

Bumblebees fauna of Turkey with
distribution maps (Hymenoptera: Apidae:
Bombinae) Part 1: *Alpigenobombus*
Skorikov, *Bombias* Robertson and
Bombus Latreille

Hikmet ÖZBEK*

Summary

The present study based upon the bumblebee material collected throughout the country in 1970-1995.

Alpigenobombus wurfleini (Radoszkowski) is a mountain species and appears in north eastern Anatolia above 1800 m. It occurs in both wooded and open area. Its population is very low. *Bombias handlirschianus* (Vogt) and *B. shaposhnikovi* (Skorikov) fly together and are also mountain species (1800-3000 m) and prefer open areas. In general they are abundant species, but their populations have been declined since the 1980s.

Bombus terrestris (Linnaeus) and *B. lucorum* (Linnaeus) are widespread species, and recorded in the same district but not at the same altitudes. Contrary to *B. lucorum*, *B. terrestris* prefers warmer areas, low altitudes, and open places. *B. cryptarum* (Fabricius) is restricted to north east Anatolia, and it prefers open area, high altitudes (1500-3000 m) and colder climates. Except *B. terrestris* the rest of the species are relatively cold-adapted insects. Long term records and observations show that in general the populations of these bumblebee species have obviously declined for two decades.

Key words: Bumblebees, Bombinae, Hymenoptera, Turkey

Anahtar sözcükler: Bambularıları, Bombinae, Hymenoptera, Türkiye

* Atatürk Üniversitesi, Ziraat Fakültesi, Bitki Koruma Bölümü, 25240, Erzurum, Türkiye

Alınış (Received): 02.04.1996

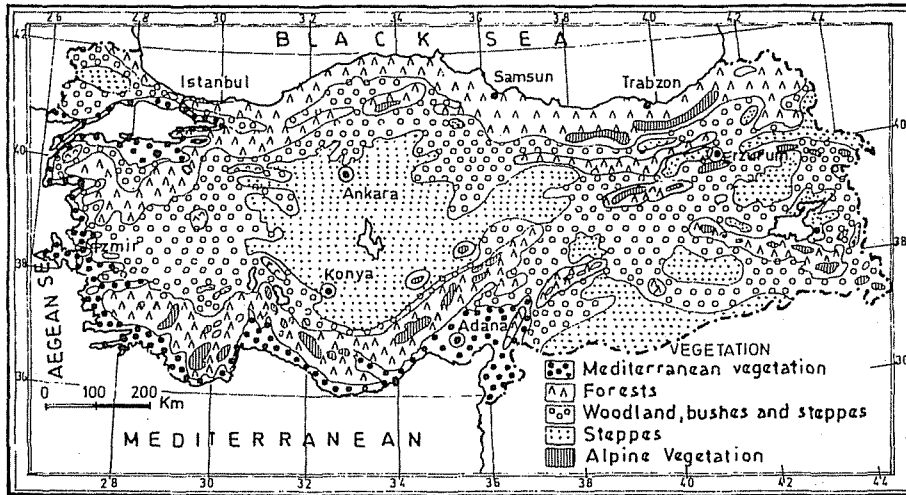
Introduction

Turkey has been described as a bridge between Europe and Asia. The European part of Turkey, Thrace which comprises 3 % of the land area, its apex on the Bosphorus, has a northern and southern fringe of mountains, and a central undulating plain through which run the valleys draining the landward slopes of both highlands.

Asiatic Turkey, Anatolia is a mountainous mass averaging about 1000 m in height and for the most an elevated steppe like plateau enclosed by mountains on all sides but the west. These mountains act as a barrier to the rain-bearing winds from the north and the south and leave the central plain arid, semidesert or steppe with scanty pasture except where the rivers flow through it with strips of fertile land bordering them. The central plateau has hot, dry summers and cold winters with rain or snow between November and May. The eastern part of the plateau is colder than the western in winter; the summers are cool in the north, but hot in the south. The change in climate is rapid from the Black Sea coastlands to the plateau. In the eastern part of this coastal region the rainfall is so abundant that tea can be cultivated. In western Anatolia the change in altitude from coast to plateau is less abrupt and the climatic change is more gradual. On the southern coastlands the temperature in winter is moderate and this is the warmest part of the country. In the southern region the summers are extremely hot, but the winters are milder than on the central plateau. Eastern Anatolia has great variations in temperature because of its mountain character. The north-eastern district (Erzurum, Kars and Ardahan) where snow lies for four months of the year, has the coldest winter in Turkey.

Of Turkey's 780,576 square kilometres about 40 per cent of natural land has not been destroyed by cultivation, which made the formation of the great plant and animal diversity possible. The forests of Turkey occupied about 13.4 per cent of the total area of the country and are almost wholly confined to the mountainous periphery, especially in the north and the east. Although the dominant tree is pine, there are also extensive stands of ash, elm, poplar, maple, chestnut, walnut, cypress and lime. Forests, however, had been diminishing for many years as a result of neglect, indiscriminate cutting, forest fires, and destruction by goats and other animals. Naturally this destruction has caused serious soil erosion in many places, with the usual harmful effects upon fauna and flora.

This brief explanation of the topographic and climatic structure of Turkey shows that there is a great variation from west to east and from north to south, naturally from this variation the richness and diversity of flora and fauna comes. It can be said that the high relief of Turkey provides a broad range of habitats for many kinds of animals including bumblebees (Map 1).



Map 1. Vegetation of Turkey

The bumblebees are among the most abundant and colourful insects of flower visitors in alpine and cool temperate and even high arctic environment of the northern continents. In the southern hemisphere they are native only in the East Indies and South America, where most species are associated with the highlands (Williams, 1991).

The bumblebees are social insects which collect nectar and pollen to nourish their larvae and themselves throughout the summer. Thus, to obtain sufficient food, they must visit numerous flower species, including many important cultivated plants. For example, under field conditions, production of a single gram of honey from red clover by workers of *Bombus fervidus* requires 90 hours of bee labour and visitation to 211200 florets (Heinrich, 1979). Therefore they are efficient pollinating insects in the world and are well adapted to pollinate many cultivated and wild plants (Holm, 1966; Free and Butler, 1968; Free,

1970; Alford, 1975; Teras, 1985). Also, because of their extremely high dependence on floral resources throughout their life histories, good candidates for close links between pollinator diversity and floral diversity. On the other hand, recently, their use to pollinate some glasshouse crops has been developed and, accordingly their mass production (Ravestij and Sande, 1991).

There are currently about 250 species of true bumblebees and 45 species of cuckoo bumblebees or cleptoparasitic bumblebees in the world (Ito, 1985; Williams, 1985). A bumblebee colony consists almost always of a single, mated queen, which lays most of the eggs, and usually of no more than a few hundred, unmated workers and some males. Cuckoo bumblebees lack a worker caste and depend for their existence on the true bumblebees in whose nests they are reared (Free and Butler, 1968; Alford, 1975; Morse, 1982; Plowright and Laverty, 1984).

