Introduction

Bumblebees are commonly pleasing, large, fluffy-haired pollinating insects with a characteristic flight (Pawlikowski, 1999). Because of their unique role in human culture, mythology, agriculture, economy and general ecology there have been many studies on their systematics, taxonomy and biology (Engel, 2001). Nevertheless, there is still no agreement on their systematics among taxonomists. In particular, the position and taxonomic importance of the subgenera remain of great interest (Aytekin and Çagatay, 2002). Although morphological studies have made some progress in this subject, new techniques and approaches have been commonly used over the last 30 years. These started morphometrically with Medler (1962) and, according to Ito (1985a), biochemically with Stephen and Chedelin. The lack of sufficient morphological key characters, and the determination of very important variations in morphological discrimination criteria are the basic reasons for these efforts.

When combined with traditional taxonomy, classical morphometry appears to give better indications of the naturality of the subgenera in Megabombus (s. lato). In this paper our aim was to show these relationships with the morphology, color variation of the body hairs and the male genitalia of the species in alternative perspectives.

Materials and Methods

Specimens from the subgenera Megabombus (s. str.) Dalla Torre, 1880, Thoracobombus Dalla Torre, 1880 and Rhodobombus Dalla Torre, 1880 of the genus Megabombus (s. lato) were analyzed by classical morphometry as well as by traditional methods. Three hundred and twenty-two specimens from eight different species of the genus Megabombus were collected from

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Central Anatolia in Turkey between 1996 and 2000, including Ankara, Aksaray, Çankırı, Eskişehir, Karaman, Kayseri, Kırıkkale, Kırşehir, Konya, Nevşehir, Niğde, Sivas, and Yozgat provinces, a total area of 178,080 km². The specimens were all caught on plants while they were searching for nectar or pollen. The bumblebees were put in small labeled boxes and kept in an mobile ice box in order to bring them to the laboratory alive. They were kept alive in the Hacettepe University Bumblebee Rearing Room until dissection; therefore all the specimens studied were fresh. The nomenclature preferred here follows that used by Rasmont (1983) and Pawlikowski (1999).

Classical Analysis

Specimens were labeled and pinned after extracting the male genitalia. For the study of the genitalia the technique and terminology follow those proposed by Prys-Jones and Corbet (1987) and Özbek (1983). Although they were found and examined in the study area, because they were given by the same authors before (Aytekin and Çağatay, 1999), the genitalia and general morphology of two species Megabombus argillaceus and M. zonatus were not illustrated and described here again. The females of M. humilis and M. armeniacus and males of M. mesomelas were not included in the same way. For the other species the morphology, color variation and the male genitalia were examined.

Morphometric Analysis

All specimens were examined for the presence of known ecto- and endo-parasites to prevent the morphometric data from possible traumatic variation (Mayr and Ashlock, 1991). The body parts were then removed from each specimen with pliers and mounted in Entellan on numbered slides. Of the paired organs the one on the right was measured (Pekkarinen, 1979). By using an Olympus monitored stereoscopic zoom dissection microscope a total of 39 characters were measured directly on the screen. Twenty of these were chosen following previous studies (Medler, 1962; Plowright and Stephen, 1973; Pekkarinen, 1979; Ito, 1987; Danforth, 1989) while 19 were defined by the authors. In the morphometrical analysis the following variables were used: 13 sets of length data from the wings (front wing: whole wing length and width; length of the marginal cell, radial sector, opposite corners of second cubital cell, the corners of first and second submarginal cells, second submarginal cell, and first submarginal cell; hind wing: whole wing length and width; length of medio + cubitus, radial sector, and cubitus-anal vein); 10 geometric angles formed by the veins (front wing: second cubital cell angles, angle of the corner below the second cubital cell, angle of the corner between the third and second submarginal cells, angle of the corner between the second submarginal cell and the first medial cell, angle of the corner between the second submarginal cell with both the first medial and first submarginal cells; hind wing: angle of the corner between the medial and radial sectors, angle of the corner between the anal and cubito-anal veins); eight sets of length data from the legs (front leg: length of the tibia and basitarsus; mid-leg: length of the tibia and basitarsus; hind leg: length and width of the tibia and basitarsus); the length of the prementum, glossa, mandible, labrum and head; the width of the head; the length of the malar area; and the compound eye. As the glossa is stretchable (Pekkarinen, 1979), it was first removed before being folded (Harder, 1982). In the statistical analysis of the morphometric data, phenograms of the samples were constructed using the Mahalanobis distances among centroids of groups in a discriminant function by UPGMA in NTSYS-pc 1.80 (Rohlf, 1992).

