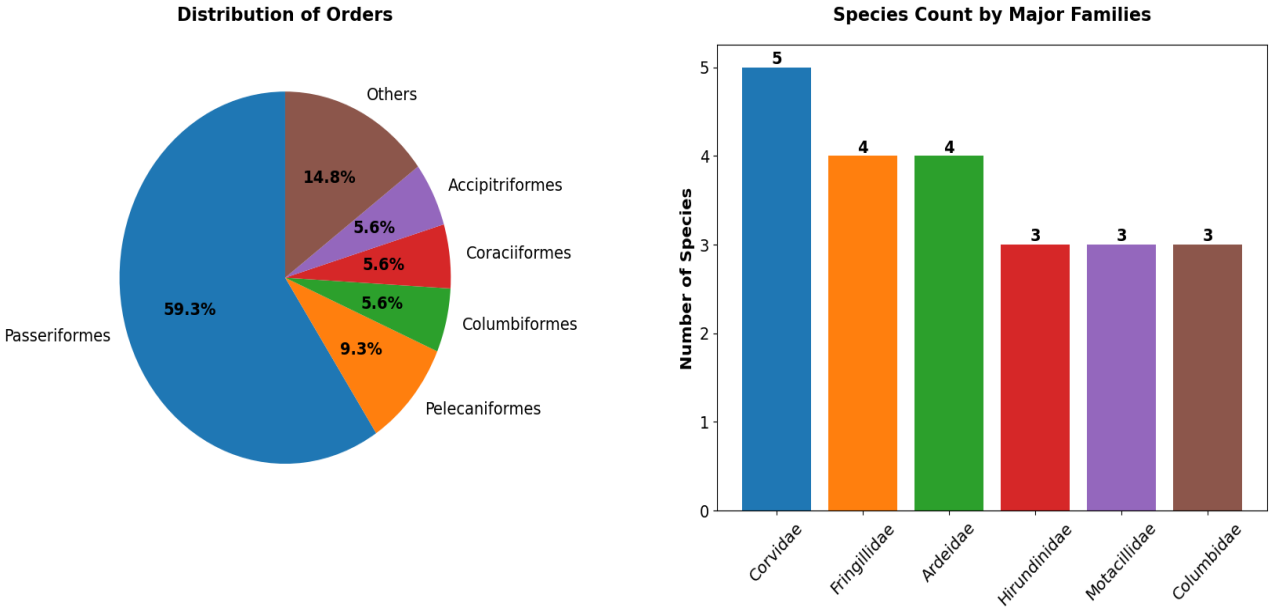

Figure 2. The distribution of identified bird species according to the orders and families

The ecological status of the observed species was distributed as follows: 42 (77.8%) resident species, 1 (1.8%) winter migrant and 11 (20.4%) summer migrants. Summer migrants included the following species: *Ciconia ciconia* (white stork), *Streptopelia turtur* (turtle dove), *Upupa epops* (hoopoe), *Merops apiaster* (bee-eater), *Apus apus* (swift), *Carpodacus erythrinus* (bullfinch), *Anthus trivialis* (tree pipit), *Emberiza melanocephala* (black-headed bunting), *Cecropis daurica* (red-rumped swallow), *Delichon urbicum* (house martin) and *Ptyonoprogne rupestris* (cliff swallow).

The seasonal analysis revealed that the highest species diversity and individual density was observed in the spring months. Especially after March, a remarkable increase in the arrival of migratory species was observed.

Table 1. Bird species recorded in the Arac stream ecosystem, Safranbolu, Türkiye (2022-2023)

No.	RDB	Status	IUCN	Order	Family	Turkish Name	Scientific Name
1	A5	R/f	LC	Columbiformes	Columbidae	Kumru	*Streptopelia decaocto*
2	A5	R/f	LC	Columbiformes	Columbidae	Kaya Güvercini	*Columba livia*
3	A3	SM/d	LC	Columbiformes	Columbidae	Üveyik	*Streptopelia turtur*
4	A3	SM/e	LC	Ciconiiformes	Ciconiidae	Leylek	*Ciconia ciconia*
5	A2	R/d	LC	Pelecaniformes	Ardeidae	Büyük Ak Balıkçıl	*Ardea alba*
6	A3	R/e	LC	Pelecaniformes	Ardeidae	Küçük Ak Balıkçıl	*Egretta garzetta*
7	A3	R/e	LC	Pelecaniformes	Ardeidae	Gri Balıkçıl	*Ardea cinerea*
8	A2	R/d	LC	Pelecaniformes	Ardeidae	Erguvani Balıkçıl	*Ardea purpurea*
9	A3	R/e	LC	Pelecaniformes	Threskiornithidae	Çeltikçi	*Plegadis falcinellus*
10	A5	R/f	LC	Anseriformes	Anatidae	Yeşilbaş	*Anas platyrhynchos*
11	A3	R/e	LC	Suliformes	Phalacrocoracidae	Karabatak	*Phalacrocorax carbo*
12	A2	R/d	LC	Coraciiformes	Alcedinidae	Yalıçapkını	*Alcedo atthis*
13	A2	SM/d	LC	Coraciiformes	Upupidae	İbibik	*Upupa epops*
14	A3	SM/e	LC	Coraciiformes	Meropidae	Arıkuşu	*Merops apiaster*
15	A3	R/e	LC	Gruiformes	Rallidae	Sutavuğu	*Gallinula chloropus*
16	A3	R/e	LC	Charadriiformes	Charadriidae	Halkalı Küçük Cılıbıt	*Charadrius dubius*
17	A3	SM/e	LC	Apodiformes	Apodidae	Ebabil	*Apus apus*
18	A4	R/e	LC	Passeriformes	Corvidae	Alakarga	*Garrulus glandarius*
19	A5	R/f	LC	Passeriformes	Corvidae	Leş Kargası	*Corvus cornix*
20	A5	R/f	LC	Passeriformes	Corvidae	Saksağan	*Pica pica*
21	A5	R/f	LC	Passeriformes	Corvidae	Kuzgun	*Corvus corax*
22	A5	R/f	LC	Passeriformes	Corvidae	Küçük Karga	*Coloeus monedula*
23	A3	R/e	LC	Passeriformes	Fringillidae	Florya	*Chloris chloris*
24	A3	R/e	LC	Passeriformes	Fringillidae	Saka	*Carduelis carduelis*
25	A4	R/f	LC	Passeriformes	Fringillidae	İspinoz	*Fringilla coelebs*
26	A2	SM/d	LC	Passeriformes	Fringillidae	Çütre	*Carpodacus erythrinus*
27	A2	R/d	LC	Passeriformes	Paridae	Mavi Baştankara	*Cyanistes caeruleus*
28	A3	R/e	LC	Passeriformes	Paridae	Büyük Baştankara	*Parus major*
29	A3	R/e	LC	Passeriformes	Turdidae	Karatavuk	*Turdus merula*
30	B2	WV/d	LC	Passeriformes	Turdidae	Öter Ardıç	*Turdus philomelos*
31	A2	R/d	LC	Passeriformes	Sylviidae	Bıyıklı Kamışçın	*Acrocephalus melanopogon*
32	A3	R/d	LC	Passeriformes	Sylviidae	Kamışbülbülü	*Cettia cetti*
33	A3	R/e	LC	Passeriformes	Motacillidae	Ak Kuyruksallayan	*Motacilla alba*
34	A2	R/d	LC	Passeriformes	Motacillidae	Dağ Kuyruksallayan	*Motacilla cinerea*
35	A3	SM/e	LC	Passeriformes	Motacillidae	Ağaç İncirkuşu	*Anthus trivialis*
36	A3	R/e	LC	Passeriformes	Muscicapidae	Kızılgerdan	*Erithacus rubecula*
37	A3	R/e	LC	Passeriformes	Muscicapidae	Taşkuşu	*Saxicola rubicola*
38	A5	R/f	LC	Passeriformes	Passeridae	Serçe	*Passer domesticus*
39	A3	R/e	LC	Passeriformes	Passeridae	Ağaç Serçesi	*Passer montanus*
40	A4	SM/e	LC	Passeriformes	Emberizidae	Karabaşlı Çinte	*Emberiza melanocephala*
41	A3	SM/e	LC	Passeriformes	Hirundinidae	Kızıl Kırlangıç	*Cecropis daurica*

Table 1. Continued

42	A5	SM/f	LC	Passeriformes	Hirundinidae	Kaya Kırlangıcı	*Ptyonoprogne rupestris*
43	A3	SM/e	LC	Passeriformes	Hirundinidae	Ev Kırlangıcı	*Delichon urbicum*
44	A2	R/d	LC	Passeriformes	Aegithalidae	Baştankara	*Aegithalos caudatus*
45	A12	R/d	LC	Passeriformes	Troglodytidae	Çitkuşu	*Troglodytes troglodytes*
46	A12	R/d	LC	Passeriformes	Regulidae	Çalıkuşu	*Regulus regulus*
47	A12	R/d	LC	Passeriformes	Cinclidae	Derekuşu	*Cinclus cinclus*
48	A5	R/f	LC	Passeriformes	Sturnidae	Sığırcık	*Sturnus vulgaris*
49	A2	R/d	LC	Passeriformes	Remizidae	Çulhakuşu	*Remiz pendulinus*
50	A3	R/d	LC	Accipitriformes	Accipitridae	Şahin	*Buteo buteo*
51	A3	R/e	LC	Accipitriformes	Accipitridae	Atmaca	*Accipiter nisus*
52	A12	R/d	LC	Piciformes	Picidae	Aksırtlı Ağaçkakan	*Dendrocopos leucotos*
53	A2	R/d	LC	Strigiformes	Strigidae	Kukumav	*Athene noctua*
54	A12	R/d	LC	Falconiformes	Accipitridae	Kaya Kartalı	*Aquila chrysaetos*

RDB categories [16]: A2: Vulnerable; A3: Rare; A4: Low risk; A5: Widespread; A12: Data insufficient; B2: Winter visitor Status: R: Resident; SM: Summer migrant; WV: Winter visitor Breeding status: d: Annual local breeding; e: Regular breeding species of local importance; f: Widespread breeding species [7, 23].

All identified bird species were classified as LC (Least Concern) according to the categories of the IUCN Red List [24]. However, according to the categories of the Red Data Book of Türkiye (RDB), the distribution of species was as follows: A2 (Vulnerable): 8 species (14.8%), A3 (Rare): 20 species (37.0%), A4 (Low Risk): 3 species (5.6%), A5 (Widespread): 9 species (16.7%), A12 (Data insufficient): 4 species (7.4%), and B2 (Winter visitor): 1 species (1.9%). *Ardea alba*, *Ardea purpurea*, *Alcedo atthis*, *Upupa epops*, *Carpodacus erythrinus*, *Cyanistes caeruleus*, *Acrocephalus melanopogon* and *Motacilla cinerea* are important ecological indicator species and are classified as endangered species (A2) [25-28].

The study has shown that the preservation of riparian vegetation and understory flora is crucial for the presence and persistence of bird species that use the stream banks. Of the species identified, 18 (33.3%) breed annually locally (d), 25 (46.3%) are regularly breeding species of local importance (e), and 11 (20.4%) are widespread and breed in most regions (f).

4. Conclusions and discussion

This study, in which 54 bird species were documented, represents 10.8% of the known avifauna of Türkiye and shows the significant ornithological value of the area. In total, 77.8% of the species are resident, 1.8% are winter migrants and 20.4% are summer migrants. In a similar study, 74 species were identified in Lake Karakuyu. 32% of the species were resident, %9 were winter migrants, 30% were summer migrants and 28% were transit migrants [29]. In the Besevler campus of Ankara University, 66 bird species were detected, of which 30% were residents, 6.1% were summer migrants, 21.2% were winter migrants, 30% were transients and 3% were vagrant species [30]. Compared to similar studies, our results were relatively different. In our study area, 77.8% of species were resident, which is significantly higher compared to Lake Karakuyu and the Besevler Campus. The proportion of migratory species in our study area was relatively low (22.2%), which can be attributed to Arac Stream being on a secondary migration route rather than a primary flyway. This difference suggests that the wetlands in the study area serve as important resting and feeding areas during migration periods.

The dominance of passerines (59.3 % of species recorded) corresponds to the general composition of the avifauna in Türkiye, where Kirwan et al. [6] reported about 55 % of species from this order. This similarity indicates that our study area represents a typical cross-section of the avifauna of Türkiye.

The distribution of species among the RDB categories emphasizes the importance of the region for nature conservation. The presence of 8 species (14.8%) in category A2 (endangered) and 20 species (37.0%) in category A3 (rare) shows that the Arac stream ecosystem plays an important role in biodiversity conservation strategies in Türkiye.

The presence of waterbirds such as *Ardea* spp, *Egretta garzetta*, *Alcedo atthis* and *Cinclus cinclus* indicates a healthy aquatic ecosystem. However, on-site observations revealed that untreated sewage is being discharged directly into the stream. Water pollution and habitat degradation pose a significant threat to the survival of these species. Iliker

et al. [31] similarly emphasized the negative effects of water pollution and habitat loss on waterbirds in Turkish wetlands.

The discharge of domestic and environmental waste into the Arac Stream has the potential to disrupt the aquatic ecosystem food chain. This disruption could impact numerous bird species, especially those that rely on aquatic food resources [32]. In addition, erratic rainfall patterns and increased flooding due to global warming have a negative impact on bird populations and may affect breeding cycles, timing of migration and availability of food resources.

The co-occurrence of forest species (*Dendrocopos leucotos*, *Garrulus glandarius*) and open habitat species (*Upupa epops*, *Merops apiaster*) demonstrates the heterogeneity of habitats. This diversity enables the coexistence of species with different ecological requirements [33].

Birds serve as excellent models for assessing the impact of land-use change on taxonomic and functional diversity, as they vary in their sensitivity to habitat degradation [34]. However, the conversion of natural habitats to anthropogenic land use is one of the greatest threats to biodiversity conservation [35]. Stream restoration works, parking structures and similar construction activities observed in the study area can lead to loss or displacement of species over time.

The ecological structures of wetlands are particularly important for the needs of waterbirds in terms of shelter, stopover and feeding. As noted by the Turkish Environmental Foundation [36], areas typically no more than 6 m deep, where sunlight penetrates to the bottom to allow phytoplankton and zooplankton to develop, and which are covered with tall vegetation such as reeds, provide ideal conditions for hiding, nesting and shelter for waterbirds. The disturbance of the natural river structure and the concrete channelization will undoubtedly have a negative impact on the aquatic ecosystem. This study, conducted during the restoration phase of the river, will serve as an important basis for assessing the future impact on bird species.

In summary, this study shows that the Safranbolu Arac Stream is an important area for bird biodiversity at both national and regional levels. The fact that the region provides critical habitats for both resident and migratory species emphasizes the importance of conservation efforts. Future research should focus on studying the effects of seasonal changes on bird communities, habitat preferences and the long-term effects of anthropogenic threats.

For the protection of biodiversity and sustainable development of the Safranbolu district in Karabuk province, more comprehensive studies should be conducted in cooperation between the relevant government institutions, civil organizations, researchers and scientists.

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Anatomical, morphological and organoleptic investigations on some spices that assist weight loss

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Abstract

Spices have been used throughout history for different purposes. Studies have shown that black cumin, cinnamon, ginger, cayenne pepper, black pepper, coriander, turmeric, rosemary, cardamom and cumin help in weight loss. It has been observed that the results of consumption of these spices prevent obesity by increasing body mass index. In this study, anatomical, morphological and organoleptic properties of these 10 different spices purchased from 5 herbalists were examined. Organoleptic properties were determined as taste, smell and color. The morphological characteristics of the spices and the impurities in the spices were determined and photographed using a stereo microscope. Sartur and chloralhydrate reagents were used to examine anatomical features and anatomical studies were photographed with the help of light microscope. Anatomical, morphological and organoleptic characteristics of black cumin, cinnamon, ginger, red pepper, black pepper, coriander, turmeric, rosemary, cardamom and cumin were compared with scientific descriptions. As a result of the study, the anatomical characteristics conform to scientific definitions, but the organoleptic and morphological characteristics of the spices vary and some of them do not conform to the definitions. In addition, a large amount of foreign matter was found in the spices. For this reason, it is thought that the spices were not stored properly and inspections were incomplete in the places where the samples were purchased. Some of the spices examined do not carry the appropriate qualifications due to the foreign substances in their content, which may create results that may endanger public health. As a result, the reliability of spices obtained from areas with inadequate control mechanisms is a matter of debate. The results of our study shed light on this.

Keywords: anatomical, spice, morphological, organoleptic, slimming

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Kilo vermeye yardımcı bazı baharatlar üzerinde anatomik, morfolojik ve organoleptik incelemeler

Özet

Baharatlar değişik amaçlarla tarih boyunca kullanılmıştır. Yapılan çalışmalar sonucunda çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyonun kilo vermeye yardımcı olduğu görülmüştür. Bu baharatların tüketimi sonucunda vücut kütle indeksini azaltarak obeziteyi engellediği gözlenmiştir. Yapılan bu çalışmada 5 farklı yerden satın alınan bu 10 baharatın anatomik, morfolojik ve organoleptik özellikleri incelenmiştir. Organoleptik özellikler; tat, koku ve renk olarak belirlenmiştir. Baharatların morfolojik özellikleri ve içeriğindeki yabancı maddeler stereo mikroskop yardımıyla tespit edilmiş ve fotoğraflanmıştır. Anatomik özelliklerini incelemek için sartur ve kloralhidrat reaktifleri kullanılmış, ışık mikroskobu yardımıyla anatomik çalışmalar fotoğraflanmıştır. Çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyonun

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anatomik, morfolojik ve organoleptik özellikleri bilimsel tanımlamalarla karşılaştırılmıştır. Çalışma sonucunda, anatomik özellikler bilimsel tanımlamalara uygundur ancak baharatların organoleptik ve morfolojik özellikleri farklılık göstermekte ve bazıları tanımlamalara uymamaktadır. Ayrıca baharatların içeriğinde fazla miktarda yabancı maddeye rastlanılmıştır. Bu sebeple örneklerin satın alındığı yerlerde, baharatların uygun şekilde muhafaza edilmediği ve denetimlerin eksik yapıldığı düşünülmektedir. İncelenen baharatların bir kısmı içeriğindeki yabancı maddelerden dolayı uygun nitelikleri taşımamakta, bu durum da halk sağlığını tehlikeye atabilecek sonuçlar yaratabilmektedir. Sonuç olarak denetim mekanizmaları yetersiz olan alanlardan temin edilen baharatların güvenilirliği tartışma konusudur. Çalışmamızın sonuçları da buna ışık tutmaktadır.

Anahtar kelimeler: anatomik, baharat, morfolojik, organoleptik, zayıflama

1. Giriş

Baharatlar, birçok ülkede yaygın olarak kullanılır ve neredeyse tüm ülkelerin diyetlerinde bulunur [1]. İnsanlık tarihini inceledikçe toplanan bilgilere göre milattan öncelerde bitkilerin yemeklerde tat değişikliği sağlamak için kullanıldığı görülmüştür [1,2]. Büyük İskender yaptığı keşifler sırasında birçok baharatı, farklı ülkelerin tanımasını sağlamıştır. Baharatlar kullanılmaya başlandıkça ipek yolu ile baharatlardan kazanç sağlanmıştır [2].

Baharatların içinde organik hidrosil, renk verici ve tat değiştirici maddeler bulunur [3]. Genellikle yemeklerin görüntüsünü ve tadını değiştirmek için kullanılır [1,3]. Aynı zamanda besinlerin kısa sürede bozulmaması için baharatlar tercih edilir [1]. Baharatların sağlığa yararları oldukça fazladır [2]. Yağların oksidasyonunu yavaşlatırlar. İnflamasyonu, ödemi ve mantar enfeksiyonlarını azalttıkları bilinmektedir [2,4]. Baharatların fazla kilonun azalmasında da etkili olduğuna dair birçok çalışma yapılmıştır [5]. Çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyon kilo vermeye yardımcı baharatlar arasındadır [6]. Zerdeçal, tarçın, kişniş, zencefilin beden kitle indeksini azalttığı saptanmıştır [5,6]. Çörek otu, plazma lipid protein düzeylerini düşürür aynı zamanda LDL kolesterolün düşmesine yardımcı olur [7]. Kırmızı biber yağ döngüsünü arttırarak yağ dokusunda önemli bir azalmaya yardımcı olur [8]. Kara biber açlık uyarıcı hormonunun salgılanmasını engeller ve bu şekilde şişmanlığın azalmasına katkıda bulunur [9]. Biberiye vücuttaki lipid miktarını kontrol altında tutar ve obezitenin engellenmesine yardımcı olur [10]. Kakule lipid düzeyini ve kandaki glukoz seviyesini azaltır [11]. Kimyonun kandaki yağ oranını ve vücut kütlesini düşürücü etkisi vardır. Aynı zamanda kan şekeri değerlerini kontrol etmek için de kullanılır [12].

Kırmızı biber, kişniş, kimyon, çörek otu, biberiye, tarçın, zerdeçal ve zencefil, bileşimlerinde yer alan şişmanlığı engelleyici bileşenlerden dolayı sıklıkla çalışmalara konu olmuş ve insanlar bu baharatları kullanarak şişmanlık dahil birçok hastalık üzerinde etkilerini gözlemlemiştir [13]. Karabiber ve kakulenin de içeriğindeki bileşenlerin fazla kiloyu ve yan etkilerini önleyebileceğine dair çalışmalar mevcuttur [14,15]. Ancak çalışmalarda baharatların kilo vermeye yardımcı özelliklerinin mekanizmalarıyla birlikte daha detaylı incelenmesi gerekmektedir.

Bu çalışmada çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyon anatomik, morfolojik ve organoleptik özellikleri bakımından incelenmiştir.

2. Materyal ve yöntem

Çalışmada kullanılan baharatlar yapılan mevcut çalışmalardaki kilo vermeye yardımcı etkileri göz önüne alınarak tespit edilmiştir.

Çalışmada kullanılan baharatlardan (çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyon) numuneler 5 farklı aktardan alınmıştır. Aktar isimleri gizli tutulmuş ve A, B, C, D ve E aktarı şeklinde isimlendirilmiştir. Her baharat birbirleriyle karışmayacak şekilde küçük şeffaf poşetlere koyulmuş ve üzerine isimleri not edilmiştir. Drogların teşhisi Bezmiâlem Vakıf Üniversitesi Eczacılık Fakültesi Farmasötik Botanik Anabilim Dalı Araştırma Laboratuvarı'nda yapılmıştır.

Satın alınan örneklerin satılış şekilleri (açık, paketli, kapalı, rafta, kavanozda) tespit edilmiş ve fotoğrafları çekilmiştir. Her bir örnekten 10-20 gramlık kısımlar hassas terazide tartılıp ayrılarak, içeriğindeki farklı bitki örnekleri ve yabancı maddeler, pens yardımıyla stereo mikroskop altında gruplandırılmış ve bu maddelerin ölçüsü alınıp fotoğraflanmıştır. Tespit edilen örneklerin ayrıntılı fotoğrafları Nikon SMZ800 trinoküler stereo mikroskop ve Kameram 122 dijital mikro yapı analiz sisteminden oluşan görüntüleme sistemi ile çekilmiştir.

İncelenen tane baharatların (biberiye, kakule ve çörek otu) stereomikroskop yardımıyla morfolojik özelliklerine bakılmıştır. İncelediğimiz farmakopelerdeki monografların morfolojik özelliklerinin tanımlamalarının uygun olup olmadığı mikroskop yardımıyla incelenmiştir. Toz droglar için organoleptik incelemede drogların renk tespiti yapılmış, bir miktar drog avuç içinde ezildikten sonra koklanarak drogların koku tespiti yapılıp, az miktarda drog alınarak dil ucu ile tadına bakılarak drogların tatlarının tespiti yapılmıştır ve droglar birbirleriyle karşılaştırılmıştır.

Anatomik incelemelerde tane örnekler toz drog haline getirilip mikroskopta incelenmiştir. Toz droglar için sartur ve kloralhidrat reaktifleriyle preparat hazırlanmıştır [16-19]. Anatomik çalışmalara ait fotoğraflar Nikon 80'i trinoküler ışık mikroskopu ve Kameram 21 dijital mikro yapı analiz sistemi ile çekilmiştir. Numuneler mikroskopta ×4,

×10, ×20 ve ×40 büyütme gücünden faydalanılarak incelenmiştir [17]. Bu aşamada da droglarda yabancı madde olup olmadığı tekrar kontrol edilmiştir.

Elde edilen bulgular doğrultusunda baharatların anatomik özellikleri göz önüne alınarak, incelenmiş olan toz droglarla karşılaştırılmıştır. Baharatların anatomik özelliklerini karşılaştırmada; Bitkisel Drogların Makroskopik ve Mikroskobik Özellikleri adlı kitaptan, 2017 Türk Farmakopesinden, WHO seçilmiş tıbbi bitkiler monografisinden ve Atlas of Microscopy'den faydalanılmıştır [19,20-22].

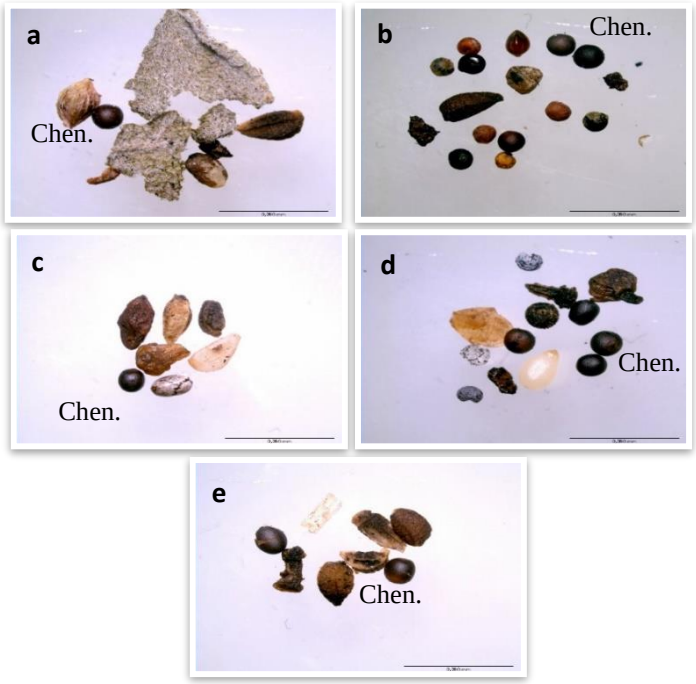
3. Bulgular

Anatomik, morfolojik ve organoleptik incelemeleri yapılan 10 baharatın sonuçları aşağıda ve Tablo 1'de verilmiştir.

3.1. Çörek otu (*Nigella sativa* L.)

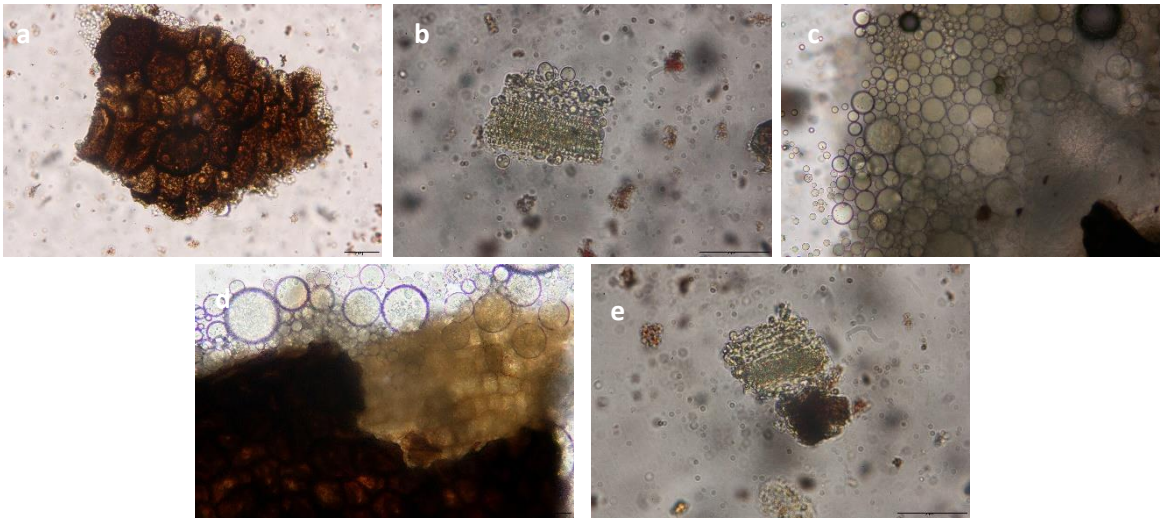
Çörek otu, yağlı ve irili ufaklı tane parçaları şeklinde satın alınmıştır. Çörek otunun tohumları 2–3 mm boyunda, 1,5-2 mm genişlikte ve 1 mm kalınlıktadır, diş minesi ile temas ettiğinde metalik tat bırakmıştır.

Çörek otunda yabancı madde olarak taş parçalarına, Chenopodium spp. meyveleri ve tespit edilemeyen diğer bitkilere ait meyve ve tohumlara rastlanmıştır (Şekil 1).



Şekil 1: Çörek otu örneklerindeki yabancı maddelerin mikroskobik görüntüleri (x0,8 büyütme) a) A aktarı, b) B aktarı, c) C aktarı, d) D aktarı, e) E aktarı (Chen.: *Chenopodium* spp. meyveleri)

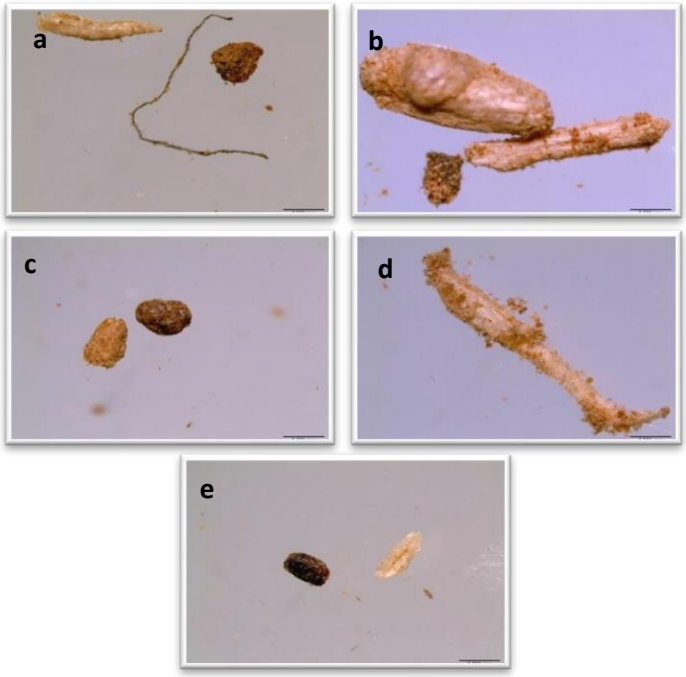
İncelenen örneklerde parankima hücreleri üzerinde testa parçaları ve yağ damlacıkları tüm aktar örneklerinde gözlenmiştir. E aktarında iletim demetleri gözlenmiştir (Şekil 2).



Şekil 2: Çörek otu örneklerinin anatomik görüntüleri a) ×20 Parankima hücreleri üzerinde testa parçaları b) ×40 İletim demeti üzerinde yağ damlacıkları c) ×20 Yağ damlacıkları d) ×20 Dikdörtgensi parankima hücreleri üzerinde testa parçası ve yağ damlacıkları e) ×40 İletim demetleri.

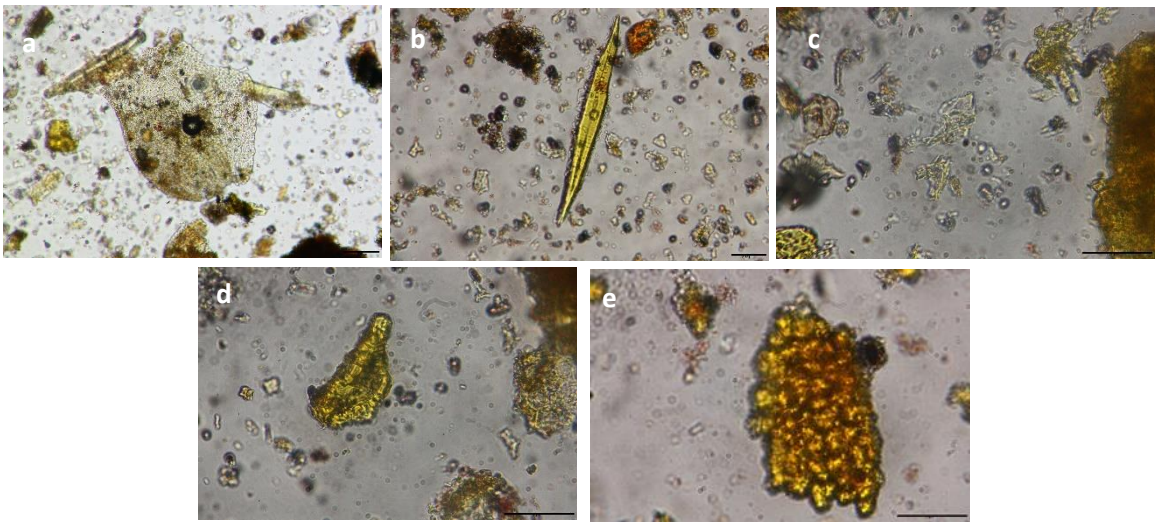
3.2. Tarçın (*Cinnamomum verum* J. Presl)

Tarçında yabancı madde olarak ip ve başka bitkiye ait parçalara rastlanmıştır. (Şekil 3).



Şekil 3: Tarçın örneklerindeki yabancı maddelerin mikroskobik görüntüleri (x3 büyütme), a) A aktarı, b) B aktarı, c) C aktarı, d) D aktarı, e) E aktarı.

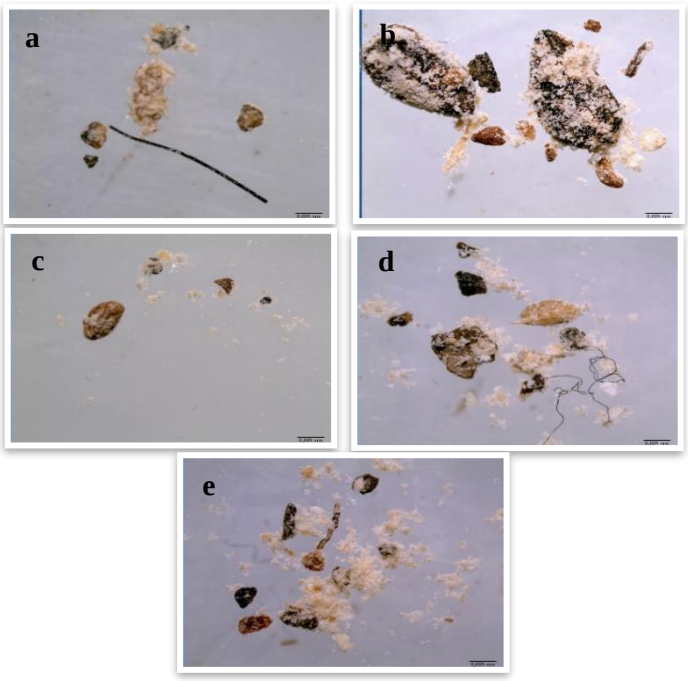
İncelenen örneklerde sklerenkima lifleri ve parankimada nişasta tanecikleri tüm aktar örneklerinde gözlenmiştir. A aktarında, taş hücreleri; A, B, D ve E aktarlarında küçük rafit kristalleri; A, B, C ve D aktarlarında parankimada salgı hücreleri gözlenmiştir (Şekil 4).



Şekil 4: Tarçın örneklerinin anatomik görüntüleri a) ×10 Taş hücreleri b) ×20 Sklerenkima lifleri c) ×40 Küçük rafit kristalleri d) ×40 Parankimada nişasta tanecikleri e) ×40 Parankimada salgı hücreleri

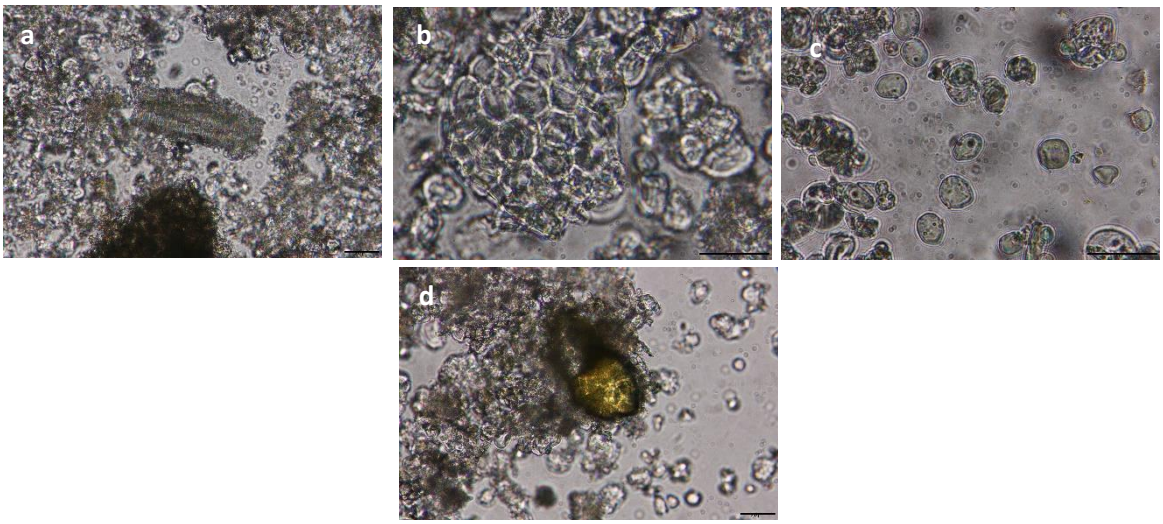
3.3. Zencefil (*Zingiber officinale* Roscoe)

Zencefilde yabancı madde olarak ip ve çok sayıda başka bitki parçalarına rastlanmıştır (Şekil 5).



Şekil 5: Zencefil örneklerindeki yabancı maddelerin mikroskobik görüntüleri (x2 büyütme) a) A aktarı, b) B aktarı, c) C aktarı, d) D aktarı, e) E aktarı.

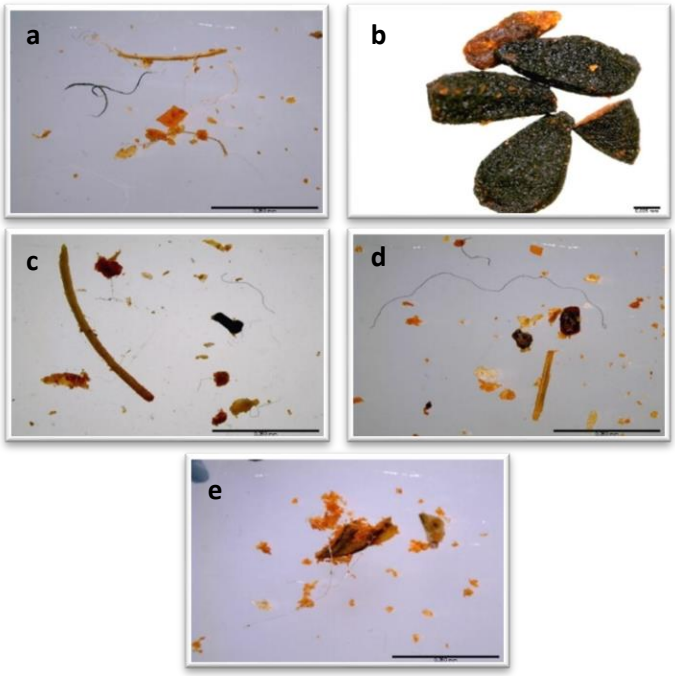
İncelenen örneklerde iletim demetleri, mantar hücreleri ve parankima dışında nişasta taneleri tüm aktar örneklerinde gözlenmiştir. D aktarında lifler; E aktarında salgı hücresi gözlenmiştir (Şekil 6).



Şekil 6: Zencefil örneklerinin anatomik görüntüleri a) ×20 İletim demetleri b) ×20 Mantar hücreleri c) ×40 Parankima dışında nişasta taneleri d) ×20 Salgı hücresi.

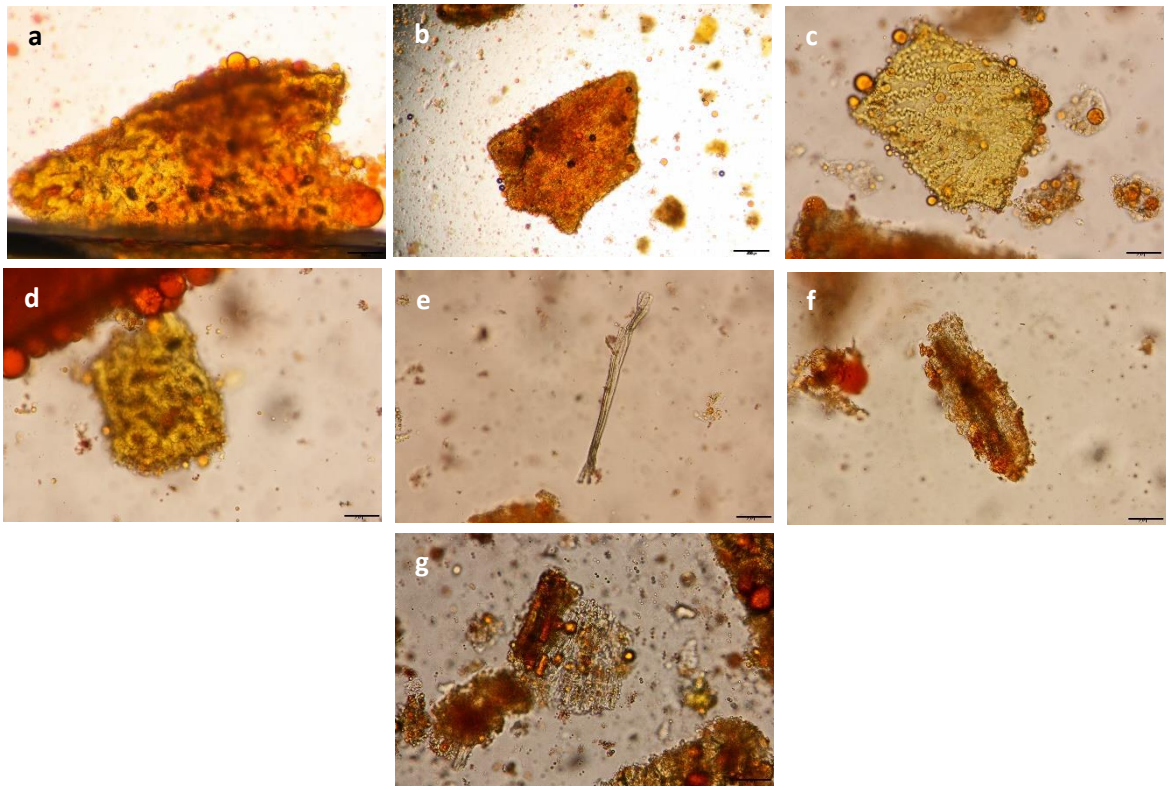
3.4. Kırmızı biber (*Capsicum annuum* L.)

Kırmızı biberde yabancı madde olarak başka bitkiye ait parçalar, ip, küçük odun parçalarına ve tüy parçasına rastlanmıştır (Şekil 7).



Şekil 7: Kırmızı biber örneklerindeki yabancı maddelerin mikroskobik görüntüleri a) A aktarı (x0,8 büyütme), b) B aktarı (x2 büyütme), c) C aktarı (x0,8 büyütme), d) D aktarı (x0,8 büyütme), e) E aktarı (x0,8 büyütme).