The family Apidae is restricted in recent classification to the subfamilies Apinae, Meliponinae and Bombinae (Wiston and Michener, 1977). In the holarctic region the family is represented by Apinae: *Apis* Linnaeus and Bombinae: *Bombus* Latreille and *Psithyrus* Lapeletier (Löken, 1973, 1984). Sakagami and Ito (1981) classified Apidae into four tribes: Euglossini (orchid bees), Meliponini (stingless bees), Bombini (bumblebees) and Apini (honeybees).

Dalla Torre (1882) first introduced the subgeneric concept in the genus *Bombus*, and erected nine subgenera. Radoszkowski (1884) recognised four supraspecific groups based on structural characters, especially of male genitalia. Vogt (1909, 1911) produced a classification, also based on genital features, and he divided *Bombus* into several subgenera; similar systems have since been put forward by Ball (1914). This approach has been refined over the intervening century and used to define many subgenera (Skorikov, 1922, 1938; Krüger, 1917, 1920; Reinig 1930; Popov, 1931; Pittioni 1939; Franklin, 1954; Tkalcu, 1972; Thorp et al., 1983; Rasmont, 1983, 1984). Richards (1968) revised all described supraspecific groups of true bumblebees, and recognised 35 subgenera under the genus *Bombus*.

Tkalcu (1972) split the true bumblebees of Old World into eight genera: *Mendacibombus*, *Confusibombus*, *Orientalibombus*, *Alpinobombus*, *Bombus*, *Alpigenobombus*, *Pyrobombus* and *Megabombus*. The last two were subdivided into several subgenera.

The genus *Psithyrus* (cuckoo bumblebees) was also divided into various subgenera (Popov, 1931; Pittioni, 1939; Löken, 1984).

Some specialists ranked the subfamily Bombinae to the family level as Bombidae (Skorikov, 1909; Richards, 1928; Reinig, 1973, 1976; Delmas, 1976; Özbek, 1983).

The Bumblebee fauna of Turkey has been studied by various authors (Fahringer, 1921; Richards, 1930; Skorikov, 1938; Reinig, 1967, 1968, 1971, 1973, 1974; Reinig and Rasmont, 1983, 1988; Tkalcu, 1973, 1994; Özbek, 1983, 1987, 1990a, 1990b). However, no detailed studies have been published on the distribution of the bumblebees.

As it is known the biodiversity crisis has brought a new emphasis on faunistic surveys as it highlights the urgent necessity of expanding our knowledge on the extant fauna. In such an important insect group like bumblebees, we need to know how many species there are, where they are and what their requirements are for survival. From these points of view the aim of the present study is to give detailed information on distribution of bumblebees and to prepare distribution maps, record plant visits and give some idea on the abundance and decline of each species on the basis of 20-25 years of records and observations.

Material and Method

This study is based upon about 15.000 specimens collected mainly by the author during the years 1970-1995 and most of them deposited for the Museum of the Entomology Department, Faculty of Agriculture at Atatürk University, Erzurum. Some of the material has also been collected by various colleagues and students throughout the country. In the collection of the material a specified set of field procedures could not be applied, a kind of casual collecting was conducted. However, more intensive and systematic collections were undertaken in Erzurum, Artvin, Ardahan, Kars, Erzincan, Gümüşhane and Tokat provinces.

During the collection or observation of bumblebees, plants visited by bees were also collected or common ones were noted.

In the present study basically Tkalcu (1972), Özbek (1983) and Rasmont (1988) were followed, the species were treated in alphabetical order within the genera and the sequence of the subgenera were

arranged according to Richards (1968). Habitats and plant records were given. Plant species were also treated alphabetically on the basis of family, genus and species.

A distribution map was prepared, and abundance of the species indicated. The reasons for decline of the bumblebee species were discussed.

Results

Genus *Alpigenobombus* Skorikov, 1914

Alpigenobombus wurfleini (Radoszkowski, 1859)

This species is found in relatively small numbers in north eastern of Anatolia (Map 2).



Map 2. Distribution of *Alpigenobombus wurfleini* and *Bombias handlirschianus* in Turkey

Records of localities: Ardahan: Ilgar Geçidi (Posof) 2400-2600 m, Hanak 2100 m, Karınca Düzü (Göle) 2200 m; Kars: İssisu (Sarıkamış) 2200 m, Allahuekber Mt. 2400 m; Artvin: Karagöl (Şavşat) 2000 m, Genye Mt. 1800 m, Altıparmak (Yusufeli) 2000 m; Erzurum: Şenkaya Yaylası 2400 m, Turnalı (Şenkaya) 2000 m, Değirmenli (Şenkaya) 1900 m, Uzunoluk (Oltu), Çamlıbel Yaylası (Oltu) 2200 m, Uzundere Yaylası

(Uzundere) 2100 m, Yukarı Meydanlar (Tortum) 2300 m; Gümüşhane: Zigana Mt. (Torul) 1900-2100 m; Trabzon: Erikbeli (Tonya) 1800 m; Rize: Anzer (İkizdere) 2100 m.

Biotopes and flower records

Mountain meadows, forest, woodland above 1800 m, Campanulaceae: *Campanula rapunculoides*; Compositae: *Cirsium* sp.; Labiatae: *Lamium album*, *Salvia* sp., *Thymus fallax*; Leguminosae: *Trifolium pratense*; Rosaceae: *Fragaria viridis*, *Potentilla* spp., *Rubus idaeus*.

Distribution data from literature cited: Zigana Geçidi (Reinig, 1971); Yalnızçam (Ardahan) (Reinig, 1973); Uzunoluk, Oltu (Erzurum) (Özbek, 1983); Aksu-pass, Eğimbel (Giresun) (Reinig and Rasmont, 1988).

Genus *Bombias* Robertson, 1903

Subgenus *Mendacibombus* Skorikov, 1914

Bombias handlirschianus (Vogt, 1909)

It is a widely distributed species in the northern part of the country from east to west.

Records of localities: Ardahan:İlgar Geçidi (Posof) 2400-2600 m, Ardahan Yaylası 2200 m, Hanak 2100 m, Göle 2000 m; Erzurum: Şenkaya Yaylası 2100 m, Süngübayır (Olur) 2000 m, Kireçli Geçidi (Narman) 2400 m, Karlı (Tortum) 2200-2600 m, Akdağ (Uzundere) 2700 m, Kargapazarı Mts. 2200-2800 m, Dumlu Mts. 2000-2700 m, Palandöken Mt. 2100-2900 m, Çakmak Mt. 2200 m, Umudum Yaylası 2200 m, Mescit Mt. 2000-2300 m; Bayburt: Soğanlı Mt. 2300 m; Gümüşhane: Zigana Mt. (Torul) 2100 m; Trabzon: Northern part of Zigana, 1600 m; Erzincan: Sakaltutan (Refahiye)2200 m, Kızıldağ 2800 m, Köseadağ 2200 m; Giresun: Ahırcık 1800 m, Karagöl Mt. 2300 m; Tokat: Yıldız Mt. 2100 m; Kastamonu: İlgaz Mt. 1900 m; Bolu: Köroğlu Mt. 2700 m (Map 2).