Abbreviations Used in the Figures

crd  cardo
lcn  lacinia
sgt  sagitta
spt  spatha
sqm  squama
stp  stipes

Results

Traditional taxonomy

Subgenus Megabombus (s. str.) Dalla Torre, 1880

Syn. Hortobombus Vogt, 1911

Megabombus (Megabombus) argillaceus (Scopoli, 1763)

Syn. Bombus sichellii (Radoszkowski), 1859

Material examined: 9-VII-1996, Beynam (Ankara), 200, 300, 500 (1100 m); 25-VI-1997, Deştiğin (Konya).
5دد (1310 m); 25-VI-1997, Kazım Karabekir (Karaman), 19, 299, 5دد (1000 m); 24-VII-1997, Mahmatlar (Kayseri), 19, 399, 3دد (1110 m); 22-VIII-1997, Hacibektas (Nevşehir), 5دد (1290 m); 25-VII-1997, Kesikköprü (Kırşehir), 299, 299, 1d (600 m); 20-VIII-1997, Kırkaya (Eskişehir), 19, 499, 399 (980 m); 15-VII-1998, Çeltik (Sivas), 19, 599, 9دد (1600 m); 6-VII-1999, Bor (Niğde), 19, 699, 9دد (900 m); 8-VII-1999, Tepesidelik (Aksaray), 399 (1200 m); 14-VII-1999, Eldivan (Çankırı), 19, 299, 5دد (1200 m); 4-VIII-2000, Akbenli (Yozgat), 19, 3دد (1200 m); 11-IX-2000, Beytepe (Ankara), 2دد (900 m).

General Distribution: USSR (Skorikow, 1928); Bulgaria (Atanassov, 1975); France, Italy, Austria, Hungary, Soviet Union, Iran, Spain, Caucasus (Rasmont, 1983); Italy (Williams, 1985); Poland (Pawlikowski, 1996).

Distribution in Turkey: Emirdağ, Sultan Dağı (Konya), Baba Dağı (Zonguldak), Uludağ (Bursa) (Reinig, 1967); Karabük, Kastamonu, Çankırı (Reinig, 1968); Van, Hattuşaş (Yozgat) (Reinig, 1971); Kayseri, Ayazma (Ankara), Crater, Ürgüp, Çayırbaşı (Reinig, 1973); Tavas, Kazıklı, Isparta, Ağlasun (Burdur), Cevizli (Antalya), Beştepe, Ulukışla (Niğde) (Reinig, 1974); Erzurum (Özbek, 1983); Ankara (Aytekin and Çagatay, 1999); Adana, Adıyaman, Aşağı, Ağrı, Aksaray, Ankara, Antalya, Ardahan, Artvin, Bayburt, Bingöl, Bitlis, Bolu, Burdur, Bursa, Çankırı, Çorum, Denizli, Elazığ, Erzincan, Erzurum, Eskişehir, Gümüşhane, Hakkari, Hatay, Iğdır, Isparta, Isparta, İzmir, Kahramanmaraş, Karaman, Kars, Kayseri, Kırıkkale, Kırşehir, Konya, Malatya, Muş, Nevşehir, Niğde, Rize, Samsun, Sivas, Tokat, Trabzon, Tunceli, Van, Yozgat (Özbek, 2002).