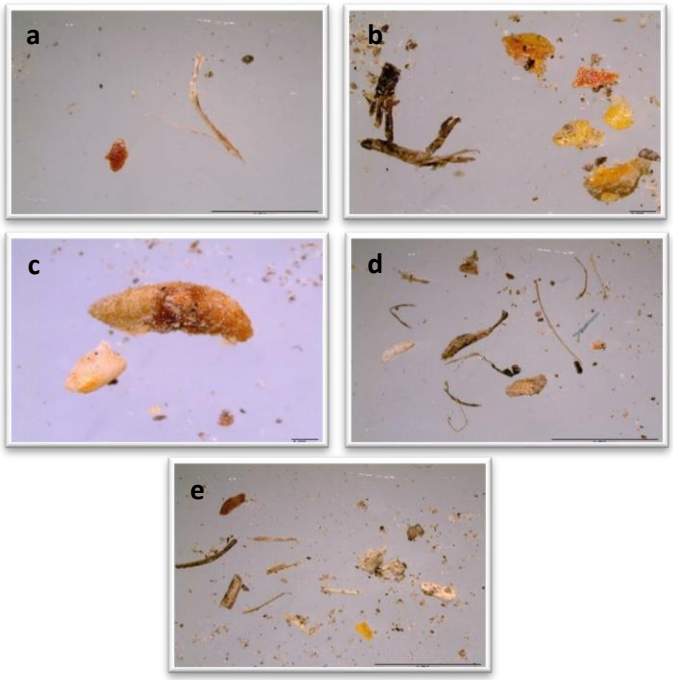
İncelenen örneklerde ekzokarp, iç epiderma, yağ damlacıkları ve karotenoidler tüm aktar örneklerinde gözlenmiştir. A, B ve C aktarlarında tohum kabuğu; A ve D aktarlarında tüy; C aktarında iletim demetleri; E aktarında billur kumu gözlenmiştir (Şekil 8).



Şekil 8: Kırmızı biber örneklerinin anatomik görüntüleri a) ×10 Ekzokarp b) ×10 Yağ damlacıkları ve karotenoidler c) ×20 İç epiderma d) ×20 Tohum kabuğu e) ×20 Tüy f) ×20 İletim demetleri g) ×20 Billur kumu.

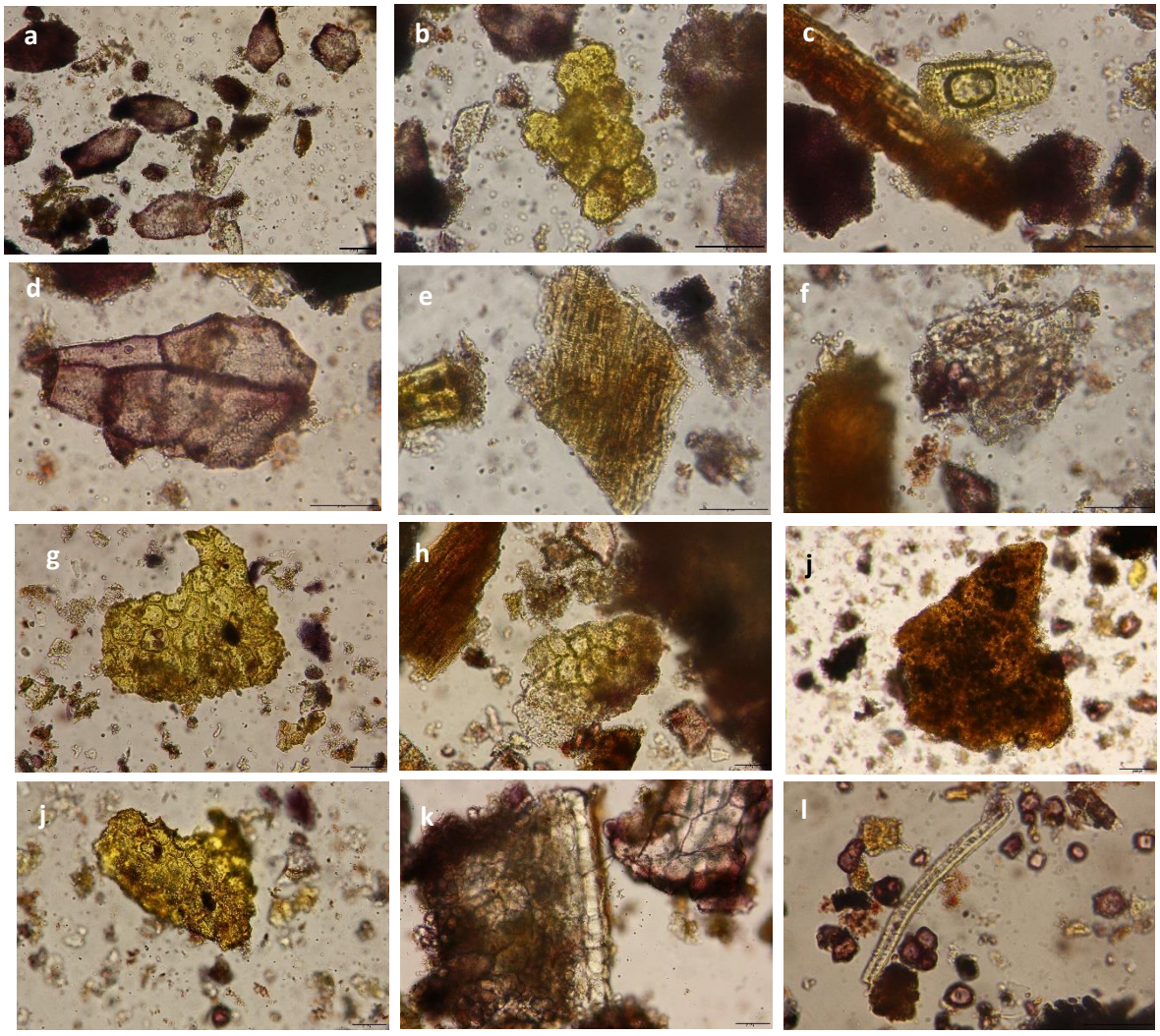
3.5. Kara biber (*Piper nigrum* L.)

Kara biberde yabancı madde olarak başka bitkiye ait parçalara, küçük odun parçalarına ve tüy parçalarına rastlanmıştır. C aktarında herhangi bir yabancı maddeye rastlanmamıştır (Şekil 9).



Şekil 9: Kara biber örneklerindeki yabancı maddelerin mikroskobik görüntüleri a) A aktarı (x0,8 büyütme), b) B aktarı (x2 büyütme), c) B aktarı (x2 büyütme), d) D aktarı (x0,8 büyütme), e) E aktarı (x0,8 büyütme).

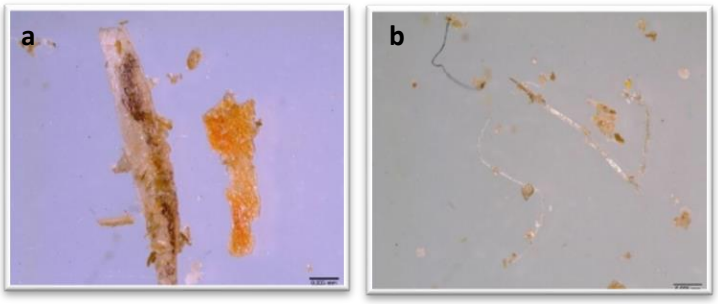
İncelenen örneklerde endokarp hücreleri tüm aktar örneklerinde gözlenmiştir. A, B, C ve E aktarlarında güçlü kalın duvarlı taş hücreler; A, C ve E aktarlarında dış mezokarptan ayrılmış taş hücreler ve yağ hücreli mezokarpın parankiması; A, C, D ve E aktarlarında iletim demeti parçası; A aktarında yüzey görünümünde pigment ve druz kristalleri içeren iki tabakalı taş hücreleri; B ve E aktarlarında yoğun şekilde sıkıştırılmış nişasta kütleleri ve bazı seyrek nişasta tanelerini içeren dış besi doku hücreleri, B, C ve D aktarlarında altta yatan renk tabakalı endokarp hücreleri gözlenmiştir (Şekil 10).



Şekil 10: Kara biber örneklerinin anatomik görüntüleri a) ×20 Güçlü kalın duvarlı taş hücreleri b) ×40 Ortada endokarp hücreleri c) ×40 Dış mezokarptan ayrılmış taş hücreleri d) ×40 Yağ hücreli mezokarpın parankiması e) ×40 İletim demeti parçası f) ×40 Yüzey görünümünde pigment ve druz kristalleri içeren iki tabakalı taş hücreleri g, h) ×20 Endokarp hücreleri i) ×10 Yoğun şekilde sıkıştırılmış nişasta kütleleri ve bazı seyrek nişasta tanelerini içeren dış besi doku hücreleri j) ×20 Altta yatan renk tabakalı endokarp hücreleri k) ×20 Tohum kabuğunun endokarp tabakası l) ×40 Saptan lifli taş hücreleri

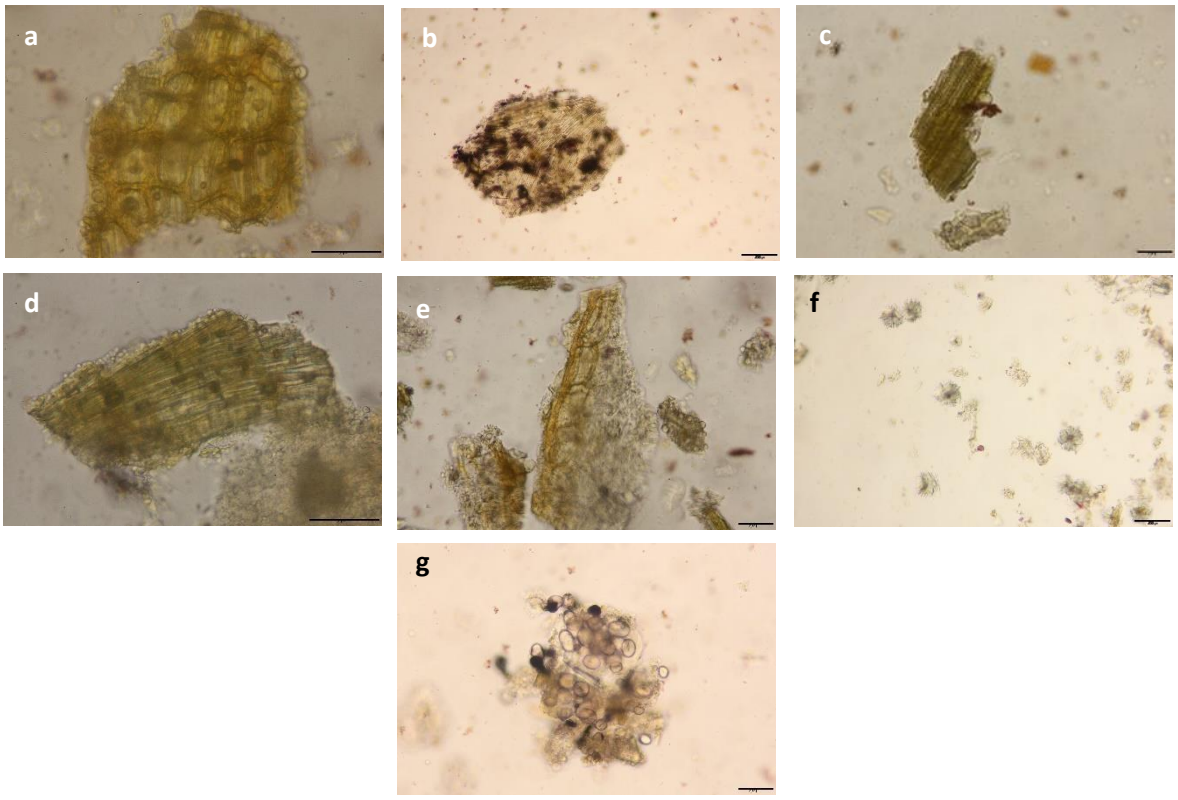
3.6. Kişniş (*Coriandrum sativum* L.)

Kişnişte yabancı madde olarak başka bir bitkiye ait parçalara ve tüylere rastlanmıştır (Şekil 11). A, C ve E aktarlarından alınan kişnişte herhangi bir yabancı maddeye rastlanmamıştır.



Şekil 11: Kişniş örneklerindeki yabancı maddelerin mikroskobik görüntüleri a) B aktarı (x0,8 büyütme) b) D aktarı (x2 büyütme).

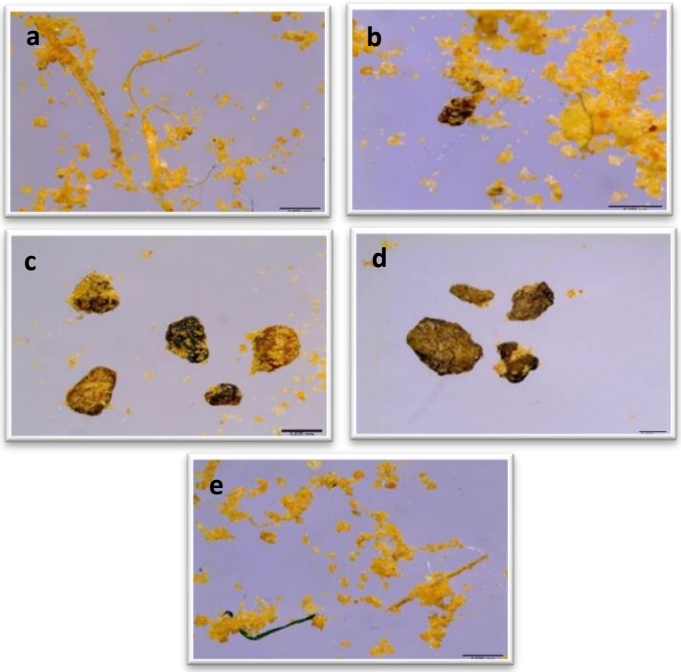
İncelenen örneklerde ekzokarp, endokarp, iletim demetleri ve mezokarpta sklerenkima demetleri tüm aktar örneklerinde gözlenmiştir. B ve D aktarlarında endosperma ve kahverengi tohum kabuğu gözlenmiştir. C aktarında kristal gözlenmiştir (Şekil 12).



Şekil 12: Kişniş örneklerinin anatomik görüntüleri a) ×40 Ekzokarp b) ×10 Endokarp c) ×10 İletim demetleri d) ×40 Mezokarpta sklerenkima demetleri e) ×20 Endosperma ve kahverengi tohum kabuğu f) ×10 Kristal g) ×20 Nişasta.

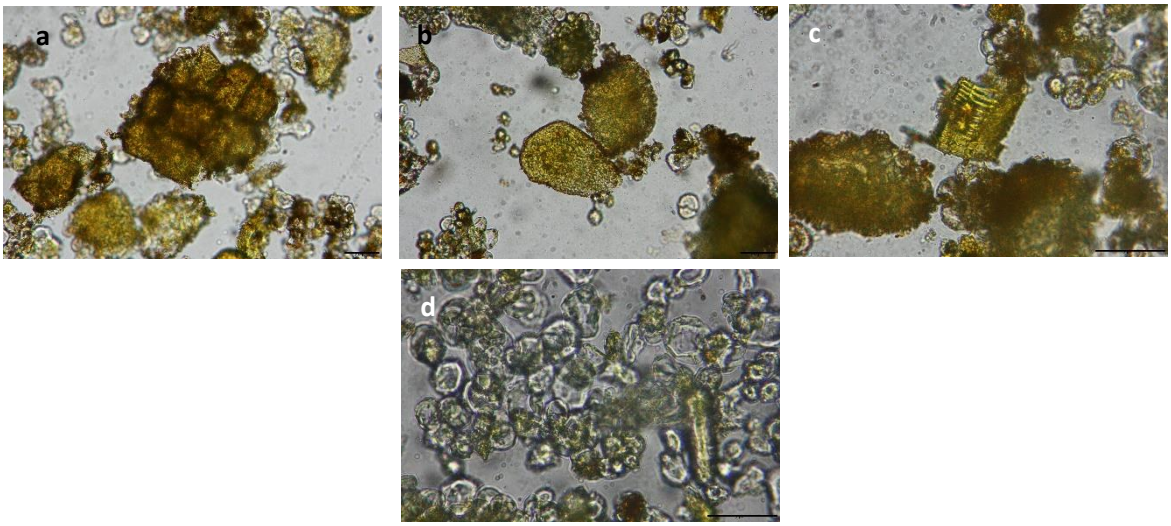
3.7. Zerdeçal (*Curcuma longa* L.)

Zerdeçalda yabancı madde olarak ip, tüy, başka bitkiye ait parçalar ve küçük odun parçasına rastlanmıştır (Şekil 13).



Şekil 13: Zerdeçal örneklerindeki yabancı maddelerin mikroskobik görüntüleri a) A aktarı (x3 büyütme) b) B aktarı (x4 büyütme) c) C aktarı (x3 büyütme) d) D aktarı (x2 büyütme) e) E aktarı (x3 büyütme).

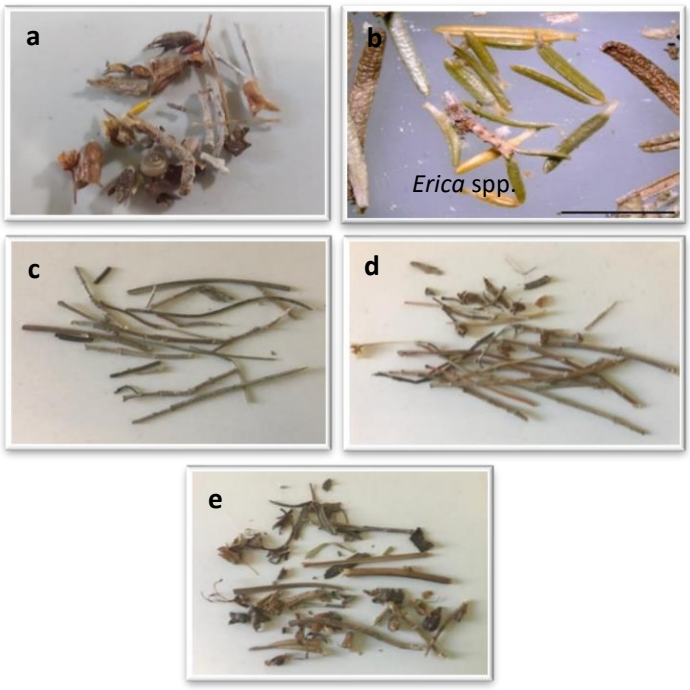
İncelenen örneklerde mantar, jelatinleşmiş nişasta taşıyan parankima hücreleri ve iletim demetleri tüm aktar örneklerinde gözlenmiştir. D aktarında parankima etrafında uçucu yağ damlacıkları gözlenmiştir (Şekil 14).



Şekil 14: Zerdeçal örneklerinin anatomik görüntüleri a) ×20 Mantar b) ×20 Jelatinleşmiş nişasta taşıyan parankima hücreleri c) ×40 İletim demetleri d) ×20 Parankima etrafında uçucu yağ damlacıkları

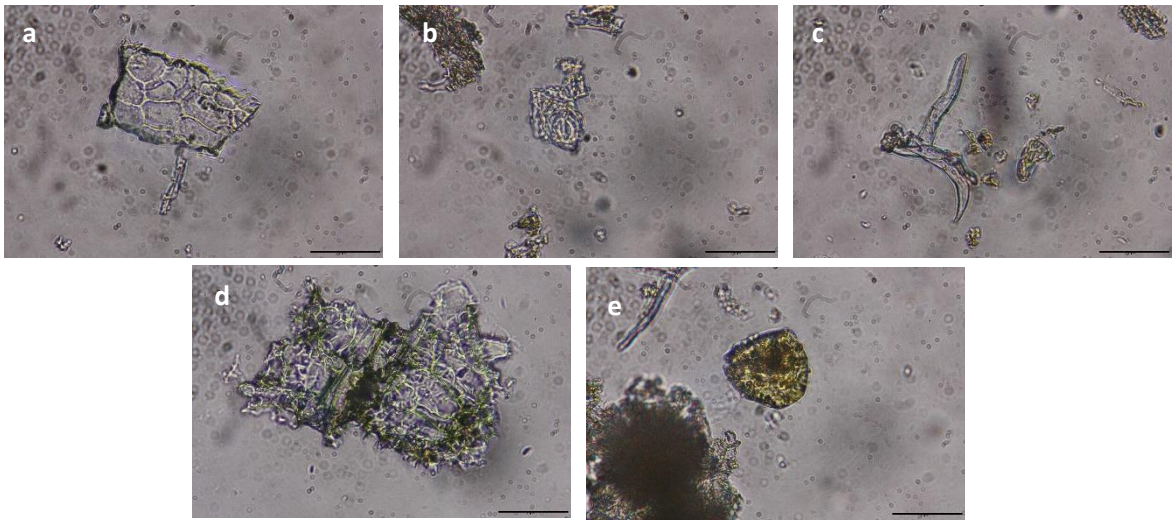
3.8. Biberiye (*Rosmarinus officinalis* L.)

Biberiye örnekleri, çalışma için seçilen 5 aktarın 4 tanesinde bulunmuştur. Biberiyede *Erica* spp. yaprakları ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlara, sümüklü böcek kabuğuna ve küçük odun parçalarına rastlanmıştır (Şekil 15).



Şekil 15: Biberiye örneklerindeki yabancı maddelerin görüntüleri a) A aktarı b) A aktarı (*Erica* spp. yaprakları) (×0,8 büyütme) c) B aktarı d) C aktarı e) E aktarı.

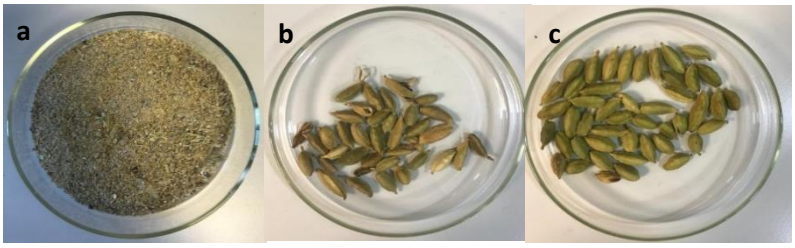
İncelenen örneklerde hipoderma, diasitik stoma, dallanmış örtü tüyü, hipoderma ve kollenkima tüm aktar örneklerinde gözlenmiştir. B aktarında salgı tüyleri gözlenmiştir (Şekil 16).



Şekil 16: Biberiye örneklerinin anatomik görüntüleri A Aktarı: a) ×40 Hipoderma b) ×40 Diasitik stoma c) ×40 Dallanmış örtü tüyü d) ×40 Hipoderma ve kollenkima e) ×40 Salgı tüyü.

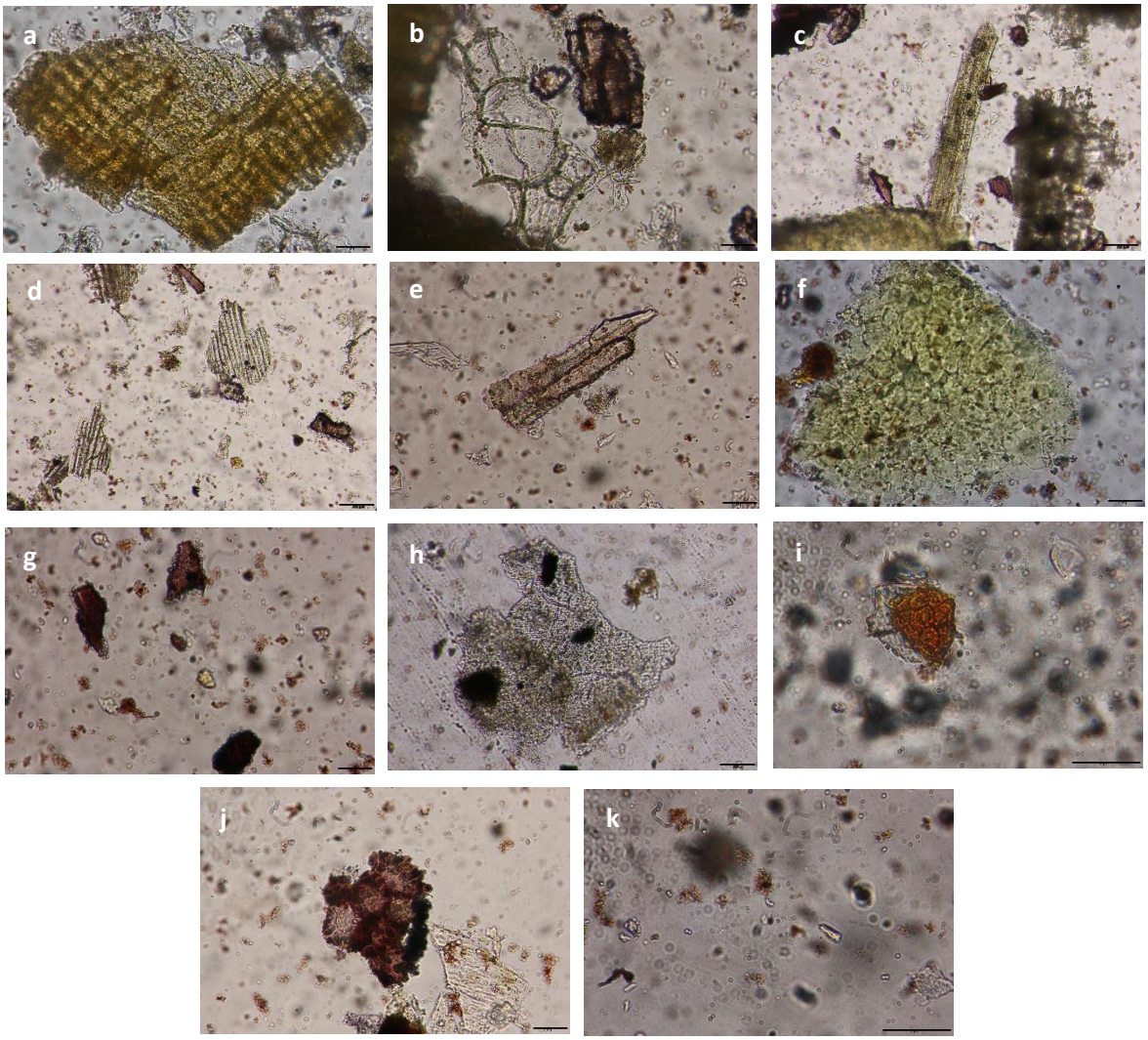
3.9. Kakule (*Elettaria cardamomum* (L.) Maton)

Kakule örnekleri, çalışma için seçilen 5 aktarın 3 tanesinde bulunmuştur. Satın alınan 1 örnek toz halde, diğerleri ise tane olarak satılan meyveler şeklindedir (Şekil 17). A, C ve E aktarlarından satın alınan kakulede yabancı maddelere rastlanmamıştır.



Şekil 17: Kakule örneklerinin makroskobik görüntüleri a) A aktarı, b) C aktarı, c) E aktarı.

İncelenen örneklerde tohum kabuğunun epiderması, yağ hücreleri taşıyan tohum kabuğunun yüzey görüntüsü, epiderma üzerinde görülen arillus hücreleri ve yüzey görünümünde tohum kabuğunun sklerenkima tabakası tüm aktar örneklerinde gözlenmiştir. A ve E aktarlarında bir grup spiral şeklinde kalınlaşmış damar ve yüzey görünümünde arillus; A ve C aktarlarında nişasta taneleri; C ve E aktarlarında nişasta taneleri içeren dış besi doku hücreleri; C aktarında yüzey görünümünde tohum kabuğunun parankiması; E aktarında prizmatik kristaller gözlenmiştir (Şekil 18).



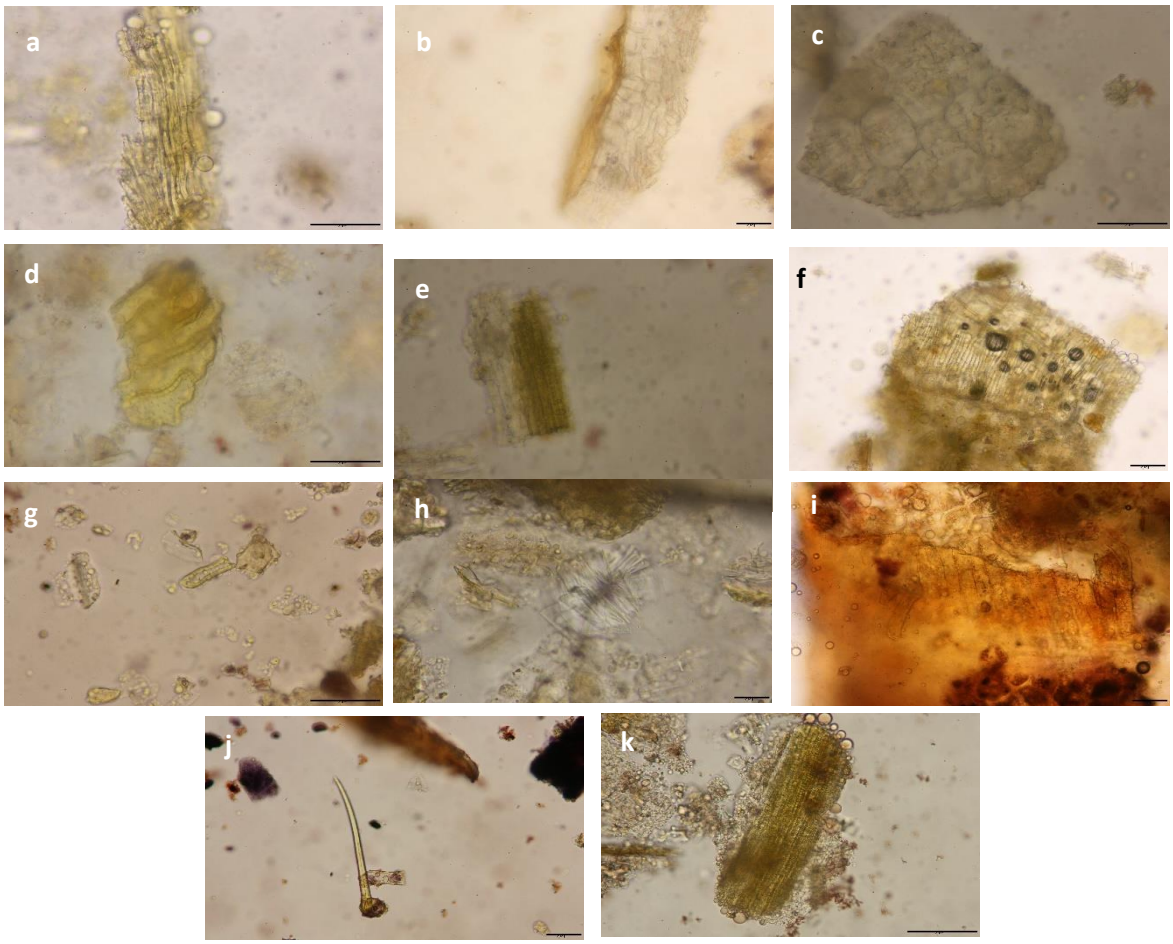
Şekil 18: Kakule örneklerinin anatomik görüntüleri a) ×20 Yüzey görünümünde tohum kabuğunun epiderması b) ×20 Yağ hücreleri taşıyan tohum kabuğunun yüzey görüntüsü c) ×10 Bir grup spiral şeklinde kalınlaşmış damar d) ×20 Epiderma üzerinde görülen arillus hücreleri e) ×20 Yüzey görünümünde arillus f) ×20 Yüzey görünümünde tohum kabuğunun sklerenkima tabakası g) ×20 Nişasta taneleri h) ×10 Nişasta taneleri içeren dış besi doku hücreleri i) ×40 Yüzey görünümünde tohum kabuğunun parankiması j) ×20 Tohum kabuğunun sklerenkima tabakası k) ×40 Prizmatik kristaller.

3.10. Kimyon (*Cuminum cyminum* L.)

A aktarından alınan kimyonda yabancı madde olarak başka bitkiye ait parçalara ve ipe rastlanmıştır. B, C, D ve E aktarlarında herhangi bir yabancı maddeye rastlanmamıştır (Şekil 19).

Şekil 19: Kimyon örneklerindeki yabancı maddelerin mikroskobik görüntüleri a) A aktarı (x2 büyütme).

İncelenen örneklerde druz kristalleri içeren endosperm tüm aktar örneklerinde gözlenmiştir. A, B ve E aktarlarda yüzey görünümünde endokarp ve enine görünümde salgı kanalı parçası; A, C, D ve E aktarlarında mezokarpın sklerenkima tabakasından bir grup taş hücreleri; A ve C aktarlarında iletim dokuyu gösteren yüzeysel görünümde perikarpın bir kısmı; C ve D aktarlarında mezokarptan bir grup taş hücresi; B aktarında yüzeysel görünümünde parankima içeren perikarp parçası; C ve E aktarlarında tüy; C aktarında rafit kristali; D aktarında iki tabakalı parmaklıkları gösteren yüzeysel görünümde epikarpın bir kısmı; E aktarında damar dokusu gözlenmiştir (Şekil 20).



Şekil 20: Kimyon örneklerinin anatomik görüntüleri a) ×20 Yüzey görünümünde endokarp b) ×20 Enine görünümde salgı kanalı parçası c) ×40 Druz kristalleri içeren endosperm d) ×40 Mezokarpın sklerenkima tabakasından bir grup taş hücreleri e) ×40 İletim dokuyu gösteren yüzeysel görünümde perikarpın bir kısmı f) ×20 Yüzeysel görünümünde parankima içeren perikarp parçası g) ×40 Mezokarptan bir grup taş hücresi h) ×20 Rafit kristali i) ×20 İki tabakalı parmaklıkları gösteren yüzeysel görünümde epikarpın bir kısmı j) ×20 Tüy k) ×40 Damar dokusu

Tablo 1. Organoleptik bulgular (Örneklerin genel görünüş, renk, koku ve tat özellikleri)

ÖRNEK	**GENEL GÖRÜNÜŞ**	**RENK**	**KOKU**	**TAT**	**YABANCI MADDE VARLIĞI**
Çörek otu (A Aktarı)	İrili ufaklı tane parçaları ve yağlı	Soluk gri-siyah	Karakteristik, keskin	Kalem tadı, aromatik ve keskin	*Chenopodium* spp. meyveleri ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar ve taş parçaları
Çörek otu (B Aktarı)	İrili ufaklı tane parçaları ve yağlı	Gri-siyah	Karakteristik, keskin	Kalem tadı, aromatik ve keskin	*Chenopodium* spp. meyveleri ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar
Çörek otu (C Aktarı)	İrili ufaklı tane parçaları ve yağlı	Gri-siyah	Karakteristik, keskin	Kalem tadı, aromatik ve keskin	*Chenopodium* spp. meyveleri ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar
Çörek otu (D Aktarı)	İrili ufaklı tane parçaları ve yağlı	Gri-siyah	Karakteristik, keskin	Kalem tadı, aromatik ve keskin	*Chenopodium* spp. meyveleri ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar
Çörek otu (E Aktarı)	İrili ufaklı tane parçaları ve yağlı	Gri-siyah	Karakteristik, keskin	Kalem tadı, aromatik ve keskin	*Chenopodium* spp. meyveleri ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar
Tarçın (A Aktarı)	Homojen ve lifli	Açık kahverengi	Karakteristik, aromatik ve hoş kokulu	Karakteristik ve biraz tatlı	İp ve başka bitkiye ait parçalar
Tarçın (B Aktarı)	Homojen toz ve lifli	Açık kahverengi	Karakteristik, aromatik ve hoş kokulu	Karakteristik ve biraz tatlı	Başka bitkiye ait parçalar
Tarçın (C Aktarı)	Homojen-ince toz ve lifli	Açık kahverengi	Karakteristik, aromatik ve hoş kokulu	Karakteristik ve biraz tatlı	Başka bitkiye ait parçalar
Tarçın (D Aktarı)	Homojen toz ve lifli	Çok açık kahverengi ve nemli	Karakteristik, aromatik ve hoş kokulu	Karakteristik ve biraz tatlı	Başka bitkiye ait parçalar
Tarçın (E Aktarı)	Homojen toz ve lifli	Açık kahverengi	Karakteristik, aromatik ve hoş kokulu	Karakteristik ve biraz tatlı	Başka bitkiye ait parçalar
Zencefil (A Aktarı)	Homojen toz	Soluk sarı	Karakteristik ve aromatik	Keskin ve aromatik	Başka bitkiye ait parçalar ve ip
Zencefil (B Aktarı)	Homojen toz	Soluk sarı	Karakteristik ve aromatik	Keskin ve aromatik	Başka bitkiye ait parçalar
Zencefil (C Aktarı)	Homojen toz	Soluk sarı	Karakteristik ve aromatik	Keskin ve aromatik	Başka bitkiye ait parçalar
Zencefil (D Aktarı)	Homojen toz	Parlak sarı	Karakteristik ve aromatik	Keskin ve aromatik	Başka bitkiye ait parçalar ve ip
Zencefil (E Aktarı)	Homojen toz	Soluk sarı	Karakteristik ve aromatik	Keskin ve aromatik	Başka bitkiye ait parçalar ve ip

Tablo 1. Devam ediyor

Kırmızı biber (A Aktarı)	İrili ufaklı kaba toz	Kırmızı	Kendine has ve keskin	Kendine has, karakteristik ve acımsı	Başka bitkiye ait parçalar, ip ve küçük odun parçaları
Kırmızı biber (B Aktarı)	İrili ufaklı kaba toz	Kırmızı	Kendine has ve keskin	Kendine has, karakteristik ve acımsı	Başka bitkiye ait parçalar
Kırmızı biber (C Aktarı)	İrili ufaklı kaba toz	Koyu kırmızı	Kendine has ve keskin	Kendine has, karakteristik ve acımsı	Başka bitkiye ait parçalar, küçük odun parçası ve tüy
Kırmızı biber (D Aktarı)	İrili ufaklı kaba toz	Kırmızı	Kendine has ve keskin	Kendine has, karakteristik ve acımsı	Başka bitkiye ait parçalar, küçük odun parçası ve tüy
Kırmızı biber (E Aktarı)	Homojen toz	Parlak kırmızı	Kendine has ve keskin	Kendine has, karakteristik ve acımsı	Başka bitkiye ait parçalar, ip
Kara biber (A Aktarı)	Homojen ince toz	Kahverengiden siyaha dönük	Kendine özgü, yakıcı ve keskin	Keskin ve acımsı	Başka bitkiye ait parçalar ve küçük odun parçası
Kara biber (B Aktarı)	Homojen ince toz	Kahverengiden siyaha dönük	Kendine özgü, yakıcı ve keskin	Keskin ve acımsı	Başka bitkiye ait parçalar
Kara biber (C Aktarı)	Homojen ince toz	Kahverengiden siyaha dönük ve soluk	Kendine özgü, yakıcı ve keskin	Keskin ve acımsı	-
Kara biber (D Aktarı)	Homojen ince toz	Kahverengiden siyaha dönük	Kendine özgü, yakıcı ve keskin	Keskin ve acımsı	Başka bitkiye ait parçalar, küçük odun parçaları ve tüy
Kara biber (E Aktarı)	Homojen ince toz	Kahverengiden siyaha dönük	Kendine özgü, yakıcı ve keskin	Keskin ve acımsı	Başka bitkiye ait parçalar ve küçük odun parçaları
Kişniş (A Aktarı)	Heterojen kalın toz	Soluk açık kahverengi	Keskin ve kendine özgü	Kendine has, aromatik ve karakteristik	-
Kişniş (B Aktarı)	Homojen ince toz	Kahverengi	Keskin ve kendine özgü	Kendine has, aromatik ve karakteristik	Başka bitkiye ait parçalar
Kişniş (C Aktarı)	Homojen ince toz	Kahverengi	Keskin ve kendine özgü	Kendine has, aromatik ve karakteristik	-
Kişniş (D Aktarı)	Homojen ince toz	Kahverengi	Keskin ve kendine özgü	Kendine has, aromatik ve karakteristik	Tüy

Tablo 1. Devam ediyor

Kişniş (E Aktarı)	Homojen ince toz	Kahverengi	Keskin ve kendine özgü	Kendine has, aromatik ve karakteristik	-
Zerdeçal (A Aktarı)	Homojen ince toz	Parlak sarı	Aromatik	Sıcak aromatik ve acı	İp, tüy
Zerdeçal (B Aktarı)	Homojen ince toz	Parlak sarı	Aromatik	Sıcak aromatik ve acı	Başka bitkiye ait parçalar, ip
Zerdeçal (C Aktarı)	Homojen ince toz	Parlak sarı	Aromatik	Sıcak aromatik ve acı	Başka bitkiye ait parçalar
Zerdeçal (D Aktarı)	Homojen ince toz	Sarı	Aromatik	Sıcak aromatik ve acı	Başka bitkiye ait parçalar
Zerdeçal (E Aktarı)	Homojen ince toz	Parlak sarı	Aromatik	Sıcak aromatik ve acı	İp, küçük odun parçası
Biberiye (A Aktarı)	İrili ufaklı heterojen kılçık şeklinde yapraklar	Koyu yeşil	Kuvvetli aromatik	Keskin aromatik, kafurlu ve acı	*Erica* spp. yaprakları ve tespit edilemeyen diğer bitki parçaları, meyve ve tohumlar, sümüklü böcek kabuğu ve küçük odun parçaları
Biberiye (B Aktarı)	İrili ufaklı heterojen kılçık şeklinde yapraklar	Soluk yeşil	Kuvvetli aromatik	Keskin aromatik, kafurlu ve acı	Küçük odun parçaları
Biberiye (C Aktarı)	İrili ufaklı heterojen kılçık şeklinde yapraklar	Yeşilden kahverengiye dönük	Kuvvetli aromatik	Keskin aromatik, kafurlu ve acı	Başka bitkiye ait parçalar ve küçük odun parçaları
Biberiye (E Aktarı)	İrili ufaklı heterojen kılçık şeklinde yapraklar	Koyu yeşil	Kuvvetli aromatik	Keskin aromatik, kafurlu ve acı	Başka bitkiye ait parçalar ve küçük odun parçaları
Kakule (A Aktarı)	Heterojen kalın toz	Açık kahverengi-açık yeşil	Aromatik	Aromatik, keskin ve hafif acı	-
Kakule (C Aktarı)	Tane meyveler	Soluk yeşil	Aromatik	Aromatik, keskin ve hafif acı	-
Kakule (E Aktarı)	Tane meyveler	Yeşil	Aromatik	Aromatik, keskin ve hafif acı	-
Kimyon (A Aktarı)	Homojen ince toz	Açık kahverengi-sarı	Güçlü ve ağır	Sıcak, acımsı, aromatik ve nahoş	Başka bitkiye ait parçalar, ip
Kimyon (B Aktarı)	Homojen ince toz	Kahverengi	Güçlü ve ağır	Sıcak, acımsı, aromatik ve nahoş	-
Kimyon (C Aktarı)	Homojen ince toz	Açık kahverengi	Güçlü ve ağır	Sıcak, acımsı, aromatik ve nahoş	-
Kimyon (D Aktarı)	Homojen ince toz	Kahverengi	Güçlü ve ağır	Sıcak, acımsı, aromatik ve nahoş	-
Kimyon (E Aktarı)	Homojen ince toz	Kahverengi	Güçlü ve ağır	Sıcak, acımsı, aromatik ve nahoş	-

4. Sonuçlar ve tartışma

Bu çalışmada kilo vermeye yardımcı baharatların belirlenmesinde, yapılan araştırmalar ve halkın tercihleri göz önünde bulundurulmuştur. Yapılan bir çalışmada kırmızı biber, zencefil ve zerdeçalın kilo vermeye yardımcı özellikler gösterdiği gözlenmiş ve özellikle kırmızı biberin insan deneklerinde yapılan araştırmada kilo vermeye yardımcı olduğu kanıtlanmıştır [5]. Baharatların enerji dengesini araştıran başka bir çalışmada kırmızı biber, tarçın, zencefil ve safranın vücutta kilo kontrolüne yardımcı oldukları belirlenmiş ve vücuttaki etkilerine dair mekanizmalar incelenmiştir [23]. Metabolik sendrom (obezite, diyabet, hipertansiyon ve dislipidemi) ve kardiyovasküler hastalıkları etkileyen fonksiyonel gıdaları inceleyen bir çalışmada zerdeçal, karabiber, tarçın ve biberiyenin vücutta yağ mekanizmalarını etkilediği görülmüş ve çörek otunun özellikle denek hayvanlarında kilo vermeye yardımcı olduğu gözlenmiştir. Fesleğen, kakule, tarçın, kişniş, sarımsak, zencefil, çörek otu ve zerdeçal kullanımını araştıran 24 çalışma, başlangıca göre vücuttaki enerji dengesini sağlayarak obezite ölçümlerinde azalmalarla ilişkilendirilmiştir. Ama en belirgin şekilde; kakule, tarçın, zencefil, çörek otu ve zerdeçal kullanımının vücut ağırlığı, vücut kütle indeksi ve bel çevresi oranlarında azalma sağladığı görülmüştür. Zencefil ve çörek otu tüketiminde, ayrıca kalça çevresinde de düşüşler görülmüştür. Zerdeçal, çörek otu ve tarçın kullanımında ek olarak, vücut yağ yüzdesinde azalmalar saptanmıştır. Kişniş tüketiminde ise, vücut kütle indeksinde azalma gözlenmiştir [6]. Mutfak baharatları arasında en çok bilinen kimyon baharatı üzerine yapılan bir araştırmada hipokalorik bir diyete eklendiğinde bel çevresi ve vücut kütle indeksini önemli oranda azaltmış, yağ mekanizması üzerinde de önemli etkiler gözlenmiştir [12]. Tüm bu çalışmalar göz önünde bulundurulduğunda, vücut ağırlığı üzerinde en fazla etkisi olan ve halkın da rahat ulaşabilip tükettiği baharatlar (çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal, biberiye, kakule ve kimyon) belirlenmiştir.