It is highland species (1800-3000 m), and occurs on mountain meadows and mountain pastures. Its population has apparently declined since the 1980s due to overgrazing in meadows and pastures particularly in eastern Anatolia. Before the 1980s this species was very abundant in some localities but now it is very rare in most of these localities.

Biotopes and flower records

Mountain meadows and mountain pastures, Boraginaceae: *Anchusa azurea*, *A. leptophylla*, *Myosotis lithospermifolia*; Campanulaceae: *Campanula glomerata*, *C. rapunculoides*; Caryophyllaceae: *Dianthus multicaulis*, *Minuartia erythrocephala*, *M. recurva*, *Silene compacta*; Compositae: *Centaurea scabiosa*, *C. depressa*, *C. iberica*, *C. jacea*, *Cichorium intybus*, *Cirsium arvense*, *C. vulgare*, *Erigeron acer*, *E. caucasicus*, *Jurinella moschus*, *Serratula tinctoria*, *Taraxacum androssovii*, *T. crepidiforme*, *Tragopogon aureus*, *Xeranthemum annuum*; Dipsacaceae: *Cephalaria sparsipilosa*, *Scabiosa caucasica*; Gentianaceae: *Gentiana gelida*, *G. vema*; Guttiferae: *Hypericum linarioides*; Labiatae: *Lamium album*, *L. macrodon*, *L. maculatum*, *Salvia candidissima*, *S. verticillata*, *Scutellaria orientalis*, *Stachys lavandulifolia*, *S. palustris*, *Teucrium chamaedrys*, *Thymus fallax*, *T. serpyllum*, *Ziziphora clinopodioides*; Leguminosae: *Astragalus aureus*, *A. christianus*, *A. lagurus*, *A. lineatus*, *A. pinoterum*, *Cicer anatolicum*, *Coronilla orientalis*, *C. varia*, *Lotus corniculatus*, *Medicago lupulina*, *M. papillosa*, *M. varia*, *Onobrychis cornuta*, *Trifolium pratense*, *T. repens*, *T. trichocephalum*, *Vicia cracca*; Onograceae: *Epilobium angustifolium*; Plumbaginaceae: *Acantholimon acerosum*; Rosaceae: *Cotoneaster nummularia*, *Geum reptans*, *Potentilla aurea*, *P. bifurca*, *P. recta*; Scrophulariaceae: *Pedicularis comosa*, *Rhinanthus angustifolius*, *Veronica gentianoides*, *V. orientalis*; Umbellifera: *Eryngium billardi*.

Distribution data from literature cited: Western Pontine Mt. 2000 m (Reinig, 1968); Eastern Pontine Mt. 2200-2600 m, Rize Mts., Kop Mts., Çakmak Mt. (Erzurum) (Reinig, 1971); Erciyes Mt. 2500 m, Ardahan and Gölebert 1800-1900 m, Kuruçay, Çayırbaşı, Yalnızçam (Ardahan) 2200 m (Reinig, 1973).

Bombias shaposhnikovi (Skorikov, 1910)

In general, *B. shaposhnikovi* occurs within the same areas and biotopes as *B. handlirsahianus*, but its population is lower in some localities. The populations of these two species have also declined recently. Both of these species prefer open habitats and they do not tolerate excessive grazing of their host plants by sheep and other animals.

Genus **Bombus** Latreille, 1802

Bombus cryptarum (Fabricius, 1758)

B. cryptarum is distributed in north east of Anatolia. In most districts it flies together with **B. lucorum** at the same altitudes and on the same plants. In principle it prefers higher altitude, colder climate and more open areas. Two Turkish subspecies were previously described (Rasmont, 1984): **B. c. reingianus** Rasmont which is located in western Anatolia such as Bolu (Aladağ) and Bursa (Uludağ) and **B. c. armeniensis** Rasmont which occurs in north-east Anatolia. Rasmont (1984) also indicated the presence of probably another subspecies in Antalya (Termessos). However, in this study specimens of **B. cryptarum** were collected only from Ardahan, Kars, Ağrı, Erzurum, Bayburt, Erzincan, Gümüşhane and Trabzon provinces (Map 3).

Record of localities: Ardahan: Cin Mt. 2400 m, Ardahan Yaylası 2200-2400 m, Ilgar Mt. 2400 m, Çayırbaşı 2100 m; Kars: Alaca Mt. 2300 m, Guthayran (Digor) 2200 m, Bölükbaşı (Selim) 2200 m, Sarıkamış 2200 m; Ağrı: Balıklıgöl Mt. 2500 m, Tahir Mt. (Eleşkirt) 2500 m; Erzurum: Turnalı (Şenkaya) 2000 m, Şenkaya Yaylası 2800 m, Süngübayır (Olur) 2200 m, Orcuk 2700 m, Başaklı 1700-2300 m, Özdere 1900-2600 m, Çamlıbel 1600-2400 m, Tutmaç (Oltu) 2000-2600 m, Kireçli Mt (Narman) (Tortum) 2500 m, Sivri (Tortum) 2300 m, Karlı 2200-2600 m, Karagöbek 2000-2600 m, Güngörmez 2400 m, Dumlubaba 2800 m, Kargapazarı Mts. 2100-2800 m, Rabat (Pasinler) 2100 m, Sakaltutan Mt. 2100-2500 m, Mescit Mt. 2000-2700 m, Southeast of Kop Mt., 2200-2600 m; Bayburt: Kop Mt., 2400 m, Aydın-tepe 2100 m; Erzincan: Karadağ 2600 m, Refahiye 2400 m, Kızıldağ 2700 m, Çağlayan 2300 m, Bahçeli 2100 m; Gümüşhane: Horlar Mt. 2200 m, Zigana Mt. (Torul) 1800-2000 m; Trabzon: North of Zigana 1600-1800 m.

Biotopes and flower records

Mountain meadows and mountain pastures, Boraginaceae: **Anchusa italicum**, **A. officinalis**, **Echium italicum**, **E. vulgare**, **Symphytum officinalis**; Compositae: **Carduus acanthoides**, **C. crispus**, **Centaurea glastifolia**, **C. montana**, **Cirsium arvense**, **C. silvaticum**, **Taraxacum androssovii**, **T. officinalis**; Dipsacaceae: **Cephalaria alpina**, **C. sparsipilosa**, **Scabiosa caucasica**; Ericaceae: **Calluna** sp., **Vaccinium myrtillus**; Gentianaceae: **Gentiana**

gelida, *G. verna*; Labiatae: *Lamium album*, *L. macrodon*, *L. maculatum*, *Mentha longifolia*, *Nepete nuda*, *Prunella grandiflora*, *P. vulgaris*, *Salvia angustifolia*, *S. officinalis*, *S. pratense*, *S. verticillata*, *Scutellaria orientalis*, *Thymus fallax*, *Ziziphora clinopodioides*, Leguminosae: *Astragalus aureus*, *A. christianus*, *A. lagurus*, *A. lineatus*, *A. pinoterum*, *Coronilla orientalis*, *C. varia*, *Lotus corniculatus*, *Medicago lupilana*, *M. papillosa*, *Melilotus officinalis*, *Onobrychis cornuta*, *O. montana*, *O. vicifolia*, *Trifolium pratense*, *T. repens*, *T. trichocephalum*, *Vicia cracca*; Onograceae: *Epilobium angustifolium*; Plantaginaceae: *Plantago lenceolata*; Ranunculaceae: *Caltha polypetala*; Rosaceae: *Alchemilla caucasica*, *A. sintenisii*, *Malus* spp., *Prunus* spp. *Rosa canina*; Salicaceae: *Salix* spp; Scrophulariaceae: *Pedicularis comosa*, *Rhinanthus angustifolias*; Umbellifera: *Eryngium alpinum*, *E. campestre*.