_Megabombus (Megabombus) hortorum_ (L., 1761)

_Syn. Apis paludosa_ Müller, 1776

**Female**

Body of the queen 18-21 mm, worker 8-14 mm; head long, queen 4.76 ± 0.77 mm (Art. Avr. ± SD), worker 3.71 ± 0.38 mm; head with black hairs; basal of the labrum with large spots, labral hollow deep and narrow; the clypeal line reaches 1/3 of the clypeus, surface little but dense punctuated; malar area long, queen 0.73 ± 0.12 mm, worker 0.67 ± 0.11 mm; collar and scutellum with yellow hairs, interalar band with black ones; first tergal hairs (T1) yellow, T2 with yellow ones at latero-proximal and black distally, T3 with black, T4-T6 with white hairs.

**Male**

11-16 mm; head long, 3.91 ± 0.25 mm; the length of the first antennal flagellum (F1) and F2 are nearly the same, both longer than F3; malar area very long, 1.12 ± 0.15 mm; head generally with black hairs, yellow and black ones mixed at vertex; collar and scutellum with yellow hairs, interalar band with black ones; T1 with yellow hairs, T2 with yellow at latero-proximal and black distally, T3 with black, T4-T5 with white, T6 with black hairs medially and with white or light yellow ones laterally, T7 with black hairs.

Genitalia: Lacinia long, high-boot shaped; squama earlap-shaped, medio-proximal area curved upwards U-shaped through the sagitta, this portion is longer as in _M. portchinsky_ and apically spherical; spatha short; lateral surface of sagitta smooth and without any projecting part, distal part slightly curved out through squama (Figure 1).

Material examined: 5-VI-1996, Çerkeş (Çankırı), 299, 599, 7دد (900 m); 9-VIII-1998, Kızılıcahamam (Ankara), 299, 299, 3دد (1900 m); 4-VIII-1999, Bozkır (Konya), 299, 399 (1000 m); 15-IX-2000, Ortabeli (Çankırı), 299, 299, 1d (1300 m).

General Distribution: USSR (Skorikow, 1928); Finland (Hänninen, 1962); England, Scotland, Wales (Alford, 1975); Bulgaria (Atanassov, 1975); Poland (Anasiewicz and Warakomska, 1977); Finland (Pekkarinen and Teräs, 1977); Denmark, Norway, Sweden, Finland, Soviet Union (Pekkarinen, 1979); Belgium, France, Ireland, Turkey, Caucasus, Iran, Corsica, Spain, Portugal, Poland, Germany, Holland, Switzerland, Czech Rep., Slovakia, Austria, Hungary, Romania, Greece, Yugoslavia (Rasmont, 1983); Yugoslavia (Stevanovic and Demajo, 1985); England (Williams, 1985); Holland (Blom, 1989); Ireland, England, Wales, Scotland, Shetland Islands, Norway, Denmark, Sweden, Finland, Russia (Pekkarinen and Teräs, 1993); Corsica (Rasmont and Adamski, 1995); Germany (Collin and Schlüter, 1996); Poland (Pawlikowski, 1999).

Distribution in Turkey: Uludağ (Bursa) (Reinig, 1967); Bolu, Dorukhan, Semen Dağı, Isfendiyar Dağı, İlgaz Dağı (Kastamonu), (Reinig, 1968); Canik Dağları, Rize, Trabzon (Reinig, 1971); Kobaklı, Arıçbaşı.
Systematical Studies on *Megabombus* (Apidae: Hymenoptera) Species in Central Anatolia

Megabombus (Megabombus) portchinsky Rad., 1883

Female

Body of the queen 18-24 mm, worker 9-16 mm; head long, queen 4.83 ± 0.61 mm, worker 3.77 ± 0.33 mm; head with black hairs; basal of the labrum with large spots, labral hollow deep and narrow; the clypeal line reaches 1/3 of the clypeus, surface little but dense punctuated; malar area very long, queen 1.34 ± 0.28 mm, worker 0.72 ± 0.22 mm; collar and scutellum with yellow hairs, interalar band with black ones; T₁ with yellow hairs, T₂ with yellow at latero-proximal and with black hairs distally, T₃ with black hairs, T₄-T₆ with dirty-white or very light yellow hairs.