Türk halk hekimliğinde obeziteye karşı kullanılan bitkilerin araştırılmasına dair yapılan bir çalışma, çalışmamızdaki baharatların seçiminde önemli bir rol oynamaktadır. Bu çalışmada obezite tedavisinde sık kullanılan bitki listesinde çalışmamızda bulunan 5 baharat (kırmızı biber, kişniş, kimyon, çörek otu ve biberiye) yer almaktadır. Aynı zamanda obezite tedavisinde kullanılan egzotik bitkiler listesinde çalışmamızda bulunan 3 baharat (tarçın, zerdeçal ve zencefil) yer almaktadır. Sonuç olarak çalışmamızdaki 10 baharattan 8'i Türk halk hekimliğinde obeziteye karşı kullanılan bitkiler listesinde bulunmaktadır [13]. Çalışmamızda sadece kilo vermek amacıyla değil genel olarak daha çok ulaşılabilir ve tercih edilen baharatların olmasına dikkat edilmiştir. Bir araştırmaya göre tüketicilerin en çok tercih ettiği bitkiler arasında çalışmamızda yer alan 6 baharat (çörek otu, kişniş, biberiye, zencefil, tarçın, zerdeçal) bulunmaktadır. İlk 3 sırada çalışmamızda da bulunan zencefil, tarçın ve zerdeçal yer almaktadır [24].

Aktarlardan satın alınan baharatların birkaçının kapalı, çoğunun ise açıkta satıldığı gözlenmiştir. Tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal ve kimyon toz halde satın alınmıştır. Biberiye, kılçık yaprak şeklinde; çörek otu tane meyve ve kakule C ve E aktarlarında tane meyve şeklinde olup, A aktarında toz şeklinde satın alınmıştır. Çörek otu, tarçın, zencefil, kırmızı biber, kara biber, kişniş, zerdeçal ve kimyon 5 aktarda da bulunmuştur. Ama biberiye ve kakule aktarların hepsinde bulunmamakla birlikte 4 aktarda biberiye, 3 aktarda kakule bulunmuştur.

Sonuç olarak; özellikle kırmızı biber, biberiye ve kakulenin organoleptik ve morfolojik tanımlamalarla eşleşmediği görülmüştür. Renk, koku ve tat bu aşamada belirleyici faktör olarak kullanılmıştır. Ancak, ışık mikroskobu ile incelenen anatomik özellikler bilimsel tanımlamalarla uyuşmaktadır. Baharatların yabancı madde analizinde stereo mikroskop kullanılmış ve baharatların içeriğinde fazla miktarda yabancı maddeye rastlanılmıştır. Bu sebeple aktarlarda, baharatların uygun şekilde muhafaza edilmediği ve denetimlerin eksik yapıldığı düşünülmektedir. İncelenen baharatların bir kısmı içeriğindeki yabancı maddeden dolayı uygun nitelikleri taşımamakta, bu durum da halk sağlığını tehlikeye atabilecek sonuçlar yaratabilmektedir. Baharatların çoğunun açık bir şekilde satılması dışarıdan gelen yabancı maddelerin karışmasına ve baharatların erken nemlenmesine sebep olmaktadır. Halk sağlığının korunabilmesi için aktarların denetim altında tutulması gerekmekte ve baharatlar mümkün olduğunca kapalı, rutubetsiz bir ortamda saklanmalıdır [25].

Kilo vermeye yardımcı baharatlar üzerinde yapılan çalışmaların sayısı artmalı ve insanlar sağlık profesyonelleri tarafından bu baharatları bilinçli kullanıma yöneltilmelidir. Elde ettiğimiz sonuçlara dayanarak bu alandaki çalışmalara ve literatüre katkı sağlayacağımızı düşünmekteyiz.

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Reproductive biology of *Centaurea lydia* Boiss. (Asteraceae)

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Abstract

Centaurea lydia, an endemic species belonging to the Asteraceae family, has a limited distribution in Turkey and is currently listed in the LR/cd category in the Red Data Book of Turkish Plants. This study, conducted in 2024, examined the impacts of wildfires in Bornova, İzmir, on the species and its reproductive biology. Key factors such as flower morphology, pollen viability, stigma receptivity, seed production success, and germination rates were evaluated.

The results showed that the species exhibits protandry and relies on insect pollinators for effective reproduction. It has a self-incompatible pollination system and a fertile seed ratio of 40.86%. The high seedling establishment rate of fertile seeds is a significant advantage that enhances the reproductive capacity of the species. However, despite the high seedling success, the wildfires in İzmir have caused severe habitat loss, placing the *Centaurea lydia* population at considerable risk. Therefore, it is suggested that the conservation status of the species should be elevated to "Vulnerable".

Keywords: *Centaurea*, secondary pollen presentation, conservation, reproduction

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Centaurea lydia Boiss'in (Asteraceae) üreme biyolojisi

Özet

Asteraceae ailesine ait endemik bir tür olan *Centaurea lydia*, Türkiye'de dar bir yayılış alanına sahiptir ve IUCN'e göre LR/cd kategorisinde yer almaktadır. Bu çalışma, 2024 yılında İzmir Bornova'daki yangınların tür üzerindeki etkilerini ve üreme biyolojisini incelemiştir. Çiçek morfolojisi, polen canlılığı, stigma alıcılığı, tohum üretim başarısı ve çimlenme oranları gibi faktörler değerlendirilmiştir.

Elde edilen sonuçlara göre, tür protandrik bir yapıya sahip olup etkin tozlaşma için böceklere bağımlıdır. Kendine uyumsuz bir tozlaşma sistemi sergileyen türde fertil tohum oranı %40.86 olarak belirlenmiştir. Fertil tohumların fide oluşturma oranının oldukça yüksek olması, türün üreme kapasitesini artıran önemli bir avantajdır. Ancak, yüksek fide başarısına rağmen, İzmir'deki yangınların türün habitatında ciddi kayıplara yol açması, *Centaurea lydia* popülasyonunun risk altında olduğunu göstermektedir. Bu nedenle, türün mevcut koruma statüsünün "Vulnerable" seviyesine yükseltilmesi gerektiği düşünülmektedir.

Anahtar kelimeler: *Centaurea*, ikincil polen sunumu, koruma, üreme

1. Introduction

The Asteraceae Bercht. & J.Presl family is the largest plant family in the world, comprising 1,707 accepted genera and over 25,000 species. Among these, *Centaurea* L., the fourth largest genus in the family, consists of 771 species distributed across the Palearctic, Afrotropical, and Oriental biogeographic regions [1]. Approximately 23% of all *Centaurea* species are naturally distributed in Turkey, where the genus is represented by 221 species. Of these taxa, 134 are endemic and endemism rate of these genus for Türkiye is 60.63% [2,26].

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Approximately 40% of endemic plant species in the Mediterranean Basin are confined to highly restricted areas [3]. Species with restricted distributions often exhibit low genetic diversity at the population level due to genetic drift, reduced individual fitness, and inbreeding depression [4]. Understanding the reproductive biology of endemic species is a critical step in elucidating the causes of their narrow distribution. Studies have demonstrated that insights into floral morphology and biology can enhance our understanding of plant pollination ecology [5-7]. Floral biology represents adaptations to various modes of pollination and is closely associated with reproductive systems [8].

Unraveling the physiological and molecular processes occurring during pollen-stigma interactions is a key goal for researchers working with plants, as it provides insights into their reproductive systems. Ultimately, this fundamental biological process is essential for food production, upon which we all depend either directly or indirectly [9]. Pollen viability refers to the ability of pollen grains to germinate and produce a growing pollen tube on a receptive stigma or pistil while maintaining survival in the environment [10]. Pollination, as an outcome of reproductive system studies, has been highlighted for its significance in understanding seed germination and seedling development, which are critical for the conservation of endangered species. This is particularly important for endemic species, as their potential for germination and seedling establishment provides key insights into their future survival [11].

In Turkey, 111 *Centaurea* taxa are reported to be under threat according to the Red Data Book of Turkish Plants. Based on IUCN (International Union for Conservation of Nature) threat categories, six species are classified as Critically Endangered (CR), 23 as Endangered (EN), 28 as Vulnerable (VU), 10 as Lower Risk/Near Threatened (LR(nt)), 11 as Lower Risk/Conservation Dependent (LR(cd)), 23 as Lower Risk/Least Concern (LR(lc)), and 10 as Data Deficient (DD) [12]. Research on the reproductive biology and systems of these taxa, a critical stage in their life cycle, has been limited to a few species, such as *Centaurea tchihatcheffii* Fisch. & C.A.Mey., *C. amanea* Boiss. & Balansa, and *C. kilaea* Boiss. [13-15].

The western and southwestern regions of Turkey, under the influence of the Mediterranean climate, are particularly vulnerable to forest fire events. Moreover, large areas of vegetation are destroyed by high rates of forest fires in these regions every year [24]. In Izmir, one of the most important areas where *Centaurea lydia* is distributed, 13,547 hectares of forest and maquis have been burned in the last 10 years due to forest fires. A total of 1,481 forest fires broke out between January and July 2024 alone, and 6,433 hectares of forest were damaged. In 2024, during the vegetation period of the species, where the *C. lydia* population is most dense, 3 fires occurred in Yamanlar Mountain, 3 in the Homeros Valley, and 1 in the Sabuncubeli Pass. Although we cannot access current forest fire data, we know that a large portion of the populations in these regions were damaged.

This study focuses on the endemic *C. lydia*, which is categorized as LR(cd) and suffered extensive habitat loss due to wildfires in 2024. The study aims to evaluate the species' current status by presenting its functional floral morphology and phenology, comprehensive assessments of pollen viability and stigma receptivity, reproductive success, seed germination studies, and the main factors threatening the species.

2. Materials and methods

Materials

Specimens of *Centaurea lydia* were chosen from the Homeros Valley in İzmir, Bornova, Türkiye. The flower and fruit samples to be studied were carefully selected, labeled and their flowers photographed, and collected for testing at various stages of development throughout May and June 2024. (accesion numbers Ege 44318, 38°30’04.88’’N, 27°13’11.16’’E WGS84; approximately 825 m a.s.l). The study areas have a warm and temperate climate; The average annual temperature, sunshine duration, rainy day and rainfall amount are 18 °C (max: 22.7 °C, min: 13.6 °C) , 8.1 hours, 77.8 days and 712.1 mm, respectively [16].

Methods

Functional floral morphology and Phenology

Flower samples were randomly selected from different plants homogeneously from the plant's distribution area, and a total of 50 flower samples from each flower stage were collected and preserved in Formalin Acetic Alcohol (FAA: acetic acid 5%, formaldehyde 5%, and ethanol 90%) solution and transported to the laboratory. To examine the structural features of the flowers, the samples were examined under an Olymus SZ61 stereomicroscope and measurements were made with a Dino-eye AM7025X camera. To understand the functional characteristics of flowers, phenological stages were observed in their natural environment. The changes in the flowers from bud to full bloom were carefully monitored. In particular, protandry characteristics, pollen presentation and stigma receptivity were examined. Measurements of flower parts were made at each stage in laboratory.

Stigma Receptivity and Pollen Viability Tests

All experiments were carried out in a laboratory where temperature, light and humidity values were constant in order to obtain standard data. The temperature of the laboratory where the experiment was carried out was fixed at 25°C,

the illumination amount was 1500 lumens and the humidity rate was 50%. In each of the tests, 30 anther and 30 stigma samples were taken for each flower stage.

p-NPA Test for Detection of Esterase Activity

To detect esterase activity in pistils, p-Nitrophenyl Acetate (Sigma, N8130) was dissolved in methanol and stored in the refrigerator. Prior to use, the p-NPA solution was diluted with ultra-pure water (at a ratio of 1:100) to obtain a working solution with a concentration of 3.5 mM [17,18]. Pistils were incubated in the working solution for an average of 5 minutes and then photographed under a microscope. Stigmas showing yellow or dark coloration were considered positive for esterase activity.

Evans Blue Test for Control of Plasma Memrane Permeability

To determine stigma permeability, a solution was prepared by dissolving Evans blue (Sigma E2129) in distilled water at a rate of 1%. The stigmas were kept in the solution for 5 min, then washed with 3 series of distilled water and photographed. It was shown that there was no plasma membrane permeability in the cells in the blue-colored areas of the tissues [36].

MTT Test for Dehydrogenase Detection

MTT (3-(4,5-Dimethyl-2-thiazolyl)-2,5-diphenyl-2H-tetrazolium bromide, Sigma M2128, 10mg) was dissolved in a 5% sucrose solution and stored as a stock solution in a dark environment at 2-8°C. The stigma sample was directly immersed in the reagent within an Eppendorf tube. For pollen samples, 5-10 µl of reagent droplets were placed on a slide, allowed to dry, and the process was repeated. After 10 minutes, pollen grains stained dark purple were considered viable, and stigmas were considered receptive [19].

TMB Test for ROS/H_2O_2 Detection

ROS/H_2O_2 localization was performed by immersing stigmas and pollen in a solution containing the ROS indicator dye TMB (3,39,5,59-tetramethylbenzidine-HCl Sigma T-8768, TRIS-acetate (Tris(hydroxymethyl)-aminomethane Acetate) TCI T3294 at 0.1 mg/ml, pH 5.0) until a blue color developed [20]. Blue staining indicated H_2O_2 production in stigmas and pollen.

DAB Test for Peroxidase Detection

The DAB test was prepared by mixing 1% DAB (3,3′-Diaminobenzidine Sigma D12384), 3% H_2O_2, and water in 60% ethanol in a V:V:V ratio of 4:11:22. The stigma sample was directly immersed in the reagent within an Eppendorf tube, while the pollen sample was placed in 5-10 µl reagent droplets on a slide, mixed thoroughly to prevent clumping, allowed to dry, and the process was repeated [21]. Pollen grains stained dark brown were considered viable.

Seed production and TTC Test for Seed Viability

To calculate the total number of seeds produced, capitula were counted from 30 random individuals. Two weeks after the flowers opened, the total number of tubular and marginal flowers were counted from one capitulum from each individual and the number of developing and non-developing achenes were counted. We determined seed viability via staining with TTC (2,3,5 triphenyltetrazolium chloride Sigma 1.08380) was measured in all seeds before experiments after desiccation and storage. Seeds were imbibed for 12 h, and immersed in 1% aqueous (w/v) TTC at 30 °C for one hour, and viability was assessed by intensity and location of staining [22]. We stained 400 seeds from tubulate and marginal seed. Results were expressed as the percent of seeds that positively reacted to the TTC.

Seed Germination Succes

Mature seed samples were collected from 30 randomly selected individuals in June 2024. Before starting the germination tests, 0.5% sodium hypochlorite solution was applied to the seeds for surface sterilization. Seeds were placed on moistened Whatman No. 1 filter paper in a single layer in glass petri dishes and subjected to germination tests at 25°C and 12 h light conditions. Petri dishes were wrapped with aluminum foil for continuous dark period application. 10 seeds were used in each petri dish and the experiments were carried out with 10 replicates. Petri dishes were checked daily and seeds with radicle emergence were accepted as germinated [23]. After 7 days, germinated seeds were transferred to soil vials. Germination Rate (GR) were calculated using the following equations (Bewley and Black, 1994). Where, G: Number of germinated seeds, T: Total number of seeds used. GR (%)= (G /T) x 100

Reproductive succes

Thirty capitula were randomly selected to determine the number of seeds and ovules under natural conditions. One month after flowering, all mature capitula were collected and the number of mature and immature fruits in each capitulum was counted. Reproductive success was calculated from the average number of mature fruits and immature fruits produced per capitulum.

Statistical Analysis

Comparisons between the bud stage and anthesis stage of the flower parts were performed using Multiple t test analysis in the Graphpad prism 8 program.

3. Results

Functional flower morphology and phenology

In the field study, capitula are observed in three different forms according to their development. The first form is the bud stage. In capitula at this stage, the upper phyllaries have not yet opened and the petals are not visible (Figure 1a). The second form is the pollination stage, where the terminal phyllaries open and the tubular and marginal flowers open (Figure 1b). The third form is the fruit development stage, where pollination is over and the corollas dry and fall off. (Figure 1c).

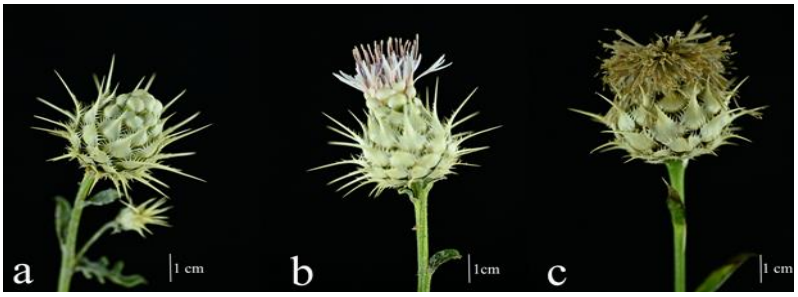

Figure 1. Capitula developmental stages **a)** bud stage **b)** pollination stage **c)** fruit development stage

The capitulum consists of marginal sterile flowers and centrally located tubular actinomorphic fertile flowers. Four key developmental stages were identified in the protandrous tubular fertile flowers, which play a critical role in reproduction. Bud Phase: During this initial stage, introrse anthers tightly surround the style and dehisce along longitudinal slits. As the style elongates, unicellular hairs located at the tip of the style collect pollen from the anthers and carry it upward (Figure 2a, f, k). Pre-anthesis Phase: In this stage, although the corolla tube opens, the rigid, pollen-free apical portion of the anther remains tightly closed, preventing contact between the pollen-laden style and the external environment. The corolla tube and style continue to elongate during this stage (Figure 2b, g). Secondary Pollen Presentation Phase: This stage is characterized by the opening of the rigid apical portion of the anther. The style extends beyond this point, presenting pollen to pollinators via the hairs on the style. Since pollen is presented through the style hairs rather than directly from the anthers, this phenomenon is referred to as secondary pollen presentation (Figure 2c, h). Female Phase: The final stage is the female phase, during which the remaining pollen on the style hairs is shed, and pollen viability decreases significantly. At this stage, the corolla begins to wither (Figure 2d, i, j).

The marginal sterile florets undergo continuous development starting from the bud stage, open their corollas with the blooming of the first tubular florets, and begin to wither during the final stages of the tubular florets (Figure 2e). Measurements associated with the flower developmental stages are presented in Table 2.

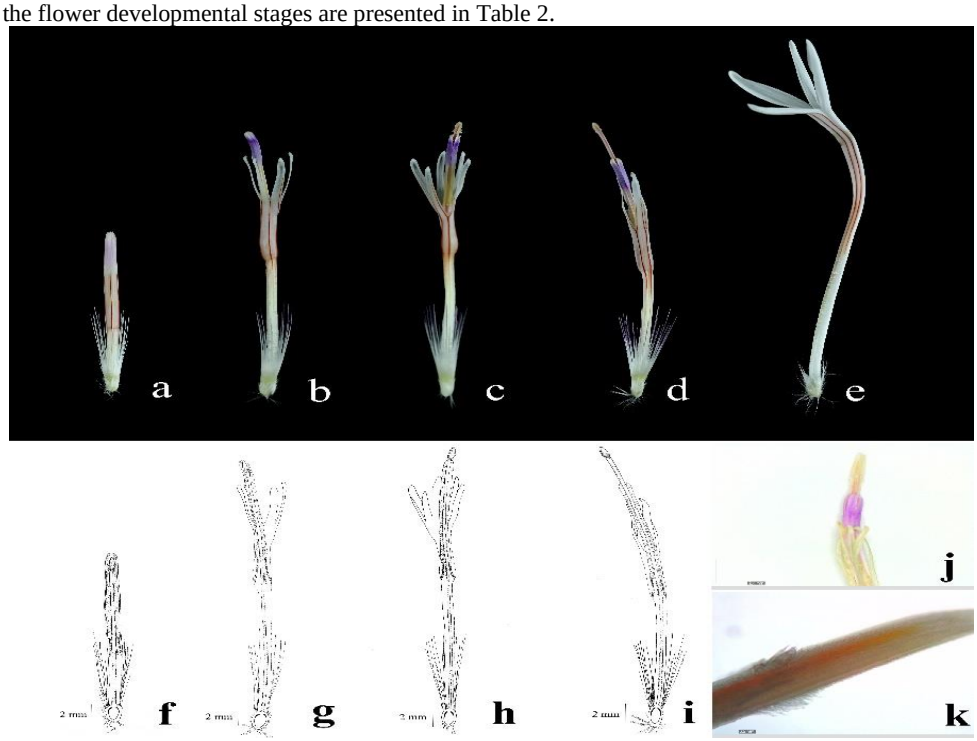

Figure 2. Flower development phases of *Centaurea lydia* **a,f)** 1st stage - bud phase **b,g)** 2nd stage pre-anthesis phase **c,h)** 3rd stage - post anthesis phase (secondary pollen presentation phase) **d,i)** 4th stage - mature pahase (female phase) **e)** marginal sterile tubular flower **j)** female phase **k)** pollen-collecting hairs on style

One of the most remarkable aspects of floral development is the increase in the length of the corolla tube and style. The corolla tube elongates rapidly during the transition from the bud stage to the anthesis stage. This rapid elongation of the corolla tube occurs simultaneously with the rapid elongation of the style (Table 2). The rapid elongation of these two structures prior to anthesis is critical for the loading of pollen grains from the anthers onto the style hairs. During the secondary pollen presentation stage, when the elongation of the corolla tube slows down, the style continues to elongate, surpassing the corolla and presenting the pollen adhered to the style to pollinators (Figure 3, Table 1).

Table 1. Flower measurements depending on development stages

	Flower development stages			
Character	1st	2nd	3rd	4th
Corolla length (mm)	20.95 ± 0.64	37.05 ± 0.44	38.55 ± 0.44	39 ± 0
Corolla lobe (mm)	7 ± 0	7 ± 0	7 ± 0	7 ± 0
Corolla tube (mm)	10.45 ± 0.64	10.55 ± 0.44	10 ± 0	10 ± 0
Corolla throat (mm)	3,5 ± 0	20 ± 0	21.55 ± 0.44	22 ± 0
Papus length (mm)	10.6 ± 0.7	10.75 ± 0.79	12.45 ± 0.44	13.05 ± 0.5
Achene length (mm)	2 ± 0	3 ± 0	3 ± 0	3.7 ± 0.26
Anther length (mm)	12.45 ± 0.37	13 ± 0	13 ± 0	13 ± 0
Anther pollen-free part length (mm)	5.25 ± 0.42	6 ± 0	6 ± 0	6 ± 0
Anther pollen part length (mm)	7 ± 0	7 ± 0	7 ± 0	7 ± 0
Filament length (mm)	3.5 ± 0	7 ± 0	7 ± 0	7 ± 0
Stamen length (mm)	15.95 ± 0.37	20 ± 0	20 ± 0	20 ± 0
Style length (mm)	16.2 ± 0.59	33.55 ± 0.44	40.65 ± 0.41	42.2 ± 0.42
Stigma length (mm)	3 ± 0	3 ± 0	3 ± 0	3 ± 0
Pistil length (mm)	21.2 ± 0.59	39.55 ± 0.44	46.65 ± 0.41	48.9 ± 0.61

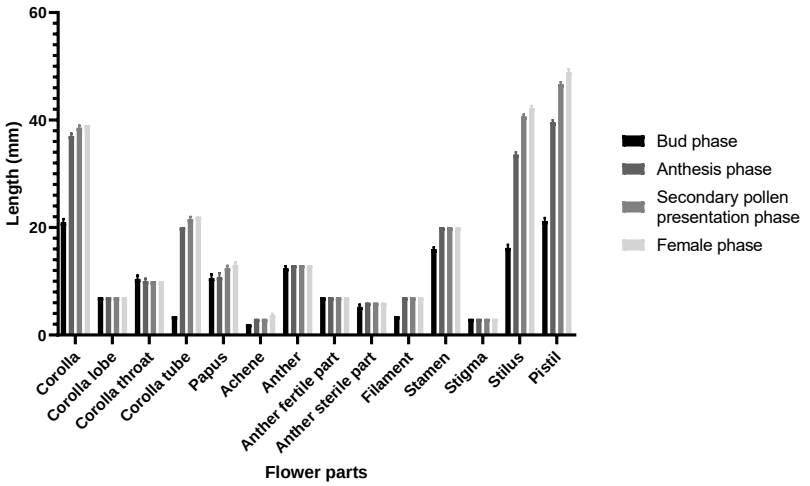

Figure 3. The sizes of flower parts according to flower development stages

Table 2. Comparison of the development of flower parts between the flower bud stage and anthesis stage in C. lydia using Multiple T tests (P value <0.05 is significant)

Flower parts	Discovery?	P value	Mean of bud phase (mm)	Mean of anhesis phase (mm)	Difference	SE of differerence	t ratio	q value
Corolla	Yes	<0,000001	20,95	37,05	-16,10	0,2461	65,43	<0,000001
Anther	Yes	0,000173	12,45	13,00	-0,5500	0,1167	4,714	0,000058
Anther sterile part	Yes	0,000027	5,250	6,000	-0,7500	0,1344	5,582	0,000011
Stamen	Yes	<0,000001	15,95	20,00	-4,050	0,1167	34,71	<0,000001
Stilus	Yes	<0,000001	16,20	33,55	-17,35	0,2315	74,93	<0,000001
Pistil	Yes	<0,000001	21,20	39,55	-18,35	0,2315	79,25	<0,000001

Capitula buds are observed from the last week of April to June and the capitula in bud form mature in about 1 week and begin the anthesis process. The pollination phase of the species takes place in a 1.5-month period from the beginning of May to the middle of June, and fruit development lasts 2 weeks after pollination. The matured seeds are dispersed into nature 1 week after fruit development (Table 3).

Table 3. Flower phenology observations of *Centaurea Lydia*

	April				May				June				July			
Weeks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Bud stage																
Pollination stage																
Fruit development stage																
Seed dispersal																

Stigma Receptivity and Pollen Viability Tests

Esterase activity begins in the stigmas at the bud stage and continues slowly until anthesis. After anthesis, an increase in esterase activity is observed. As esterase activity increases, the structure of the plasma membrane of stigma cells degenerates and cell permeability decreases. NADPH-dependent dehydrogenase activity of stigmata, which is directly related to respiration, is not seen at the bud stage. It shows a gradual increase in respiration in stigmas before anthesis. The activity of peroxidases is also observed in the flower bud stage to eliminate toxic effects by scavenging reactive oxygen species (ROS) formed as a result of respiration and increases with anthesis. ROS-H_2O_2, which is an important signal molecule for pollen germination in the stigma, shows a sudden increase before anthesis, reaches the highest level with the anthesis of the flower, and then declines again with the maturity stage. All tests indicate that stigma receptivity occurs at stages after the bud stage and that stigma receptivity is highest at the anthesis stage. The results of the tests are given in Table 4 and Figure 4.

It was determined that pollen grains were viable from the bud stage to the maturity stage. It was determined that pollen viability was highest in the pre-anthesis stage (dehydrogenase 78.17% and Peroxidase 82.75) and lowest in the bud stage. The observation of ROS-H_2O_2 in pollen at all stages except the bud stage shows that even if the pollen is alive, it has the ability to germinate only at the pre-anthesis and post-anthesis stages. The germination ability of pollen grains was also determined to be at the post-anthesis stage (71.83%). The results of the tests are given in Table 5 and Figure 4.

Table 4. Chromogenic enzyme activity test results applied to stigma depending on flower development stages

Flower development stage	Esterase activity	Permeability	Dehydrogenase activity	Peroxidase activity	Peroxidase activity and endogen H_2O_2
(1) Bud	+	+	-	+	-
(2) Pre-anthesis	+	+	+	+	++
(3) Post-anthesis	++	++	++	++	+++
(4) Maturity	++	+++	+++	++	++

(-) no reaction; (+) weak reaction; (++) medium reaction; (+++) strong reaction.

Table 5. Chromogenic enzyme activity test results applied to pollen grains depending on flower development stages

Flower development stage	Dehydrogenase activity	Peroxidase activity	Peroxidase activity and endogen H_2O_2
(1) Bud	37,23 ±5,56	49 ±3,34	0
(2) Pre-anthesis	78,17 ±7,56	82,70 ±5,09	71,83 ±4,18
(3) Post-anthesis	71,57 ±5,49	75,27 ±4,58	28,57 ±3,5
(4) Maturity	All the pollen has spread		

Seed production and TTC Test for Seed Viability

An individual produces approximately 42.6 capitula and approximately 84.01% of the flowers produced in these capitulums consist of tubular flowers and 15.99% consists of infundibular flowers. It was determined that 81.61% of the achenes of tubular flowers and 97.38% of the achenes of marginal flowers developed approximately 1 week after flowering (Figure 5, Table 6). In the seed viability test (TTC) carried out on developed achenes, it was determined that the seeds in the infundibular flower achenes were completely sterile and 59.5% of the seeds in the tubular flowers were viable (Figure 6, Table 7).

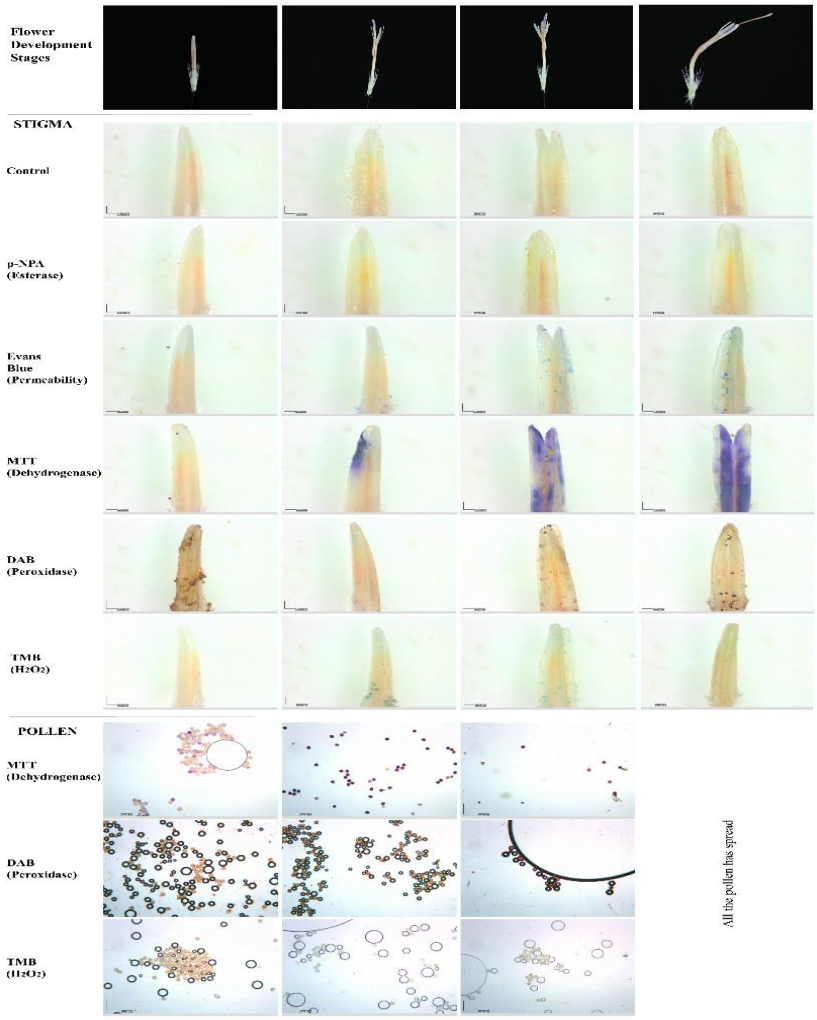

Figure 4. Patterns of chromogenic enzyme activity tests in stigma and pollen depending on flower development stages in *Centaurea lydia*.

Figure 5. *C. lydia* flowers and achenes. a) tubular b) marginal

Table 6. Flower and seed production of *C. lydia*

Character	Mean	Min-Max
Capitula in a plant (C)	42.6 ± 24.18	16–92
Total flowers in a capitula (CF)	128.03 ± 20.77	101–171
Tubular flowers in a capitula (T)	107.86 ± 18.76	85–148
Infundibular flowers in a capitula (I)	20.17 ± 2.15	16–24
Developing tubular flower achenes per capitula (TD)	88.03 ± 15.78	69–121
Non-developing tubular flower achenes per capitula (TN)	19.83 ± 3.05	16–26
Developing infundibular flower achenes per capitula (ID)	19.67 ± 1.75	17–22
Non-developing infundibular flower achenes per capitula (IN)	0.53 ± 0.73	0–2

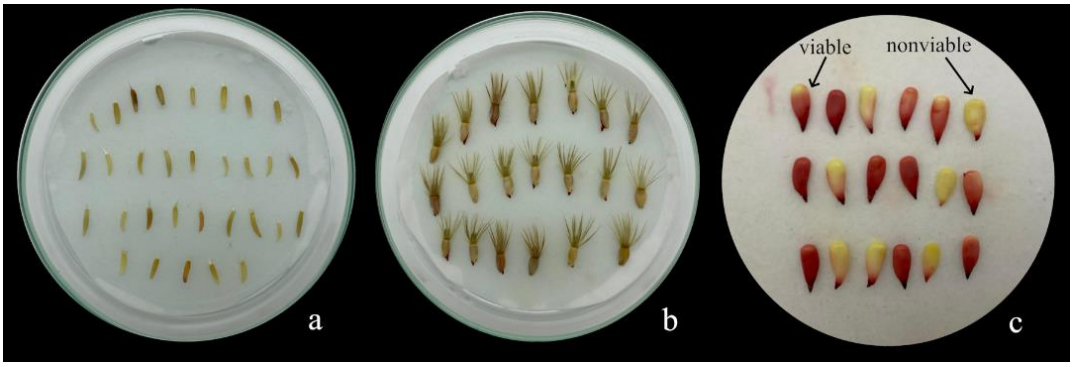

Figure 6. *Centaurea lydia* seed viability tests a) achenes of marginally sterile flowers b) achenes of tubular flowers c) seeds of tubular flowers

Table 7. *Centaurea lydia* seed viability test results

Seed source	Number of seeds analyzed	Number of viable seeds	Viable seeds (%)	Nonviable seeds (%)
Tubular flower achenes (VT)	400	238	59,5	40,5
Infundibular flower achenes (VI)	400	0	0	100

Seed Germination Succes

It was observed that the seeds planted in the petri dish germinated within 2-5 days. At the end of the 5th day, the seed germination rate was determined to be 66% (±15.1). The seeds germinated and began to show their radicles 2 days after the experiment was established. In addition to radicle elongation, hypocotyl region elongation was observed from the 3rd to the 7th day. At the end of the 7th day, there was no loss in the seeds transferred to soil vials. On the 14th day, the seeds that photosynthesize with their cotyledons begin to develop their first leaf primodia and on the 21st day, they begin to develop their second leaf (Figure 7).

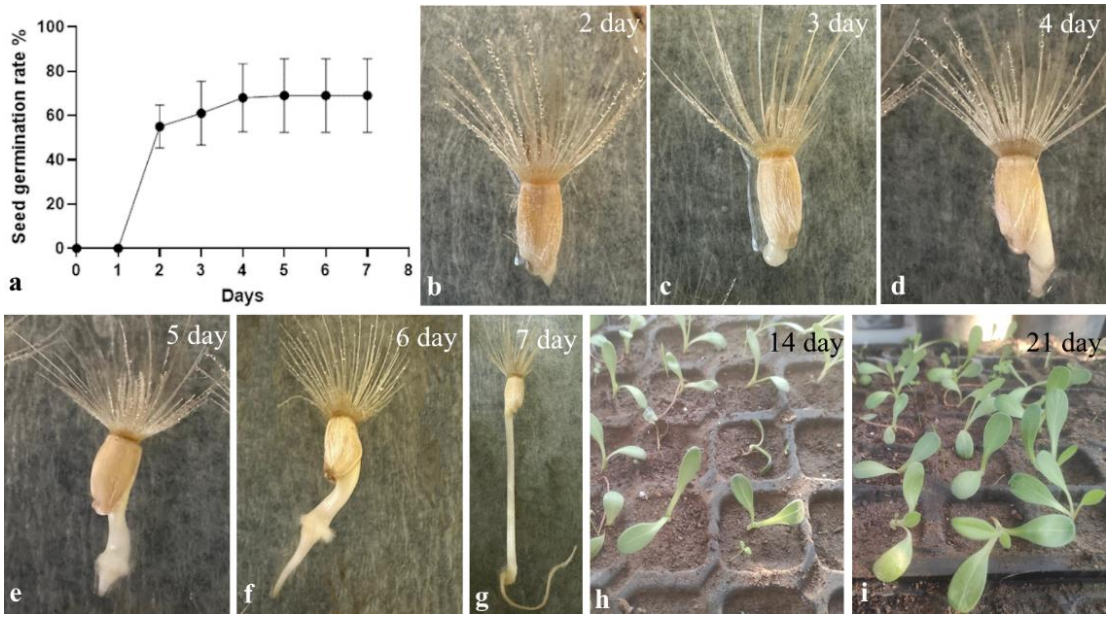

Figure 7. The observation of seed germination **a)** day by day seed germination rate **b)** 2 day **c)** 3 day **d)** 4 day **e)** 5 day **f)** 6 day **g)** 7 day **h)** 14 day **i)** 21 day

Reproductive succes

An individual produces approximately 5456 seeds. 40.86% of the seeds produced are fertile. 15.9% of the 59.14% loss in seed development is due to negativities in the pre-zygotic stage, and 43.24% is due to loss of vitality due to negativities in the use of maternal resources after fertilization (Table 8). Despite these failures, no loss was experienced during the transfer of germinated seeds from petri dishes to vials and from there to soil.

Table 8. Reproductive succes of *Centaurea lydia*

Reproductive success criteria	Calculation formula	Results
Total Number of Seeds Produced in a Plant	C×(TD+TN+ID+IN)	5456,36
Number of Fertile Seeds Produced in a Plant	C×((TD×VT/100)+(ID×VI/100))	2228,82
Rate of Fertile Seeds Produced in a Plant (%)	(Fertile Seeds Produced in a Plant/Total seeds in a plant) × 100	40,86
Number of Sterile Seeds Produced in a Plant	Total seeds in a plant-Fertile Seeds Produced in a Plant	3227,54
Rate of Sterile Seeds Produced in a Plant (%)	(Sterile Seeds in a Plant/Total seeds in a plant) × 100	59,14
Failure Rate Due to Non-Developing Seeds (%)	((TN+IN)/(T+I))x100	15,90
Failure Rate Due to non-viability (%)	(C×(TD×(1-VT/100)+ID×(1-VI/100)))/Total seeds in a plant	43,24

C: Average number of capitula on a plant; T: Average number of tubular flowers per capitula; I: Average number of infundibular flowers per capitula; TD: Average number of developing tubular flower achenes per capitula; TN: Average number of non-developing tubular flower achenes per capitula; ID: Average number of developing infundibular flower achenes per capitula; IN: Average number of non-developing infundibular flower achenes per capitula; VT: Viability rate of developing tubular flower achenes; VI: Viability rate of developing marginal flower achenes

4. Conclusions and discussion

In our research on the reproductive system of *C. lydia*, we examined the stigma receptivity and pollen viability tests in detail with multiple chromogenic enzyme activity tests at 4 different stages of flower development. It has often been emphasised that understanding pollen-stigma interactions requires the use of multiple assays [29,30,31,32]. Therefore, in our study, we used multiple assays to investigate pollen viability and stigma receptivity. Among the tests we used, MTT indicated the presence of respiration through dehydrogenase activity, DAB revealed whether ROS produced as a result of respiration were scavenged by peroxidases, TMB detected the presence of H_2O_2, which acts as a signalling molecule in pollen germination on stigmas, TMB detected the presence of H_2O_2, which acts as a signalling molecule in pollen germination, in stigmas, p-NPA showed at which flower stage the stigma tissue was softened with esterase activity and provided a suitable environment for pollen germination, and Evans Blue showed at which stage the permeability of the stigma cells was reduced and stigma secretions were released for pollen germination. Recent studies have shown that higher levels of H_2O_2 than other reactive oxygen species (ROS) are required for pollen grains to germinate on stigmas [33,34,35]. We observed that dehydrogenase activity in *C. lydia* stigmas gradually increased after the second stage of flowering and that peroxidase activity, which functions to scavenge ROS produced during respiration, increased in parallel. The high levels of H_2O_2 required for pollen germination in stigmas at all flowering stages except the bud stage indicated that the stigmas were receptive at these stages and that both esterase and permeability in the stigmas were impaired at these stages, suggesting that the stigmas provided a suitable environment for pollen germination. The fact that pollen is viable and the stigma is receptive in the pre-anthesis and post-anthesis stages of the flower suggests that the species is open to both autogamy and allogamy. It was determined that pollination can occur before the flowers start to open and during the secondary pollen presentation. In addition to Hildebrand's [25] secondary pollen presentation mechanism in genus *Centaurea*, measurements were made in detail at 4 flower phases in the species we studied, and showed that the coral tube and style elongation are of critical importance in presentation. Additionally, in this study, which we initiated for ex-situ conservation purposes at the Ege University Botanical Garden with seed samples collected from pre-fire populations, positive results were obtained and the grown seedlings were transferred back to the natural population. In addition, within the scope of the "Collection and Ex Situ Conservation of Rare, Endemic and Threatened Plant Species in İzmir Province" project carried out by the Aegean Agricultural Research Institute, seed samples taken from the mentioned regions were transferred to the National Gene Bank. According to our studies, the fact that the fertile seeds produced by the species with a potential of 40.86% can be obtained as seedlings without any loss shows the high success of the species in reproduction. However, the fact that the Izmir population of *C. lydia* is located very close to the city is the biggest threat to the species, as seen in the fires that occurred in 2024 and before.