Anchusa italicum, *A. officinalis*, *Centaurea glastifolia*, *Cephalaria alpina*, *Cirsium arvense*, *Epilobium angustifolia*, *Gentiana gelida*, *Lamium album*, *Lotus corniculatus*, *Trifolium repens*, *Taraxacum androssovii* and *Vaccinium myrtillus* are the plants species most often visited by *B. cryptarum*.

The population of *B. cryptarum* has declined due to mostly overgrazing. At the localities where this species is present, habitat destruction is very obvious.

***Bombus lucorum* (Linneaus, 1761)**

B. lucorum is a widespread species in this country. In most cases both *B. lucorum* and *B. terrestris* were collected and observed in the same district but not at the same altitudes. In general *B. lucorum* occurs above 500-600 m up to ca 3000 m, and its distribution is connected mainly with forest and cold climate.

Biotopes and flower records

Wooded places, gardens, orchards, meadows, mountain meadows and pastures, Boraginaceae: *Anchusa azurea*, *A. italicum*, *A. leptophylla*, *A. officinalis*, *Echium italicum*, *E. vulgare*, *Symphytum officinalis*; Campanulaceae: *Campanula glomerata*, *Cerinthe minor*; Caryophyllaceae: *Minuartia erythrosepala*, *M. reurva*, *Silene compacta*; Compositae: *Anthemis tinctoria*, *Arctium lappa*, *Cardaus acanthoides*, *C. crispus*, *C. defloratus*, *C. nutans*, *C. personata*, *C. carlinoides*, *Centaurea glastifolia*, *C. jacea*, *C. iberica*, *C.*

montana, *C. scabiosa*, *Cichorium intybus*, *Cirsium arvense*, *C. eriophorum*, *C. palustre*, *C. silvaticum*, *Crepis foedita*, *Echinops ritro*, *E. sphaerocephalus*, *Erigeron caucasicus*, *Hieracium umbellatum*, *H. oculichristi*, *Inula helenicum*, *Solidago virgaurea*, *Tanacetum vulgare*, *Taraxacum androssovii*, *T. crepidiforme*, *Tragopogon* spp.; Dipsacaceae: *Cephalaria alpina*, *C. sparspilosa*, *Dipsacus silvester*, *Knautia arvensis*, *Scabiosa atropurpurea*, *S. caucasica*, *S. columbaria*; Ericaceae: *Arbutus unedo*, *Calluna vulgaris*, *Vaccinium myrtillus*; Euphorbiaceae: *Euphorbia* spp.; Gentianaceae: *Gentiana gelida*, *G. vema*; Geraniaceae: *Geranium sylvaticum*; Hypericaceae: *Hypericum maculatum*; Labiatae: *Ajuga chamaepitys*, *A. reptans*, *Ballota nigra*, *Glechoma hederaceum*, *Galeopsis speciosa*, *Hyssopus officinalis*, *Lamium album*, *L. macrodon*, *L. maculatum*, *Marrubium vulgare*, *Mentha longifolia*, *Nepeta nepetella*, *N. nuda*, *N. racemosa*, *Prunella grandiflora*, *P. vulgaris*, *Salvia angustifolia*, *S. azurea*, *S. candidissima*, *S. nemorosa*, *S. officinalis*, *S. pratense*, *S. verticillata*, *Scutellaria orientalis*, *Stachys lanata*, *S. officinalis*, *Thymus fallax*, *Ziziphora clinopodioides*; Leguminosae: *Anthyllis vulneraria*, *Astragalus aureus*, *A. christianus*, *A. lagurus*, *A. lineatus*, *A. pinoterum*, *Athyllis vulneraria*, *Cicer anatolicum*, *Coronilla emerus*, *C. orientalis*, *C. varia*, *Cytisus scoparius*, *Lathyrus montanus*, *L. pratensis*, *L. sylvestris*, *Lotus corniculatus*, *Medicago lupulina*, *Melilotus officinalis*, *Onobrychis cornuta*, *O. viciifolia*, *Ononis spinosa*, *Pisum arvense*, *Psoralea bituminosa*, *Trifolium pratense*, *T. repens*, *T. trichocephalum*, *Vicia canescens*, *V. cracca*, *V. sepium*, *V. silvatica*; Liliaceae: *Allium* spp.; Oleaceae: *Ligustrum vulgare*; Onagraceae: *Epilobium angustifolium*; Plumbaginaceae: *Acantholimon acerosum*; Polygalaceae: *Polygala anatolica*; Ranunculaceae: *Aconitum vulpina*, *Caltha polypetala*, *Consolida orientalis*, *Delphinium coelestinum*, *Helleborus* spp.; Ribesiaceae: *Ribes* spp.; Rosaceae: *Alchemilla caucasica*, *A. sintenisii*, *Dryas octopetala*, *Geum rivale*, *G. montanum*, *Malus domestica*, *Potentilla bifurca*, *P. fruticosa*, *Prunus avium*, *P. domestica*, *Rosa canina*, *Rubus billorus*, *R. idaeus*; Salicaceae: *Salix* spp.; Scrophulariaceae: *Digitalis ambigua*, *D. lutea*, *D. purpurea*, *Pedicularis comosa*, *Rhinanthus angustifolius*, *Veronica gentianoides*, *V. orientalis*; Umbelliferae: *Eryngium alpinum*, *E. campestre*, *E. billardiei*; Vallerianaceae: *Valeriana peucophaea*.

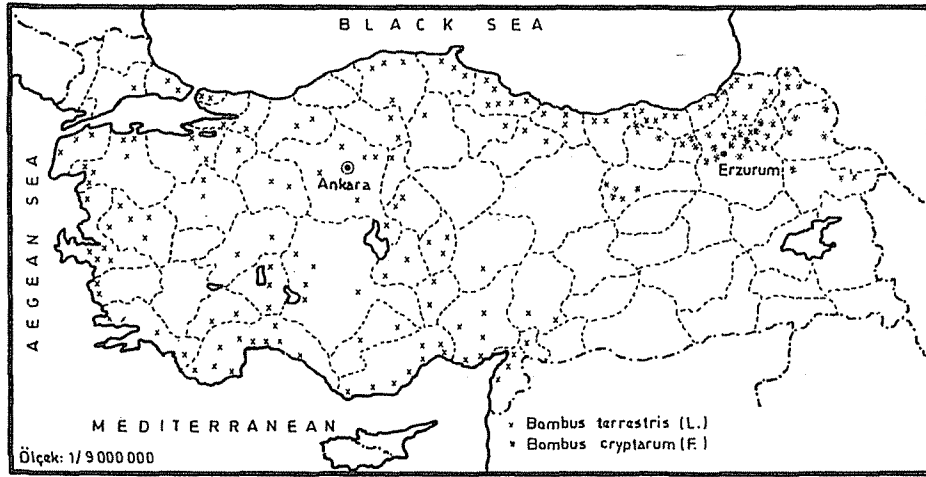
Anchusa italicum, *Cephalaria alpina*, *Coronilla varia*, *Echium italicum*, *Gentiana gelida*, *Lamium album*, *Salvia officinalis*

nalis, *S. sclarea*, *Trifolium repens* and *Vicia cracca* are the most often visited plants species by *B. lucorum*.

Distribution data from literature cited: Uludağ, (Krüger, 1951); Uludağ, Sultandağ, Babadağ, (Reinig, 1967); Bolu Mts., Ilgaz Mts., İsfendiyar Mts., (Reinig, 1968); Uludağ, Bolu, Kızılcahamam (Ankara), Abant (Bolu), Canik Mts., Ulubey, Amasya, Rize Mts., Çamlık (Rize), Aygır pass, İspir (Erzurum), Kopdağı (Bayburt), Çakmak Mt., Eleşkirt (Ağrı) (Reinig, 1971); Kaz Mt. (Balıkesir), Gölebert (Ardahan), Çayırbaşı (Ardahan), Yalnızçam Mt., Şavşat (Artvin) (Reinig, 1973); Alihoca Maden (Niğde) (Reinig, 1974); Ardahan (Özbek, 1980); Erzurum, Dumlubaba (Erzurum), Pazaryolu (Erzurum), Köroğlu Forest (Oltu, Erzurum), Göle, Ardahan (Özbek, 1983); Palandöken and Kargapazarı Mts. (Erzurum) (Özbek, 1990a).

Bombus terrestris (Linnaeus, 1758)

B. terrestris is one of the most widespread bumblebee species in Turkey (Map 3).



Map. 3. Distribution of *Bombus cryptarum* and *B. terrestris* in Turkey

Record of localities: Artvin: Arhavi, Sarp, Dasköy, Cankurtaran geçidi 700 m, (Hopa), Borçka Orman Fidanlığı Yolu 600 m, Yanıklı (Şavşat) 650 m, Çoruh valley, Ferhatlı (Ardanuç), Demirkent, Çiftlik düzü 600 m, Sebzeçiler 560 m, Sarıgöl 900 m, İshan 700 m (Yusufeli); Erzurum: Köprübaşı, Çataksu (Olur); Ayvalı (Oltu); Şelale (Uzundere)

850 m; Rize: Ortaalan Fındıklı 50 m, Işıklı (Ardeşen) 200 m, Dernek (Pazar) 100 m; Trabzon: Sürmene, Çubuklu (Araklı) 150 m, Kaşüstü (Yomra), Beşikdüzü, Deregözü (Vakfikebir); Gümüşhane: Altıpınar (Torul); Giresun: Espiye, Pazarsuyu (Bulancak), Ambarlı (Eynesil), Yenicehisar (Karabulduk) 200 m; Ordu: Çavuşlar, Kaleyaka (Perşembe) 150 m, Mesudiye, Gök köy, Ontamış (Ulubey), Uzunisa, Yalıköy, Ünye 100 m; Tokat: Reşadiye, Gökdere, Erbaa; Amasya: Uluköy (Taşova); Çorum: Kargı 800 m; Samsun: Terme, Çarşamba, Tarımsal Araştırma, Şeker fabrikası, Karaköy (Bafra), Kavak 600 m, Kapaklı (Alaçam) 100 m, Malgölü (Yakakent); Sinop: Kerim, Çalıboğaz (Gerze) 100 m, Aliköy, Yenikonak (Ayancık) 600 m; Kastamonu: Gemiciler (İnebolu), Küre, Seyeliler, Ümit 800 m, Kırık, Ilgaz Mts.; Çankırı: Ilgaz, Korgan, Süleymanlı; Kırıkkale: Yahşihan 850 m; Kırşehir: Kalegöz 900 m, Karakaya 950 m; Ankara: Çubuk Barajı, Esenboğa, Kızılcahamam 1000 m, Atatürk Orman Çiftliği, Beytepe 900 m, Beylikköprü (Polatlı), Gölbaşı, Şereflikoçhisar; Eskişehir: Taşlyük (Mahmudiye), Sultandere, Sivrihisar; Kütahya: Tavşanlı, Domaniç; Bursa: İnegöl, Uludağ 1100-1300 m, Gemlik; Bolu: Bolu Mt. pass, Abant Lake; Bilecik: Ulupınar; Yalova: Çınarcık 50 m; İstanbul: Polonez Köy, Şile, Kemerburgaz, Kilyoz, İstanbul University Forestry Faculty, Silivri, Rumeli Kavağı, Anadolu Kavağı; Tekirdağ: Çorlu; Balıkesir: Kapıdağı peninsula 50-300 m, Bandırma, Kuşçenneti National Park, Edremit, Burhaniye, Ayvalık; Çanakkale: Serçeler, Lapseki, Ezine; Manisa: Alaşehir, Akhisar, Bakır, Kırkağaç, Soma, Salihli, Turgutlu, Saruhanlı; İzmir: Ege University Campus, Agricultural Research Institute (Menemen), Çiğli, Yenifoça, Kemalpaşa, Torbalı, Selçuk; Aydın: Dilek Peninsula National Park 50-300 m, Davutlar, Kuşadası; Muğla: Milas, Bodrum, Ula, Köyceğiz, Fethiye; Antalya: Narenciye Research Institute, Akdeniz University Campus, Kurşunlu, Gebiz, Serik, Belkız (Aspendos), Akseki 800 m, Alanya, Termessos National Park 800-1200 m, Çakırlar 50 m, Alimpınarı 1000 m, Beldibi, Kemer, Kumluca, Finike 1-50 m; Burdur: Taşkapı, Bucak; Isparta: Sütçüler, Eğirdir, Yalvaç; Afyon: Ekinhisar, Sandıklı; Konya: Akşehir 1100 m, Yeşilköy, Ilgın, Sarıköy, Beyşehir, Sille; Karaman: Yollarbaşı, Çavuşpınar; Aksaray: Arıpınar, Taşpınar; Niğde: Bahçeli, Karacaviran; Nevşehir: Ürgüp, Sulusaray, Çardak; İçel: Anamur, Bozyazı, Ovacık, Gülnar, Taşucu, Susanoğlu, Silifke, Kızkalesi, Erdemli, Çamlıyayla, Tarsus; Adana: Çukurova University Campus, Yumurtalık, Karataş, Kozan, Osmaniye; Hatay: Harbiye, Belen Geçidi 700 m, Dört Yol, Yakacık, Yeşilköy; Gaziantep: Bayırtepe (İslahiye); Kahramanmaraş: Narlı, Pazarcık.