The close proximity of the population of *C. lydia* in Izmir to urban areas has resulted in the occurrence of several human-induced fires within its distribution range in 2024 and in previous years. The response of *Centaurea* species to fire and post-fire conditions varies among taxa. In the United States, high-temperature summer fires have been shown to be effective in controlling the invasive species *Centaurea stoebe* by reducing its dominance and decreasing soil levels of the allelopathic compound catechin [27]. A similar outcome was reported in a study by Riba et al. [28], who exposed seeds from 20 *Centaurea* taxa to heat treatments ranging from 70–110°C. While eight taxa exhibited increased germination rates with rising temperatures, the remainder showed decreased germination, with most of these being rare

species. These findings suggest that rare taxa may have limited capacity for post-fire recruitment and establishment. Within this context, fire represents a significant threat to *C. lydia*, a narrow endemic species. A substantial proportion of its population in Izmir has already been affected by fire, and the majority of extant populations are located in close proximity to residential areas, leaving the species continuously vulnerable to future fire events. Given this ongoing threat, it is estimated that at least 10% of the population may be lost within the next 100 years, highlighting the urgent need for a comprehensive population study to realistically assess its conservation status. A comparable reassessment was observed in *Centaurea amanea*, whose conservation status was elevated from Endangered (EN) to Critically Endangered (CR) due to anthropogenic pressures [13]. Although *C. lydia* exhibits relatively high seed germination rates, the inability to protect its habitat from human disturbance undermines the effectiveness of all conservation actions undertaken to date.

Acknowledgements

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Contributions to the family *Arachnopezizaceae* from Çanakkale (Türkiye)

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Abstract

Based on phylogenetic and morphological analyses, the family Arachnopezizaceae Hosoya, J.G. Han & Baral, which is placed in the order Helotiales, contains non-operculate Discomycetes. Subiculum and septate spores are important morphological characters in this family. Subiculum refers to the protruding hyphal elements forming an interconnected network-like structure on the substratum surrounding the apothecia. This study focused on the micro and macro characters of *Arachnoscypha aranea* (De Not.) Boud. detected on decaying *Pinus brutia* L. branches near the dam lake in Bayramiç district, Çanakkale on 25 and 28 January 2025, and *Arachnopeziza obtusipila* Grelet detected on decaying branches of *Quercus coccifera* L.–*Pinus brutia* L. near Serçiler village. Macrofungal samples were identified as a result of meticulous field and laboratory studies. As a result of the data obtained, the macro- and micromorphological characteristics of the new genus record *Arachnoscypha aranea* and the new species record *Arachnopeziza obtusipila* were described and illustrated. In order to make the macrofungi described based on morphological characters clearer and more understandable, micromorphological features were drawn using CorelDRAW drawing software. The first record of the genus *Arachnoscypha*, which is represented by two species in the world, and the third species of the genus *Arachnopeziza*, which is represented by two species in our country, were given in this study, contributing to the mycobiota of Türkiye,

Keywords: *Ascomycota, Helotiales*, new record, subiculum

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Çanakkale (Türkiye)'den Arachnopezizaceae familyasına katkılar

Özet

Filogenetik ve morfolojik analizlere dayanarak Helotiales ordosu içerisinde konumlandırılan Arachnopezizaceae Hosoya, J.G. Han & Baral familyası noperkülat Discomycetes türleri içermektedir. Subikulum ve septat sporlar bu familyada öne çıkan önemli morfolojik karakterlerdir. Subikulum, apothecia'yı çevreleyen substratum üzerinde birbirine bağlı ağ benzeri bir yapı oluşturan çıkıntılı hifal elemanları ifade etmektedir. Bu çalışma 25 ve 28 Ocak 2025 tarihlerinde Çanakkale, Bayramiç ilçesinde yer alan Baraj gölü yakınlarında çürümekte olan *Pinus brutia* L. dalları üzerinde tespit edilen *Arachnoscypha aranea* (De Not.) Boud. ve Serçiler köyü civarında *Quercus coccifera* L.–*Pinus brutia* L.'nın çürümekte olan dalları üzerinde tespit edilen *Arachnopeziza obtusipila* Grelet'nın mikro ve makro karakterlerine odaklanmıştır. Makrofungus örnekleri titizlikle gerçekleştirilen saha ve laboratuvar çalışmaları neticesinde teşhis edilmiştir. Elde edilen veriler neticesinde yeni cins kaydı *Arachnoscypha aranea* ve yeni tür kaydı olan *Arachnopeziza obtusipila*'nın makro ve mikromorfolojik özellikleri tanımlanmış ve gösterilmiştir. Morfolojik karakterlere dayalı olarak tanımlanan makrofungusların daha anlaşılır ve net olması için CorelDRAW çizim programı kullanılarak mikromorfolojik özellikler çizilmiştir. Dünyada iki tür ile temsil edilen *Arachnoscypha* cinsinin ilk kaydı, ülkemizdeki tür sayısı iki olan *Arachnopeziz*a cinsinin üçüncü türü bu çalışmada verilerek Türkiye mikobiotasına katkı sağlanmıştır.

Anahtar kelimeler: *Ascomycota, Helotiales*, yeni kayıt, subikulum

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1. Introduction

Leotiomycetes were defined by Eriksson and Winka [1] to include the inoperculate discomycetes under one umbrella. The members of Leotiomycetes are characterized by apothecial ascomycetes with inoperculate, unitunicate ascus, which only open by apical perforation or pore to release their spores [2-4]. Leotiomycetes contained a wide variety of taxa before it was studied by Ekanayaka et al. [4]. However, phylogenetic analyses ended this complexity within the class [5-6]. According to recent morphological and phylogenetic-based studies, this class includes 12 orders, 44 families, and about 580 genera, excluding new taxa [4,7]. Helotiales, the order with the highest species diversity in the Leotiomycetes, is one of the apothecial ascomycete groups containing 29 families, 3000-4000 taxa, including non-stromatic discomycetes with inoperculate ascus, usually a few mm in diameter [8-11]. Morphological characters are essential to distinguish the families of Helotiales, whose apothecia are cupulate-discoid in shape and covered with brightly colored, primarily excipular hairs [2, 12-14]. In the traditional broad sense, Helotiales' largest and most diverse family is Hyaloscyphaceae [4,8]. When Nannfeldt [15] at 1932 introduced the concept of Hyaloscyphaceae, it included three tribes, Arachnopezizeae, Hyaloscypheae, and *Lachneae*, and 13 genera. In Nannfeldt's classification, *Lachneae* included species with lanceolate paraphyses and multi-segmented granular hairs and *Arachnopezizeae* species with a subiculum surrounding the apothecia [4]. Studies involving multigene phylogenetic analyses have shown that Hyaloscyphaceae is polyphyletic [16-17]. There are also six or more clades distributed among the clades of Helotiales. These clades exhibit hyaloscyphoid characteristics. They correspond to corrected tribes/subfamilies/families and two newly described families (Arachnopezizaceae, Hyaloscyphaceae s.str., *Lachnaceae*, Pezizellaceae, Vandijckellaceae), as well as unnamed groups [18].

Of the three original tribes described by [15], Arachnopezizeae consisted of very few species, and Nannfeldt tentatively classified the tribe in this group to be sure of its status. However, Korf (1951) [19] confirmed the tribe. He emphasized the importance of the subiculum together with the septate spores as essential morphological characters defining a natural group. The subiculum refers to the protruding hyphal elements that form an interconnected network-like structure in the substratum surrounding the apothecia [8,17,19] also described the tribe as having septate bristles and partly thick-walled excipular cells. He included the genera *Arachnopeziza*, *Eriopezia*, and *Tapesina* in *Arachnopezizeae* and placed *Arachnoscypha* as a synonym of *Arachnopeziza*. Later, Korf [20] recognized *Arachnopezizeae* as a subfamily within *Hyaloscyphaceae*. However, Han et al. [16] addressed the delimitation and relationship between *Hyaloscyphaeae* and *Arachnopezizeae* in their phylogenetically based study. Finally, Baral et al. [5] raised the order of *Arachnopezizeae* to its current status as a family including the genera *Arachnopeziza*, *Arachnoscypha*, *Austropezia*, *Eriopezia*, and *Parachnopeziza*.

The genus *Arachnoscypha* listed by Boudier [21] was founded with a single species (‘L'espèce typique’), *Peziza aranea*. Boudier [22] included *P. aranea* in *Arachnopeziza* and unified it. However, the genus was later re-examined by Korf [19] and *Arachnoscypha* was accepted as a synonym of *Arachnopeziza* based on the presence of multiseptate hairs, septate spore, and a subiculum. As a result of molecular phylogenetic analyses carried out in recent years, *Arachnoscypha* was defined as a different genus, and the type specimen was determined as *Arachnoscypha aranea* [17].

When the mycobiota of Türkiye listed by Sesli et al. [23] and some recent studies were examined it was determined that *Arachnoscypha aranea* (De Not.) Boud. was a new record at the genus level, and *Arachnopeziza obtusipila* Grelet was a new record at the species level for the mycobiota of Türkiye.

2. Materials and methods

Fresh ascomata specimens of *Arachnoscypha* were collected from decaying *Pinus brutia* branches on 25 January 2025 in a forested area near Bayramiç Dam Lake, and fresh ascomata specimens of *Arachnopeziza* were collected on *Quercus coccifera/Pinus brutia* branches near Serçiler Village cemetery on 28 January 2025. All morphological characters of *Arachnopeziza* and *Arachnoscypha* specimens collected on *Pinus* and *Quercu*s branch fragments, the geographical location of the collection site and other relevant details, were meticulously noted in the field notebook. Photographing was crucial for identification and was carried out with great care and documentation. After the fieldwork, the mushroom samples were transported to the fungarium. They were dried in an environment out of the sun and labeled for later use. Sections were taken from the fungarium material under Motic SMZ-171 Stereo Zoom Microscope (China), and preparations were prepared in water and Melzer Reagent. A Leica DM500 light microscope was used to analyse the microcharacters. Microscopic characters (asci, paraphyses, ascospores, hairs, etc.) were measured at least 30 times using Leica Application Suite (version 3.4.0) to determine the most reliable reference intervals. *Arachnoscypha aranea* (De Not.) Boud., a new genus record for the mycobiota of Türkiye, and *Arachnopeziza obtusipila* Grelet [17,19] were identified following the methods described by the authors. Micromorphological characters of *Arachnopeziza obtusipila* and *Arachnoscypha aranea* were drawn and illustrated to enhance clarity using CorelDRAW (64-bit) software. After species identification, *Arachnopeziza* and *Arachnoscypha* specimens, which were previously converted into fungarium material, were preserved in Van Yüzüncü Yıl University, Faculty of Science, Department of Biology (VANF) fungarium under appropriate conditions.

3. Results

A brief description of *Arachnopeziza obtusipila* and *Arachnoscypha aranea*, macromorphological pictures, and microcharacter drawings are presented.

Ascomycota Caval.-Sm.
Leotiomycetes O.E. Erikss. & Winka
Helotiales Nannf.
Arachnopezizaceae Hosoya, J.G. Han & Baral
Arachnopeziza Fuckel
Arachnopeziza obtusipila Grelet **(Figure 1–2)**

Apothecia measure 0.1–0.4 mm, are sessile and gregarious, with a white or whitish disc that becomes plane to concave upon drying. They exhibit an abundant subiculum composed of cobweb-like hyaline hyphae. Subiculum whitish, scanty, smooth or slightly roughened, sometimes septate. The margin is provided with sparse and conspicuous hyaline hairs, multiseptate, with obtuse apices and walls encrusted with deciduous gummy material. **Hairs** (45–)75–100(–110) × 4-5 (below) × 3.5–4 (apex) µm, gradually tapering from base to apex, sometimes slightly swollen at apex, occasionally constricted at septa, smooth or with external particles. **Asci** measure 65-90 × 8–12 µm, are clavate, arising from croziers, with an abruptly truncate tip. The pore turns blue in Melzer's Reagent, and each ascus contains eight spores. **Ascospores** (18–)22–35(–37) × 2.8–3.8(–4.2) µm biseriate, hyaline, subfusoid, attenuate below, irregularly, 3(4)-septate at maturity. **Paraphyses** 1.4–1.8 µm wide, filiform, hyaline, septate, simple or branched, apex often variously misshapen, about as long as the asci. **Ectal excipulum** gelatinized textura intricata, up to –23µm, hyphae approximately 1.5 µm wide, hyaline, thick-walled, consisting of textura prismatica, hyphae 5.2-8 µm wide, giving rise to hairs.

Specimens examined: Türkiye, Çanakkale, near Serçiler village, 40°03′02"N, 26°35′35"E, 115 m, on decaying *Pinus brutia* and *Quercus coccifera* branches, 28.01.2025, Acar 2048.

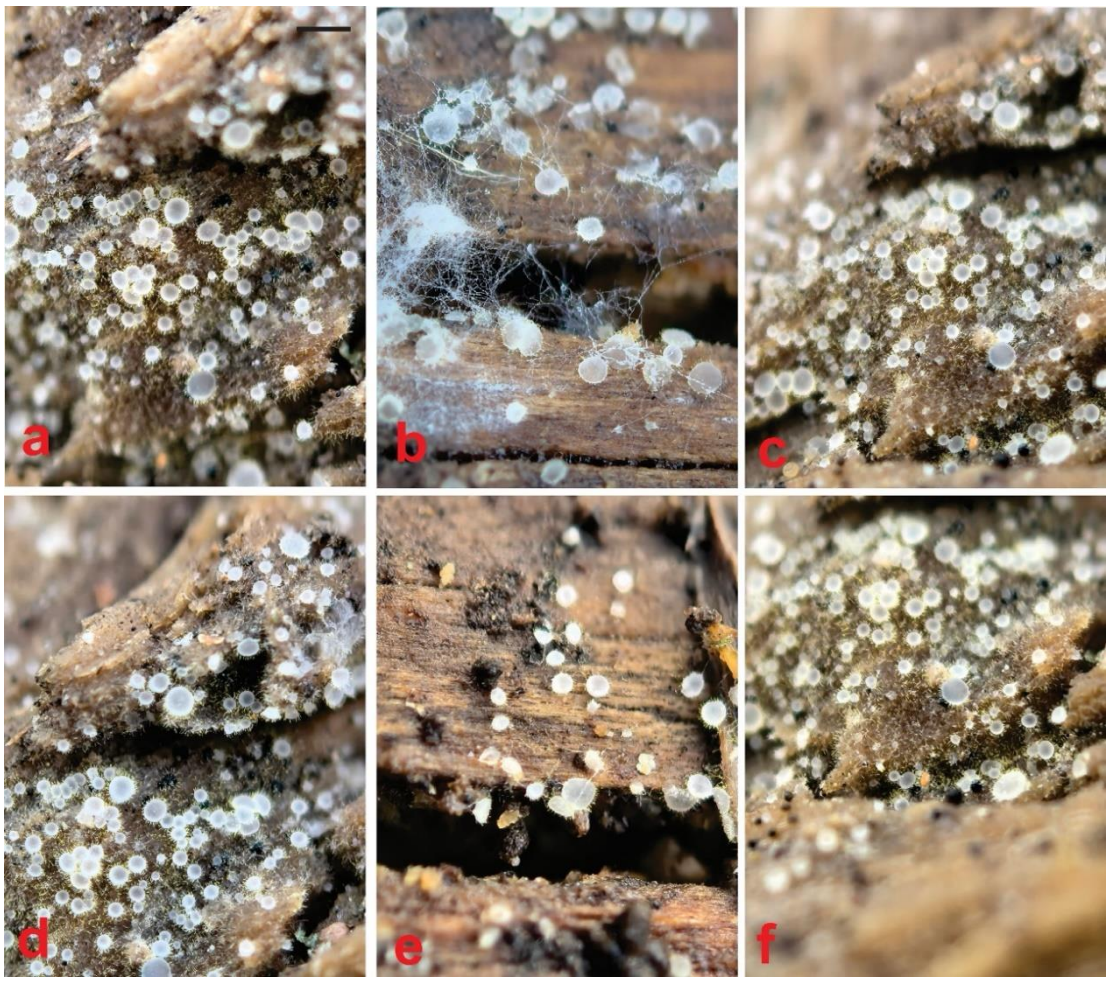

Figure 1. *Arachnopeziza obtusipila* **a-f.** Ascomata **Scale bar**: 1 mm for (a)

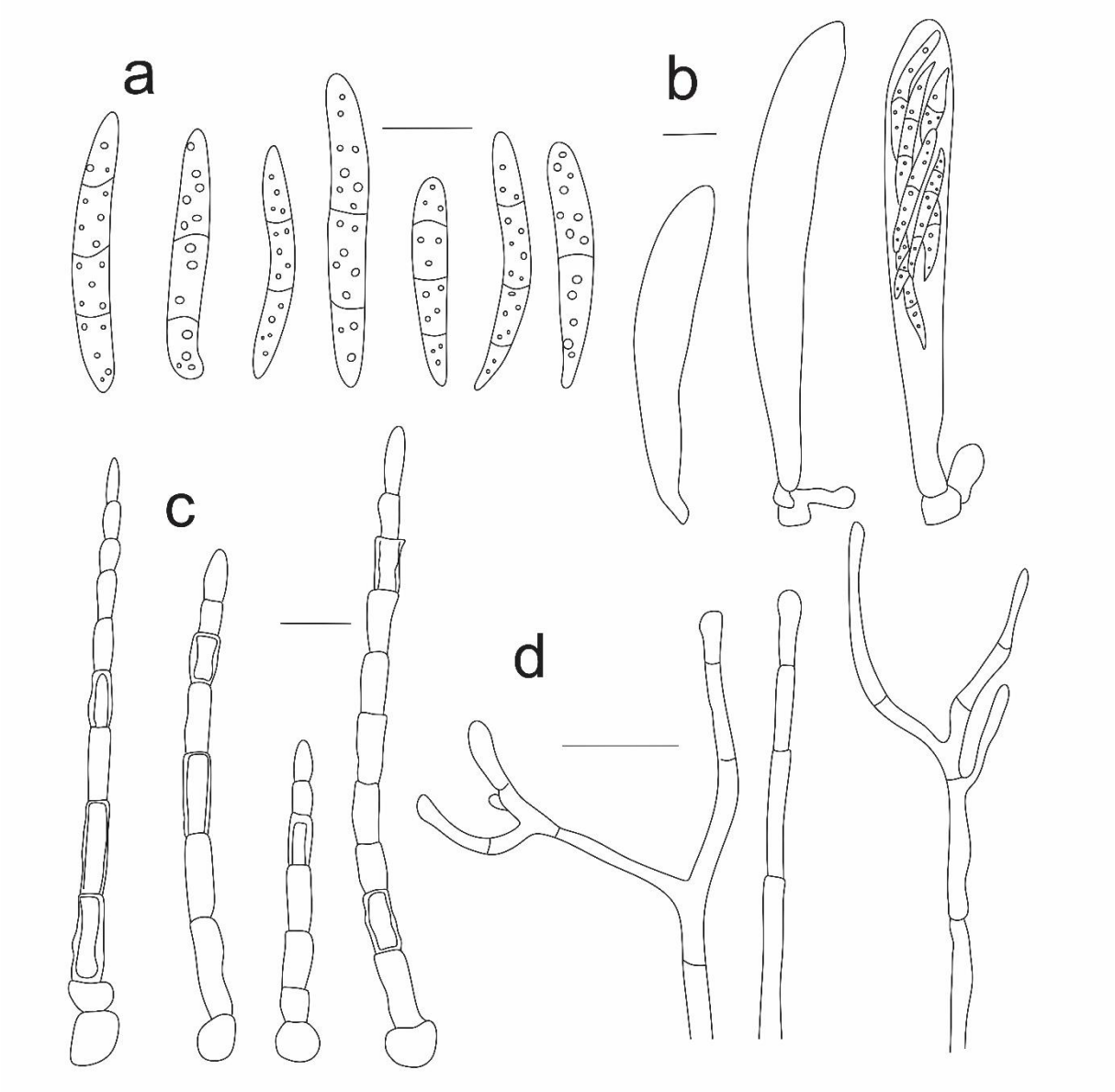

Figure 2. *Arachnopeziza obtusipila* **a.** ascospores, **b.** asci, **c.** hairs, **d.** paraphyses **Scale bar**: 10 µm

Arachnoscypha Boud.
Arachnoscypha aranea (De Not.) Boud. **(Figure 3–4)**

Apothecia 0.2–0.6 mm, sessile, white–pale yellow, surrounded by a 'mesh of" of wavy hairs arising from the sides and with superficially similar fastening hyphae arising from the base. The fresh hymenium yellowish in color. **Hairs** 38–95 × 3.8–6.5 µm, 2–4 septate, markedly enlarged, bulb-shaped, and have relatively short basal cells. Thanks to their thin-walled structure, they are usually covered with crystalline exudate. Numerous long hairs are present, some of them up to several hundred µm long. The width varies slightly but usually does not exceed 5 µm. These sparsely septate bristles taper at their tips to a slender apex 1–2.5 µm wide. They may also exhibit a twisted structure with irregular intervals and may contain crystalline exudate. **Asci** 40–65 × 5–7(–7.5) µm, cylindrical to clavate, ascus apex turning blue at IKI, with crosier at the base. **Ascospores** 6–10.5(–12.3) × 1.8–3 µm, hyaline, smooth, nonguttulate, subfusoid to slightly allantoid, cylindrical, sometimes with a septum. **Paraphyses** simple or bifurcated near the tips, about 1–2.2 µm wide, and irregularly wavy in appearance. The connective hyphae are 3.2–5.8 µm wide and slightly thick-walled. These hyphae contain crystalline exudate similar to bristles and show sparse branching. The textura prismatica-type ectal excipulum with variable wall thickness transitions to a gelatinized textura prismatica structure towards the inner parts, cells 7.5–12.5 µm long, and exhibits a distinct morphological difference during this transition.

Specimens examined: Türkiye, Çanakkale, around Bayramiç Dam Lake, 39°48′47"N, 26°39′56"E, 188 m, on decaying branches of *Pinus brutia*, 25.01.2025, Acar 2015.

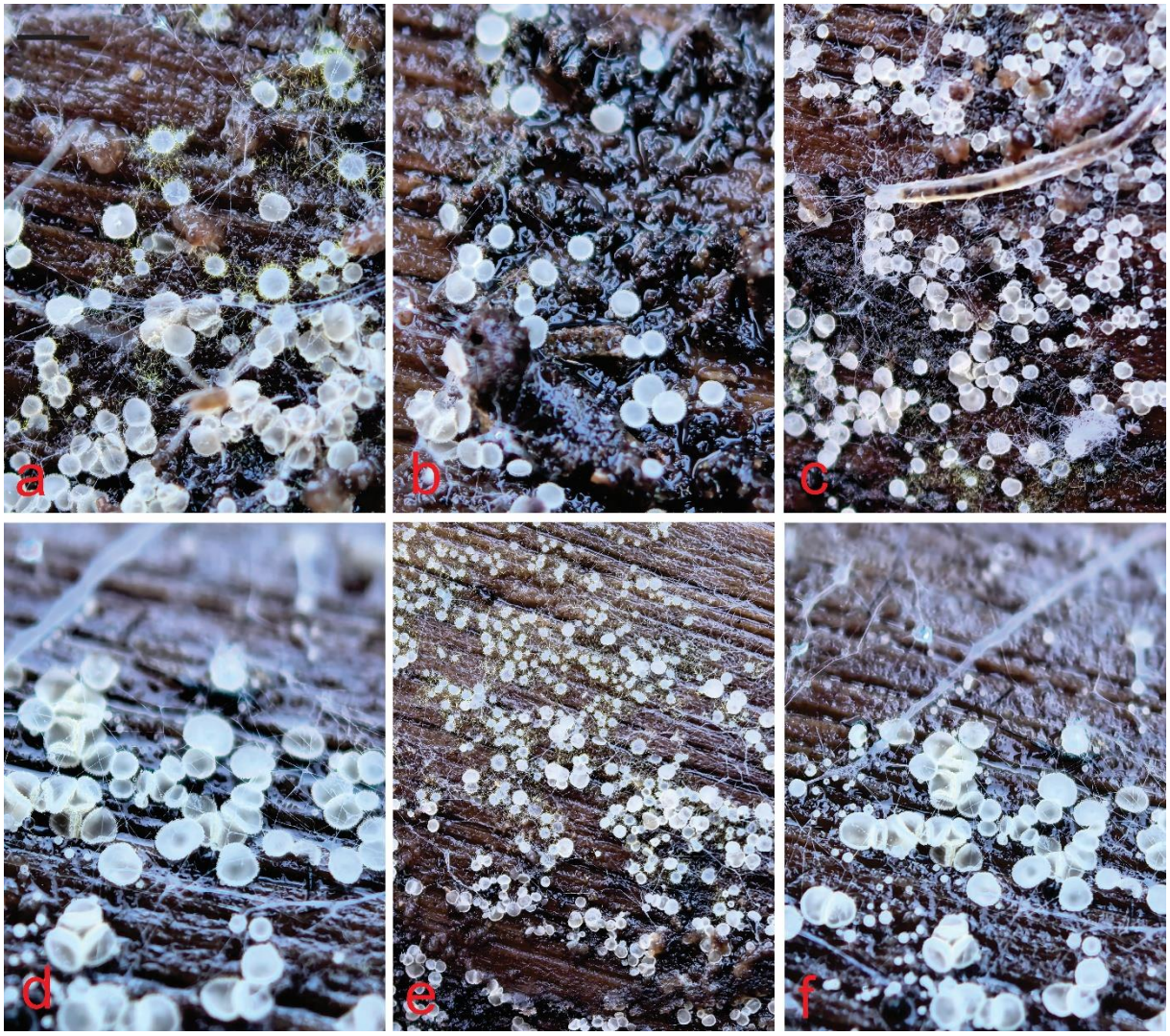

Figure 3. *Arachnoscypha aranea* **a-f.** Ascomata **Scale bar**: 1 mm for (a)

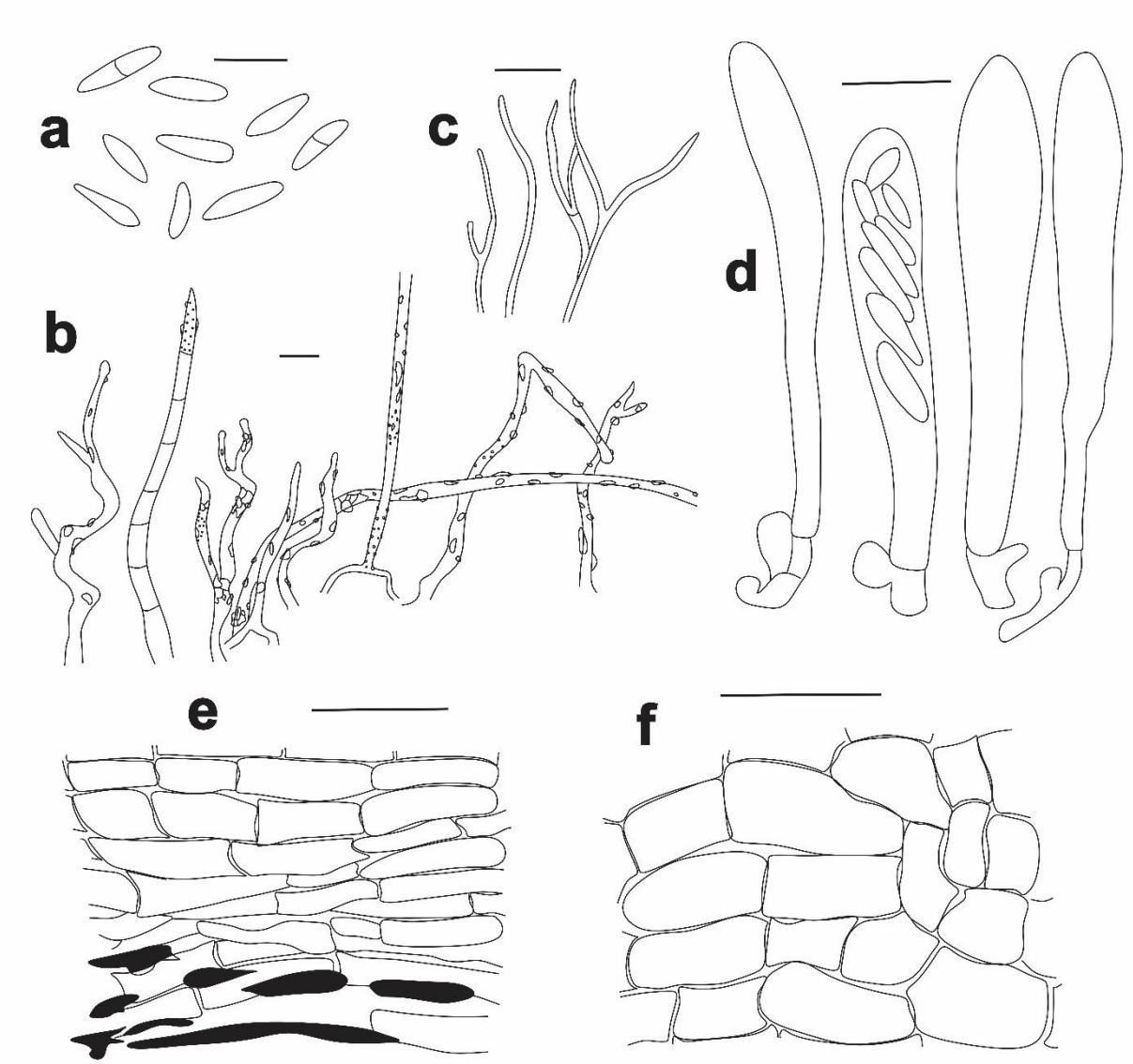

Figure 4. *Arachnoscypha aranea* **a**. ascospores, **b.** hairs, **c.** paraphyses, **d.** asci, **e.** excipulum with gelatinized textura prismatica, **f.** basal ectal excipulum **Scale bar**: 10 µm

4. Conclusions and discussion

Arachnopeziza obtusipila is macromorphologically similar to A. aurata as well as to Arachnoscypha aranea, the other species examined in our study. It is simple to distinguish *A. obtusipila* from the other two specimens microscopically. All three species' spore structures and sizes differ [17,19].

In his monograph *Arachnopeziza*, Korf (1951) restricted *Arachnoscypha aranea* to a rare species associated with *Castanea*. However, Kosonen et al. [18] emphasized that the species may occur in different substrates. Since our study specimen was found on a branch of *Pinus brutia*, it supports [18]. *A. aranea* is morphologically very similar to *Arachnopeziza* species when collected in its natural habitat. However, phylogenetic analyses and some micromorphological characters show that this species is on a different evolutionary line [17].

Two previous studies of the *Arachnopezizaceae* family have been conducted in our country. The first of these was *Arachnopeziza aurata* Fuckel in the survey conducted by Sümer [24], and the second was *A. aurelia* (Pers.) Fuckel in the study conducted by Işık and Türkekul [25]. As a result of this study, *Arachnopeziza obtusipila* was recorded as the third species of the family in Türkiye, while *Arachnoscypha aranea* was documented as the first genus-level record, contributing to the country mycobiota.

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Honey Plants of Artvin (Türkiye)

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Abstract

In this study, information about nectar and pollen plants crucial in beekeeping activities in Artvin province is presented. The aim of the research is to identify, introduce, and highlight the floristic richness of honey plants in the vicinity of Artvin province for beekeeping purposes. Through the examination of related studies, 789 plant taxa belonging to 355 genera and 91 families that honey bees (*Apis mellifera*) can benefit from were identified. 90 taxon were determined only within the scope of this study. The scientific and Turkish names, habitats, and active flowering periods important for bees were provided for these identified taxa. Lamiaceae are the largest families represented by 78 taxa each, followed by Rosaceae with 65 taxa, Asteraceae with 63 taxa, Fabaceae with 58 taxa and Apiaceae with 33 taxa. Moreover, it was determined that 600 out of the 789 plant taxa that can be used as nectar and pollen sources. This study provides information about the distribution in Artvin province, their respective families, Latin and Turkish names, districts where they are found, habitats, and active flowering periods for some plants crucial for beekeeping. Due to the absence of chemical fertilizers, herbicides, and other chemical substances for weed and pest control, the region holds significant potential for organic honey production. The high-quality organic honey produced in the region is in demand nationwide, enabling beekeepers to generate substantial income from honey production.

Keywords: Artvin, beekeeping, honey bee, honey plants, nectar plants

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Artvin'in (Türkiye) Ballı Bitkileri

Özet

Bu çalışmada, Artvin ilindeki arıcılık faaliyetlerinde kritik öneme sahip nektar ve polen bitkileri hakkında bilgiler sunulmuştur. Araştırmanın amacı, Artvin ili çevresinde arıcılık amaçları için bal bitkilerinin floristik zenginliğini tanımlamak, tanıtmak ve vurgulamaktır. İlgili çalışmaların incelenmesi sonucunda, bal arılarının (*Apis mellifera*) yararlanabileceği 91 familya, 355 cins ve 789 bitki taksonu tespit edilmiştir. Bu çalışmanın kapsamı dahilinde 90 takson yalnızca bu çalışma ile belirlenmiştir. Belirlenen taksonlar için bilimsel ve Türkçe isimler, habitatlar ve arılar için önemli olan aktif çiçeklenme dönemleri verilmiştir. Lamiaceae, 78 takson ile en büyük aile olarak temsil edilirken, bunu 65 takson ile Rosaceae, 63 takson ile Asteraceae, 58 takson ile Fabaceae ve 33 takson ile Apiaceae takip etmektedir. Ayrıca, nektar ve polen kaynağı olarak 789 bitki taksonundan 600'ünün kullanılabileceği belirlenmiştir. Bu çalışma, bal bitkilerinin Artvin ilindeki dağılımları, ait oldukları familyalar, Latince ve Türkçe isimleri, bulundukları ilçeler, habitatlar ve arıcılık için önemli olan aktif çiçeklenme dönemleri hakkında bilgi sağlamaktadır. Kimyasal gübreler, herbisitler ve diğer yabancı ot ve haşere kontrolü için kimyasal maddelerin bulunmaması nedeniyle, bölge organik bal üretimi için önemli bir potansiyele sahiptir. Bölgede üretilen yüksek kaliteli organik bal, ülke genelinde talep görmekte olup, arıcıların bal üretiminden önemli gelir elde etmelerini sağlamaktadır.

Anahtar kelimeler: Artvin, arıcılık, bal arısı, bal bitkileri, nektar bitkileri

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1. Introduction

Beekeeping is a branch of agriculture that has a long history as a soilless farming method. The goal of beekeeping is to allow bee colonies to collect nectar, pollen, and propolis from the natural plant sources in the area during the main nectar flow period, and to convert these into various bee products in the most economical way possible. Nectar and pollen constitute the carbohydrate and protein sources for bees, and both wild and honey bees perform an important role in pollination, which is ecologically and economically significant [1-3]. To achieve this goal, it is necessary to have a good understanding of the flora in the area where beekeeping is practiced, as well as the timing and duration of flowering and nectar flow, and the amount of nectar available. The yield from beekeeping is dependent on the productivity, strength, and diligence of the colony, as well as the variety and abundance of nectar and pollen sources [6]. Therefore, identifying suitable production areas and their capacities will not only maximize the utilization of plant sources, but also directly impact production and productivity [4].

In nature, the interrelationships between organisms hold great importance in terms of maintaining the balance of natural life. The relationship between bees and plants is important for both the continuity of plants and as a food source for bees, as well as providing high-nutrient value products for humans. Beekeeping, which is a form of animal-based agricultural production, presents significant economic opportunities in today's world. The ability of beekeeping enterprises or families to engage in production is fundamentally based on the floral resources in the areas where they practice beekeeping. Honey bees (*Apis mellifera* L.) collect nectar (honeydew), pollen (flower dust), and propolis from the flora and transform these substances into commercial products in the most economical way [5]. Therefore, it is necessary to have a good understanding of the flora in the beekeeping area, as well as knowing the flowering time and nectar potential [6].

Türkiye, where four seasons coexist, is one of the most important countries in terms of agricultural diversity and ecological regions. It is also a genetic center for many plants and animals due to its unique characteristics. In this regard, Türkiye is like a paradise for beekeeping. With a population of 6.88 million beehives and an annual honey production of 105,000 tons, Türkiye ranks second in the world after China. Türkiye, where high-quality honey is obtained in different regions, has approximately 75% of the world's honey plant flora. With its rich flora, suitable ecology, colony presence, and genetic variations among its bee populations, Türkiye has a significant potential for beekeeping [7]. Despite having favorable conditions for beekeeping, there have been limited studies on the recognition of nectar plants, pollen, and flowering times [8,9].

Artvin province, which is located in a transition climate between the Black Sea and Continental climates, with almost four seasons coexisting, rich plant diversity, and almost no use of agricultural chemicals and fertilizers, no industry, and surrounded by abundant and clean water sources, is highly suitable for beekeeping. Artvin is the richest province in terms of plant diversity in Türkiye, with a total of 2,727 natural plant taxa belonging to 137 families and 761 genera. Different vegetation types, such as pseudomaki, stream, forest, alpine, and subalpine vegetation, are distributed at different elevations in Artvin [10-12]. Just as Türkiye is a special and important country for beekeeping globally, Artvin province and its districts hold a special and important place for Türkiye. Artvin province has the highest number of beekeepers per capita in Türkiye. Artvin is one of the most valuable gene centers that protect and maintain the Caucasian race in the beekeeping sector. It is also among the top 10 provinces in Türkiye in terms of queen bee and honey production. Artvin province is one of the most valuable gene centers that protect and maintain the Caucasian race in the beekeeping sector. Artvin province has 110,822 bee colonies and produces 1.062 tons of honey (2,075 beekeepers), ranking 16th in Türkiye [13]. In Artvin province, where the Caucasian bee race is protected, mobile beekeeping is dominant. Despite the limited parcel size of the province, it is highly suitable for beekeeping due to its clean water sources, which range from zero meters to 3,564 meters above sea level [11].

Artvin is located in a suitable position in terms of natural and cultural plant resources that are important for beekeeping. Due to its geography, water sources, and climate differences, it is rich in floral resources. In this study, honey plants that are important for honey bees in the Artvin flora were identified. To contribute to the beekeeping sector in provinces and countries. This study is an important step to increase Artvin's beekeeping potential and to increase the income of beekeepers.

2. Material and method

2.1 Study Area

Artvin province is located between the north latitudes 40° 35' to 41° 32' and east longitudes 41° 07' to 42° 00', covering an area of 7367 km² in the Black Sea Region of Türkiye. The province constitutes approximately 0.9% of the total land area of Türkiye (783,577 km²). It shares borders with Ardahan to the east, Erzurum to the south, Rize to the west, and Georgia to the north. To the northwest, it has a coastline along the Black Sea that is 34 km long. The extension of the Eastern Black Sea Mountains, named Kaçkar, Altıparmak, Kükürtlü, and İskaristi Mountains, runs parallel to the Black Sea coast within the provincial boundaries (Figure 1). On top of this mountain range, numerous peaks and high

hills can be found. Moving from west to east along the Black Sea coast, the Kaçkar Mountain, with an elevation of 3937 m, forms the highest point of the Eastern Black Sea Mountains. The watershed lines of this mountain determine the borders of Artvin, Rize, and Erzurum provinces. Another significant mountain in the province is the Karçal Mountain, located between the Şavşat and Borçka districts, extending to the Georgian border with an elevation of 3428 m. It is characterized by the Çoruh and Berta valleys [11].

Figure 1. Artvin provinces

2.2 Data collection

The main material of the study consists of plants that are distributed in Artvin province and its districts and have honey potential. A total of 2727 plant species found in Artvin province were scanned based on their characteristics such as nectar, pollen, honeydew, and propolis, and species possessing these qualities were listed. Field studies were conducted for these species commonly known as honey plants, and living samples or seeds were collected from the field for many of them. Field studies were conducted from 2019 to 2023 during the vegetation period, with two visits per month, for the purpose of collecting plant samples from Artvin province and its surroundings.

Three or four duplicate samples were prepared from each plant, and these samples were deposited in the Artvin Çoruh University Herbarium (ARTH). Photographs of each plant were taken in the field and information such as location, habitat characteristics, elevation, flowering time and collection date were documented. These samples were dried according to herbarium techniques, diagnosed using a binocular stereo zoom microscope, and transformed into herbarium material. The identification of plant samples was based on the book "Flora of Turkey and the East Aegean Islands" [14] for specific names, and for general names, the references used were " List of Plants of Türkiye Vascular Plants [15], " Turkish Plant Names Dictionary" [16], Artvin's National Plants [11]. The current names were also verified through IPNI [17].

3. Results

A total of 789 plant taxa belonging to 355 genera and 91 families were identified as honey plants, 366 plants are nectar-pollen sources, 194 are pollen sources, and 40 are nectar sources (Table 1, 2).

Table 1. The number and ratios of taxa containing nectar and pollen in the research field

Nectar or Pollen Sources	Takson Number	%
Nectar-Pollen	366	46%
Pollen	194	25%
Nectar	40	5%
Unknown	189	24%

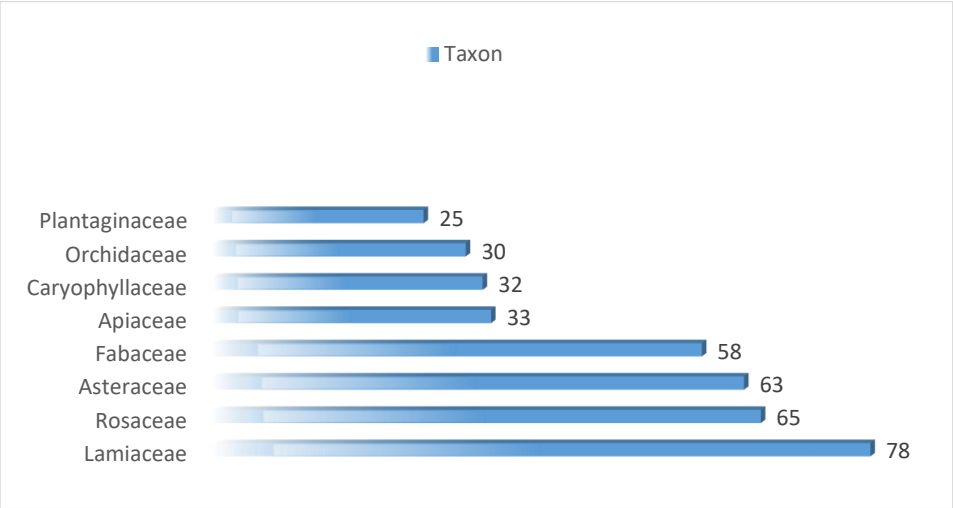

Figure 2. The distribution of identified honey-bearing plants based on families

Lamiaceae are the largest families represented by 78 taxa each, followed by Rosaceae with 65 taxa, Asteraceae with 63 taxa, Fabaceae with 58 taxa and Apiaceae with 33 taxa (Figure 2). Phylogeographic distributions were determined (Figure 3). 90 taxa were only determined within the scope of this study (Figure 4-5).