B. terrestris is a very common and widespread species in most parts of the country, particularly along the coastal area where urbanisation is not present and in areas which are uncultivated and protected. It is not known if it exists in South East Anatolia, because no research has been carried out there. It is a lowland species and prefers open habitats. In general, it occurs below 1000 m but it has been recorded in 1200-1300 m at some localities in particularly Western Anatolia. In North East Anatolia it is encountered in valleys and in lowland lying between hills or mountains up to 1000-1200 meters, where fruit-growing is sporadically present. In Central Anatolia it is collected only in uncultivated open area and valleys, its population is very low. In cereal growing area it is mostly extinct.

Although all bumblebee species are considered seriously threatened on a countrywide scale, *B. terrestris* is of some special importance, in its decline in Turkey. My 25-years of observations show that the population of this species has declined dramatically throughout the country. It has become extinct or rare in cultivated lands such as Çukurova, many localities of the Aegean and Marmara regions particularly in monoculture plantations, because of habitat destruction and use of pesticides. It is also extinct in some localities along the coasts of the Mediterranean, the Aegean, Marmara and some of the Black Sea, due to heavy urbanisation, industrialisation and pollution by pesticides. In Turkey, particularly in Central Anatolia, probably peculiar to this country, farmers burn the cereal residue left in the field after harvest, to make ploughing easier. But in general, this practice is not restricted to the arable fields and causes the burning of the neighbouring natural land, inevitably bushes, and trees as well. This practice has expanded in the last 10-15 years and has naturally reduced the wild bee populations, including *B. terrestris* and other bumblebees (Özbek and Yıldırım, 1996). Another thing that is also peculiar to Turkey: The use of *B. terrestris* has become common in pollination of tomatoes and other plants in glass houses in Netherlands and Belgium (Ravestijn and Sande, 1991). Two companies from the Netherlands with Turkish partners obtained a license from Government agencies to breed *B. terrestris* in Turkey for export. Unfortunately, overwintered queens and whole nests of *B. terrestris* have been collected in the field and transferred abroad illegally for about 4 years (1989-1992). Over the last couple of years Turkish tomato growers have started to use natural populations of *B. terrestris* in glass houses in

the pollination of tomatoes. These are all significant factors in the decline of this important bumblebee species in Turkey.

Biotopes and flower records

Meadows, pastures, gardens, orchards, roadsides. It is a pollinator of orchards in some localities. It prefers to visit mostly the flowers of the top of fruit trees. Boraginaceae: *Anchusa azurea*, *A. italicum*, *A. officinalis*, *Echium vulgare*, *E. creticum*, *Cerinth* sp.; Campanulaceae: *Campanula* sp.; Cistaceae: *Cistus* sp.; Compositae: *Arctium lappa*, *Carduus* spp.; *Carthamus vulgaris*, *C. lanatus*, *Centaurea scabiosa*, *C. solstitialis*, *Cirsium acaule*, *C. arvense*, *C. eriophorum*, *C. palustre*, *Echinops sphaerocephalus*, *E. viscosus*, *Helianthus annuus*, *Taraxacum officinale*; Cruciferae: *Brassica napus*; Ericaceae: *Erica cinerea*, *Vaccinium myrtillus*, *Vaccinium* sp.; Gentianaceae: *Gentiana* sp.; Geraniaceae: *Geranium* spp.; Labiatae: *Ajuga* sp., *Glechoma dederingia*, *Lamium album*, *L. maculatum*, *Lavandula* sp., *Mentha longifolia*, *Salvia* spp., *Stachys alpina*, *S. germanica*, *S. lanata*, *S. officinalis*, *Teucrium* spp. *Thymus* spp.; Leguminosae: *Anthyllis vulneraria*, *Astragalus* spp. *Cytisus* sp., *Coronilla emerus*, *C. varia*, *Lathyrus pratensis*, *Lotus corniculatus*, *Onobrychis viciifolia*, *Trifolium pratense*, *T. repens*, *Vicia cracca*, Liliaceae: *Asphodeline taurica*; Lythraceae: *Lythrum* sp.; Malvaceae: *Malva* sp., *Lavatera* sp.; Rosaceae: *Malus domestica*, *Prunus* spp. *Rubus idaeus*; Salicaceae: *Salix* spp.; Umbellifera: *Eryngium* spp.; Verbenaceae: *Vitex agnuscastus* (This plant is the favourite one after mid-summer by the end of the season in Mediterranean and Aegean region).

Distribution data from literature cited: Amanos Mt. (Hatay) Fahringer and Friese (1921); Uludağ (Bursa), Sultandağ (Konya) and Baba Mt. (Zonguldak) (Reinig, 1967); Uludağ, Dorukhan pass (Bolu), Ilgaz Mts. (Çankırı), İsfendiyar Mts. (Kastamonu) (Reinig, 1968); Rize Mts., Fatsa, Ünye, Canik Mts., Ulubey (Ordu), Uludağ (Bursa), Bolu Mts., Seben Mt., Aladağ, Abant (Bolu), Kızılcahamam (Ankara), Kazdağı (Balıkesir) (Reinig, 1973); Isparta, Ağlasun (Burdur), Termessos (Antalya), Cevizli (Antalya), Kireli (Konya), Beyşehir, Ereğli (Konya), Aksaray, Ulukışla (Niğde) (Reinig, 1974).

There are probably two subspecies; *B. t. dalmatinus* Dalla Torre, 1882 which occurs in Thracia and Western Anatolia, *B. t. luciformis* Krüger, 1954 in eastern part of Anatolia, but it is difficult to draw a definite borderline and separate these two subspecies taxonomically.

Acknowledgements

I would like to thank: my colleagues Dr. Mikdat Doğanlar, Dr. Şaban Güçlü, Dr. Erol Yıldırım, Dr. Rüstem Hayat, Mr. İrfan Aslan, Mr. Göksel Tozlu, Mr. Önder Çalmaşur, Mr. Levent Gültekin and Mr. Hüseyin Özışık for big help in collecting the material, Dr. Zeki Özer, Dr. Ahmet Günçan, Dr. Tuna Ekim and Dr. Hüseyin Zengin for determination of plant species. My sincere gratitude to Drs. Willem Hurkmans for his review of the manuscript and correcting the English. I would also like to express my gratitude to Mr. Zafer Erkan for drawing of the maps.

Özet

Türkiye'nin bambuları faunası ve türlerin dağılış haritaları (Hymenoptera: Apidae: Bombinae)

Kısım 1: *Alpigenobombus* Skorikov, *Bombias* Robertson ve *Bombus* Latreille

Bu çalışma, 1970-1995 yılları arasında ülkemizin hemen her tarafından toplanmış olan materyal üzerinde yapılmıştır.