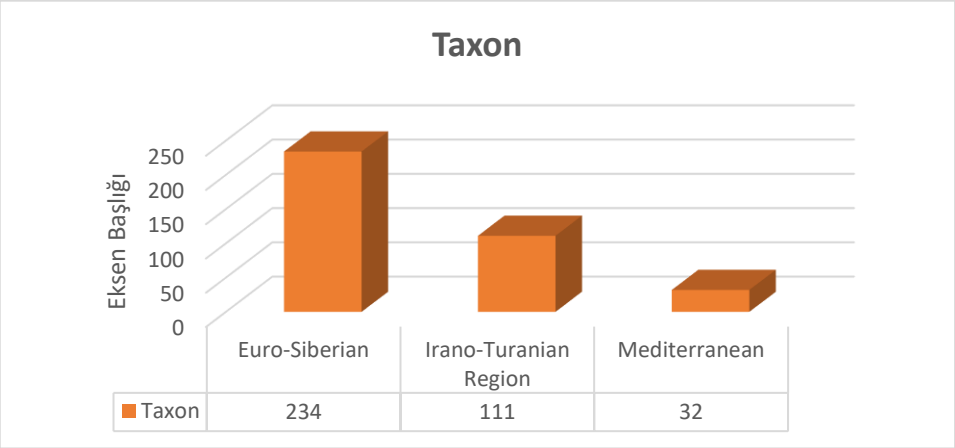

Figure 3. Phylogeographic distributions of honey plants from Artvin

As a result of the investigation into the phytogeographical regions of the plant species identified in the field, it was determined that 234 species are of Euro-Siberian origin, 111 species are of Irano-Turanian origin, and 37 species are of Mediterranean origin. No data were found for 412 plant species.

According to the results of this study, the natural pastures in the Narman district contain important honey-bearing plant species. It was observed that 789 plant species in the field are frequently visited by bees. These plant species are stated to be important for beekeeping and honey production.

The distribution of these plants by families, their local names, habitats, elevations, and information about whether bees prefer them more for nectar or pollen, herbarium code are provided in Table 2. All samples were collected from the field, and the preferences of bees for nectar and pollen from these plants were reviewed from the literature, with the sources provided.

Figure 4. Some honey plants in Artvin; a- *Achillea millefolium* b-*Rhododendron caucasicum*, c-*Vaccinium arctostaphylos*, d- *Arbutus andrachne*, e- *Ajuga chamaepitys*, f- *Lathyrus laxiflorus*, g- *Lamium garganicum*, h- *Salvia forskahlei*

Figure 5. Some honey plants in Artvin; a- *Allium schoenoprasum* b-*Cotinus coggygria*, c-*Rhus coriaria*, d- *Achillea millefolium*, e- *Cistus creticus*, f- *Cistus salviifolius*

4. Conclusions and discussion

In this study, carried out between 2019 and 2023 in Artvin, plant identification and descriptions were carried out based on both literature review and field observation, sampled from the field. A total of 789 plant taxa belonging to 355 genera and 91 families were identified as honey plants in this study. The fact that these taxa have long flowering periods, spread over wide areas in their growing regions, and are rich in nectar and pollen content means that bees frequently visit these plants (Figure 4-5). Therefore, it is anticipated that beekeepers will closely monitor these plant taxa. In a study conducted on honeybees and honey plants in Egypt, it was determined that 35.2% of the plants on which honeybees feed belong to medicinal-aromatic and ornamental plants, followed by vegetables (34.1%), fruits (21.9%), and field crops (8.8%) [25]. In Artvin, 90% of the identified honey plants are medicinal-aromatic plants [11]. In the study titled "Evaluation of Ethnobotanical Studies Conducted in Türkiye within the Scope of Traditional Beekeeping Activities," 52 plant taxa belonging to 24 families that bees benefit from were recorded. Of these plants, 51 are used for nectar and pollen collection, 1 is used for propolis production, and 1 is used for both nectar and pollen collection and propolis production. The top five families with the highest number of taxa from which bees collect nectar and pollen are Lamiaceae (14 taxa), Asteraceae (6 taxa), Boraginaceae (5 taxa), Fabaceae (4 taxa), and Ericaceae (3 taxa). In their study identifying bee plants on Sütey Plateau within the borders of Bitlis Province, Görhan & Öztürk identified 282 bee plant taxa belonging to 44 families. Of these taxa, 264 are pollen sources, 191 are nectar sources, and 27 are secretion sources. The top 7 families of the identified taxa are as follows: Fabaceae 42 (15%), Asteraceae 33 (12%), Lamiaceae 28 (10%), Rosaceae 18 (6%), Ranunculaceae 13 (5%), Liliaceae 13 (4%), and Caryophyllaceae 12 (4%). In general, it has been determined that the top five ranks of bee plants families show similarities. In this study, Lamiaceae are the largest families represented by 78 taxa each (10%), followed by Rosaceae with 65 taxa (8%), Asteraceae with 63 taxa (8%), Fabaceae with 58 taxa (7%) and Apiaceae with 33 taxa (4%) (Figure 2). Moreover, it was determined that 600 out of the 789 plant taxa that can be used as nectar and pollen sources.

The Artvin (Türkiye) flora is rich with suitable plants for honey bees as source of pollen, nectar or both. The degree of suitability of these plants to honey bees need to be assessed to classify plants as excellent, good or poor source of pollen or nectar. Such investigations need to be done to provide deep understanding of the Artvin flora. A total of 789 plant taxa belonging to 355 genera and 91 families were identified as honey plants in this study. Due to the presence of steep slopes carved by rivers in our province, the absence of wide plains in the valley bottoms, and the proximity to highways, migratory beekeepers face accommodation issues during early spring and late autumn periods. The distance to certification organizations, market-related challenges, and the remoteness from major cities create disadvantages in honey production and marketing.

Considering the suitability of Artvin province for beekeeping and its diverse plant species, it is crucial to prioritize the establishment of "honey forests." This is not only to preserve and ensure the continuity of such a rich flora but also to enhance beekeeping. Given the significant global importance of bee populations for pollination and biodiversity, emphasis should be placed on the creation of "honey forests" to maintain the continuity of these vital populations and ensure sustainable food security.

It has been determined that bees in the Artvin province collect pollen and nectar from 366 out of 789 honey plants, only pollen from 194 plants, and only nectar from 40 plants. It is important for the integrity of the ecosystem that the taxa distributed in Artvin have honeyed plant characteristics.

In conclusion, the aim of this study is to create a significant database for beekeepers and future scientific research by providing data on the flowering periods of important plants for beekeeping and their distribution across provinces in the Artvin province. Organic farming, which is one of the activities aimed at restoring the natural balance of the ecosystem disrupted by various factors, places honey bees in a crucial position among its key elements. Honey bees play a vital role in the genetic transmission of many plant species to future generations and contribute significantly to the natural vegetation diversity. Recognizing honey bees as a significant player in organic farming and utilizing them extensively in pollination is essential. This approach not only allows bees to assess Nectar and Pollen sources in natural pasture areas but also enhances the quality and production quantity of many plant species in these areas.

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Table 2. Important Plants for Beekeeping in the Artvin Province

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
1	Alismataceae	*Alisma plantago-aquatica* L.	çakalkulağı	N	ES	0-2300	Lake and river banks, marshes, wet soils or surface waters, ditches.	6-9	[9]; [10]; [11]	ARTH 17536
2	Amaryllidaceae	*Allium rotundum* L. (syn*: Allium scorodoprasum* subsp. *rotundum* (L.) Stearn)	deli pırasa	N, P	BS	0-1400	Calcareous and clayey degraded slopes, grasslands, prairies, beaches, sands.	5-6	[18]	ARTH 17537
3	Amaryllidaceae	*Allium schoenoprasum* L.	peynirsirmosu	N, P	--	2000-3300	Streams, lakeside, alpine meadows, wet meadows, calcareous and shaded cliffs	6-8	[19]; [20]	ARTH 17538
4	Anacardiaceae	*Cotinus coggygria* Scop.	boyacısumağı	N, P	--	0-1300	Maquis, scrubland and forests.	4-6	[9]; [10]; [11]	ARTH 17539
5	Anacardiaceae	*Rhus coriaria* L.	sumak	N, P	--	600-1900	Thickets, coasts, forests	6-7	[5]	ARTH 17540
	Anacardiaceae	*Rhus chinensis* Mill.	çin sumağı	--	--	0-100	Seaside, roadside.	8-10	*	ARTH 17541
6	Apiaceae	*Aegopodium podagraria* L.	keçiayağı	P	ES	0-750	Woodlands	5-6	[21]	ARTH 17542
7	Apiaceae	*Angelica sylvestris* L.	kekire	P	ES	50-2200	Streams, wet grassy areas	7-8	[11]	ARTH 17543
8	Apiaceae	*Anthriscus kotschyi* Fenzl ex Boiss. & Bal.	çahır	--	--	2200-3505	Rocks and meadows	7-9	[19]	ARTH 17544
9	Apiaceae	*Astrantia maxima* Pall	yıldızca	P	Med	1300-2400	Woodlands, very wet meadows	6-7	[11]	ARTH 17545
10	Apiaceae	*Astrodaucus orientalis* (L.) Drude	havyıldız	--	IT	350-2700	Fields, hillsides, steppes, roadsides	5-7	[22]	ARTH 17546
11	Apiaceae	*Bifora radians* M.Bieb.	gısbana	--	--	700-1800	Waste floor and field edges, calcareous areas	4-8	[9]	ARTH 17547
12	Apiaceae	*Bupleurum falcatum* L.	çataltavşan	--	--	600-1500	Roadsides	4-8	[19]	ARTH 17548
13	Apiaceae	*Caucalis platycarpos* L.	kavkal	--	--	0-2200	Fields, slopes, roadsides, wastelands	5-7	[19]	ARTH 17549
14	Apiaceae	*Chaerophyllum macrospermum* (Willd. ex Sprengel) Fisch. & C.A.Mey ex Hohen.	irihandokotu	--	IT	1260-2900	Dry valleys, rocks, wet meadows, fields	7-8	[9]	ARTH 17550
15	Apiaceae	*Conium maculatum* L.	baldıran	--	--	0-2400	Woodlands and stream banks	4-8	[9]	ARTH 17551
16	Apiaceae	*Daucus carota* L.	havuç	N, P	--	0-2000	Meadows, slopes, sandy sands, fields	6	[20]; [5]; [22]	ARTH 17552
17	Apiaceae	*Eryngium billardierei* F.Delaroche	hıyarok	N, P	IT	1400-3810	Rocky slopes, steppes, fallow fields	7-8	[20]; [22]	ARTH 17553
18	Apiaceae	*Eryngium campestre* var. *virens* (Link) Weins	yerkestanesi	N, P	--	0-1800	Forest clearings, stony hill sides, degraded steppe, fallow fields, dunes	7-9	[22]	ARTH 17554
19	Apiaceae	*Eryngium giganteum* M. Bieb.	boğadikeni	N, P	BS	800-2300	Forest clearing, scrub, rocky or bare slopes	7-8	[10]; [11]	ARTH 17555
20	Apiaceae	*Eryngium maritimum* L.	kumboğadikeni	N, P		0-10	Sandy	6-8	[9]	ARTH 17556
21	Apiaceae	*Ferula orientalis* L.	kıngor		IT	1600-2900	Rocky slopes	5-6	[22]	ARTH 17557
22	Apiaceae	*Foeniculum vulgare* Mill.	rezene	N		0-1200	Dry slopes, pine forests, river banks	5-9	[10]; [11]	ARTH 17558
23	Apiaceae	*Heracleum platytaenium* Boiss.	öğrekotu			0-1500	Mixed forests, rocky slopes, stream banks, coasts	5-7	[9]	ARTH 17559
24	Apiaceae	*Heracleum sphondylium* subsp. *artvinense* (Manden.) Davis. **(EN)**	kadifekoçuk		BS	2800	Floodplain in volcanic slopes, cliffs	7	[11]	ARTH 17560
25	Apiaceae	*Laser trilobum* (L.) Borkh.	kefekimyonu	P		0-1800	Coniferous woodlands and maculate cliffs next to the sea	5-8	[9] ;[10]; [11]	ARTH 17561

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
26	Apiaceae	*Pimpinella peregrina* L.	elanasonu	P		0-2500	Fields, groves, rocky places	4-7	[9]	ARTH 17562
27	Apiaceae	*Pimpinella rhodantha* Boiss.	gülanason	P		600-2150	Forests scrub	7-8	[9] ;[10]; [11]	ARTH 17563
28	Apiaceae	*Prangos ferulacea* (L.) Lindl.	eşekçakşırı	P		600-2500	Rocks	5-7	[20]	ARTH 17564
29	Apiaceae	*Prangos pabularia* Lindl.	beyik	P	IT	780-3000	Cascades, rocky, limestone slopes	6-7	[20]	ARTH 17565
30	Apiaceae	*Scandix pecten-veneris* L.	zühretarağı	P		0-980	Rocky limestone slopes, *Pinus* and *Populus* plantations, roadsides, field sides	3-6	[9]	ARTH 17566
31	Apiaceae	*Seseli libanotis* (L.) W.D.J.Koch	dağhavucu		ES	1300-3000	Rocky shores, wet meadows, river banks, *Picea* forests.	6-8	[22]	ARTH 17567
32	Apocynaceae	*Periploca graeca* L.	gariplerurganı		D. Med	0-1200	Moist deciduous forests, scrub, stream banks, rocks	4-7	[9] ;[10]; [11]	ARTH 17568
33	Apocynaceae	*Vinca herbacea* Waldst. & Kit.	bikirçiçeği	P		400-2000	sparsely sunny slopes, on sand, gravel, fallow fields, rocks, scrub	3-5	[9] ;[10]; [11]	ARTH 17569
34	Apocynaceae	*Vincetoxicum fuscatum* (Hornem.) Rchb.				750-1900	open, rocky slopes, river valleys, *Quercus* forest	5-7	[9] ;[10]; [11]	ARTH 17570
35	Aquifoliaceae	*Ilex colchica* Poj.	ışılgan	P	BS	60-1800	Forests (*Fagus, Abies*) scrub and shady rocks.	6-7	[9] ;[10]; [11]	ARTH 17571
36	Araceae	*Arum maculatum* L.	yılanekmeği	P		80-1200	Deciduous woodlands, scrub, open or shady slopes.	4-6	[21]	ARTH 17572
37	Araliaceae	*Hedera helix* L.	duvarsarmaşığı	N, P		0-1500	Forests scrub and shady rocks	8-9	[5]	ARTH 17573
38	Aristolochiaceae	*Aristolochia clematitis* L.	lohusaotu	N, P	ES	0-1250	Shady places in valleys, empty space, between coastal dunes, fields.	4-8	[18]	ARTH 17574
39	Asparagaceae	*Asparagus persicus* Baker	mereço		IT	800-1700	Scrub, damp grassland, volcanic cascade, saline steppe	5-8	[19]	ARTH 17575
40	Asparagaceae	*Muscari armeniacum* Leichtlin ex Baker	gâvurbaşı	N, P		0-275	Calcareous slopes, *Juniperus* thickets, *Pinus brutia* and *P. sylvestris* and *Quercus* forests	3-5	[19]	ARTH 17576
41	Asparagaceae	*Ornithogalum oligophyllum* E.D.Clarke	kurtsoğanı	N, P		700-3000	Grassy and rocky slopes, snow patches	4-7	[19]; [5]	ARTH 17577
42	Asparagaceae	*Ornithogalum orthophyllum* Ten.	bayıryıldızı		--	0-2170	Scrub, grassy, wooded areas	3-6	[19]	ARTH 17578
43	Asparagaceae	*Ornithogalum sphaerocarpum* A.Kern.	salkımsakarca		--	0-1800	Volcanic and calcareous slopes, hill sides, frigana, prairies	4-7	[19]	ARTH 17579
44	Asparagaceae	*Polygonatum orientale* Desf.	boğumluca		BS	570-1830	*Pinus nigra* forests, *Quercus* thickets, shady cliffs, mountain tops	5-6	[19]	ARTH 17580
45	Asparagaceae	*Ruscus aculeatus* L.	tavşanmemesi	P	--	10-100	Oak forests, scrub, calcareous slopes and cliffs	3-5	[9] ;[10]; [11]	ARTH 17581
46	Asparagaceae	*Scilla monanthos* K. Koch	sümbülcük	P	BS	1800-2200	Woodlands, subalpine meadows	1-4	[9] ;[10]; [11]	ARTH 17582
47	Asteraceae	*Achillea arabica* Kotschy.	hanzabel	P	--				[19]	ARTH 17583
48	Asteraceae	*Achillea biserrata* M.Bieb.	Aksırıkotu	P	BS	150-2400	Pine or deciduous forests, moist area	5-8	[9] ;[10]; [11]	ARTH 17584
49	Asteraceae	*Achillea kotschyi* Boiss.	ayvadana	P	--	1200-3000	Stony slope, limestone rocks, alpine meadow	6-8	[9]	ARTH 17585
50	Asteraceae	*Achillea millefolium* L.	civanperçemi	P,N	ES	500-3450	Mountain meadow	6-9	[23]; [19]; [20]	ARTH 17586

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
51	Asteraceae	*Achillea schischkinii* Sosn. **(EN)**	delicivanperçemi	P,N	IT	700-2200	Steppe, rocky slopes, fallow fields	5-7	[23]	ARTH 17587
52	Asteraceae	*Anthemis cretica* subsp. *albida* (Boiss.) Grierson	akçabaş	P,N	--	300-3200	Rocky slopes, sandy shores, ravines	5-7	[23]; [19]; [20]	ARTH 17588
53	Asteraceae	*Anthemis cretica* subsp. *umbilicata* (Boiss. & A.Huet) Grierson	babunç	P		180-2000	Steppe, rocky slope	5-7	[24]	ARTH 17589
54	Asteraceae	*Artemisia absinthium* L.	acıpelin	N, P		0-2600	Riparian, field, slope, steppe	6-9	[19]	ARTH 17590
55	Asteraceae	*Artemisia vulgaris* L.	kabayavşan	N, P		0-2500	Vacant lot, roadside, riverside, bushy slope	7-9	[20]	ARTH 17591
56	Asteraceae	*Bellis perennis* L.	koyungözü	N, P	ES	0-200	Humid area, forest	3-8	[23]; [21]; [5]	ARTH 17592
57	Asteraceae	*Carduus adpressus* C.A.Mey.	boyludevedikeni	N, P	BS	1800-2600	Wet meadow, grassland, rocky slope, rocky outcrops	7-8	[9] ;[10]; [11]	ARTH 17593
58	Asteraceae	*Centaurea aggregata* Fisch. & Mey. ex DC.	kümedüğme			700-2000	Arid rocky slope, forest	7-8	[9] ; [11]	ARTH 17594
59	Asteraceae	*Centaurea carduiformis* DC.	kavgalaz	N, P		500-2200	Steppe, fallow field	6-7	[19]	ARTH 17595
60	Asteraceae	*Centaurea iberica* Trevir. ex Spreng.	deligözdikeni	N, P		0-2300	Field, roadside, empty field	6-8	[19]; [23]; [20]	ARTH 17596
61	Asteraceae	*Centaurea pseudoscabiosa* Boiss. & Buhse	yamankavgalaz	N, P	IT	1500-2900	Steppe, rocky slope	6-7	[20]	ARTH 17597
62	Asteraceae	*Centaurea rhizantha* C.A.Mey.	timurdikeni	N, P	IT	900-3600	Rocky slope, ravine	6-7	[20]	ARTH 17598
63	Asteraceae	*Centaurea solstitialis* L.	çakırdikeni	N, P		0-1900	*Pinus* forest, arid slope, fallow field, vacant lot	6-8	[19]; [23]; [20]	ARTH 17599
64	Asteraceae	*Centaurea triumfettii* All. (Syn: *Cyanus triumfettii* (All.) Dostál ex Á.Löve & D.Löve.)	delikapele	N, P		500-3500	*Pinus* forest, *Quercus* thicket, rocky, slope, pasture, mountain steep	5-8	[23]	ARTH 17600
65	Asteraceae	*Centaurea urvillei* subsp. *stepposa* Wagenitz	yerkötürümü		IT	500-1500	Steppe, stony slope	6-7	[19]	ARTH 17601
66	Asteraceae	*Centaurea virgata* Lam.	acısüpürge	N, P	IT	100-2000	Arid hills, steppe, arid wasteland	6-9	[23]; [19]; [20]	ARTH 17602
67	Asteraceae	*Chondrilla juncea* L.	karakavuk	N		150-1700	Rocky area, sandy area, fallow field	7-9	[9]	ARTH 17603
68	Asteraceae	*Cichorium intybus* L.	hindiba	N, P		0-3050	Cultivated field, meadow, empty field	4-9	[19]; [20]; [21];	ARTH 17604
69	Asteraceae	*Cirsium arvense* (L.) Scop.	köygöçüren	N, P	--	30-2100	Roadside, stream bank, ditch, grassland, cultivated area, wheat and corn field, tea plantation	5-10	[20]; [19]; [23]	ARTH 17605
70	Asteraceae	*Cirsium echinus* (M.Bieb.) Hand.-Mazz.	kirpikangalı		IT	0-2500	Rocky slopes, rarely beaches	7-8	[19]	ARTH 17606
71	Asteraceae	*Cirsium hypoleucum* DC.	vişnekangalı	N, P	BS	0-2000	Forest, shady shore, rock outcrops	5-9	[9] ;[10]; [11]	ARTH 17607
72	Asteraceae	*Cirsium simplex* C.A. Meyer	bodurkangal	N, P	BS	2000-2900	Banks of streams and waterfalls	7-8	[9] ;[10]; [11]	ARTH 17608
73	Asteraceae	*Cirsium vulgare* (Savi) Ten.	yaygınkangal	N, P	--	0-2000	Grazed area within *Pinus* forest, roadside, slope, river bank, canal	7-10	[9] ;[10]; [11]	ARTH 17609
74	Asteraceae	*Cota tinctoria* (L.) J.Gay.	boyacıpapatyası	N	--	180-2000	Steppe, rocky slope	5-7	[19]; [24]	ARTH 17610
75	Asteraceae	*Crepis foetida* subsp. *rhoeadifolia* (M.Bieb.) Čelak.	kohum		--	0-2000	Rocky slope in steppe, moist area, forest, maquis, sandy beach coast	5-10	[19]; [20]	ARTH 17611

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
76	Asteraceae	*Crepis sancta* (L.) Bornm.	yabankıskısı	N, P	--	0-2450	Forest, rocky volcanic slope, rocky limestone slope, *Artemisia* -step, lush grassy slope	2-8	[23]; [19]; [20]	ARTH 17612
77	Asteraceae	*Crepis vesicaria* L.	kesekıskısı	N, P	Med	0-800	Meadow, scrub, gharic, marsh	4-6	[5]	ARTH 17613
78	Asteraceae	*Crupina crupinastrum* (Moris) Vis.	gelindöndüren		--	100-1400	*Pinus brutia* forest clearing, steppe, rocky limestone slope, field edge	4-6	[19]	ARTH 17614
79	Asteraceae	*Doronicum caucasicum* M.Bieb.	kaplanotu	N, P	--	50-1900	Shady forest and scrubland	3-7	[19]; [5]	ARTH 17615
80	Asteraceae	*Echinops orientalis* Trautv.	dağşekeri	N, P	IT	0-1980	Steppe, stony and shale slopes, limestone cliff, igneous rock, fallow field, *Quercus*	6-8	[20]; [22]	ARTH 17616
81	Asteraceae	*Echinops ossicus K.Koch*	ormantopuzu	N, P	BS	0-1800	*Quercus* and *Corylus* scrub, *Pinus*, *Fagus* forest	7-8	[9]	ARTH 17617
82	Asteraceae	*Echinops pungens* Trautv.	bongıl	N, P	IT	1400-2000	Rocky limestone, serpentine slope and magmatic slope in steppe, fallow field, roadside	6-8	[23]; [19]; [22]	ARTH 17618
83	Asteraceae	*Eupatorium cannabinum* L.	koyuntırpağı	N, P	ES	0-1200	Between rocks, damp areas	7-10	[9] ;[10]; [11]	ARTH 17619
84	Asteraceae	*Gelasia tomentosa* (L.) Zaika, Sukhor. & N.Kilian **(EN)**	alabent	P	IT	800-2600	Steppe, rocky slope, cliff	6-8	[9] ; [11]	ARTH 17620
85	Asteraceae	*Helianthus tuberosus* L.	yerelması	N, P	--		Culture plant, sandy, humus-rich, loamy soil		[9] ;[10]; [11]	ARTH 17621
86	Asteraceae	*Helichrysum arenarium* subsp. *aucheri* (Boiss.) Davis & Kupicha **(EN)**	yaylaçiçeği	N	IT	250-3200	Arid calcareous or sandy soil, steppe, edges	5-8	[23]	ARTH 17622
87	Asteraceae	*Helichrysum armenium* DC.	altınotu	P	IT	900-2500	Limestone rocky slope, forest clearing, steppe	6-8	[9] ;[10]; [11]	ARTH 17623
88	Asteraceae	*Helichrysum graveolens* (M.Bieb.) Sweet	hencecalik	P	--	900-3670	*Pinus nigra* forest clearings, pits with wet soil	6-9	[9]	ARTH 17624
89	Asteraceae	*Helichrysum plicatum* DC.	mantuvar	P	--	1400-2850	*Pinus nigra* and *Abies cilicica* forest clearing, scrub, rocky slope	6-8	[9]	ARTH 17625
90	Asteraceae	*Inula helenium* subsp. *orgyalis* (Boiss.) Grierson**. (EN)**	kocaandızotu		BS	1000-2560	Water and lakeside, forest, scrubland	7-9	[9] ;[10]; [11]	ARTH 17626
91	Asteraceae	*Inula montbretiana* DC.	kökçayı	P	IT	850-2400	Arid calcareous slope, sandy steppe	6-8	[9]	ARTH 17627
92	Asteraceae	*Jacobaea othonnae* (M.Bieb.) C.A.Mey.	tekkanaryaotu	P	ES	700-3050	Rocky forest slope, scrub, moist area	6-8	[9]	ARTH 17628
93	Asteraceae	*Lactuca serriola* L.	eşekhelvası	N, P	ES	0-1750	Grassy slope, rocky slope, field edge, fallow field, cultivated field	7-9	[19]; [5]	ARTH 17629
94	Asteraceae	*Lapsana communis* subsp. *intermedia* var. *aurantia* Yıld. **(EN)**			--	100-2400	Deciduous forest, *Pinus* forest clearing, rough grassland, shady slope, streamside	5-10	[9] ;[10]; [11]	ARTH 17630
95	Asteraceae	*Leontodon crispus* subsp. *asper* (Waldst. & Kit.) Röhl. var. *asper*	aslandişi		--	250-2900	Forest, rocky limestone slope, steppe	5-8	[19]	ARTH 17631
96	Asteraceae	*Lophiolepis lappacea* subsp. *anatolica* (Petr.) Del Guacchio, Bureš,	hamurkesen		--		Cleared forest, roadside, field (weed)		[19]	ARTH 17632
97	Asteraceae	*Omalotheca sylvatica* (L.) F.W.Schultz & Sch.Bip. (Syn: *Gnaphalium sylvaticum* L.)	çambozağanı	P	ES	1000-2700	Pine forest, alpine pasture, ravine	7-8	[9] ;[10]; [11]	ARTH 17633
98	Asteraceae	*Onopordum acanthium* L.	galagan	N, P	--	600-2600	Rocky slope, ravine, cleared forest, roadside,	6-8	[23]	ARTH 17634
99	Asteraceae	*Pallenis spinosa* (L.) Cass.	dikenotu	N, P	Med	0-250	Roadsides, rocky ground, limestone cliffs	4-8	[5]	ARTH 17635
100	Asteraceae	*Pentanema oculus-christi* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort. (Syn: *Inula oculus-christi* L.)	yolotu		ES	900-2300	Meadow, rolling slope, cleared forest clearing	6-8	[9] ;[10]; [11]	ARTH 17636

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
101	Asteraceae	*Pentanema salicinum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort. (Syn: *Inula salicina* L.)	suandızotu		ES	0-2440	Water cannabis, between bush	5-9	[9]	ARTH 17612
102	Asteraceae	*Petasites hybridus* (L.) G.Gaertner, B.Mey. & Scherb.	kabalak	N	ES	0-1800	Damp areas, water edge	5-6	[9] ;[10]; [11]	ARTH 17613
103	Asteraceae	*Picris hieracioides* Sibth. & Sm.			ES	340-2300	Meadow, river edge, Yolkenari	6-9	[9]	ARTH 17614
104	Asteraceae	*Pulicaria dysenterica* (L.) Bernh.	yaraotu	P		0-1600	Water and River Coast, Near Coast	7-9	[9] ;[10]; [11]	ARTH 17615
105	Asteraceae	*Scorzonera cana* (C. A. Meyer) Hoffm.	tekesakalı	N, P		200-400	Meadow, rocky slope, era	5-8	[19]; [20]	ARTH 17616
106	Asteraceae	*Senecio pseudo-orientalis* Schischk.	sarışiro	N, P	IT	1200-2700	Grassland slope, damp area, step	5-8	[19]; [20]	ARTH 17617
107	Asteraceae	*Senecio viscosus* L.	yağlıkanaryaotu			1100-2300	Grove, rocky slope, cultivated field	6-9	[19]	ARTH 17618
108	Asteraceae	*Senecio vulgaris* L.	taşakcılotu	N, P		0-700	Sandy and empty space, field, maki	3-8	[19]; [5]; [22]	ARTH 17619
109	Asteraceae	*Solidago virgaurea* L.	altınbaşakçiçeği	N, P	ES	0-2440	River edge and limestone rocky, often grove, rarely cultivated soils	7-9	[5]	ARTH 17620
110	Asteraceae	*Solidago virgaurea* subsp. *alpestris* (Waldst. & Kit.) Gremli.		N, P	ES	1900-3200	Grass, rock and grove openness	8-9	[5]	ARTH 17621
111	Asteraceae	*Sonchus asper* subsp. *glaucescens* (Jord.) Ball	gevirtlek	N, P		0-1920	Forest opening, sandy area, cultivated field	3-8	[9] ;[10]; [11]	ARTH 17622
112	Asteraceae	*Sonchus oleraceus* L.	zoko	N, P		0-1300	Field, empty space	3-5	[5]; [22]	ARTH 17623
113	Asteraceae	*Tanacetum armenum* (DC.) Sch.Bip.	kayapapatyası			1000-2900	Limestone slits, Konglomera Kayalar, sometimes Srende	7-8	[19]	ARTH 17624
114	Asteraceae	*Tanacetum balsamita* L.	gümüşdüğme	P		1100-2050	Moist area, shape, area	7-9	[19]	ARTH 17625
115	Asteraceae	*Tanacetum coccineum* (Willd.) Grierson	pireotu	N, P		1100-2000	Forest opening	6-7	[9] ;[10]; [11]	ARTH 17626
116	Asteraceae	*Tanacetum parthenium* (L.) Schultz Bip.	beyazpapatya	P		0-2438	Walls, empty places, stream banks, shady forests and rock outcrops	5-9	[9] ;[10]; [11]	ARTH 17627
117	Asteraceae	*Taraxacum stevenii* (Spreng.) DC.	gelingöbeği	N	--		……		[19]	ARTH 17628
118	Asteraceae	*Taraxacum turcicum* Soest (EN)	ağcakavağı		--	600-2200	…..	4-9	[9] ;[10]; [11]	ARTH 17629
119	Asteraceae	*Telekia speciosa* (Schreb.) Baumg.	puğre	P	ES	300-1700	By the water, between small trees	7-9	[9] ;[10]; [11]	ARTH 17630
120	Asteraceae	*Tragopogon coloratus* C.A.Mey.	katıryemliği		--	350-2500	Stony area	5-8	[19]	ARTH 17631
121	Asteraceae	*Tripleurospermum melanolepis* (Boiss. & Buhse) Pobed.	esmergöde		--	1250-4400	Volcano craters, fertile soils, cascade, cascade	7-8	[24]	ARTH 17632
122	Asteraceae	*Tussilago farfara* L.	öksürükotu	N, P	--	0-2400	Empty and sandy areas, damp areas	3-4	[23]	ARTH 17633
123	Asteraceae	*Urospermum picroides* (L.) Scop. ex F.W.Schmidt	acıyemlik	N, P	Med	0-2230	Scrubland, limestone slope, open space	3-6	[5]	ARTH 17634
124	Asteraceae	*Xanthium spinosum* L.	pıtrak	N, P	---	10-1750	Arid slope, empty space	8-10	[5]	ARTH 17635
125	Asteraceae	*Xeranthemum annuum* L.	kâğıt çiçeği	N, P	--	0-1950	Steppe, arid coast, loose sand dune	6-9	[19]; [21]	ARTH 17636

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
126	Asteraceae	*Xeranthemum cylindraceum* Sm.	deli kâğıt çiçeği	P	--	0-1150	Garic, steppe, arid coast	6-7	[19]	ARTH 17662
127	Asteraceae	*Xeranthemum longipapposum* Fisch. & C.A.Mey.	uslukâğıtçiçeği	N/P	IT	1100-1850	Steppe, unproductive areas	6-8	[23]	ARTH 17663
128	Berberidaceae	*Epimedium pubigerum* (DC.) C.Morren & Decne.	tekeotu	P	BS	20-1200	Forest	4-5	[21]	ARTH 17664
129	Betulaceae	*Alnus glutinosa* subsp. *barbata* (C.A. Meyer) Yalt.	Kızılağaç		BS	0-1700	*Picea orientalis* or mixed deciduous forest, moist slopes, streamside	4	[9] ;[10]; [11]	ARTH 17665
130	Betulaceae	*Betula medwediewii* Regel	moşi		BS	1300-2160	*Picea orientalis* mixed subalpine forest, *Rhododendron* thicket	5-6	This is the finding of the study.	ARTH 17666
131	Betulaceae	*Betula pendula* Roth.	huşağacı	N, P,I	--	1300-3050	heather forest, rocky or volcanic slopes	4-5	[5];	ARTH 17667
132	Betulaceae	*Carpinus betulus* L.	gürgen	P	ES	10-1800	extensive deciduous (*Quercus-Fagus*) or mixed (*Abies-Picea-Fagus*) forests, pure unity	7-8	[21]	ARTH 17668
133	Betulaceae	*Corylus avellana* L.	fındık	P	ES	20-1700	deciduous broad-leaved forests (*Quercus-Carpinus-Fagus*) or mixed forests	2-3	[9] ;[10]; [11]	ARTH 17669
134	Boraginaceae	*Alkanna orientalis* (L) Boiss.	sarısormuk	N, P	IT	0-2450	rocky places, steppe, volcanic slopes	4-8	[19]	ARTH 17670
135	Boraginaceae	*Anchusa azurea* Mill.	sığırdili	N, P	--	0-2500	fields, dry steppe	4-7	[24]; [23]; [19]	ARTH 17671
136	Boraginaceae	*Anchusa leptophylla* Roem. & Schult.	ballık	P	--	800-3000	rocky slopes, sandy steppe	6-7	[19]	ARTH 17672
137	Boraginaceae	*Buglossoides arvensis* (L.) I.M.Johnst.	tarlataşkeseni	N, P	--	0-2500	limestone slopes, field edges, grain fields, rocky slopes, fallow fields	2-6	[9] ;[10]; [11]	ARTH 17673
138	Boraginaceae	*Cerinthe glabra* Miller	çobansüzeği	N, P	ES	1600-3300	*Pinus sylvestris* and *Abies* forest, roadsides, rocky slopes, limestone slopes	6-8	[9]	ARTH 17674
139	Boraginaceae	*Cynoglossum creticum* Miller	pisiktetiği	N, P	--	0-1000	frigana, limestone and calcareous slopes, sandy cliffs, shady shores, roadsides	3-7	[5]	ARTH 17675
140	Boraginaceae	*Cynoglossum montanum* L.	dağköpekdili	P	ES	360-2200	*Quercus* and *Juniperus* thickets, steppe, rocky slopes, meadows, edges	4-8	[9] ;[10]; [11]	ARTH 17676
141	Boraginaceae	*Cynoglossum officinale* L.	gözpıtrağı	N, P	ES	500-2100	*Abies-Fagus* forest, deciduous woodlands, stony limestone slopes, meadows, edges	4-7	[9] ;[10]; [11]	ARTH 17677
142	Boraginaceae	*Echium angustifolium* Miller	agres	N, P	D. Med	0-870	Coastal dunes, sandy slopes, coasts, maquis, shrublands, steppes	3-8	[5]	ARTH 17678
143	Boraginaceae	*Echium italicum* L.	kurtkuyruğu	N, P	Med	0-1950	limestone slopes, fields, degraded land	5-8	[24]; [23]; [21]	ARTH 17679
144	Boraginaceae	*Echium plantagineum* L.	kırkbatıran	N, P	Med	0-2400	fields, coasts, barren places, grassy and rocky slopes	3-9	[5]	ARTH 17680
145	Boraginaceae	*Echium vulgare* L.	engerekotu	N, P	ES	0-2440	*Picea* and *Abies* forest, roadsides, scrub, b.g.	5.Eyl	[5]; [18]	ARTH 17681
146	Boraginaceae	*Moltkia coerulea* Lehm.	mavikesen		IT	700-1850	Stony steppe, fields, field edges	4-6	[24]	ARTH 17682
147	Boraginaceae	*Myosotis alpestris* subsp. *alpestris*	boncukotu	N, P	--	1000-3500	Rocks, slopes, earthy or grassy places	4-8	[19]	ARTH 17683
148	Boraginaceae	*Myosotis arvensis* (L.) Hill	kardeşboncuğu	N, P	ES	0-1400	Dry damp places, often rough	4-7	[5]	ARTH 17684
149	Boraginaceae	*Myosotis lithospermifolia* (Willd.) Hornem.	taşboncukotu	N, P	--	50-2350	Rocky dry slopes, dry sparse woodlands, maquis	5-6	[19]; ;	ARTH 17685
150	Boraginaceae	*Myosotis olympica* Boiss.	uluboncukotu	N, P	BS	2000-4100	Rocky slopes, grassy alpine meadows	5-9	[20]	ARTH 17686

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
151	Boraginaceae	*Myosotis propinqua* Fisch. & C.A.Mey.	ayaklıkuşgözü	N	BS	1300-1830	Humid places	5-7	[19]	ARTH 17687
152	Boraginaceae	*Myosotis ramosissima* Rochel ex Schult.	kuşgözü	N, P	--	0-1400	Dry places	4-7	[5]	ARTH 17688
153	Boraginaceae	*Onosma isaurica* Boiss. & Heldr. **(EN)**	külemcek		IT	300-3000	Rocky slopes, cliffs, *Pinus* and *Quercus* woodland, steppe etc.	5-9	[19]	ARTH 17689
154	Boraginaceae	*Onosma microcarpa* DC.	minikemcek		IT		….	4-8	[24]; [22]	ARTH 17690
155	Boraginaceae	*Onosma sericea* Willd.	kâğıtemcek	N	--		….	4-7	[9] ;[10]; [11]	ARTH 17691
156	Boraginaceae	*Trachystemon orientalis* (L.) G. Don.	kaldirik	P	BS	50-1000	*Fagus* forest, shady river banks, damp bays	3-5	[9] ;[10]; [11]	ARTH 17692
157	Brassicaceae	*Aethionema arabicum* (L.) Andrz. ex DC.	araptaşçantası		--	600-2700	Field, stony slope	4-6	[9] ;[10]; [11]	ARTH 17693
158	Brassicaceae	*Aethionema grandiflorum* Boiss. & Hohen.	kocakayagülü	P	IT	1000-3000	Arid rocky slope	5-6	[23]	ARTH 17694
159	Brassicaceae	*Alyssum alyssoides* (L.) L.	hezelotu	P	--	0-2000	Disturbed area	3-8	[20]	ARTH 17695
160	Brassicaceae	*Alyssum contemptum* Schott & Kotschy	tarlakevkesi	P	IT	180-2200	cropland, metamorphic slope, volcanic slope	3-7	[20]	ARTH 17696
161	Brassicaceae	*Alyssum dasycarpum* Stephan ex Willd.	asikuduzotu	N, P	--	100-2600	cultivated area, steppe	3-6	[19]	ARTH 17697
162	Brassicaceae	*Alyssum desertorum* Stapf	dumanotu	P	--	0-2000	cultivated area, open space	5-6	[20]	ARTH 17698
163	Brassicaceae	*Alyssum pateri* subsp. *prostratum* (Nyar.) Dudley **(EN)**	yatıkkevke		IT	1350-2600	cultivated land, bare land, stony land	6-7	[9]	ARTH 17699
164	Brassicaceae	*Arabis caucasica* Willd.	kazteresi	P	--	350-2900	rocky, cliff, slope	3-8	[22]	ARTH 17700
165	Brassicaceae	*Arabis nova* Vill.	tıfılkazteresi	P	--	800-2400	stony area	5	[9]	ARTH 17701
166	Brassicaceae	*Barbarea vulgaris* R.Br.	nicarotu	N, P	--	-1251	water's edge, swamp	4-5	[9]	ARTH 17702
167	Brassicaceae	*Berteroa mutabilis* (Vent.) DC.	delitere	P	--	40-2000	edge, wall, rocky slope	6-8	[9]	ARTH 17703
168	Brassicaceae	*Brassica elongata* Ehrh.	uzunşalgam	N, P	--	450-1700	arid rocky slope, steppe, cultivated field	4-6	[9]	ARTH 17704
169	Brassicaceae	*Bunias orientalis* L.	çırşalgamı	N, P	--	1600-2300	field, rocky slope	5-8	[5]	ARTH 17705
170	Brassicaceae	*Capsella bursa-pastoris* (L.) Medik.	çobançantası	N, P	--	0-2000	cultivated land, empty land	1-12	[22]	ARTH 17706
171	Brassicaceae	*Cardamine quinquefolia* (M.Bieb.) Schmalh.	hanımgömleği	P	ES	0-1900	forest, scrubland	3-5	[9] ;[10]; [11]	ARTH 17707
172	Brassicaceae	*Draba polytricha* Ledeb.	rizedolaması	P	--	1500-3100	rocky, indentation	4-7	[9] ;[10]; [11]	ARTH 17708
173	Brassicaceae	*Hesperis bicuspidata* (Willd.) Poir. **(EN)**	gecemenekşesi		--	1300-2800	rocky slope, coast, edge	5-7	[19]	ARTH 17709
174	Brassicaceae	*Hesperis isatidea* (Boiss.) D.A.German & Al-Shehbaz (Syn: *Tchihatchewia isatidea* Boiss.) **(EN)**	allıgelin	N, P	IT	1000-2000	coastal erosion, debris	6	[9] ;[10]; [11]	ARTH 17710
175	Brassicaceae	*Isatis tinctoria* L.	çivitotu		--	850-1150	ruderal	5	[21]	ARTH 17711