Alpigenobombus wurfleini (Rad.)'nin Kuzey Doğu Anadolu'da lokalize olduğu ve genelde 1800 m'nin üzerindeki hem açık, hem de ormanlık alanlarda görüldüğü ve yoğunluğunun çok düşük olduğu saptanmıştır. *Bombias handlirschianus* (Vogl) ve *Bombias shaposhnikovii* (Skorikov)'nin birlikte buldukları, yüksek yerleri (1800-3000 m) ve açık alanları tercih ettikleri, genelde yüksek popülasyona sahip olmakla birlikte, özellikle 1980'li yıllardan bu yana popülasyonlarında belirgin bir düşüşün olduğu gözlenmiştir.

Bombus terrestris (Linnaeus) ve *B. lucorum* (Linnaeus) ülkemizde yaygın olan türlerdir. Her ikisi de aynı yörelerde bulunmakla birlikte, *B. terrestris* taban arazide ve açık alanlarda, diğeri ise yüksek yerlerde ve sıklıkla ormanlık alanlarda görülmektedir. *B. cryptarum* (Fabricius)'a sadece Kuzey Doğu Anadolu'da rastlanmış, yüksek yerleri (1500-3000 m) ve açık alanları tercih ettiği belirlenmiştir.

Genel olarak, son 20 yıldan bu yana bambuları türlerinin popülasyonunda önemli düzeyde bir azalmanın varlığı dikkati çekmiş, özellikle *B. terrestris*'in, başta Çukurova olmak üzere, bazı tarım alanlarında, yerleşimin yoğun olduğu Akdeniz, Ege ve Marmara kıyılarında hemen tümüyle yok olduğu belirlenmiştir.

Literature

- Alford, D.V., 1975. Bumblebees. Davis-Poynter, London, 352 p.
- Ball, F.J., 1914. Les Bourdons de la Belgique. *Annls. Soc. ent. Belgique*, **58**: 77-108.
- Dalla Torre, K.W., 1882. Bemerkungen zur Gattung *Bombus* Latr. II. 3. Zur Synonymie und geographischen Verbreitung der Gattung *Bombus* Latr. *Ber. naturw.-med. Ver. Innsbruck*, **12**: 14-31.

- Delmas, R., 1976. Contribution a l'étude de la faune Française des Bombidae (Hymenoptera, Apoidea, Bombidae). **Annls Soc. ent. Fr. (N.S.)**, **12**: 247-290.
- Fahringer, J., 1921. Hymenopterologische Ergebnisse einer wissenschaftlichen Studienreise nach Türkei und Kleinasien. **Arch Naturgesch.**, **88**: 149-222.
- Fahringer, J. and H. Friese, 1921. Eine Hymenopteren-Ausbeute aus dem Amanus gebirge (Kleinasien und Nordsyrien, südl. Armenien). **Arch. f. Naturgeschb.**, **A87** (3): 150-176.
- Franklin, H.J., 1954. The evolution and distribution of American bumblebee kinds. **Trans. Am. ent. Soc.**, **80**: 43-51.
- Free, J.B., 1970. Insect Pollination of Crops. Academic Press, New York, 544 p.
- Free, J.B. and C.G. Butler, 1968. Bumblebees Collins. London, 208 p.
- Heinrich, B., 1979. Bumblebee Economics. Harvard University Press, Cambridge, 246 p.
- Holm, S.N., 1966. The utilization and management of bumblebees (*Bombus* Latr.) for red clover and alfalfa seed production. **Annual Rev. Entom.**, **11**: 155-182.
- Ito, M., 1985. Supraspecific classification of bumblebees based on the characters of male genitalia. **Contributions from the Institute to Low Temperatures Science, Ser. B**, **20**: 1-143.
- Krüger, E., 1917. Zür Systematik der mitteleuropaischen Hummeln (Hym.). **Entomologische Mitteilungen**, **6** (1-3): 55-66.
- Krüger, E., 1920. Beitrage zur Systematik und Morphologie der mitteleuropaischen Hummeln. **Zoologische Jahrbücher, Abteilung für Systematik**, **42**: 289-464.
- Krüger, E., 1951. Phanoanalytische Studien an einigen Arten der Untergattung *Terrestribombus* O. Vogt. (Hymen. Bomb.). I. Teil. **Tijdschrift voor Entomologie**, **93**: 1431-197.
- Löken, A., 1973. Studies on Scandinavian bumblebees (Hymenoptera, Apidae). **Norsk entomologist Tidsskrift**, **20** (1): 1-218.
- Löken, A., 1984. Scandinavian species of the genus *Psithyrus* Lepeletier (Hymenoptera, Apidae). **Entomologica Scandinavica, Suppl.** **23**: 1-45.
- Morse, D.H., 1982. Behavior and ecology of bumblebees. In Hermann, H.R., Social Insects, 3: 245-322, London.
- Özbek, H., 1980. Kars yöresinde yembezelyesi (*Pisum arvense* L.)'ni tozlayan arılar. **Türk. Bit. Kor. Derg.**, **4** (3): 193-195.
- Özbek, H., 1983. Doğu Anadolu'nun bazı yörelerindeki Bombinae (Hym.: Apoidea, Bombidae) türleri üzerinde taksonomik ve bazı biyolojik çalışmalar. Atatürk Üniversitesi Basımevi, Erzurum, 70 s.
- Özbek, H., 1987. Türkiye'nin *Psithyrus* Lepeletier (Hym.: Apidae) türleri. Türkiye I. Entomoloji Kongresi Bildirileri (13-16 Ekim 1987, İzmir), 661-673.
- Özbek, H., 1990a. Palandöken ve Kargapazarı Dağları arı (Hym.: Apoidea) faunası. X. Ulusal Biyoloji Kongresi (18-20 Temmuz 1990, Erzurum), Atatürk Üniversitesi, Fen Edebiyat Fakültesi, Erzurum, 153-162.