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
176	Brassicaceae	*Noccaea perfoliata* (L.) Al-Shehbaz (Syn: *Thlaspi perfoliatum* L.)	giyle	P	--	0-2570	cultivated land, empty land	2-5	[9]; [11]	ARTH 17712
177	Brassicaceae	*Raphanus raphanistrum* L.	eşekturpu	N, P	--	0-400	fallow field, cultivated field, sandy field	3-5	[9]	ARTH 17713
178	Brassicaceae	*Rapistrum rugosum* (L.) All.	kediturpu	N, P	--	0-1000	cultivated area	4-6	[5]	ARTH 17714
179	Brassicaceae	*Rhamphospermum arvense* (L.) Andrz. ex Besser (Syn: *Sinapis arvensis* L.)	hardal	N, P	--	0-1800	roadside, empty space	4-6	[19];[21];[20]; [5]	ARTH 17715
180	Brassicaceae	*Rorippa austriaca* (Crantz) Spach	topçakandura		--	0-1500	moist area	5-6	[9];[10]; [11]	ARTH 17716
181	Brassicaceae	*Rorippa sylvestris* (L.) Besser	çakandura	P	--	0-1800	swamp, river bank, cultivated area	6-9	[9]	ARTH 17717
182	Brassicaceae	*Sisymbrium altissimum* L.	ergelenotu		--	0-1400	cultivated land, empty land	3-6	[9]	ARTH 17718
183	Buxaceae	*Buxus sempervirens* L.	şimşir	P,N	ES	100-2000	mixed deciduous forests (often with *Fagus*), slope scrub, rocks	4-7	[9] ;[10]; [11]	ARTH 17719
184	Campanulaceae	*Asyneuma amplexicaule* (Willd.) Hand.-Mazz.	hoşdeğnek	N		1370-2700	sparse forests, rocky slopes	6-8	[19]	ARTH 17720
185	Campanulaceae	*Asyneuma limoniifolium* subsp. *pestalozzae* (Boiss.) Damboldt **(EN)**	tavşankatığı			400-2400	steppe, meadows, rocky slopes	6-7	[19]	ARTH 17721
186	Campanulaceae	*Campanula alliariifolia* Willd.	akçan	P	BS	0-1830	steep spruce forests and scrub edges, cliffs	6-9	[9] ;[10]; [11]	ARTH 17722
187	Campanulaceae	*Campanula betulifolia* K.Koch	çıngırakotu	P	BS	250-2285	volcanic fissures, calcareous cliffs	5-9	[9] ;[10]; [11]	ARTH 17723
188	Campanulaceae	*Campanula glomerata* subsp. *hispida* (Witasek) Hayek	yumakçanı	N,P	ES	0-2700	scrubland, forest edges, grasslands, etc.	6-9	[9] ;[10]; [11]	ARTH 17724
189	Campanulaceae	*Campanula involucrata* Aucher ex A.DC.	sarımçanı	N,P	IT	1000-2550	sparse forests, cascades	5-7	[23]; [19]; [20]	ARTH 17725
190	Campanulaceae	*Campanula olympica* Boiss.	ormançanı	P	BS	150-2700	forests, alpine meadows, rocky and grassy slopes	5-9	[9] ;[10]; [11]	ARTH 17726
191	Campanulaceae	*Campanula rapunculoides* L.	elmacık	N	ES	650-2200	forest edges, sloping meadows	7-9	[9] ;[10]; [11]	ARTH 17727
192	Campanulaceae	*Campanula rapunculoides* subsp. *cordifolia* (K.Koch) Damboldt	elmacık	N		300-2200	spruce forest, rocky slopes, limestone cliffs	7-8	[9] ;[10]; [11]	ARTH 17728
193	Campanulaceae	*Campanula stevenii* M.Bieb.	yançançiçeği	N,P	BS	1830-3290	sparse meadows, rocky, stony slopes	6-8	[20]	ARTH 17729
194	Campanulaceae	*Campanula stricta* L.	gürçançiçeği	N,P	IT	1200-3050	cliffs, stony slopes	6-9	[19]; [20]	ARTH 17730
195	Cannabaceae	*Celtis australis* L.	çitlenbik	N, P	Med	50-1000	bare rocky slopes and thickets, rarely forests, most often individual, cultivated	3-5	[5]	ARTH 17731
196	Cannabaceae	*Humulus lupulus* L.	şerbetçiotu		ES	0-1000	edges or bushy areas	6-8	[9] ;[10]; [11]	ARTH 17732
197	Caprifoliaceae	*Cephalaria gigantea* (Ledeb.) Bobrov.	devpelemir	N, P	BS	1350-2600	stream banks, wet meadows, rocky slopes	7-8	[9] ;[10]; [11]	ARTH 17733
198	Caprifoliaceae	*Cephalaria syriaca* (L.) Roem. & Schult.	pelemir			120-1700	fields, wastelands	5-7	[9] ;[10]; [11]	ARTH 17734
199	Caprifoliaceae	*Dipsacus laciniatus* L.	fesçitarağı	P		50-1808	roadsides, shores, fields	7-9	[9] ;[10]; [11]	ARTH 17735
200	Caprifoliaceae	*Knautia involucrata* Somm. & Lev.	delieşekkulağı	P	BS	1000-2700	rocky slopes, scrub and open forests	7-8	[9]	ARTH 17736

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
201	Caprifoliaceae	*Lomelosia argentea* (L.) Greuter & Burdet (Syn: *Scabiosa argentea* L.)	yazısüpürgesi	N, P		0-2500	barren places, fields, steppe, stony slopes	5-10	[19]; [20]; [5]	ARTH 17737
202	Caprifoliaceae	*Lomelosia micrantha* (Desf.) Greuter & Burdet (Syn: *Scabiosa micrantha* Desf)	kavurotu	N, P		400-2250	hills, cascades	5-7	[9] ;[10]; [11]	ARTH 17738
203	Caprifoliaceae	*Lonicera caprifolium* L.	hanımeli	N, P					[5]	ARTH 17739
204	Caprifoliaceae	*Lonicera caucasica* Pall.	çakkana	P	--	500-2790	coniferous or deciduous forests, shrublands	5-7	[20]	ARTH 17740
205	Caprifoliaceae	*Lonicera iberica* M.Bieb.	dadaşhanımeli		BS	800-2500	rocky slopes, spiraea and *Quercus* thickets	6-7	[9] ;[10]; [11]	ARTH 17741
206	Caprifoliaceae	*Valeriana alliariifolia* Vahl	pisot	P	--	1000-3000	shady places on the banks of streams	6-8	[9] ;[10]; [11]	ARTH 17742
207	Caprifoliaceae	*Valeriana erotica* Christenh. & Byng (Syn: *Centranthus longiflorus* Stev.)	mahmuzçiçeği		IT	0-2300	cascades, rocky slopes	4-9	[22]	ARTH 17743
208	Caryophyllaceae	*Agrostemma githago* L.	buğdaykaramuğu		--	0-1750	fields are often in cornfields	4-7	[9] ;[10]; [11]	ARTH 17744
209	Caryophyllaceae	*Atocion compactum* (Fisch. ex Hornem.) Tzvelev (Syn: *Silene compacta* Fisch.ex Hornem.)	kanlıbasıraotu	P	--	0-2100	slopes, coasts, forest clearings	5-8	[23]; [20]	ARTH 17745
210	Caryophyllaceae	*Cerastium banaticum* (Roch.) Heuffel	hasırboynuzotu	N, P	--	800-2250	slopes and cascades	6-8	[9] ;[10]; [11]	ARTH 17746
211	Caryophyllaceae	*Cerastium chlorifolium* Fisch. & C.A.Mey.	parlakboynuzotu		--	500-2800	fields	4-6	[19]	ARTH 17747
212	Caryophyllaceae	*Cerastium glomeratum* Thuill.	boynuzotu	N, P	--	0-850	fields, slopes, orchards	3-6	[19]; [5]	ARTH 17748
213	Caryophyllaceae	*Cerastium gnaphalodes* Fenzl (EN)	dağhıyarı	N, P	--	2000-4400	ravines, slopes and coasts	6-9	[9] ;[10]; [11]	ARTH 17749
214	Caryophyllaceae	*Cerastium purpurascens* Adams	alacaboynuzotu	P	--	1800-3800	slopes, meadows, ravines	6-8	[9] ;[10]; [11]	ARTH 17750
215	Caryophyllaceae	*Cherleria circassica* (Albov) A.J.Moore & Dillenb.	yaylatıstısı	N	BS	1980-3800	mountain pastures	7-8	[9] ;[10]; [11]	ARTH 17751
216	Caryophyllaceae	*Dianthus cretaceus* subsp. *multicaulis* (Boiss. & A.Huet) Nersesian	taşkaranfili		IT	2000-3900	rock cliffs	8	[22]	ARTH 17752
217	Caryophyllaceae	*Dianthus crinitus* Sm.	uzunçanak		--	800-2600	volcanic rock slopes and mountain steppes	5-8	[19]	ARTH 17753
218	Caryophyllaceae	*Dianthus orientalis* Adams	yarkaranfili	N, P	--	500-3160	with cliffs, rock slopes and cascades	6-9	[9] ; [11]	ARTH 17754
219	Caryophyllaceae	*Dichodon cerastoides* (L.) Rchb. (Syn: *Cerastium cerastoides* (L.) Britton)	yumakboynuzotu	P	--	1800-2800	wet wet hillsides, slopes and fields	6-8	[9] ;[10]; [11]	ARTH 17755
220	Caryophyllaceae	*Paronychia kurdica* Boiss.	bozkepekotu	P	--	320-1400	rocky places	5-7	[9] ;[10]; [11]	ARTH 17756
221	Caryophyllaceae	*Petrorhagia saxifraga* (L.) Link	şimalzarçiçeği	N, P	ES	0-1500	slopes, walls, shores	4-9	[9]	ARTH 17757
222	Caryophyllaceae	*Rabelera holostea* (L.) M.T.Sharples & E.A.Tripp (Syn: *Stellaria holostea* L.)	urgancık	P	ES	50-1600	thicket, roadside, wet places	3-6	[9]	ARTH 17758
223	Caryophyllaceae	*Sabulina juniperina* (L.) Dillenb. & Kadereit (Syn: *Minuartia juniperina* (L.) Maire & Petitm.)	hanımşiltesi		--	900-2700	rocky places	6-7	[19]	ARTH 17759
224	Caryophyllaceae	*Saponaria officinalis* L.	sabunotu			200-1100	roadsides, wet woods, water edges, shady places	6-8	[9]	ARTH 17760
225	Caryophyllaceae	*Saponaria orientalis* L.	delisabunotu	N		400-2000	rocky slopes, cascades, fallow fields	4-8	[9] ;[10]; [11]	ARTH 17761

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
226	Caryophyllaceae	*Silene argentea* Ledeb.	boznakıl	P	IT	800-2300	Steppe, slopes	5-7	[20]	ARTH 17762
227	Caryophyllaceae	*Silene armena* Boiss.	çığıştak	N, P			Steppe, slopes	7-8	[19]	ARTH 17763
228	Caryophyllaceae	*Silene chlorifolia* Sm.	puşkullu	N	IT	850-3100	slopes, hill sides, cascades	5-7	[19]	ARTH 17764
229	Caryophyllaceae	*Silene dichotoma* Ehrh.	çatalnakıl	N, P		0-2100	slopes, steppes	4-7	[19]; [5]	ARTH 17765
230	Caryophyllaceae	*Silene gallica* L.	serçeçiçeği	N, P	C	0-400	fields, scrubland	4-6	[5]	ARTH 17766
231	Caryophyllaceae	*Silene italica* (L.) Pers.	yuğuşyüreği	N, P		650-2400	open places, mostly *Pinus nigra* open places	6-7	[19]; [5]	ARTH 17767
232	Caryophyllaceae	*Silene lasiantha* K.Koch	erzincannakılı	P		1500-3300	cascades and rocky slopes	6-8		ARTH 17768
233	Caryophyllaceae	*Silene latifolia* Poir.	gıcıgıcı						[19]	ARTH 17769
234	Caryophyllaceae	*Silene marschallii* C.A.Mey.	salkımçiçeği	P	IT	1300-3200	slopes, rocky and open places	6-7	[19]; [20]	ARTH 17770
235	Caryophyllaceae	*Silene odontopetala* Fenzl	kunduzotu	N, P		1500-4000	rocks, cliffs, mountain meadows	6-9	[9]	ARTH 17771
236	Caryophyllaceae	*Silene saxatilis* Sims.	simotu	P		1000-3400	rock formations, open places, coasts	6-8	[9]	ARTH 17772
237	Caryophyllaceae	*Silene spergulifolia* (Willd.) M.Bieb.	ananakılı	N,P	IT	800-3100	cascades, slopes and steppe	5-7	[23]; [19]	ARTH 17773
238	Caryophyllaceae	*Silene vulgaris* (Moench) Garcke.	ecibücü	P		0-3000	thickets, slopes, open places	5-8	[19]	ARTH 17774
239	Caryophyllaceae	*Silene vulgaris* subsp. *commutata* (Guss.) Hayek	ecibücü	P		0-2250	fields, hillsides	5-8	[9]	ARTH 17775
240	Caryophyllaceae	*Stellaria aquatica* (L.) Scop. (Syn: *Myosoton aquaticum* (L.) Moench.)	vergelotu	P	ES	0	damp places and wooded	5-7	[9]	ARTH 17776
241	Caryophyllaceae	*Stellaria media* (L.) Vill.	kuşotu	N, P			slopes	4-6	[5]	ARTH 17777
242	Celastraceae	*Euonymus latifolius* (L.) Mill.	iğağacı	N, P	ES	800-2000	bushes, forests	5-6	[9] ;[10]; [11]	ARTH 17778
243	Cistaceae	*Cistus creticus* L.	laden	N, P	Med	0-1000	maki, garik	3-6	[24]; ; [5]; [18]	ARTH 17779
244	Cistaceae	*Cistus salviifolius* L.	kartli	N, P		0-500	coastal hill calcareous maquis, garik	3-5	[5]; [18]	ARTH 17780
245	Cistaceae	*Helianthemum salicifolium* (L.) Mill.	söğütgüngülü	N, P	--	0-1100	limestone arid scrub, steppe	3-6	[5]	ARTH 17781
246	Colchicaceae	*Colchicum speciosum* Steven	şepart	P	ES	700-2600	light scrub and woodland, subalpine and alpine meadows, rain-flooded streams, moist grassy or stony slopes	7-10	[9] ;[10]; [11]	ARTH 17782
247	Colchicaceae	*Colchicum szovitsii* Fisch. & C.A.Mey.	katırçiğdemi	N, P	IT	200-3250	wet meadows and moist marshy places, steppes, *Pinus* forest edges	2-5	[19]; [20]	ARTH 17783
248	Convolvulaceae	*Calystegia sepium* (L.) R. Br.	çitsarmaşığı	N	--	0-800	on the banks of rivers and lakes, or along fences or on the heights of wastelands	5-9	[9]	ARTH 17784
249	Convolvulaceae	*Calystegia silvatica* (Kit.) Griseb	bürük	P	--	0-1450	forest edges, groves, thickets, hedgerows	4-8	[9] ;[10]; [11]	ARTH 17785
250	Convolvulaceae	*Calystegia soldanella* (L.) R.Br.	kumsarmaşığı	N, P	--	0	coastal dunes	5-7	[5]	ARTH 17786

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phyto. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
251	Convolvulaceae	*Convolvulus arvensis* L.	tarlasarmaşığı	N, P	--	0-3050	sandy steppe, fallow fields, over the edges of ditches, rivers and lakes	4-9	[19]; [20]; [5]; [18]	ARTH 17787
252	Convolvulaceae	*Convolvulus calvertii* Boiss.	hamıza	N, P	IT	915-2600	non-calcareous mobile rocky, schisty slopes	5-7	[20]	ARTH 17788
253	Convolvulaceae	*Convolvulus cantabrica* L.	çadırçiçeği	N, P	--	0-1700	maquis, *Pinus brutia* woodland edge, rocky and clastic slopes, chalky edge, etc.	4-8	[5]	ARTH 17789
254	Convolvulaceae	*Convolvulus galaticus* Rost. ex Choisy	bozsarmaşık	N, P	IT	880-2000	*Pinus* groves, sparse steppes, stony slopes, meadows, cultivated and fallow fields	5-8	[19]; [20]	ARTH 17790
255	Convolvulaceae	*Convolvulus holosericeus* M.Bieb.	gündüzsefası		--	250-1700	*Pinus brutia* woodland, maquis, dry steppe, sandy, eroded, schist clayey and calcareous hills	5-7	[19]	ARTH 17791
256	Convolvulaceae	*Convolvulus lineatus* L.	topyayılgan	N/P	--	800-2135	Pinus brutia woodland, maquis, dry steppe, sandy, eroded, shale clay and calcareous hills	4-7	[23]; [19]	ARTH 17792
257	Cornaceae	*Cornus mas* L.	kızılcık	N, P	ES	20-1500	*Artemisia* steppe, under *Quercus*, rocky slopes, bare edges, stream banks	4-5	[18]	ARTH 17793
258	Cornaceae	*Cornus sanguinea* subsp. *cilicica* (Wangerin) Chamberlain.	demircik	P	D. Med	0-1400	broad-leaved forests, scrub	5-6	[9] ;[10]; [11]	ARTH 17794
259	Cornaceae	*Cornus sanguinea* subsp. *australis* (C.A.Mey.) Jáv.	kansiğdiren	N, P	ES	0-1400	limestone slopes, forested areas	5-6	[9]	ARTH 17795
260	Crassulaceae	*Phedimus stolonifer*(S.G.Gmel.)'t Hart	pisikulağı	N, P	BS	900-1800	forests, moist coasts	7-8	[9] ;[10]; [11]	ARTH 17796
261	Crassulaceae	*Sedum album* L.	çobankavurgası	N, P	--	100-2500	walls, rocky slopes and crevices	6-9	[19]; [20]	ARTH 17797
262	Crassulaceae	*Sedum pallidum* M.Bieb.	koyunörmece	N, P	--	0-1900	deciduous forests, bedrock	6-8	[9] ;[10]; [11]	ARTH 17798
263	Crassulaceae	*Sedum tenellum* M. Bieb.	narindamkoruğu	N, P	--	1700-3400	snow beds, rock depressions	6-8	[9] ;[10]; [11]	ARTH 17799
264	Crassulaceae	*Sempervivum armenum* Boiss& A Huet.	gelinparmağı	N, P	BS	1600-3200	limestone hills, volcanic slopes, mobile rocks	7-8	[9]	ARTH 17800
265	Cupressaceae	*Juniperus communis* L.	ardıç	P	--	2000-2700	volcanic rock, forest edges	5	[9] ;[10]; [11]	ARTH 17801
266	Cupressaceae	*Juniperus excelsa* M. Bieb.	bozardıç	N, P	--	150-2700	arid rocky slopes of hills and mountains.		[20]	ARTH 17802
267	Cupressaceae	*Juniperus oxycedrus* L.	katranardıcı	N, P	--	0-1800	pine forest, oak scrub, maquis		[24]; [20]	ARTH 17803
268	Cyperaceae	*Carex divisa* Huds.	zevzirçimeni	N, P	ES	0-2800	saline pastures, lakesides, pastures, canals, ponds, rice paddies		[5]	ARTH 17804
269	Cyperaceae	*Carex pendula* Huds.	salkımsaparna	N, P	ES	0-2000	forests or other shaded areas, riverbanks, springs or depressions		[5]	ARTH 17805
270	Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn	eğrelti	P	--	0-1900	cut forest, cut grove, dune		[9]	ARTH 17806
271	Dioscoreaceae	*Dioscorea communis* (L.) Caddick & Wilkin.	dolanbaç	P	--		forest		[9] ;[10]; [11]	ARTH 17807
272	Ebenaceae	*Diospyros kaki* Thunb.	trabzonhurası		--	50-1100	planted gardens and orchards	6	[9] ;[10];	ARTH 17808
273	Ebenaceae	*Diospyros lotus* L.	hırnık	N, P	--	50-1100	In the slopes of alnus and chestnut forests	5-6	[9] ;[10];	ARTH 17809
274	Elaeagnaceae	*Elaeagnus angustifolia* L.	iğde	N, P	--	0-3000	streams and river banks	4-6	[20]; [22]	ARTH 17810
275	Elaeagnaceae	*Hippophae rhamnoides* subsp. *caucasica* Rousi	çıçırgan		--	0-3000	river banks, coasts, rocky and sandy slopes	3-5	[9] ;[10]; [11]	ARTH 17811

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
276	Equisetaceae	*Equisetum arvense* L.	atkuyruğu	P	--	0-1700	empty space, waterfront		[9] ;[10]; [11]	ARTH 17812
277	Ericaceae	*Arbutus andrachne* L.	sandalağacı	N, P	--	0-800	maquis, *Pinus brutia* forests	3-5	[9] ;[10]; [11]	ARTH 17813
278	Ericaceae	*Epigaea gaultherioides* (Boiss. & Balansa) Takht.	dağelması		BS	920-2290	*Fagus* and *Picea* forests with *Vaccinium* and *Rhododendron*, N. slope	5-7	*	ARTH 17814
279	Ericaceae	*Erica spiculifolia* Salisb.	çırpıntı		ES	920-2290	*Fagus orientalis* and *Picea orientalis* forests	6-9	*	ARTH 17815
280	Ericaceae	*Pyrola media* Swartz	meşekekliküzüm	P	ES	1300-1850	deciduous or coniferous forests, open hills, acidic habitats	6-7	[9] ;[10]; [11]	ARTH 17816
281	Ericaceae	*Rhododendron caucasicum* Pall.	dağkumarı		BS	1830-3000	north-facing slopes on acidic soils, often above the tree line	5-7	*	ARTH 17817
282	Ericaceae	*Rhododendron luteum* Sweet	zifin	N, P	BS	0-2200	*Fagus-Pinus* and *Abies* forest understory, grassy slopes, rarely above tree line	4-9	[24]	ARTH 17818
283	Ericaceae	*Rhododendron ponticum* L.	kumar	N, P	BS	0-2100	*Fagus orientalis* forest,	3-8	[24]	ARTH 17819
284	Ericaceae	*Rhododendron smirnowii* Trautv.	kızılkumar		BS	850-; 2300	*Rhododendron* thicket, sometimes with *Picea*, both acidic and basic substrates	6-7	*	ARTH 17820
285	Ericaceae	*Rhododendron ungernii* Trautv.	beyazkumar		BS	1000-2000	often in pine forests, sometimes among beeches or in R*hododendron* thickets	6-8	*	ARTH 17821
286	Ericaceae	*Rhododendron x davisianum* R. Milne **(EN)**	kaful		BS	2000	eroded rocks or subalpine grasslands	6-7	*	ARTH 17822
287	Ericaceae	*Rhododendron x filidactylis* R. Milne **(EN)**	zelenika		BS	1750	*Rhododendron ponticum, R. ungerni* scrub, rarely with *R. smirnovii* and other hybrids	6-7	*	ARTH 17823
288	Ericaceae	*Rhododendron x rosifaciens* R. Milne **(EN)**	tiryalkumarı		BS	1650	edges of degraded *Rhododendron* thicket	6-7	*	ARTH 17824
289	Ericaceae	*Rhododendron x sochadzeae* Kharadze & Davlianidze	melezkumar		BS	1700-2400	*Rhododendron* thicket, often above tree line, rarely *Fagus* forest	6-7	*	ARTH 17825
290	Ericaceae	*Rhodothamnus sessilifolius* P.H. Davis **(EN)**	dağgülü		BS	2150-2400	moist coasts and volcanic cliff faces	6-7	*	ARTH 17826
291	Ericaceae	*Vaccinium arctostaphylos* L.	likarpa	N, P	BS	0-1830	sparse beech and fir forests, thickets	5-7	[9] ;[10]; [11]	ARTH 17827
292	Ericaceae	*Vaccinium myrtillus* L.	ayıüzümü		ES	1280-2700	acidic habitats, among them *Rhododendron caucasicum, Pinus or Juniperus*	5-7	[9] ;[10]; [11]	ARTH 17828
293	Euphorbiaceae	*Chrozophora tinctoria* (L.) A.Juss.	siğilotu	N	--	0-1650	maquis, firigana, *Pinus brutia* forest clearing, stony places, saline steppe, fields, paths	3-9	[9]	ARTH 17829
294	Euphorbiaceae	*Euphorbia amygdaloides* L.	zerana	N, P	ES	50-2000	*Fagus* and *Abies* forest, *Carpinus* areas	3-8	[9] ;[10];	ARTH 17830
295	Euphorbiaceae	*Euphorbia arvalis* Boiss. & Heldr.	tarlasütleğeni		IT	930-2000	steppe, fields, roadsides	4-7	[19]	ARTH 17831
296	Euphorbiaceae	*Euphorbia denticulata* Lam.	karasütlük	N	IT	800-3050	*Quercus* forests, scrub, rocky limestone and igneous slopes, steppe, ruins	4-8	[19]	ARTH 17832
297	Euphorbiaceae	*Euphorbia eriophora* Boiss.	şiremara	N, P	IT	650-1850	chalky marl in steppe, fallow fields,	5-9	[20]	ARTH 17833
298	Euphorbiaceae	*Euphorbia helioscopia* L.	feribanotu	N, P	--	0-1400	limestone cliffs and slopes, firigana, riverbanks, ruins, fallow fields,	2-6	[9]	ARTH 17834
299	Euphorbiaceae	*Euphorbia hirsuta* L.	kıllısütleğen	N, P	--	0-1400	riverbanks, marshes, salt marshes, sandy beaches	4-9	[5]	ARTH 17835
300	Euphorbiaceae	*Euphorbia iberica* Boiss.	gaşil		IT	1700-3500	deciduous *Quercus* thicket, stony slopes, ravines, grasslands, pastures,	6-8	[9] ;[10]; [11]	ARTH 17836

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
301	Euphorbiaceae	*Euphorbia macroclada* Boiss.	neblul		IT	250-2500	*Pinus* and *Quercus* forest clearing, *Astragalus* and *Artemisia* steb, rocky slopes,	5-9	[19]	ARTH 17837
302	Euphorbiaceae	*Euphorbia myrsinites* L.	delisütleğen		--	450-2200	igneous slopes, alpine meadows, *Pinus* forest, steppe, sandy gravels, edges, field	4-8	[22]	ARTH 17838
303	Euphorbiaceae	*Euphorbia rigida* MBieb.	sütleğen	P,N	--	0-2000	*Pinus brutia* forest clearing, *Quercus coccifera* maquis, firigana, limestone slopes	3-8	[9] ;[10]; [11]	ARTH 17839
304	Euphorbiaceae	*Euphorbia stricta* L.	katısütleğen	P	ES	0-2100	*Abies*, *Picea*, *Pinus*, *Fagus* and *Quercus* forests, rocks on limestone and sandstone	4-8	[19]	ARTH 17840
305	Euphorbiaceae	*Euphorbia szovitsii* Fisch. & C.A.Mey.	urussütleğeni		IT	300-2000	*Quercus* and *Pinus* forest, scrub, stony areas, degraded steppe, fields, vineyards	5-8	[19]	ARTH 17841
306	Euphorbiaceae	*Euphorbia tommasiniana* Bertol. (syn: *Euphorbia esula* subsp. *tommasiniana* (Bertol.) Kuzmanov)	eşeksütleğeni	N/P	--	650-2100	Rocky slopes, screes, eroded clay hills, dry river-banks, shingle, scrub, sandy fields, partly cultivated hillsides	6-7	[23]	ARTH 17842
307	Euphorbiaceae	*Mercurialis annua* L.	parşen	N, P	--	0-1100	limestone slopes, *Pinus* forest, firigana	2-7	[9]	ARTH 17843
308	Fabaceae	*Anthyllis vulneraria* L.	çobangülü	N, P	--		draining calcareous soils on chalk and limestone grasslands, rocky outcrops and near the sea on shingle and sand dunes.	5-9	[5]	ARTH 17844
309	Fabaceae	*Astragalus acmophylloides* Grossh. (EN)	bayırgeveni		--		pine forest edge	6	[19]	ARTH 17845
310	Fabaceae	*Astragalus aduncus* Willd.	kemaliyegeveni		IT	300-2370	rocky places and wastelands	4-7	[19]	ARTH 17846
311	Fabaceae	*Astragalus angustiflorus* K.Koch	incegeven	N	IT	750-2380	open rocky areas, steppe	5-6	[9]	ARTH 17847
312	Fabaceae	*Astragalus incertus* Ledeb.	koçtaşağı	N, P	IT	2300-3400	Steppe, screes and rocky slopes	7-8	[20]	ARTH 17848
313	Fabaceae	*Astragalus lagopoides* Lam.	somgeven		IT	1200-2890	Steppe, mountains, hilly pasture	6-8	[19]	ARTH 17849
314	Fabaceae	*Astragalus odoratus* Lam.	miskgeveni	N, P	--	700-1950	marshes, wet meadows, barren places	6-7	[19]; [20]	ARTH 17850
315	Fabaceae	*Astragalus ornithopodioides* Lam.	palageveni	N	IT	700-2300	moors, grassy slopes with schist	3-7	[19]	ARTH 17851
316	Fabaceae	*Astragalus pendulus* DC. (Syn: *Astragalus campylosema* Boiss.)	sırıkgeveni	N, P	IT	800-2000	oak scrub, rocky slopes	5-6	[20]	ARTH 17852
317	Fabaceae	*Astragalus stevenianus* DC.	arıkaldıran	N, P	--	400-2130	stony places, steppe	4-7	[9]	ARTH 17853
318	Fabaceae	*Astragalus subcaulescens* Ledeb.	pullugeven	N, P	IT	1600-2400	alpine meadows, stony slopes	5-7	[20]	ARTH 17854
319	Fabaceae	*Chamaecytisus hirsutus* (L.) Link	keçitırfılı	P	--	100-1600	hill slopes, sparse woods, roadsides	4-6	[9]	ARTH 17855
320	Fabaceae	*Coronilla orientalis* Mill.	alakörigen	N	--	100-2300	destroyed and stony places	4-7	[23]; [19]	ARTH 17856
321	Fabaceae	*Coronilla scorpioides* (L.) W.D.J.Koch	akrepburçağı	N, P	--	0-1000	cultivated and destroyed places	3-7	[5]	ARTH 17857
322	Fabaceae	*Coronilla varia* L. (Syn: *Securigera varia* (L.) Lassen.)	körigen	N, P	--	250-2150	stony places and deciduous woods and thickets, cultivated places	5-8	[19]	ARTH 17858
323	Fabaceae	*Genista tinctoria* L.	boyacıkatırtırnağ		ES	0-2200	rocky slopes, scrub and sparse forests	4-7	[9] ;[10]; [11]	ARTH 17859
324	Fabaceae	*Hedysarum varium* Willd.	batalak	N, P	IT	300-2100	steppe, bare slopes, oak groves, fallow fields, cultivated land	6-7	[9]	ARTH 17860
325	Fabaceae	*Kartalinia acaulis* (Hoffm.) Brullo, C.Brullo, Cambria, Acar, Salmeri & Giusso	--	N, P	BS	450-1950	rocky benches and edges	5-8	[9]	ARTH 17861

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
326	Fabaceae	*Lathyrus annuus* L.	dağdırılcası	N, P	Med	0-1000	thicket, hedgerows, wet meadows, between rocks, fields	5-7	[18]	ARTH 17862
327	Fabaceae	*Lathyrus aureus* (Stev.) D.Brandza.	korumürdümüğü	N, P	BS	15-2000	forest and scrubland	5-7	[9] ;[10]; [11]	ARTH 17863
328	Fabaceae	*Lathyrus cicera* L.	colban	N, P	--	May.00	oak scrub, *Pinus brutia* forest, rocky slopes, vineyards, grain and fallow fields	4-5	[19]; [5]; [18]	ARTH 17864
329	Fabaceae	*Lathyrus laxiflorus* (Desf.) Kuntze	deliburçak	N, P	--	0-1900	forest, scrubland, shady shores	5-7	[5]; [18]	ARTH 17865
330	Fabaceae	*Lathyrus nissolia* L.	çimenburçak	N, P	--	0-1900	*Pinus nigra* forest, oak scrub, grassland, marshes	5-7	[19]; [18]	ARTH 17866
331	Fabaceae	*Lathyrus pratensis* L.	yılangürülü	N, P	ES	0-2300	Wet meadows, stream banks, thickets	6-7	[20]	ARTH 17867
332	Fabaceae	*Lathyrus roseus* Stev.	gülmürdümüğü	N, P	BS	30-1800	forests (*Picea*, *Pinus*), scrub (*Quercus*, *Corylus)*	5-7	[9]; [10]; [11]	ARTH 17868
333	Fabaceae	*Lathyrus rotundifolius* Willd.	hırıgürü	N, P	--	1000-2200	Scrub, hedges, lush meadows, corn and fallow fields	6-7	[9]; [10]; [11]	ARTH 17869
334	Fabaceae	*Lathyrus rotundifolius* subsp. *miniatus* (Bieb. Ex Stev.) P.H.Davis	hırıgürü		--	1000-2200	scrub (usually on N. slopes), hedgerows, very wet meadows, cereal and fallow fields	6-7	[9]; [10]; [11]	ARTH 17870
335	Fabaceae	*Lathyrus vernus* (L.) Bernh.	baharkülürü	P	ES	60-1400	forests, scrub, rocky ridges	4-5	[21]	ARTH 17871
336	Fabaceae	*Lotus corniculatus* L.	gazalboynuzu	N, P	--	0-2500	mountainous slopes and meadows	6-8	[23]	ARTH 17872
337	Fabaceae	*Lotus graecus* L. (Syn: *Dorycnium graecum* (L.) Ser.)	akkaplanotu	P	BS	0-2000	roadsides, open slopes, scrub, coniferous and deciduous forests	4-8	[19]	ARTH 17873
338	Fabaceae	*Lotus* tenuis Waldst. & Kit. ex Willd. (syn: *Lotus corniculatus* var. *tenuifolius* L.)	gazalboynuzu	P	--	0-2500	mountainous slopes and meadows	6-8	[9]; [10]; [11]	ARTH 17874
339	Fabaceae	*Medicago arabica* (L.) Huds.	benliyonca	P	--	0-830	groves	3-5	[21]	ARTH 17875
340	Fabaceae	*Medicago fischeriana* (Ser.) Trautv.	mızrakyonca		IT	-	meadows, fields, wastelands		[19]	ARTH 17876
341	Fabaceae	*Medicago lupulina* L.	bitçikotu	N, P	--	0-2000	thickets, meadows, fields, wastelands	5-7	[23]; [19]	ARTH 17877
342	Fabaceae	*Medicago minima* (L.) Bartal.	gurnik	N, P	--	0-1750	rocky limestone slopes, steppe, dunes, fields	3-5	[19]; [5]	ARTH 17878
343	Fabaceae	*Medicago sativa* L.	karayonca	N, P	--	0-2500	steppe, rocky and grassy slopes, dense oak scrub, meadows, dunes, fields	4-9	[19]; [21]; [20]; [5]	ARTH 17879
344	Fabaceae	*Medicago x varia* Martyn	yabanyoncası	N, P	--	250-2000	rocky slopes, steppe (chalky shores, clay hills, meadows), fallow fields	5-8	[9]	ARTH 17880
345	Fabaceae	*Melilotus officinalis* (L.) Lam.	kokuluyonca	N, P	--	0-1750	destroyed places	5-9	[20]; [5] [22]	ARTH 17881
346	Fabaceae	*Onobrychis cornuta* (L.) Desv.	kuşkaçıran	N, P	IT	1200-3100	rocky slopes; and ravines	5-7	[20]; [19]	ARTH 17882
347	Fabaceae	*Ononis spinosa* subsp. *leiosperma* (Boiss.) Sirj.	demirdelen	N, P	--	0-2250	stony slopes, vineyards, cultivated land	5-8	[20]	ARTH 17883
348	Fabaceae	*Oxytropis albana* Stev.	akgagageveni	N, P	--	2500-3500	alpine meadows, ravines	7	[9]	ARTH 17884
349	Fabaceae	*Oxytropis lazica* Boiss.	lazgagageveni	N, P	--	2100-2900	alpine meadow	7-8	[9]; [10]; [11]	ARTH 17885
350	Fabaceae	*Pisum sativum* L.	bezelye	N, P	--		Culture	4-5	[5]	ARTH 17886

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
351	Fabaceae	*Scorpiurus muricatus* L.		N, P	--			4-5	[9]; [10]; [11]	ARTH 17887
352	Fabaceae	*Trifolium ambiguum* M.Bieb.	pisikkulağı	N, P	--	1700-2750	steep ravines, slopes, forest edges, fields	6-8	[20]; [22]	ARTH 17888
353	Fabaceae	*Trifolium arvense* L.	tavşanayağı	N, P	--	0-23	grassy and barren places, usually in sparse communitarian	3-5	[19]; [5]; [18]	ARTH 17889
354	Fabaceae	*Trifolium aureum* Pollich	altuniüçgül	N, P	ES	500-2165	N. slopes	7-8	[9]; [10]; [11]	ARTH 17890
355	Fabaceae	*Trifolium badium* Schreb.	katuna	N, P	--				[9]	ARTH 17891
356	Fabaceae	*Trifolium campestre* Schreb.	üçgül	N, P	--	0-2200	fields, wastelands	2-4	[19]; [5]; [21]	ARTH 17892
357	Fabaceae	*Trifolium canescens* Willd.	sarıüçgül	N, P	BS	200-2000	subalpine meadows, river banks, volcanic groves	5-8	[9]	ARTH 17893
358	Fabaceae	*Trifolium hybridum* L.	melezüçgül	N, P	--	0-2000	meadow, wet places	5-9	[19]; [22]	ARTH 17894
359	Fabaceae	*Trifolium medium* L.	köseyonca	N, P	--	0-2000	forests, scrub, grasslands	5-8	[9]; [10]; [11]	ARTH 17895
360	Fabaceae	*Trifolium pratense* L.	çayırgülü	N, P	--	0-2300	meadows, roadsides, forest clearings	5-9	[24]; [19]; [20];	ARTH 17896
361	Fabaceae	*Trifolium pratense* var. *americanum* Harz	çayırgülü	N, P	--	0-2300	meadows, roadsides, forest clearings	5-9	[5]	ARTH 17897
362	Fabaceae	*Trifolium repens* L.	aküçgül	N, P	--	500-2700	marshy land, grasslands	3-9	[24]; [19]; [21]; [5];[22]; [18]	ARTH 17898
363	Fabaceae	*Trifolium sylvaticum* Gerard & Loisel.	ormanüçgülü		--	250-1600	hill slopes, valleys in the mountains	4-5	[9]	ARTH 17899
364	Fabaceae	*Trifolium trichocephalum* M.Bieb.	hemşinüçgülü	N, P	--	1670-2600	meadows, woodland and reed beds	5-7	[9]	ARTH 17900
365	Fabaceae	*Vicia balansae* Boiss.	pisikfiği		BS	1100-2600	*Picea* and *Pinus sylvestris* forests, mountainous areas, coasts	5-7	[9]; [10]; [11]	ARTH 17901
366	Fabaceae	*Vicia cracca* L.	kuşfiği	N, P	ES	100-2270	deciduous thickets, hedges, damp meadows	4-8	[23]; [20]; [5]; [19]; [22]	ARTH 17902
367	Fabaceae	*Vicia grandiflora* Scop.	kocabakla	N, P		0-1200	forest, scrubland, fields, roadsides	4-6	[5]	ARTH 17903
368	Fabaceae	*Vicia hirsuta* (L.) Gray	bozfiğ	N, P	--			5	[9]	ARTH 17904
369	Fabaceae	*Vicia peregrina* L.	kavli		--	0-1400	oak scrub, frigana, rocky limestone slopes, grain and fallow fields	3-6	[19]	ARTH 17905
370	Fabaceae	*Vicia sativa* subsp. *nigra* (L.) Ehrh.	eşekgürülü	N, P	--	0-1900	rocky limestone slopes, cascades, fields	3-5	[9]; [10]; [11]	ARTH 17906
371	Fagaceae	*Castanea sativa* Mill.	kestane	N, P	ES	30-1500	well-watered, deciduous and mixed forests (*Quercus-Fagus* or *Picea-Fagus*)	6-7	[24]; [5]	ARTH 17907
372	Fagaceae	*Fagus orientalis* Lipsky	kayın	P N	ES	30-2000	Deciduous and mixed forests (*Quercus-Castanea-Carpinus* or *Abies*, *Pinus nigra*)	5	[9]; [10]; [11]	ARTH 17908
373	Fagaceae	*Quercus hartwissiana* Steven	ıstırancameşesi	P	BS	20-1750	Broad deciduous (*Carpinus*, *Fagus*, *Fraxinus*, *Quercus*, *Alnus*) and mixed (*Pinus*, *Abies*)	7-8	[21]	ARTH 17909
374	Fagaceae	*Quercus macranthera* subsp. *syspirensis* (K.Koch) Menitsky **(EN)**	ispirmeşesi		--	1000-1900	*Quercus pubescens*, *Pinus nigra*, *Pinus sylvestris*, populus tremula on arid slopes	8-10	[19]	ARTH 17910
375	Fagaceae	*Quercus petraea* subsp. *polycarpa* (Schur) Soó	ballıkmeşesi	N, P	--				[9]; [10]; [11]	ARTH 17911

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
376	Fagaceae	*Quercus pontica* K. Koch	yaylapeliti		BS	800-2100	*Fagus orientalis, Picea orientalis, Rhododendron* forest	8-9	*	ARTH 17912
377	Gentianaceae	*Centaurium erythraea* Rafn.	kırmızıkantaron	N, P	ES	0-900	Sunny edge, rocky slopes, scrub and sparse forest	5-8	[5]	ARTH 17913
378	Gentianaceae	*Gentiana septemfida* Pallas	yedigentiyan	P	BS	1800-3200	Alpine meadows, puddles and sparse *Abies* forest	7-8	[9]; [11]	ARTH 17914
379	Gentianaceae	*Gentiana verna* subsp. *pontica* (Soltok.) Hayek	hemşingentiyanı		BS	1830-3660	Alpine meadow and mound	5-7	[24]	ARTH 17915
380	Geraniaceae	*Erodium ciconium* (L.) L'Hér.	kocakarıığnesi	N, P	--	0-1500	Fields, meadows, steppe	4-5	[5]; [19]	ARTH 17916
381	Geraniaceae	*Erodium cicutarium* (L.) L' Herit.	iğnelik		--	50-1300	Fields, meadows, steppe	3-5	[19]	ARTH 17917
382	Geraniaceae	*Geranium collinum* Steph. Ex Willd.	ıtırçiçeği	P	--	1000-2000	Wet meadows, riverbanks	6-8	[19]	ARTH 17918
383	Geraniaceae	*Geranium columbinum* L.	güvercınıtırı	N, P	--	0-1200	Rocky slopes, sandy beaches, roadsides	4-6	[5]	ARTH 17919
384	Geraniaceae	*Geranium dissectum* L.	dilimliıtır	N, P	--	0-400	Wet places, coasts, swamps	4-5	[5]	ARTH 17920
385	Geraniaceae	*Geranium lucidum* L.	dakkaotu	N, P	--	0-1700	Shady places, often in limestone cliffs	3-5	[5]	ARTH 17921
386	Geraniaceae	*Geranium molle* L.	yumuşakıtır	N, P	--	0-1500	Hill sides, fields, dunes, orchards	3-4	[9]; [10]; [11]	ARTH 17922
387	Geraniaceae	*Geranium psilostemon* Ledeb.	zarifıtır	P	BS	1400-2400	Pistachio forests, scrub and meadows	6-9	[9]; [10]; [11]	ARTH 17923
388	Geraniaceae	*Geranium purpureum* Vill	ebedön	N, P	--	0-2200	Rocky or shady places, waterfalls, shores, fields	3-4	[5]	ARTH 17924
389	Geraniaceae	*Geranium pyrenaicum Burm.* Fil.	gelinçarşafı	P	--	50-2400	Woods, meadows, coasts, rocky slopes, streams	5-7	[9]; [10]; [11]	ARTH 17925
390	Geraniaceae	*Geranium robertianum* L.	dağıtırı	N, P	--	0-2000	Forests, shady rocks	4-6	[9]; [10]; [11]	ARTH 17926
391	Geraniaceae	*Geranium rotundifolium* L.	helilok	N, P	--	0-1700	Coasts, floodplains, rocks and barren places	3-5	[19]; [5]	ARTH 17927
392	Geraniaceae	*Geranium sintenisii* Freyn (Syn: *Geranium asphodeloides* subsp. *sintenisii* (Freyn) Davis) (EN)	çayırıtırı		BS	600-1800	meadows	6-8	[9]	ARTH 17928
393	Geraniaceae	*Geranium sylvaticum* L.	ormanıtırı	P	ES	1600-1700	coniferous forests, meadows, rocky slopes	6-7	[9]; [10]; [11]	ARTH 17929
394	Geraniaceae	*Geranium tuberosum* L.	çakmuz	N, P	--	0-2500	stony slopes and degraded habitats, especially fallow fields	4-6	[5]; [19]	ARTH 17930
395	Hypericaceae	*Hypericum androsaemum* L.	kamaniça	N, P	ES	250-1300	grove edges and stream banks	6-7	[9]; [10]; [11]	ARTH 17931
396	Hypericaceae	*Hypericum calycinum* L.	koyunkıran	P	BS	30-1200	canopy groves and shores	5-8	[9]	ARTH 17932
397	Hypericaceae	*Hypericum elongatum* Ledeb. ex Rchb.	ülserotu		IT	900-2900	rocky slopes	5-7	[24]	ARTH 17933
398	Hypericaceae	*Hypericum lydium* Boiss.	cayesancıyan	N, P	--	400-2700	rocky slopes and *Pinus* groves	5-7	[23]; [19]; [20]	ARTH 17934
399	Hypericaceae	*Hypericum montbretii* Spach	çaykantaronu	N, P	--	200-1750	wet and shady places between rocks	4-7	[5]; [18]	ARTH 17935
400	Hypericaceae	*Hypericum orientale* L.	sandıkçiçeği	N, P	--	0-2300	volcanic rock slopes and woodlands	5-7	[9]; [10]; [11]	ARTH 17936

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
401	Hypericaceae	*Hypericum perforatum* L.	kantaron	N, P	--	0-2500	dry habitats in mesophytic regions	4-8	[19]; [23]; [18]	ARTH 17937
402	Hypericaceae	*Hypericum scabrum* L.	karahasançayı	N, P	IT	750-3200	dry rocky slopes, open woodlands or steppe	5-8	[24]; [23]; [19]; [20]; [22]	ARTH 17938
403	Iridaceae	*Iris caucasica* subsp. *turcica* B. Mathew	türknavruzu		IT	1200-3500	bare stony slopes, ravines and plateaus	4-5	[19]	ARTH 17939
404	Iridaceae	*Iris caucasica* M.Bieb.	kafnavruzu	N, P	ES	2200-2300	rocky slopes and mountain steppes	6	[20]	ARTH 17940
405	Iridaceae	*Iris nezahatiae* Güner et H.Duman (EN)	mavruzo		IT	600-1000	rocky slopes and mountain steppes	5-7	*	ARTH 17941
406	Juglandaceae	*Juglans regia* L.	ceviz	N, P	--	0-1550	*Quercus* or mixed deciduous forest, calcareous rocky slopes, alluvial soils	5	[19]; [21]	ARTH 17942
407	Juncaceae	*Juncus effusus* L.	cilotu	P	--	0-1950	humid places	4-7	[9]; [10]; [11]	ARTH 17943
408	Juncaceae	*Luzula spicata* (L.) DC.	dölekluzul		--	1600-2800	alpine meadows, heathlands, open areas	5-7	[24]	ARTH 17944
409	Lamiaceae	*Ajuga chamaepitys* (L.) Schreb.	acıgıcı	N, P	--	500-900	stony slopes steppe vineyards	5-7	[19]; [20]; [5]	ARTH 17945
410	Lamiaceae	*Ajuga chamaepitys* subsp. *chia* (Schreb.) Arcang.	acıgıcı	N	--	0-2000	stony slopes steppe vineyards, fallow fields barren and gravelly places	4-7	[9]; [10]; [11]	ARTH 17946
411	Lamiaceae	*Ajuga genevensis* L.	çayırmayasılı	N, P	ES	0-500	*Pinus* thickets, moist meadows	5-6	[5]	ARTH 17947
412	Lamiaceae	*Ajuga orientalis* L.	dağmayasılı		--	0-3130	Shrubs, forests, rocky slopes, grasslands	4-7	[9]; [10]; [11]	ARTH 17948
413	Lamiaceae	*Ajuga reptans* L.	meryemsaçı	N, P	ES	50-1500	forests, pastures	3-6	[9]; [10]; [11]	ARTH 17949
414	Lamiaceae	*Ajuga salicifolia* (L.) Schreb.	sivrimayasıl	N, P	IT	0-1850	stony hills, steppe, fallow fields	5-7	[9]	ARTH 17950
415	Lamiaceae	*Ballota nigra* L.	yalancıısırgan	N, P	ES	0-1650	bushy places, spiraea bush	6-7	[5]	ARTH 17951
416	Lamiaceae	*Betonica macrantha* K.Koch (Syn: *Stachys macrantha* (K. Koch) Stearn)	kocasoğulcan	N, P	BS	1600-3300	very wet meadows, rocky slopes, mixed *Pinus* forests and on the edge of *Fagus* scrub	6-9	[9]; [10]; [11]	ARTH 17952
417	Lamiaceae	*Clinopodium grandiflorum* (L.) Kuntze.	kabafesleğen	P	ES	300−2450	damp and shady places, forests and scrub, often on limestone	6-10	[9]; [10]; [11]	ARTH 17953
418	Lamiaceae	*Clinopodium vulgare* L.	yabanifesleğen	P N	--	0-2500	sparse forests, rocky slopes	6-9	[5]	ARTH 17954
419	Lamiaceae	*Clinopodium vulgare* subsp. *arundanum* (Boiss.) Nyman.	kamışfesleğen	P N	--	150-2000	river or shady jenars, thickets, arid limestone slopes, grasses and prairies	6-8	[9]; [10]; [11]	ARTH 17955
420	Lamiaceae	*Glechoma hederacea* L.	yernanesi	N, P	ES	20-1665	wet bays wet pastures, among the bushes	3-6	[9]; [10]; [11]	ARTH 17956
421	Lamiaceae	*Lallemantia canescens* (L.) Fisch. & C.A.Mey.	topajdarbaşı	N, P	IT	1300-3200	fallow fields, hillsides, roadsides, volcanic rock, limestone slopes and ravines	6-8	[9]; [10]; [11]	ARTH 17957
422	Lamiaceae	*Lallemantia iberica* (M.Bieb.) Fisch. & C.A.Mey.	ajdarbaşı	--	IT	500-2150	roadsides, slopes, fallow fields, cultivated fields, cheeky weeds	4-6	[19]	ARTH 17958
423	Lamiaceae	*Lamium album* L.	balıcak	N, P	ES	990-3100	*Abies* forests, oak scrub, rocky slopes (often volcanic), stream banks	5-8	[19]; [5]; [20]	ARTH 17959
424	Lamiaceae	*Lamium amplexicaule* L.	baltutan	N, P	ES		hill slopes sparse steppe, cultivated land roadsides wastelands	2-11	[19]; [5]; [20]	ARTH 17960
425	Lamiaceae	*Lamium garganicum* L.	bolbalıcak	N, P	--	400-2300	Shaded calcareous and volcanic rocks rock crevices, creeks, walls, ruins, river	3-5	[19]; [5]; [20]	ARTH 17961

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
426	Lamiaceae	*Lamium garganicum* subsp. *striatum* (Sm.) Hayek.	telbalıcak	--	--	400-2300	Shaded calcareous and volcanic rocks rock crevices, creeks, walls, ruins, river	3-5	[24]	ARTH 17962
427	Lamiaceae	*Lamium purpureum* L	ballıbaba	N, P	ES	30-1700	Oak and *Abies* forests, earthy slopes, gravelly stream banks, fields and wastelands	3-5	[24]; [5]; [22]; [18]	ARTH 17963
428	Lamiaceae	*Lycopus europaeus* L.	kurtayağı	---	ES	10-1680	wet banks of streams, ponds, lakes and swamps, dry shores, frequent shadows	6-10	[9]; [10]; [11]	ARTH 17964
429	Lamiaceae	*Marrubium anisodon* K. Koch	yayotu	N	--	1750-1980	rocky limestone slopes	6-8	[9]	ARTH 17965
430	Lamiaceae	*Marrubium astracanicum* Jacq.	moryayotu	N, P	--	950-3200	slopes, wooded areas, roadsides	5-9	[23]	ARTH 17966
431	Lamiaceae	*Marrubium parviflorum* Fisch. & C.A.Mey.	bozotu	N, P	IT	450-1900	arid fallow fields, calcareous and gypsiferous soils, steppe, scrub	5-9	[19]; [20]; [22]	ARTH 17967
432	Lamiaceae	*Mentha aquatica* L.	sunanesi	N, P	--	0-1300	river and lake banks, coasts and marshes	8-0	[19]; [5]	ARTH 17968
433	Lamiaceae	*Mentha longifolia* subsp. *typhoides* (Briq.)Harley	derenanesi	N, P	--	900-2135	marshy fields, near streams and rivers	7-10	[9]; [10]; [11]	ARTH 17969
434	Lamiaceae	*Mentha longifolia* (L.) L.	pünk	N, P	BS	600-2300	riverbanks and swamps	6-8	[23]; [19]; [5]	ARTH 17970
435	Lamiaceae	*Mentha pulegium* L.	yarpuz	N, P	--	0-1300	wet places that dry out in summer	6-9	[5]	ARTH 17971
436	Lamiaceae	*Mentha spicata* L.	eşeknanesi	N, P	--	0-2200	wet shores, ditches, stream banks	6-9	[5]	ARTH 17972
437	Lamiaceae	*Nepeta italica* L.	eşekçayı		--	0-1300	*Quercus (cerris, coccifera, pubescens) calcareous* rock and volcanic slopes, dry stream beds	5-7	[19]	ARTH 17973
438	Lamiaceae	*Nepeta nuda* L.	morküncü	N, P	--	1100-2250	meadows rock slopes edges, Juniperus thickets, *Pinus* groves	6-8	[19]; [5]	ARTH 17974
439	Lamiaceae	*Nepeta nuda* subsp. *albiflora* (Boiss.) Gams	karaküncü	P	--	850-2750	deciduous and coniferous drylands, meadows, stream banks, limestone rocks and grasslands	5-8	[23]	ARTH 17975
440	Lamiaceae	*Nepeta racemosa* Lam.	pisikotu	N, P	IT	1500-2800	limestone rocks and volcanic slopes, ravines, field edges, with *Pinus sylvestris*	6-8	[20]	ARTH 17976
441	Lamiaceae	*Origanum acutidens* (Hand.-Mazz.) Letswaart (EN)	zemul	N, P	IT	1000-3000	calcareous and non-calcareous rocks, hillsides and rillsides	6-8	[22]	ARTH 17977
442	Lamiaceae	*Origanum rotundifolium* Boiss.	yuvarlakmercan		BS	250-1300	calcareous and non-calcareous rocks and slopes	6-9	*	ARTH 17978
443	Lamiaceae	*Origanum vulgare* L.	karakınık	N, P	ES	0-250	dry hills and rocky slopes, calcareous and non-calcareous soils, coniferous or mixed forests, maquis	5-10	[5]	ARTH 17979
444	Lamiaceae	*Origanum vulgare* subsp. *viridulum* (Martrin-Donos) Nyman	istanbulkekiği	N, P	--	2-500	dry hills and rocky slopes, calcareous and non-calcareous soils, coniferous or mixed forests, maquis	5-10	[9]	ARTH 17980
445	Lamiaceae	*Phlomis armeniaca* Willd.	bozşavlak	N, P	IT	800-2350	pine groves, steppe, dry calcareous rock, corn and fallow fields	6-8	[24]; [19]; [20]	ARTH 17981
446	Lamiaceae	*Phlomis herba-venti* subsp. *pungens* (Willd.) Maire ex DeFilipps (Syn: *Phlomis pungens* var. *hirta* Velen.)		N, P	--	250-2400	steppe, grasslands, fallow fields, roadsides, dry stony slopes, *Pinus* forests	6-8	[9]; [10]; [11]	ARTH 17982
447	Lamiaceae	*Prunella laciniata* (L.) L.	bodurfesleğen	N, P	ES	0-1800	broad-leaved and coniferous forests, meadows, fields	5-7	[19]	ARTH 17983
448	Lamiaceae	*Prunella vulgaris* L.	gelinciklemeotu	N, P	ES	0-2900	fields, woods, roadsides and damp; edges, streams	5-9	[23]; [5]	ARTH 17984
449	Lamiaceae	*Salvia aethiopis* L.	habeşadaçayı	--	--	0-2100	steppe, volcanic and limestone slopes, fallow fields, roadsides, coasts	5-8	[19]	ARTH 17985
450	Lamiaceae	*Salvia bracteata* Banks & Sol.	çobanşalbası	--	IT	50-2000	volcanic and calcareous slopes, with *Quercus brantii*, fallow fields, vineyard edges,	5-7	[19]	ARTH 17986

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
451	Lamiaceae	*Salvia candidissima* Vahl	galabor	N, P	IT	700-2000	rocky limestone and schist slopes, thickets, *Pinus*, *Quercus*, *Abies* and *Cedrus*, fallow fields.	5-9	[9]	ARTH 17987
452	Lamiaceae	*Salvia forskahlei* L.	dolmayaprağı	N	BS		broad and coniferous forests, meadows, steep edges	6-9	[9]; [10]; [11]	ARTH 17988
453	Lamiaceae	*Salvia glutinosa* L.	okluşalba	N, P	BS	780-2360	moist places in deciduous (*Fagus*, *Alnus*, *Corylus*) forests and thickets, *Picea* forest	7-10	[9]; [10]; [11]	ARTH 17989
454	Lamiaceae	*Salvia microstegia* Boiss. & Balansa	yağlambaç	--	IT	970-3350	rocky limestone and volcanic slopes, mobile rocks	6-8	[19]	ARTH 17990
455	Lamiaceae	*Salvia multicaulis* Vahl	kürtreyhanı	N/P	IT	550-2600	rocky limestone and volcanic slopes, shale and sandy slopes, mobile cliffs	4-7	[19]; [23]; [20]	ARTH 17991
456	Lamiaceae	*Salvia nemorosa* L.	gehareş	N, P	--	1000-2300	rocky slopes in the steppe, fallow fields, hillside meadows, barren places	5-9	[24]	ARTH 17992
457	Lamiaceae	*Salvia sclarea* L.	paskulak	N, P	--	0-2000	rocky volcanic slopes, mixed coniferous and deciduous groves shale shores	5-8	[19]	ARTH 17993
458	Lamiaceae	*Salvia staminea* Montbret Et Aucher Ex Bentham	erkekşalba	--	IT	1700-3150	limestone and volcanic rocky slopes, oak scrub, cliffs, moving rock, alpine meadow	5-8	[9]; [10]; [11]	ARTH 17994
459	Lamiaceae	*Salvia verticillata* L.	dadırak	N, P	ES	0-2300	*Pinus*, *Quercus*, *Fagus* and *Corylus* woodlands, meadows, gravelly stream beds, roadsides	6-8	[23]; [19]; [21]	ARTH 17995
460	Lamiaceae	*Salvia verticillata* subsp. *amasiaca* (Freyn & Bornm.) Bornm.	hartşalbası	--	IT	150-2300	Rocky slopes, stipa steep, sandy shores, *Quercus* and *Pinus* forests, prairies, roadsides	5-9	[24]	ARTH 17996
461	Lamiaceae	*Salvia virgata* Jacq.	fatmanaotu	N, P	IT	0-2300	shrub woodland, meadows, fallow fields, roadsides	5-9	[23]; [19]; [5]	ARTH 17997
462	Lamiaceae	*Salvia viridis* L.	zarifşalba	N, P	Med	0-1300	rocky slopes, scrub with *Cistus*, *firigana*, dunes, fields and wastelands	3-7	[19]; [5]	ARTH 17998
463	Lamiaceae	*Satureja hortensis* L.	çibriska	N, P	--	0-1920	rocky and eroded patches, gullies, gravelly places, loose dunes on coasts, fallow	6-9	[23]	ARTH 17999
464	Lamiaceae	*Satureja spicigera* (K. Koch) Boiss.	çorbakekiği	--	BS	20-1500	eroded dry edges and rocky places, benches, cascades	8-9	[9]; [10]; [11]	ARTH 18000
465	Lamiaceae	*Scutellaria albida* L.	akkaside	N	D. Med	0-1700	cleared *Fagus*, *Pinus* sylvestris, *Pinus nigra* forests, oak scrub	5-7	[9]; [10]; [11]	ARTH 18001
466	Lamiaceae	*Scutellaria orientalis* L.	sarıkaside	N, P	IT	450-1500	volcanic rock (incl serpentine) and foggy hill slopes	6-8	[24]; [5]	ARTH 18002
467	Lamiaceae	*Sideritis armeniaca* Bornm. (EN)	yüzükçayı	N, P	IT	1600	rocky slopes, steppe	7-9	[9]; [11]	ARTH 18003
468	Lamiaceae	*Sideritis montana* L.	karaçay	N, P	Med	0-2000	cultivated and fallow fields, steppe, dry slopes, pine forests, oak scrub, saline places	5-7	[5]	ARTH 18004
469	Lamiaceae	*Stachys balansae* Boiss. & Kotschy (EN)	bozçayçe	N	--	1700-2800	rocky slopes, grasslands, river banks, very wet meadows	6-9	[19]	ARTH 18005
470	Lamiaceae	*Stachys cretica* L.	deliçay	N, P	--				[19]; [5]	ARTH 18006
471	Lamiaceae	*Stachys iberica* Bieb	tokdeliçay	N, P	IT	400-2400	Limestone rock slopes and escarpments, river banks, volcanic coasts	5-8	[19]	ARTH 18007
472	Lamiaceae	*Stachys lavandulifolia* Vahl	tüylüçay	N, P	IT	1000-3660	calcareous volcanic rock slopes and rills	5-8	[19]; [23]; [20]	ARTH 18008
473	Lamiaceae	*Stachys palustris* L.	gölısırganı		ES	0-1100	wet stony places, corners of forests	6-10	[9]	ARTH 18009
474	Lamiaceae	*Stachys spectabilis* Choisy ex DC.	alacakarabaş		IT	1000-2200	stream and river banks wet rock slopes, maquis	6-9	[9]	ARTH 18010
475	Lamiaceae	*Stachys sylvatica* L.	hamısırgan	P	ES	0-2440	Picea and Fagus forests, mixed woodlands, gravelly slopes, coasts, wet places	6-9	[9]; [10]; [11]	ARTH 18011

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
476	Lamiaceae	*Stachys viscosa* Montbret & Aucher ex Bentham	yağlıkarabaş		IT	960-1800	steep cliffs, rock slopes and crevices	5-8	[24]	ARTH 18012
477	Lamiaceae	*Teucrium chamaedrys* L.	kısamahmut	N, P	ES	0-1600	sparse forests, cliffs, slopes, steppes	6-8	[19]; [20]; [5]	ARTH 18013
478	Lamiaceae	*Teucrium hircanicum* L.	yağmurotu		BS	0-600	shady walls and damp places	6-8	*	ARTH 18014
479	Lamiaceae	*Teucrium orientale* L.	kirveotu	N, P	IT	600-2150	sparse oak and Pinus forests, meadows, rocky slopes	6-9	[19]; [20]	ARTH 18015
480	Lamiaceae	*Teucrium orientale* var. *puberulens* T. Ekim	kirveotu	N, P	IT	300-2400	rocky slopes, sparse areas, fields and roadsides	6-9	[23]	ARTH 18016
481	Lamiaceae	*Teucrium orientale* var. *glabrescens* Hausskn. ex Bornm.	kirveotu		--	800-3000	sparse *Pinus nigra* forests, dry volcanic or limestone slopes and steppe	6-8	[9]; [11]	ARTH 18017
482	Lamiaceae	*Teucrium polium* L.	acıyavşan	N, P	--	0-2050	dry places, oak bushes, rocky places, dunes, field edges	6-9	[21]; [20]; [5]	ARTH 18018
483	Lamiaceae	*Teucrium scordium* subsp. *scordioides* (Schreb.) Arcang.	kurtluca	N	ES	150-1800	damp places, salt marshes, stream channels, forests, humid dunes, fallow fields	5-9	[9]; [11]	ARTH 18019
484	Lamiaceae	*Thymus praecox* Opiz	yaylakekiği	N, P	--	--	Subalpine, rocky places,	5-8	[9]; [10]; [11]	ARTH 18020
485	Lamiaceae	*Thymus sipyleus* Boiss.	sipilkekiği	N, P	--	400-2700	mountain steppes, rocky slopes	5-8	[24]; [19]; [22]	ARTH 18021
486	Lamiaceae	*Ziziphora capitata* L.	anuk	N	IT	0-2200	dry open places, stony slopes, rocky, steppe	4-8	[20]	ARTH 18022
487	Lamiaceae	*Ziziphora tenuior* L.	fareotu	N, P	IT	0-1750	steppe, rocky slopes, fallow fields, sandy and pebbly coasts	4-8	[5]; [19]	ARTH 18023
488	Lauraceae	*Laurus nobilis* L.	defne	N, P	Med	0-1200	coastal maquis, dense bushes planted with *Myrtus, Phillyrea and Erica arborea*, *Pinus brutia*	3-5	[5]	ARTH 18024
489	Liliaceae	*Fritillaria latifolia* Willd.	yaylalâlesi	N, P	BS	1800-3000	grassy areas, *Pinus* zones	5-7	[18]	ARTH 18025
490	Liliaceae	*Gagea glacialis* K.Koch	buzyıldızı	P	IT	1900-290	alpine meadows, (with melting snow)	5-8	[10]; [11]	ARTH 18026
491	Liliaceae	*Gagea taurica* Steven	bozkıryıldızı		IT	900-2500	steppes, stony hill sides	4-5	[24]	ARTH 18027
492	Liliaceae	*Lilium kesselringianum* Miscz.			BS	1450-2400	wooded slopes, meadows, *Picea* forest, grain fields	6-7	*	ARTH 18028
493	Liliaceae	*Lilium ponticum* K.Koch.	hemşinzambağı	N, P	--	1450-2400	wooded slopes, meadows, *Picea* forest, grain fields	4-5	[9]; [10]; [11]	ARTH 18029
494	Liliaceae	*Tulipa armena* Boiss.	hoşlale		IT	1000-2750	Rocky slopes and screes, mainly	4-6	*	ARTH 18030
495	Linaceae	*Linum austriacum* L.	zeyrek		--	0-1800	degraded steppe, fallow fields, roadsides	4-6	[19]	ARTH 18031
496	Linaceae	*Linum catharticum* L.	arsızketen		ES	0-2500	stream banks, damp banks, puddles, azalea bushes	6-8	[19]	ARTH 18032
497	Linaceae	*Linum hypericifolium* Salisb.	çayırketeni	N, P	--	1700-2500	forests, shrubs, meadows, rocky places	6-7	[9]; [10]; [11]	ARTH 18033
498	Linaceae	*Linum tenuifolium* L.	narinketen		--	200-1700	calcareous slopes and cascades, steppe, scrub slopes and open pine forests	6	[19]	ARTH 18034
499	Lythraceae	*Lythrum salicaria* L.	hevhulma	N, P	--	100-2000	wet places in lakes and streams, dry river beds	6-8	[19]; [5]	ARTH 18035
500	Lythraceae	*Punica granatum* L.	nar	N, P	---	250-600	calcareous slopes, scrub	5-6	[5]	ARTH 18036

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
501	Malvaceae	*Alcea calvertii* (Boiss.) Boiss.	hıraçiçeği	N, P	IT	600-1500	eroded coasts, slopes, volcanic hills	6-8	[20]; [22]	ARTH 18037
502	Malvaceae	*Malva neglecta* Wallr.	çobançöreği	N, P	--	0-2000	steppe, fields, roadsides, wastelands	5-8	[20]; [22]	ARTH 18038
503	Malvaceae	*Malva sylvestris* L.	ebegümeci	N, P	--	0-1500	bushes, fields, open places	5-10	[5]; [18]	ARTH 18039
504	Melanthiacea	*Veratrum album* L.	dokuztepeli	N,P	ES	1400-1900	wet slopes, forest edges	6-8	[9]; [10]; [11]	ARTH 18040
505	Nitrariaceae	*Peganum harmala* L.	üzerlik	N, P	--	0-1500	wastelands, steppe (sometimes saline)	5-7	[5]	ARTH 18041
506	Oleaceae	*Chrysojasminum fruticans* (L.) Banfi (Syn: *Jasminum fruticans* L.)	boruk	P	Med	0-1500	dry rocky places in scrub, *Pinus brutia* forest, oak scrub, countryside edges	5	[9]; [10]; [11]	ARTH 18042
507	Oleaceae	*Olea europaea* L.	zeytin	N, P	Med	0	Culture	5	[21]; [5]	ARTH 18043
508	Onagraceae	*Circaea lutetiana* L.	kankurutan	P	--	50-2100	shady slopes, coniferous or deciduous forests	6-9	[9]	ARTH 18044
509	Onagraceae	*Epilobium angustifolium* L.	yakıotu	N, P		650-3050	forests, open greenery, rocky slopes	6-8	[9]; [10]; [11]	ARTH 18045
510	Onagraceae	*Epilobium hirsutum* L.	hasanhüseyinçiçeği	N, P	--	0-2300	swamps, river banks	7-9	[9]; [10]; [11]	ARTH 18046
511	Onagraceae	*Epilobium lanceolatum* Sebast. & Mauri	dilyakısı	N, P	--	150-2000	forest edges, in thickets, along roadsides	6-7	[9]; [10]; [11]	ARTH 18047
512	Onagraceae	*Epilobium parviflorum* Schreb.	ırazyakıotu	N, P	--	100-1750	stream and lake areas, wet places	5-7	[5]	ARTH 18048
513	Onagraceae	*Epilobium ponticum* Hausskn.	garapil	N, P	--	1800-3350	wet places, streams	6-8	[9]; [10]; [11]	ARTH 18049
514	Orchidaceae	*Anacamptis coriophora* (L.) R.M.Bateman, Pridgeon & M.W.Chase.	pirinççiçeği	P	--	20-1930	Wet meadows, nr streams, also in dry sandy places, open forests	5-7	*	ARTH 18050
515	Orchidaceae	*Anacamptis palustris* (Jacq.) R.M.Bateman, Pridgeon & M.W.Chase.	çayırsalebi	P	--	0-1950	Wet meadows and swamps	6-7	*	ARTH 18051
516	Orchidaceae	*Anacamptis pyramidalis* (L.) Rich.	sivrisalep	P	--	0-1750	rocky slopes in maquis and frigena, meadows, grassy forest openings, olive groves	4-6	*	ARTH 18052
517	Orchidaceae	*Cephalanthera damasonium* (Miller) Druce	ormankuşçuğu	P	ES	0-1800	shady places in deciduous and coniferous forests, mountainous areas	5-7	*	ARTH 18053
518	Orchidaceae	*Cephalanthera kurdica* Bornm. ex Kranzlin	kurtkuşçuğu	P	IT	0-1500	maquis, *Quercus* and Coniferous forests, calcareous and shaly soils	4-5	*.	ARTH 18054
519	Orchidaceae	*Cephalanthera longifolia* (L.) Fritsch	kuğusalebi	P	ES	200-2000	meadows, deciduous and coniferous forests on forest flanks	4-6	*	ARTH 18055
520	Orchidaceae	*Cephalanthera rubra* (L.) Rich.	çamçiçeği	P	--	0-2000	maquis, *Quercus* thickets, mixed and coniferous forests, calcareous and swollen soils	5-7	[9]; [10]; [11]	ARTH 18056
521	Orchidaceae	*Corallorhiza trifida* Chatel.	mercansalebi		--				*	ARTH 18057
522	Orchidaceae	*Dactylorhiza euxina* (Nevski) Czerep.	lazsalebi		BS	1150-2900	wet meadows, streams, forest edges	6-7	*	ARTH 18058
523	Orchidaceae	*Dactylorhiza iberica* (Bieb. ex Willd.) Soo	kırımsalebi		D. Med	900-2500	wet meadows and pastures, lakes and streams	5-7	*	ARTH 18059
524	Orchidaceae	*Dactylorhiza incarnata* subsp. *cilicica* (Klinge) H.Sund.*	gövdelisalep		IT	1500-3300	damp and alpine meadows, *Salix* or *Tamarix* thickets, stream banks	6-7	*	ARTH 18060
525	Orchidaceae	*Dactylorhiza maculata* subsp. *saccifera* (Brongn.) Diklic	keselisalep		D. Med	800-1680	forests, forest edges, riverbanks	6-7	*	ARTH 18061

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
526	Orchidaceae	*Dactylorhiza osmanica* (Klinge) P.F.Hunt & Summerh.	osmanlısalebi	P	IT	550-2400	damp places, wet meadows, forest edges, streams	6-7	[9]; [10]; [11]	ARTH 18062
527	Orchidaceae	*Dactylorhiza romana* (Seb.) Soo	elçik	P	Med	0-2000	calcareous slopes, scrub and *Quercus* thickets,	4-6	*	ARTH 18063
528	Orchidaceae	*Dactylorhiza romana* subsp. *georgica* (Klinge) Soo ex Renz & Taub.	elçik	P	BS	20-2000	coniferous forests and forest edges, *Quercus* thickets, alpine meadows	4-6	*	ARTH 18064
529	Orchidaceae	*Dactylorhiza urvilleana* (Steudel) Baumann & Künkele	balkaymak	P	BS	0-2500	moist places, deciduous and coniferous forests, *Picea-Rhodendron* thickets, stream banks	6-7	*	ARTH 18065
530	Orchidaceae	*Dactylorhiza viridis* (L.) R.M.Bateman, Pridgeon & M.W.Chase.	kurbağasalebi	P	--				*	ARTH 18066
531	Orchidaceae	*Epipactis helleborine* (L.) Crantz	bindallıçiçeği	P	--	0-1800	groves, thickets	6-7	*	ARTH 18067
532	Orchidaceae	*Epipactis microphylla* (Ehrh.) Sw.	minikbindallı	P	ES	200-1700	groves, thickets	6	*	ARTH 18068
533	Orchidaceae	*Epipactis palustris* (L.) Crantz	danakıranotu	P	ES	0-2000	wet marsh meadow	7	*	ARTH 18069
534	Orchidaceae	*Epipactis persica* (Soó) Hausskn. ex Nannf.	acemdanakıranı	P	--	250-1700	*Fagus, Abies* and *Picea* forests	6-7	*	ARTH 18070
535	Orchidaceae	*Epipactis veratrifolia* Boiss. & Hohen.	ırazbindallı	P	IT	200-1500	calcareous wet slopes, stream banks	6-7	*	ARTH 18071
536	Orchidaceae	*Epipogium aphyllum* Sw.	cazısalebi	P	ES	900-1700	wet *Fagus* and *Abies* forests	7-8	*	ARTH 18072
537	Orchidaceae	*Goodyera repens* (L.) R. Br.	yersalebi	P	ES	1300-1850	moist *Picea* and *Pinus* forests	7-8	*	ARTH 18073
538	Orchidaceae	*Gymnadenia conopsea* (L.) R. Br.	başaksalebi	P	ES	1000-2800	alpine and subalpine meadows, prairies	7-8	*	ARTH 18074
539	Orchidaceae	*Limodorum abortivum* (L.) Sw.	saçuzatan	P	--	350-2300	deciduous and mixed forests, forest understory, *Carpinus* and *Quercus* thickets, maquis	4-7	*	ARTH 18075
540	Orchidaceae	*Listera cordata* (L.) Rich.	pisipisisalebi	P	--		West-Side Forest, East-Side Forest, Coastal, Moist Riverbanks	5-6	*	ARTH 18076
541	Orchidaceae	*Neottia nidus-avis* (L.) Rich.	asalaksalep	P	ES	250-1950	shady *Fagus* forests, and basic soils	6-7	*	ARTH 18077
542	Orchidaceae	*Ophrys apifera* Huds.	arısalebi	P	--	0-750	grassy limestone hills, maquis, frigana, meadow, *Neottia* roadside, coniferous and deciduous forest.	4-6	[21]	ARTH 18078
543	Orchidaceae	*Ophrys sphegodes* subsp. *taurica* (Aggeenko) Soó ex Niketic & Djordjevic (Syn: *Ophrys caucasica* Woronow ex Grossh.)	kafablamutu		ES	300-900	grassy, moist places, poor chalk grassland, heathland, open to closed places among short grasses in hazelnut fields	5-6	*	ARTH 18079
544	Orchidaceae	*Orchis mascula* (L.) L.	ersalebi		--	150-2400	Glades and edges of coniferous forest, Fagus forest, *Quercus* scrub	5-6	*	ARTH 18080
545	Orchidaceae	*Orchis pallens* L.	solgunsalep	P	ES	1000-2400	treeless places, subalpine meadows and forests	5	[9]; [10]; [11]	ARTH 18081
546	Orchidaceae	*Orchis punctulata* Steven ex Lindl.	selef	--	D. Med	20-1350	thickets, forest edges	4-5	*	ARTH 18082
547	Orchidaceae	*Orchis purpurea* Huds.	hasancık	--	ES	1100-1750	between deciduous forests, thickets, calcareous soils	4-5	*	ARTH 18083
548	Orchidaceae	*Orchis simia* Lam.	saleppüskülü	--	Med	0-1200	grassy hills, scrub, calcareous soils	4-5	*	ARTH 18084
549	Orchidaceae	*Platanthera bifolia* (L.) Rich.	guguksalebi	--	ES	0-2000	forest clearings, forest edges, meadows, calcareous and acidic soils	5-7	*	ARTH 18085
550	Orchidaceae	*Platanthera chlorantha* (Custer) Reichb.	çarpıksalep	--	--	0-2200	coniferous and deciduous forests, wet forest edges	6-7	*	ARTH 18086

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
551	Orchidaceae	*Spiranthes spiralis* (L.) Chevall.	incisalebi	--	Med	0-500	*Pinus* forests, grassy areas	7-10	*	ARTH 18087
552	Orchidaceae	*Traunsteinera sphaerica* (Bieb.) Schlechter	yaylasalebi	--	BS	1600-2400	alpine meadows and grasslands, forest edges	6-7	*	ARTH 18088
553	Orobanchaceae	*Euphrasia pectinata* Ten.	gözotu	P	ES	0-2900	grove edges, stubble, alpine pastures	5-8	[9]; [10]; [11]	ARTH 18089
554	Orobanchaceae	*Melampyrum arvense* L.	inekbuğdayı	P	ES	150-2100	Grasslands in *Quercus* and *Fagus* thickets, rocky slopes, grain fields	5-9	[9]; [10]; [11]	ARTH 18090
555	Orobanchaceae	*Odontites aucheri* Boiss.	sadırlıdavunotu	P	IT	850-3050	limestone and metamorphic slopes, scrub, countryside edge	6-9	[9]; [10]; [11]	ARTH 18091
556	Orobanchaceae	*Pedicularis pontica* Boiss.	şimalbitotu	P	BS	1830-3400	alpine meadows, near melting snows, cascades and rocky volcanic slopes	6-8	[9]; [10]; [11]	ARTH 18092
557	Orobanchaceae	*Pedicularis wilhelmsiana* Fischer Ex Bieb.	teleklibitotu	P	BS	1700-2400	*Pinus sylvestris* forest, stream bank	5-7	[11]	ARTH 18093
558	Orobanchaceae	*Rhynchocorys elephas* (L.) Griseb.	filburnu	P	ES	30-2600	stream banks, meadows, rocky volcanic slopes, under *Alnus, Fagus, Pinus, Abies*	5-9	[10]; [11]	ARTH 18094
559	Orobanchaceae	*Rhynchocorys stricta* (K.Koch) Albov	hoşfilburnu	P	BS	1370-2700	meadows, forest edges, rocky slopes	6-9	[10]; [11]	ARTH 18095
560	Oxalidaceae	*Oxalis acetosella* L.	ekşiyonca	P	--	10-1700	coasts in forests	4	[9]; [10]; [11]	ARTH 18096
561	Oxalidaceae	*Oxalis corniculata* L.	sarıekşiyonca	N, P	--	0-1000	open places	3-8	[9]; [10]; [11]	ARTH 18097
562	Paeoniaceae	*Paeonia arietina* G.Anderson.	şakayık		--				*	ARTH 18098
563	Paeoniaceae	*Paeonia daurica* subsp. *macrophylla* (Albov) D.Y.Hong	gagaç		--	2000-2400	Alpine meadows, granite slopes	6	*	ARTH 18099
564	Paeoniaceae	*Paeonia daurica* subsp. *wittmanniana* (Hartwiss ex Lindl.) D.Y.Hong.			--	2000-2400	Alpine meadows, granite slopes	6	*	ARTH 18100
565	Papaveraceae	*Chelidonium majus* L.	kırlangıçotu	P	ES	0-1450	forest understory shade, thicket	4-8	[9]; [10]; [11]	ARTH 18101
566	Papaveraceae	*Corydalis alpestris* C.A.Mey.	gökkazgagası	P	BS	2000-3300	alpine rocky slope, rubble	7	[9]; [10]; [11]	ARTH 18102
567	Papaveraceae	*Corydalis angustifolia* (M.Bieb.) DC.	korutarlakuşu		--		rocky slope, rubble		*	ARTH 18103
568	Papaveraceae	*Corydalis caucasica* DC.	çalıtarlakuşu		BS	1000	thicket	4	*	ARTH 18104
569	Papaveraceae	*Corydalis conorhiza* Ledeb.	yaylakazgagası		BS	2280-2850	alpine slope	7	*	ARTH 18105
570	Papaveraceae	*Corydalis oppositifolia* DC.	iparkazgası		--	1300-2800	stony slope	4-7	*	ARTH 18106
571	Papaveraceae	*Fumaria asepala* Boiss.	akşahtere	N, P	IT	500-1700	field, hillside, vineyard	4-8	[20]	ARTH 18107
572	Papaveraceae	*Fumaria officinalis* L.	şahtere	N, P	--	0-700	cultivated area	4-5	[9]; [10]; [11]	ARTH 18108
573	Papaveraceae	*Glaucium flavum* Crantz	gündürmelâlesi	P	--	0	seaside	5-7	[20]	ARTH 18109
574	Papaveraceae	*Glaucium leiocarpum* Boiss.	gâvurhaşhaşı	N, P	--	15-1600	hill slope, stony field	6-7	[9]; [11]	ARTH 18110
575	Papaveraceae	*Papaver arenarium* M.Bieb.	pampal	P	--	500-2300	oak thicket, hill slope	4-7	[20]	ARTH 18111

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
576	Papaveraceae	*Papaver dubium* L.	köpekyağı	N, P	--	0-1001	empty place, field	4-6	[23]; [18]; [5]	ARTH 18112
577	Papaveraceae	*Papaver fugax* Poiret	gelingülü		--	1700-3100	arid slope, rubble	4-6	[9]	ARTH 18113
578	Papaveraceae	*Papaver lateritium* Koch. (EN)	potot	P	BS	1200-3000	coasts, meadows, rubble	7-8	[9]; [10]; [11]	ARTH 18114
579	Papaveraceae	*Papaver macrostomum* Boiss. & A.Huet	minimitçe	P	IT	1300-1600	cultivated land	6	[20]; [19]	ARTH 18115
580	Papaveraceae	*Papaver rhoeas* L.	gelincik	N, P	--	0-1400	field, empty place	3-8	[21]; [22]	ARTH 18116
581	Pinaceae	*Abies nordmanniana* (Stev.) Spach (EN)	kafkasgöknarı	P	BS	1200-2500	forest, with Picea		[22]	ARTH 18117
582	Pinaceae	*Picea orientalis* (L.) Peterm.	lâdin	P	--	50-2000	mixed forest		[20]	ARTH 18118
583	Pinaceae	*Pinus pinea* L.	fıstıkçamı	P	Med	0-350	beach		[20]	ARTH 18119
584	Pinaceae	*Pinus sylvestris* var. *hamata* Steven	sarıçam	P	ES	1000-2500	hill slope, forest		[20]	ARTH 18120
585	Plantaginaceae	*Antirrhinum majus* L.	aslanağzı	P	B. Med	0-50	coastal cliffs and walls	5-6	[21]	ARTH 18121
586	Plantaginaceae	*Digitalis ferruginea* L.	arıkovanı	N, P	ES	0-2700	forests, clearings, rocky slopes and roadside banks	6-9	[5]	ARTH 18122
587	Plantaginaceae	*Digitalis ferruginea* subsp. *schischkinii* (K.V.Ivanova) K.Werner	ayımısırı	N	BS	1200-2000	forests, scrub and grassy slopes	6-9	[9]; [10]; [11]	ARTH 18123
588	Plantaginaceae	*Globularia trichosantha* Fisch. & C.A.Mey.	köseyayılımı		IT	200-2470	rocky and grassy areas, dense forests, limestone serpentine and volcanic	4-7	[19]	ARTH 18124
589	Plantaginaceae	*Lagotis stolonifera* Maxim.	sururotu	N, P	IT	1300-2300	short clods, heavy clay, subalpine grasslands, prairie edges	4-6	[20]	ARTH 18125
590	Plantaginaceae	*Linaria corifolia* Desf. (EN)	tarlanevruzotu		IT	0-2200	steppe, rocky, often calcareous slopes, ravines, fallow fields	5-8	[19]	ARTH 18126
591	Plantaginaceae	*Linaria genistifolia* (L.) Mill.	somnevruzotu	P	ES	0-2100	woodland, scrub, maquis, rocks, soil slopes, roadsides	5-8	[19]	ARTH 18127
592	Plantaginaceae	*Linaria kurdica* Boiss. & Hohen.	sarınevruzotu	P	IT	800-2400	thickets, rocky slopes, mountainous steppes, fallow fields, edges	7-8	[20]	ARTH 18128
593	Plantaginaceae	*Linaria simplex* Desf.	yalınnevruzotu	N, P	Med	0-1750	sparse maquis, rocky and stony places, fallow fields	4-6	[5]	ARTH 18129
594	Plantaginaceae	*Plantago lanceolata* L.	damarlıca	N, P	--	1350	seashores, sandy beaches, meadows, marshy places, maquis, river banks, etc.	4-10	[23]; [19]; [20]; [5]; [18]	ARTH 18130
595	Plantaginaceae	*Plantago major* L.	sinirotu	N, P	--	0-2240	stream and river banks, ditches, path edges, cultivated land, pastures and wastelands	6-8	[20]; [5]	ARTH 18131
596	Plantaginaceae	*Plantago maritima* L.	yılandili	N, P	--	0-2400	lake shores, sandy and stony places, alpine meadows, marine habitats, marsh	5-8	[20]; [5]; [19]	ARTH 18132
597	Plantaginaceae	*Veronica anagallis-aquatica* L.	sugedemesi	N, P	--	0-2350	streams, ditches, banks, springs, reeds, wet meadows	3-9	[5]; [19]	ARTH 18133
598	Plantaginaceae	*Veronica arvensis* L.	ekinmavişi		ES	0-1700	sparse forests, scrub, grassland, rocky slopes, prairies, roadsides, coasts	3-6	[19]	ARTH 18134
599	Plantaginaceae	*Veronica baranetzkii* Bordz.	yaylamavişi	P	BS	2000-3400	subalpine meadows, rocky slopes, cascades	5-8	[9]; [10]; [11]	ARTH 18135
600	Plantaginaceae	*Veronica beccabunga* L.	atteresi		--	20-3200	streams, marshes, ditches, wet meadows, preferably in running water	5-10	[19]	ARTH 18136