- Özbek, H., 1990b. A new bumblebee species of *Pyrobombus* Dalla Torre (Hymenoptera: Apidae, Bombinae) in eastern Anatolia, Turkey. **Türk. Entomol. derg.**, **14**(4): 207-214.
- Özbek, H. and E. Yıldırım, 1996. Anız yakmanın Apoidea ve Vespoidea (Hymenoptera, Aculeate) türlerine olumsuz etkileri. Tarım-Çevre İlişkileri Sempozyumu (13-15 Mayıs 1996, Mersin), 140-149.
- Pittioni, B., 1939. Die Hummeln und Schmarotzerhummeln der Balkan-Halbinsel mit besonderer Berücksichtigung der Fauna Bulgariens. II: Spezieller Teil. **Mitteilungen aus den Königlichen Naturwissenschaftlichen Instituten in Sofia**, **12**: 49-122.
- Plowright, R.C. and T.M. Laverty, 1984. The ecology and sociobiology of bumble bees. **Annual Rev. Entom.**, **29**: 175-199.
- Popov, V.V., 1931. Zur Kenntnis der palaearktischen Schmarotzerhummeln (*Psithyrus* Lep.). **Eos Madrid**, **7**(2): 131-209.
- Radoszkowski, O., 1884. Revision des armures copulatrices des males du genre *Bombus*. **Byulletin Moskovskogo obshchesta ispytatelei prirody**, **59**: 51-92.
- Rasmont, P., 1983. Catalogue commenté des Bourdons de la region ouest-paléarctique (Hymenoptera, Apidae, Bombinae). **Notes fauniques de Gembloux**, **7**: 1-72.
- Rasmont, P., 1984. Les Bourdons du genre *Bombus* Latreille sensu stricto en Europe Occidentale et Centrale (Hymenoptera, Apidae). **Spixiana, München**, **7**: 135-160.
- Rasmont, P., 1988. Monographie écologique et zoogéographique des Bourdons de France et de Belgique (Hymenoptera, Apidae, Bombinae). Faculté des Sciences agronomiques de l'Etat Gembloux, 309+1xi pp., Ph. D. thesis.
- Ravestijn, W. van and van der J. Sande, 1991. Use of bumblebees for the pollination of glasshouse tomatoes. In: Heemert, C. van and A. de Ruijter (eds.). The sixth international symposium on pollination, Tilberg, Netherlands, 27-31 August 1990. **Acta Horticulturae**, **288**: 204-212.
- Reinig, W.F., 1930. Untersuchungen zur Kenntnis der Hummelfauna des Pamir-Hochlandes, In: **Z. Morphol. Ökol.**, **17**: 68-123.
- Reinig, W.F., 1967. Zur Kenntnis der Hummelfauna einiger Gebirge West-Kleinasiens, In: **Nachr. bl. Bayer. Ent. Jg.**, **16**: 81-91.
- Reinig, W.F., 1968. Über die Hummeln und Schmarotzerhummeln Nordwest-Anatoliens, In: **Nachr. b. Bayer. Ent. Jg.**, **17**: 101-112.
- Reinig, W.F., 1971. Zur Faunistik und Zoogeographie des Vorderen Orients. 3. Beitrag zur Kenntnis der Hummeln und Schmarotzerhummeln Anatoliens. **Veröffentlichungen der Zoologischen Staatssammlung München**, **15**: 139-165.
- Reinig, W.F., 1973. Zur Kenntnis der Hummeln und Schmarotzerhummeln des Saarlandes und der Pfalz (Hym., Bombidae). **Abhandlungen der Arbeitsgemeinschaft für tier und pflanzengeographische Heimatforschung un Saarland**, **4**: 3-28.
- Reinig, W.F., 1974. Zur Verbreitung einiger Hummelarten auf der Balkan-Halbinsel (Hym., Bombidae). **Nachrichtenblatt der Bayerischen Entomologen**, **23**: 11-13.

- Reinig, W.F., 1976. Über die Hummeln und Schmarotzerhummeln von Nordrhein-Westfalen (Hymenoptera, Bombidae). **Bonner zoologische Beiträge**, **27**: 267-299.
- Reinig, W.F. and P. Rasmont, 1983. Über den Anatolischen *Megabombus (Thoracobombus) pascuorum* (Scopoli) (Hym., Apidae). **Spixiana, München**, **6**(2): 153-165.
- Reinig, W.F. and P. Rasmont, 1988. Beitrag zur Kenntnis des Berghummel *Alpigenobombus wurfleini* (Rad.) (Hym., Apidae, Bombinae). **Spixiana, München**, **11** (1): 37-67.
- Richards, O.W., 1928. A revision of European bees allied to *Psithyrus quadricolor* Lepeletier (Hymenoptera, Bombidae). **Transactions Royal entomological Society London**, **76**: 345-365.
- Richards, O.W., 1930. The bumble bees captured on the expeditions to Mount Everest (Hym., Bombidae). **Annals and Magazine of natural History, serie 10**, **56**: 633-658.
- Richards, O.W., 1968. The subgeneric divisions of the genus *Bombus* Latreille (Hymenoptera, Apidae). **Bulletin of the British Museum (Natural History), Entomology**, **22** (5): 211-276.
- Sakagami, S.F. and M. Ito, 1981. Specific and subgeneric variations in tibial corbication of male bumblebees (Hymenoptera, Apidae), an apparently functionless character. **Entomologica Scandinavica Suppl.**, **15**: 365-376.
- Skorikov, A.S., 1909. Nouvelles formes des bourdons (Hymenoptera, Bombidae). **Russk. ent. Obzr.**, **9**: 409-413 (In Russian).
- Skorikov, A.S., 1922. Shmeli paleartiki. Chast I. Obshchaya biologiya (so vklyucheniem zoogeografii). **Izvestiya Severnoi Oblastnoi Stantsii Zashchity Rastanii ot Vreditel'ei**, **4**: 1-160.
- Skorikov, A.S., 1938. Zoogeographische Gesetzmässigkeiten der Hummelfauna im Kaukasus, Iran and Anatolien (Hymenoptera, Bombinae). **Entomologicheskoe Obozrenie**, **27**: 145-151.
- Tanoğlu, A.E. and E. Tümer, 1961. Türkiye Atlası. Milli Eğitim Basımevi İstanbul.
- Teras, I., 1985. Food plants and flower visits of bumblebees (*Bombus*: Hymenoptera, Apidae) in southern Finland. **Acta Zoologica Fennica**, **179**: 1-120.
- Thorp, R.W., D.S. Horning and L.L. Dunning, 1983. Bumble bees and cuckoo bumble bees of California (Hymenoptera: Apidae). **Bulletin of the California Insect Survey No. 23**: 1-79.
- Tkalcu, B., 1972. Arguments contre l'interprétation traditionnelle de la phylogénie des abeilles (Hymenoptera, Apoidea). Première partie. Introduction et exposés fondamentaux. **Bull. Soc. ent. Mulhouse**, **(4-6)**: 17-28.
- Tkalcu, B., 1973. Taxonomie von *Pyrobombus brodmannicus* (Vogt) (Hymenoptera, Apoidea, Bombinae). **Acta entomologica bohemoslovaca**, **70** (4): 259-268.
- Tkalcu, B., 1994. Trois nouveaux taxa d'abeilles de Turquie (Hymenoptera, Apoidea). **Bull. Soc. ent. Mulhouse.**, **Octobre-Décembre**: 87-90.

- Vogt, O., 1909. Studien über das Artproblem. I. Mitteilung. Über das Varrriere der Hummeln. I. Teil. **Schriften der Berlinischen Gesellschaft Naturforschender, Freunde, Berlin**, 1909: 28-84.
- Vogt, O., 1911. Studien über das Artproblem. II. Mitteilung. Über das Varrieren der Hummeln. 2. Teil. **Schriften der Berlinischen Gesellschaft Naturforschender, Freunde, Berhin**, 1911: 31-74.
- Williams, P.H., 1985. A preliminary cladistic investigation of relationships among the bumble bees (Hymenoptera, Apidae). **Systematic Entomology**, **10**: 239-255.
- Williams, P.H., 1991. Bumble bees of the Kashmir Himalaya (Hymenoptera: Apidae, Bombini). **Bull.Br. Mus. nat. Hist (Ent.)**, **60** (1): 1-209.
- Winston, M.L. and C.D. Michener, 1977. Dual origin of highly social behavior among bees (Hymenoptera, Apidae). **Proc. Nat. Acad. Scien. U.S.A.**, **74**: 1135-1137.