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
601	Plantaginaceae	*Veronica biloba* schreb. ex L.	çiftemaviş		IT	1300-2700	bare soils in sparse forests, gullies, dykes	5-6	[19]	ARTH 18137
602	Plantaginaceae	*Veronica bozakmanii* M.A.Fisch.	bozakmanmavişi		IT	700-2500	*Pinus* and *Abies* forests, wet places, often on clay	4-7	[19]	ARTH 18138
603	Plantaginaceae	*Veronica liwanensis* K.Koch	livanemavişi		BS	300-2440	*Picea* forest, limestone and volcanic rocks, benches, gullies and crevices	4-7	*	ARTH 18139
604	Plantaginaceae	*Veronica multifida* L.	devesabunu		IT	100-2300	sparse forests, ravines, rocky slopes, steppes, pastures, grasslands, fallow fields	4-6	[19]	ARTH 18140
605	Plantaginaceae	*Veronica officinalis* L.	oropaçayı	N	ES	900-1800	*Pinus*, *Abies* and deciduous forests, grassland	4-8	[19]	ARTH 18141
606	Plantaginaceae	*Veronica orientalis* Mill.	gözmumcuğu	N, P	IT	850-3050	forests, shrublands, steppes, meadows, calcareous and volcanic slopes and ravines	4-7	[20]	ARTH 18142
607	Plantaginaceae	*Veronica persica* Poir.	cırcamuk	N, P	--	0-700	cultivated land, edges, roadsides, vacant lots	1-12	[21]	ARTH 18143
608	Plantaginaceae	*Veronica verna* L.	ergenmaviş		ES	1000-2100	sparse *Pinus* and *Quercus* forests, rocky and sandy steppe, grasslands, meadows	4-6	[19]	ARTH 18144
609	Platanaceae	*Platanus orientalis* L.	çınar	N, P	--	0-1100	forests, valley bottoms, alluvial soils, riverbanks	3-5	[5]; [20]	ARTH 18145
610	Plumbaginaceae	*Acantholimon acerosum* (Will.) Boiss.	pişikkeveni	N, P	IT	120-2000	volcanic slope cliffs, calcareous and sandy soils, steppe	6-8	[9]; [10]; [11]	ARTH 18146
611	Plumbaginaceae	*Acantholimon armenum* Boiss. & A.Huet	kurredikeni	N	IT	500-2740	stony slopes	6-9	[23]	ARTH 18147
612	Plumbaginaceae	*Acantholimon caryophyllaceum* Boiss.	kirpidikeni	P	--	1600-2745	volcanic and limestone slope cliffs, steppe	6-8	[24]	ARTH 18148
613	Plumbaginaceae	*Plumbago europaea* L.	karakına		ES		dry gravelly patches, fields of limestone and volcanic slopes, wastelands	7-9	[9]; [10]; [11]	ARTH 18149
614	Poaceae	*Alopecurus myosuroides* Huds.	tarlatilkikuyruğu	P	ES	0-1850	deciduous forest, wet meadows, cultivated areas, road banks, ditches	3-8	[11]	ARTH 18150
615	Poaceae	*Brachypodium sylvaticum* (Huds.) P. Beauv.	korukılcanı	P	ES		forested slopes (*Pinus*, *Abies*, *Picea*, *Fagus*) hazelnut thickets, calcareous slopes and gorges	6-9	[11]	ARTH 18151
616	Poaceae	*Bromus arvensis* L.	tarlabromu	P	--	0-2900	hard in red pine forest, barren, roadsides, agricultural lands, irrigated lands	6-8	[11]	ARTH 18152
617	Poaceae	*Cynodon dactylon* (L.) Pers.	köpekdişi	P	--	0-1830	dry and stony slopes, riverbanks, freshwater marsh, and seashore dunes	4-9	[11]	ARTH 18153
618	Poaceae	*Cynosurus echinatus* L.	toptarakotu	P	Med	0-1950	woodland (deciduous), dry hills, meadows, fields, roadsides	4-8	[11]	ARTH 18154
619	Poaceae	*Dactylis glomerata* L.	domuzayrığı	P	ES	0-2300	pine forest, hills, fields	5-7	[11]	ARTH 18155
620	Poaceae	*Holcus lanatus* L.	kadifeotu	P	ES	0-2000	sandy soil and wet alpine slopes near the sea	5-8	[11]	ARTH 18156
621	Poaceae	*Poa trivialis* L.	kabasalkımotu	P	--	0-2210	woodlands, pastures, damp places, meadows near the coast, alpine meadow steppes,	5-8	[11]	ARTH 18157
622	Polygalaceae	*Polygala alpestris* Reichb.	yaylasütotu	P	ES	200-2600	meadow, pasture, slope	4-8	[9]; [11]	ARTH 18158
623	Polygalaceae	*Polygala vulgaris* L.	sütotu	N	ES	1650	Edges and clearings of forests.	5-6	[9]; [11]	ARTH 18159
624	Polygonaceae	*Bistorta carnea* (K.Koch) Kom.	dağlahanası		BS	1800-3600	wet places, slopes, forests	6-8	*	ARTH 18160
625	Polygonaceae	*Polygonum aviculare* L.	köyotu	P	C	0-700	barren places	7-11	[21]	ARTH 18161

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
626	Polygonaceae	*Rumex acetosella* L.	kuzukulağı	N, P	C	0-2300	fields, coasts, wastelands	5-8	[5]; [19]	ARTH 18162
627	Polygonaceae	*Rumex pulcher* L.	ekşilik	N, P	--	0-1300	dunes, roadsides, ditches	5-7	[5]	ARTH 18163
628	Polygonaceae	*Rumex scutatus* L.	ekşimen	P	--	300-2200	slopes, cascades, hill sides, fields	6-8	[9]; [10]; [11]	ARTH 18164
629	Portulacaceae	*Portulaca oleracea* L.	semizotu	P	--	0	cultivated fields and barren areas near the sea	7-11	[9]; [10]; [11]	ARTH 18165
630	Primulaceae	*Anagallis arvensis* L.	farekulağı	N, P	--	0-1400	cultivated land, riverside, clay soil, rocky slopes	4-9	[5]	ARTH 18166
631	Primulaceae	*Cyclamen coum* Mill.	yersomunu	P	--	0-2135	*Pinus brutia*, *Abies* and *Quercus-Fagus* forest, under bushes on rocky hills	2-5	[9]; [10]; [11]	ARTH 18167
632	Primulaceae	*Cyclamen parviflorum* Pobed. (EN)	filiski	P	BS	1200-2300	alpine grassland with melting snow, under *Pinus* and *Picea* forests and *Rhododendron caucasicum*	4-6	[9]; [10]; [11]	ARTH 18168
633	Primulaceae	*Primula algida* Adams	dağtutyası	P	--	2000-3600	rocky ridges, rugged edges, wet grasslands	5-8	[9]; [10]; [11]	ARTH 18169
634	Primulaceae	*Primula auriculata* Lam.	felçotu	P	--	1250-3150	Moist turf, wet flushes often nr snow, margins of streams and lakes	5-8	[9]; [10]; [11]	ARTH 18170
635	Primulaceae	*Primula elatior* subsp. *pallasii* (Lehm.) W.W.Sm. & Forrest	sarıtutya		ES	1300-3200	marshy alpine meadows and floodplains, dry upland slopes	5-7	*	ARTH 18171
636	Primulaceae	*Primula longipes* Freyn & Sint. (EN)	zarifçuha	P	BS	1625-3400	wet grassy slopes or benches, damp crevices, often in running water	7-8	[11]	ARTH 18172
637	Primulaceae	*Primula megaseifolia* Boiss. & Balansa	martçiçeği		BS	50-1100	wet bays, shady woods and edges	3-4	*	ARTH 18173
638	Primulaceae	*Primula pseudoelatior* Kusn. (Syn: *Primula elatior* subsp. *pseudoelatior* (Kusn.) W.W.Sm. & Forrest)	çayırtutyası		BS	2300-3050	rocky slopes and thickets, stream banks	6-7	*	ARTH 18174
639	Primulaceae	*Primula veris* subsp. *macrocalyx* (Bunge) Lüdi	ayrançiçeği		ES	1800-2500	between rocks, sparse grassy slopes	5-6	*	ARTH 18175
640	Primulaceae	*Primula veris* subsp. *columnae* (Ten.) Maire & Petitm. (Syn: *Primula veris* subsp. *suaveolens* (Bertol.) Gutermann & Ehrend.)	tutya		ES	1225-2135	exposed slopes, dense wet alpine meadows, deciduous thickets, pine woodlands	4-6	*	ARTH 18176
641	Primulaceae	*Primula vulgaris* Huds. (Syn: *Primula acaulis* (L.) L.)	çuhaçiçeği	P	ES	500-2100	sparse or shady patches of slopes, alpine thickets, often in wet places	3-6	[9]; [10]; [11]	ARTH 18177
642	Primulaceae	*Primula vulgaris* subsp. *rubra* (Sm.) Arcang.	evvelbaharçiçeği		ES	500-2100	sparse or shady patches of slopes, alpine thickets, often in wet places	3-6	*	ARTH 18178
643	Ranunculaceae	*Aconitum orientale* Mill.	kurtboğan	P	BS	1650-2200	forest, scrub, meadow	7-8	[9]; [10]; [11]	ARTH 18179
644	Ranunculaceae	*Aconitum variegatum* subsp. *nasutum* (Fisch. ex Rchb.) Götz	boğanotu	P	--		forest, scrub, meadow		[11]	ARTH 18180
645	Ranunculaceae	*Adonis aestivalis* L.	kandamlası	P	--		field, rocky slope, disturbed steppe		[20]; [19]	ARTH 18181
646	Ranunculaceae	*Adonis flammea* Jacq.	cinlâlesi	P	--	0-1900	field, steppe, rocky	4-6	[20]	ARTH 18182
647	Ranunculaceae	*Anemonoides blanda* (Schott & Kotschy) Holub	dağlâlesi	N, P	--	150-2600	rocky slope, thicket	3-4	[5]	ARTH 18183
648	Ranunculaceae	*Aquilegia olympica* Boiss.	hasekiküpesi	N, P	--	1700-2800	wet meadow, *Picea* forest	6-7	[10]; [11]	ARTH 18184
649	Ranunculaceae	*Clematis orientalis* L.	köpektutağı		--	0-2000	thicket, forest	7-9	[19]	ARTH 18185
650	Ranunculaceae	*Clematis vitalba* L.	akasma	N	--	0-1500	thicket, forest	6-8	[9]; [10]; [11]	ARTH 18186

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
651	Ranunculaceae	*Delphinium ajacis* L. (Syn: *Consolida orientalis* (J.Gay) Schrödinger)	morçiçek	N, P	--	0-1900	cultivated field, fallow field	5-8	[20]; [18]	ARTH 18187
652	Ranunculaceae	*Helleborus orientalis* Lam.	çöpleme	P	BS	0-2200	thicket, forest	3-5	[24]	ARTH 18188
653	Ranunculaceae	*Ranunculus arvensis* L.	mustafaçiçeği	N, P	--	0-1850	cultivated place, crop field	3-6	[19]; [20]; [5]	ARTH 18189
654	Ranunculaceae	*Ranunculus caucasicus* M.Bieb.	dimdana	N, P	--		thicket, forest		[9]; [10]; [11]	ARTH 18190
655	Ranunculaceae	*Ranunculus kotschyi* Boiss.	giritlâlesi	P	--	1300-2400	meadow, forest clearing, rocky slope, waterfall edge	5-6	[20]	ARTH 18191
656	Ranunculaceae	*Ranunculus muricatus* L.	kutsaldefne	N, P	--	0-800	damp field, muddy roadside, in ditches	3-5	[11]	ARTH 18192
657	Ranunculaceae	*Ranunculus polyanthemos* L.	savotu		--	600-2700	damp place	6-7	[19]	ARTH 18193
658	Ranunculaceae	*Ranunculus repens* L.	tiktakdana	P	--	0-2450	damp place	5-7	[19]	ARTH 18194
659	Ranunculaceae	*Trollius ranunculinus* (Smith.) Stearn	zarifçünkotu	P	--	2000-3000	wet place	5-6	[10]; [11]	ARTH 18195
660	Resedaceae	*Reseda lutea* L.	muhabbetçiçeği	N, P	--	0-2000	ubiquotis, roadside, field, pit, bare stony hill slope	4-8	[19]; [20]; [5]	ARTH 18196
661	Rhamnaceae	*Frangula alnus* Mill.		P	ES	10-1700	forests, thickets, riverbanks	6-7	[9]; [11]	ARTH 18197
662	Rhamnaceae	*Paliurus spina-christi* P.Mill.	karaçalı	N, P	--	0-1400	gorges, river valleys, wastelands	5-7	[9]; [10]; [11]	ARTH 18198
663	Rhamnaceae	*Rhamnus cathartica* L.	akdiken	N, P	--			4-5	[9]; [10]; [11]	ARTH 18199
664	Rhamnaceae	*Rhamnus imeretina* Booth, Petz. & Kirchn.	çatcehrisi	N, P	--	1300-1700	Edge of mixed forest	4-5	*	ARTH 18200
665	Rhamnaceae	*Rhamnus microcarpa* Boiss.	kayacehrisi	N, P	--	1500-2900	On dry slopes and adpressed to rocks	5	*	ARTH 18201
666	Rhamnaceae	*Rhamnus pallasii* Fisch. & Mey.	alacehri	N, P	--	450-1600	rocky slopes	5	*	ARTH 18202
667	Rosaceae	*Hedlundia armeniaca* (Hedl.) Mezhenskyj			--	1800-2000	rocky places, forests	5-6	*	ARTH 18203
668	Rosaceae	*Hedlundia kuznetzovii* (Zinserl.) Mezhenskyj	ufa		--	1800-2000	rocky places, forests	5-6	*	ARTH 18204
669	Rosaceae	*Rosa boissieri* Crép.	hasgül		--			5-6	[24]	ARTH 18205
670	Rosaceae	*Agrimonia eupatoria* L.	fıtıkotu	N, P	--	0-2300	wet meadows, stream banks	5-9	[19]; [5]	ARTH 18206
671	Rosaceae	*Alchemilla caucasica* Buser	kafşebnemlisi		BS	1665-2500	pine bottoms, mountain slopes	6-7	*	ARTH 18207
672	Rosaceae	*Alchemilla hirtipedicellata* Juz.	kıllıpençe		BS	1100		7-8	*	ARTH 18208
673	Rosaceae	*Alchemilla mollis* (Buser) Rothm.	sukeltatı		--	900-2100	streams, *Abies* va *Fagus* forests	6-8	*	ARTH 18209
674	Rosaceae	*Alchemilla pseudocartalinica* Juz.	kartalpençesi	N	--	1200-3000	wet grassland volcanic rocky slopes	5-8	[19]	ARTH 18210
675	Rosaceae	*Alchemilla sericea* Willd.	akpençe		BS	2200-3700	rocky mountain slopes	6-8	*	ARTH 18211

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
676	Rosaceae	*Aria graeca* (Lodd. ex Spach) M. Roem.	oltuüvezi		--	1500-2000	rocky places, forests	5-6	*	ARTH 18212
677	Rosaceae	*Aria umbellata* (Desf.) Sennikov & Kurtto	oltuüvezi		--	1500-2000	rocky places, forests	5-6	*	ARTH 18213
678	Rosaceae	*Aruncus dioicus* (Walter) Fernald.	hoşkeçisakalı		--	l.-2000	Scrub and forests, mostly along streams and amongst rocks	6-7	*	ARTH 18214
679	Rosaceae	*Cotoneaster integerrimus* var. *nummularius* (Fisch. & C.A.Mey.) Fiori	garagat	N	-	800-2300	Limestone rocky slopes and shady banks, in steppe and among open scrub and small trees,	4-6	[19]	ARTH 18215
680	Rosaceae	*Cotoneaster nummularius* Fisch. & C.A.Mey.	dağmuşmulası	N, P	--	800-2300	calcareous rocky slopes, shady shores, steep and sparse scrub, among small trees	4-6	[19]	ARTH 18216
681	Rosaceae	*Crataegus germanica* (L.) Kuntze (Syn: *Mespilus germanica* L.)	muşmula	P	BS	0-1650	growing in the country, least abundant in N. Anatolia, sparse forests, rocks and maquis	5-6	[9]; [10]; [11]	ARTH 18217
682	Rosaceae	*Crataegus microphylla* K. Koch.	kocakarıarmudu	P	BS	20-450	forests, dense oak thicket	4-6	[9]; [10]; [11]	ARTH 18218
683	Rosaceae	*Crataegus monogyna* Jacq.	yemişen	N, P	---	0-1800	hill sides, scrub, oak scrub, mixed forests, roadsides	4-6	[23]; [19]; [20]; [5] ; [18]	ARTH 18219
684	Rosaceae	*Crataegus orientalis* Pallas ex Bieb.	alıç	N, P	--	750-2240	rocky places, forests	5-7	[20]	ARTH 18220
685	Rosaceae	*Crataegus pentagyna* Waldst. & Kit. Ex Willd.	kömüşdikeni	N, P	ES	0-1700	forested areas	5-6	[5]	ARTH 18221
686	Rosaceae	*Drymocallis rupestris* (L.) Soják (Syn: *Potentilla rupestris* L.)	yamanparmakotu		ES	1200-2600	rocky slopes	6-7	*	ARTH 18222
687	Rosaceae	*Fragaria vesca* L.	dağçileği	N, P	--	200-2450	humid places, especially forests	4-6	[19]	ARTH 18223
688	Rosaceae	*Geum aleppicum* Jacq.	arapçiçeği	P	--	0	shady river and lake banks, forests	5-7	[11]	ARTH 18224
689	Rosaceae	*Geum coccineum* Sibth. & Sm.	kızılmeryemotu	P	ES	1200-2400	marshy slopes and wet woodlands	5-7	*	ARTH 18225
690	Rosaceae	*Geum rivale* L.	mübarekotu	P	--	1250-3000	wet meadows, stream banks	5-7	*	ARTH 18226
691	Rosaceae	*Geum urbanum* L.	meryemotu	P	ES	0-1700	shady river and lake banks and forests	5-7	[21]	ARTH 18227
692	Rosaceae	*Hedlundia persica* (Hedl.) Mezhenskyj	eyvaz	P	--	1300-2000	mixed shrubs, rocky slopes,	5-6	*	ARTH 18228
693	Rosaceae	*Malus floribunda* Siebold ex Van Houtte	japon çiçek elması		--	0-2000	Roadside	4-5	[9]; [10]; [11]	ARTH 18229
694	Rosaceae	*Malus sylvestris* subsp. *sylvestris*	yabanelması	N, P	--	1100-1600	deciduous and mixed forests	5-6	[20]; [5]	ARTH 18230
695	Rosaceae	*Malus sylvestris* subsp. *orientalis* (Uglitzk.) Browicz	acıelma	N, P	--	150-2000	forests, mixed shrubs, rocky slopes, streams, field edges	5-6	[9]; [10]; [11]	ARTH 18231
696	Rosaceae	*Potentilla argentea* L.	gümüşparmakotu	P	--	1100-2400	rocky slopes, grasslands	5-7	[9]; [10]; [11]	ARTH 18232
697	Rosaceae	*Potentilla crantzii* (Crantz) G. Beck ex Fritsch	beşparmakotu	P	ES	1000-3600	alpine slopes and ridges	6-9	[9]; [11]	ARTH 18233
698	Rosaceae	*Potentilla erecta* (L.) Raeusch.	kurtpençesi	P	--	0-2400	wet places	4-8	[21]	ARTH 18234
699	Rosaceae	*Potentilla micrantha* Ramond Ex DC.	cüceparmakotu	P	--	0-1800	forests, streams	3-7	[9]; [11]	ARTH 18235
700	Rosaceae	*Potentilla recta* L.	suparmakotu	N	--	0-2300	meadows, pastures, wet and shady places	5-7	[9]; [11]	ARTH 18236

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
701	Rosaceae	*Potentilla reptans* L.	reşatınotu	N, P	--	0-2300	river and lake banks and wet shady places	5-8	[9]; [11]	ARTH 18237
702	Rosaceae	*Prunus avium* (L.) L.(syn: *Cerasus avium* (L.) Moench)	kiraz	N, P,I	--	0-1600	mixed forests	3-5	[5]	ARTH 18238
703	Rosaceae	*Prunus cerasifera* Ehrh.	Kiraz eriği	N, P	--		mixed forests	3-4	[20]	ARTH 18239
704	Rosaceae	*Prunus cerasus* L. (syn: *Cerasus vulgaris* Mill.)	vişne	N, P	--		cultivated areas	3-5	[5]	ARTH 18240
705	Rosaceae	*Prunus laurocerasus* L.	karayemiş	P	--	20-2000	forests, mostly with *Fagus* and *Rhododendron*	4-6	[9]; [11]	ARTH 18241
706	Rosaceae	*Prunus mahaleb* L. (syn *:Cerasus mahaleb* (L.) Mill.)	mahlep		--	300-1850	calcareous or volcanic slopes oak thickets	3-5	[9]; [11]	ARTH 18242
707	Rosaceae	*Prunus spinosa* L.	çakaleriği	N, P	--	0-1900	hills, mountain slopes, field edges, roadsides	3-4	[20]	ARTH 18243
708	Rosaceae	*Prunus x domestica* L.	erik	N, P	--	0-1900	hills, mountain slopes, field edges, roadsides	3-4	[5]	ARTH 18244
709	Rosaceae	*Pyracantha coccinea* M.Roem.	ateşdikeni	N, P	--	30-1800	calcareous slopes, dunes, sparse forests and thickets	4-6	[21]	ARTH 18245
710	Rosaceae	*Pyrus communis* subsp. *caucasica* (Fed.) Browicz.	kafarmudu	N, P	--	0-1650	forests and thickets	4-5	[9]; [11]	ARTH 18246
711	Rosaceae	*Pyrus elaeagnifolia* Pallas	ahlat	N, P	--	0-1700	coniferous and deciduous forests and forest remnants, fields	4-5	[19]	ARTH 18247
712	Rosaceae	*Rosa canina* L.	kuşburnu	N, P	--	30-1700	coasts, rocky slopes, scrub, hedgerows, forests and clearings, mainly limestones	5-7	[23]; [19]; [5]; [20]	ARTH 18248
713	Rosaceae	*Rosa foetida* Herrm.	acemsarısı	N, P	IT	700-1900	culture for ornamental plant, sometimes fences, sometimes natural roadsides, slopes and fields	4-6	[19]; [20]	ARTH 18249
714	Rosaceae	*Rosa hemisphaerica* Herrm.	kadıngöbeği	N	IT	800-1800	native dry habitats, deep streams, slopes and limestone shores, volcanic cliffs	5-6	[19]	ARTH 18250
715	Rosaceae	*Rosa pulverulenta* M.Bieb.	bodurgül		--	700-2250	dry, sparse, mostly grassland, Juniperus shrub, Picea grove, *Artemisia* steppe	6-7	[19]	ARTH 18251
716	Rosaceae	*Rubus canescens* DC.	çobanköseteği	N, P	ES	0-2150	sparse forests, scrubland, stony hillsides, coasts	5-8	[19]; [20]; [5]	ARTH 18252
717	Rosaceae	*Rubus canescens* var. *glabratus (Godron) Davis & Meikle*	böğürtlen	P	ES	0-2150	sparse forests, thickets, stony hillsides, coasts	5-8	*	ARTH 18253
718	Rosaceae	*Rubus caucasicus* Focke	zarifböğürtlen	P	BS	460	mountain bushes	5-6	[9]; [10]; [11]	ARTH 18254
719	Rosaceae	*Rubus hirtus* Waldst. Et Kit.	tüntürük	P	ES	0-2000	deciduous and mixed forest	6-8	[9]; [10]; [11]	ARTH 18255
720	Rosaceae	*Rubus idaeus* L.	ahududu	P	--	900-2200	forests, meadow edges, stony slopes	7	[9]; [10]; [11]	ARTH 18256
721	Rosaceae	*Rubus platyphyllus* C. Koch.		P	BS	900-2200	Forests, edge, meadows, rocky slopes	7	*	ARTH 18257
722	Rosaceae	*Sanguisorba minor* Scop.	çayırdüğmesi		--		open spaces, fields and vacant lots		[19]	ARTH 18258
723	Rosaceae	*Sorbus aucuparia* L.	kuşüvezi	N, P	ES	1500-2500	woodlands, pine forests, rocky colcanic slopes	5-6	[9]; [10]; [11]	ARTH 18259
724	Rosaceae	*Sorbus subfusca* (Ledeb. ex Nordm.) Boiss.	yaylaüvezi		BS	1200-2400	forest edges shrub thickets, subalpine meadows	6-7	*	ARTH 18260
725	Rosaceae	*Torminalis glaberrima* (Gand.) Sennikov & Kurtto	pitlicen	N, P	--		deciduous and mixed forests		[5]	ARTH 18261

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
726	Rubiaceae	*Asperula arvensis* L.	tarlabelumotu		Med	0-1900	open spaces, fields and vacant lots	3-7	[19]	ARTH 18262
727	Rubiaceae	*Asperula involucrata* Wahlenb.	akçabelumotu	P	BS	200-2000	deciduous and mixed forests, cleared forest clearings	5-9	[9]	ARTH 18263
728	Rubiaceae	*Asperula orientalis* Boiss. & Hohen.	gökçebelumotu	N	IT	100-2000	steppe, *Quercus* scrub, bare ground, fields	4-7	[9]; [10]; [11]	ARTH 18264
729	Rubiaceae	*Asperula taurina* L.	küçükfevve	P	--	150-1000	deciduous forests, between rocks	5-6	[9]; [10]; [11]	ARTH 18265
730	Rubiaceae	*Galium album* Mill.	bursaiplikçiği	N	--		open spaces, fields		[9]	ARTH 18266
731	Rubiaceae	*Galium verum* L.	boyalık	N, P	ES	30-2400	rocky slopes, stony pastures, fallow fields, drying marshes, stream beds	5-8	[9]; [10]; [11]	ARTH 18267
732	Rutaceae	*Citrus trifoliata* L.	üçturunç	P	--	0-500			[9]; [10]; [11]	ARTH 18268
733	Salicaceae	*Populus tremula* L.	titrekkavak	N, P	ES	0-2350	deciduous forest, mixed forest (*Abies-Fagus*), *Pinus nigra* and *Pinus sylvestris* forest	3-4	[19] ;[5]	ARTH 18269
734	Salicaceae	*Salix alba* L.	aksöğüt	N, P	ES	0-2000	lake shores, stream and river banks	4-5	[19];[21];[20]	ARTH 18270
735	Salicaceae	*Salix caprea* L.	sorgun	N, P	ES	0-2250	stream bank, deciduous forest clearing	4-5	[20]; [5]	ARTH 18271
736	Salicaceae	*Salix caucasica* Andersson	yaylasöğüdü		BS	1560-1700	*Picea* or *Rhododendron* forest	5	This is the finding of the study.	ARTH 18272
737	Sapindaceae	*Acer campestre* L.	ovaakçaağacı	N, P	ES	0-1600	mixed forests and deciduous shrubs	4-5	[19]	ARTH 18273
738	Sapindaceae	*Acer cappadocicum* Gleditsch	beşparmakağacı	N, P	BS	600-1600	Forests	3-5	[22]	ARTH 18274
739	Sapindaceae	*Acer heldreichii* subsp. *trautvetteri* (Medw.) A.E.Murray.	kafkasakçaağacı	P	--		Forests	4-5	[9]; [11]	ARTH 18275
740	Sapindaceae	*Acer platanoides* L.	çınarakçaağacı	N, P	ES	500-1900	mixed forests	3-5	[20]	ARTH 18276
741	Sapindaceae	*Acer tataricum* L.	tatarakçaağacı	N, P-	--	500-1700	deciduous oak thickets, rocky slopes, river valleys	5-6	[20]	ARTH 18277
742	Saxifragaceae	*Saxifraga cymbalaria* L.	sarıtaşkıran	N, P	--		between rocks, on stream banks, on shady hillsides	4	[5]	ARTH 18278
743	Saxifragaceae	*Saxifraga rotundifolia* L.	benlitaşkıran	N, P	ES	60-2400	groves, shady lean cliffs and rocks	4-9	[9]; [10]; [11]	ARTH 18279
744	Saxifragaceae	*Saxifraga sibirica* L.	hoştaşkıran	N, P	--	500-3500	between rocks, on stream banks, on shady hillsides	4-8	[5]	ARTH 18280
745	Scrophulariaceae	*Scrophularia ilwensis* K. Koch	meşesıracası		IT	1100-2750	*Picea* and *Pinus sylvestris* forests, *Quercus* thickets, rocky limestone slopes	4-7	[19]	ARTH 18281
746	Scrophulariaceae	*Scrophularia kotschyana* Benth.	darbeotu		--	600-2400	those who weave shady hidden cascades, crevices and banks, barren places	4-8	[19]	ARTH 18282
747	Scrophulariaceae	*Scrophularia nodosa* L.	tavuksıracası	N, P	ES	400-2275	river banks, grassy areas, maquis	7	[20]	ARTH 18283
748	Scrophulariaceae	*Scrophularia scopolii* Hoppe ex Pers.	elköpürten	N, P	--	15-2300	forests, moist rocky slopes, stream banks, thickets	4-8	[5]	ARTH 18284
749	Scrophulariaceae	*Verbascum cheiranthifolium* Boiss.	bozkulak	N, P	--	680-1930	forests, *Quercus* thickets, steppes, grasslands, grasslands, limestone cliffs	5-8	[19]; [5]	ARTH 18285
750	Scrophulariaceae	*Verbascum gnaphalodes* M.Bieb.	uslusığırkuyruğu		BS	0-2500	coastal dunes, sand dunes, moist coasts, *Quercus* and *Corylus* thickets, coniferous forests	5-9	[9]; [10]; [11]	ARTH 18286

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
751	Scrophulariaceae	*Verbascum natolicum* (Fisch. & C.A.Mey.) Hub.-Mor.	anasığırkuyruğu		IT	1100-1700	limestone cliffs and outcrops, volcanic slopes, steppe	6-7	[19]	ARTH 18287
752	Scrophulariaceae	*Verbascum oreophilum* K.Koch	dağcısığırkuyruğu	P	IT	900-2700	steppe, grassland, meadows, scrub, deciduous forests	6-8	[9]	ARTH 18288
753	Scrophulariaceae	*Verbascum phlomoides* L.	yünotu	P	ES	0-480	barren places, roadsides, sparse groves	6-9	[21]	ARTH 18289
754	Scrophulariaceae	*Verbascum phoeniceum* L.	yanıksığırkuyruğu	P	--	250-2750	*Quercus* scrub, meadows, grasslands, volcanic slopes	6-7	[20]	ARTH 18290
755	Scrophulariaceae	*Verbascum pyramidatum* M.Bieb.	arsızsığırkuyruğu	P	BS	0-2300	coniferous and deciduous forests, *Corylus* scrub, maquis, steppe, vineyards	6-9	[9]	ARTH 18291
756	Scrophulariaceae	*Verbascum speciosum* Schrad.	zelve		--	0-2500	*Pinus* forests, grain fields, dry places, steppes	6-9	[22]	ARTH 18292
757	Scrophulariaceae	*Verbascum thapsus* L.	burunca		ES	350-1100	riverbanks, forests, *Corylus* and *Quercus* thickets, volcanic clods	6-8	[24]	ARTH 18293
758	Smilacaceae	*Smilax excelsa* L.	dikenucu	N, P	Med	0-760	maquis, thickets, forests	5	[5]	ARTH 18294
759	Solanaceae	*Alkekengi officinarum* Moench	güveyfeneri	P	--		roadsides, hedgerows		[21]	ARTH 18295
760	Solanaceae	*Atropa bella-donna* L.	güzelavratotu	P	--		roadsides, hedgerows	6-8	[9]; [10]; [11]	ARTH 18296
761	Solanaceae	*Datura stramonium* L.	boruçiçeği	N, P	--	0-950	fields, wastelands, roadsides, hedgerows	5-11	[5]	ARTH 18297
762	Solanaceae	*Hyoscyamus niger* L.	banotu	N, P	--		fields, wastelands, roadsides, hedgerows	4-8	[19]; [5]	ARTH 18298
763	Solanaceae	*Solanum dulcamara* L.	sofur	N, P	ES	0-2300	on the edges of lakes, marshes or reeds, dry river beds	5-9	[5]	ARTH 18299
764	Staphyleaceae	*Staphylea pinnata* L.	ağızlıkçalısı	N, P	--	0-1500	forests and shady places	4-5	[11]	ARTH 18300
765	Tamaricaceae	*Tamarix smyrnensis* Bunge	ılgın	N, P	--	0-1000	river banks	4-8	[5]	ARTH 18301
766	Tamaricaceae	*Tamarix tetrandra* Pall. ex M.Bieb..	gezik	N, P	--	0-1300	river beds and coasts	5	[9]; [10]; [11]	ARTH 18302
767	Taxaceae	*Taxus baccata* L.	porsuk	P	--	000-1900	slope		[9]; [10]; [11]	ARTH 18303
768	Thymelaeaceae	*Daphne glomerata* Lam.	ezentere		BS	1400-2500	subalpine and alpine meadows and the edge of *Vaccnium myrtillus*, *Pinus* forests	5-7	*	ARTH 18304
769	Thymelaeaceae	*Daphne oleoides* Schreb.	gövçek	N, P	--	1050-3200	limestone, slopes and rocks, oak scrub, *Pinus* nigra forests, *Astragalus* steppes	5-9	[9]; [11]	ARTH 18305
770	Thymelaeaceae	*Daphne pontica* L.	sırımağu	N	BS	0-2200	on volcanic rock, limestone slopes, *Abies-Fagus* forests, *Rhododendron* and *Corylus*	3-8	[9]; [11]	ARTH 18306
771	Thymelaeaceae	*Thymelaea passerina* (L.) Cosson & Germ.	çekem	P	--		fallow fields eroded slopes, dry riverbeds, saline flatlands	4-8	[9]	ARTH 18307
772	Ulmaceae	*Ulmus glabra* Huds.	dağkaraağacı		ES	100-1800	mixed deciduous forests	3-4	[19]	ARTH 18308
773	Ulmaceae	*Ulmus minor* Mill.	ovakaraağacı	N, P	D. Med	0-1600	Mixed deciduous forests, thickets along rivers and streams, bare slopes	3-4	[20] ;[5]	ARTH 18309
774	Urticaceae	*Parietaria judaica* L.	Duvar fesleğeni		--	0-2000	Limestone cliffs, boulders, cavity mouths, walls	4-8	*	ARTH 18310
775	Urticaceae	*Urtica dioica* L.	ısırgan	N, P	ES	500-2700	Forests, shady valleys and rocks, water edges	6-9	[18]	ARTH 18311

Table 2. Continued

No	Family	Taxon	Local Names	N/ P	Phytogeo. Regions	Altitude	Habitat	FT	N/ P References	Herbarium code
776	Verbenaceae	*Verbena officinalis* L.	mineçiçeği	N, P	--	0-1800	Rough, degraded land, rocky places, dry river beds, dunes, forest, scrubland	6-8	[5]	ARTH 18312
777	Viburnaceae	*Sambucus ebulus* L.	mürverotu	P	ES	500-2000	Deciduous forests, roadsides, coasts	7-8	[9]; [10]; [11]	ARTH 18313
778	Viburnaceae	*Sambucus nigra* L.	ağaçmürver	P, N	ES	0-1700	Bushes, forest edges	4-7	[9]; [10]; [11]	ARTH 18314
779	Viburnaceae	*Viburnum lantana* L.	germeşe	N, P	ES	1000-2000	Forest or bush, rocky slopes	6-7	[19]; [5]	ARTH 18315
780	Viburnaceae	*Viburnum opulus* L.	gilaburu	N, P	ES	10-1450	Forest edges, fences	5-6	[22]	ARTH 18316
781	Violaceae	*Viola alba* Besser	akmenekşe	N, P	--	l.-2000	Forest edges, fences	3-4	[11]	ARTH 18317
782	Violaceae	*Viola kitaibeliana* Schult.	yabanimenekşe	N, P	--	0-1800	Stony slope, rubble, scrub, coastal	3-6	[11]	ARTH 18318
783	Violaceae	*Viola sieheana* W.Becker	çayırmenekşesi	N, P	--	50-1800	Shady area, near water	3-6	[9]; [10]; [11]	ARTH 18319
784	Violaceae	*Viola tricolor* L.	hercaimenekşe	N	--	0-2200	Hillside, woods, waterfront	6-8	[10]; [11]	ARTH 18320
785	Vitaceae	*Vitis vinifera* L.	deliasma		--		Culture plant vineyards	4-6	[9]; [10]; [11]	ARTH 18321
786	Xanthorrhoeaceae	*Asphodeline damascena* (Boiss.) Baker	çekiçlik		IT	370-2000	Stony and rocky slopes, alpine meadows, steppes, forest clearings, river banks	5-7	[19]	ARTH 18322
787	Xanthorrhoeaceae	*Asphodeline lutea* (L.) Rchb.	sarıçiriş	N, P	Med	0-1650	Scrub, scrubland, calcareous slopes, forest clearings	3-6	[5]	ARTH 18323
788	Xanthorrhoeaceae	*Hemerocallis fulva* (L.) L.	güngüzeli	N, P	--		Slopes, forest clearings	6-8	[9]	ARTH 18324
789	Zygophyllaceae	*Tribulus terrestris* L.	çobançökerten	P	--	0-1200	Open and sandy places, fallow fields	6-9	[9]; [11]	ARTH 18325

***** This is the finding of the study, **N:**nectar, **P:** pollen, **I:** Insect secretion**, ES:** Euro-Siberian, **IT:** Irano-Turanian Region, **Med.:** Mediterranean, **C:** Kozmopolit

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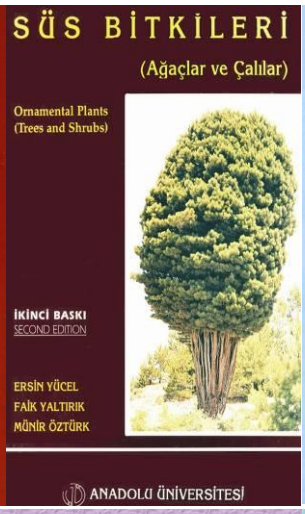

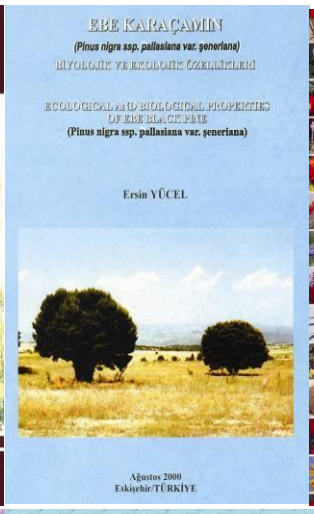

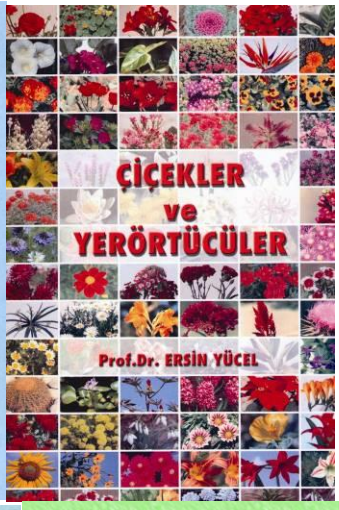

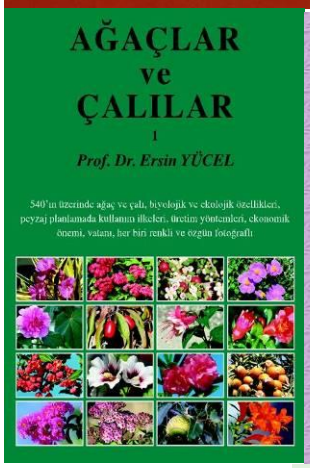

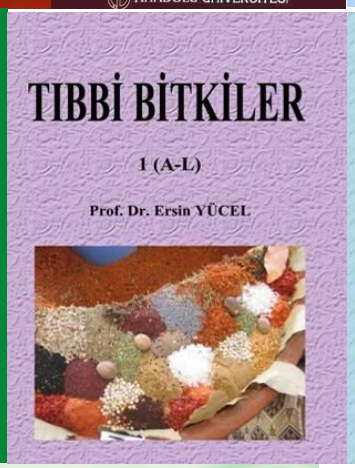

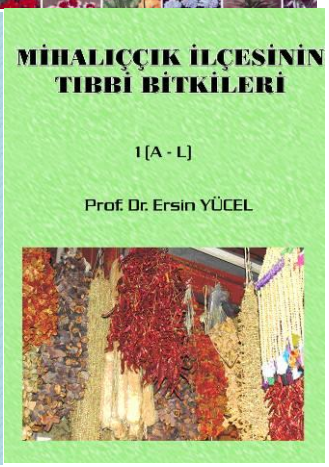

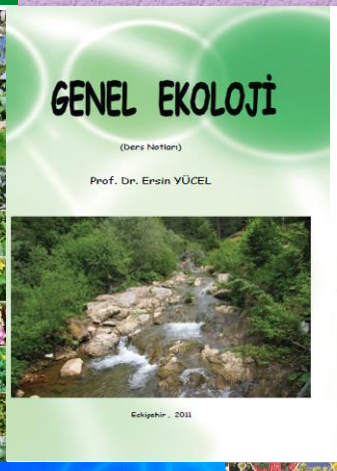

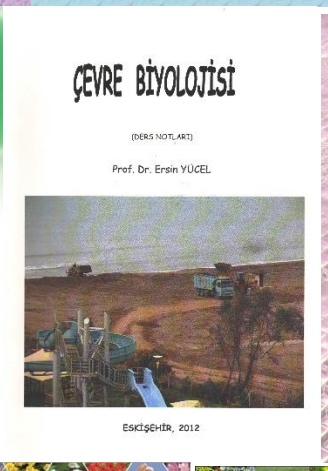

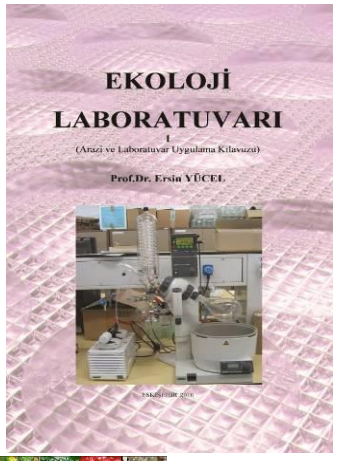

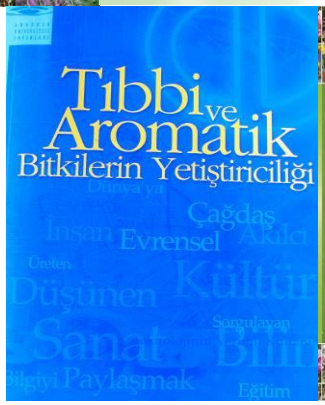

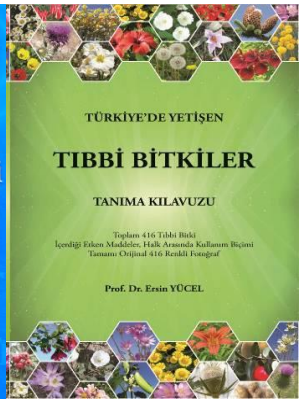

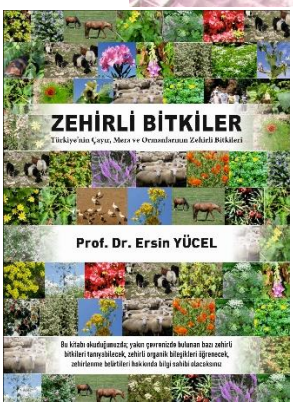

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