Male

12-17 mm; head long, 3.71 ± 0.25 mm; the length of F₁ and F₂ are nearly the same, both longer than F₃;

malar area very long, 1.18 ± 0.11 mm; head generally with black hairs, yellow and black ones mixed at vertex; collar and scutellum with yellow hairs, interalar band with black ones; T₁ with yellow hairs, T₂ with yellow at latero-proximal and black hairs distally, T₃ with black hairs, T₄-T₅ with white hairs, T₆ with black hairs.

Genitalia: Lacinia long, high-boot-shaped; squama earlap-shaped, medio-proximal area curved upwards U-shaped through the sagitta, this portion is shorter as in *M. hortorum* and apically pointed; spatha short; lateral surface of sagitta smooth and without any projecting part, distal part lightly turned out through squama (Figure 2).

Material examined: 15-VII-1998, Çeltik (Sivas), 2♀, 3♂, 5♂♀; 5-IX-1999, Uzunseki (Sivas), 2♀, 2♂, 3♂♀ (1600 m). (First recorded from Sivas province).

General Distribution: Turkey, Caucasia, Iran (Rasmont, 1983).

Distribution in Turkey: Ardahan, Çayırbaşı (Reinig, 1973); Erzurum, Ağrı (Özbek, 1983); Ağrı, Ardahan, Bayburt, Erzurum (Özbek, 2002).
Subgenus Thoracocobus Dalla Torre, 1880
Syn. Agrobombus Vogt, 1911

Megabombus (Thoracocobus) zonatus (Smith, 1854)

Material examined: 5-VI-1996, Çerkeş (Çankırı), 1♀ (900 m); 9-VII-1996, Beynam (Ankara), 3♂♂ (1100 m); 25-VI-1997, Kazımkarabekir (Karaman), 1♂, 2♀♀ (1000 m); 24-VI-1997, Yüksektaş (Nevşehir), 2♀♀ (1290 m); 24-VII-1997, Mahmatlar (Kayseri), 1♂ (1110 m); 25-VII-1997, Kesikkapı (Kırşehir), 2♀♀, 2♀♀ (600 m); 25-VIII-1998, Seyfe (Kırşehir), 1♂, 2♀♀, 2♀♀ (1100 m); 24-VII-1997, Hacibektas (Nevşehir), 2♂♂ (1290 m); 24-VII-1997, Mahmatlar (Kayseri), 1♂ (1110 m); 25-VII-1997, Kazımırkaş (Karaman), 1♂, 2♀♀, 1♂ (1000 m); 25-VIII-1998, Seyfe (Kırşehir), 1♂, 2♀♀, 2♀♀, 1♂ (1100 m); 30-VIII-1998, Elmadağ (Ankara), 2♀♀ (1500 m); 7-VII-1999, İftlik (Niğde), 1♂, 2♀♀ (1400 m); 14-VII-1999, Eldivan (Çankırı), 2♀♀ (1200 m); 25-VIII-1999, Bozkır (Konya), 4♀♀ (1000 m); 8-VII-1999, Tepesidelik (Aksaray), 1♀ (1200 m); 4-VIII-2000, Akbenli (Yozgat), 2♀♀ (1200 m).

General Distribution: Bulgaria (Atanassov, 1975); Romania, Hungary, Greece, Soviet Union, Iran, Caucasus (Rasmont, 1983).

Distribution in Turkey: Uludağ (Bursa) (Reinig, 1967); Kastamonu, Sultan Dağları (Konya), Baba Dağları (Zonguldak), Çankırı (Reinig, 1968); Van, Çorum, Akşehir, Afyon, Yozgat (Reinig, 1971); Mavikara, Derinkuyu, Develi (Kayseri) (Reinig, 1973); Sİparta, Beşşehir, Konya, Ulukışla (Niğde) (Reinig, 1974); Erzurum, Sarıkamış, Hınıs, İspir, Oltu, Tortum, Tercan (Özbek, 1983); Ankara (Aytékin and Çağatay, 1999); Pozanti (Adana), Çölbaş (Adıyaman), Hamur, Çumaçay, Doğuşeyzat (Ağrı), Aksaray, Turhal (Amasya), Çubuk, Beypazarı, Haymana, Elmadag, Polatlı, Şerflikoçhisar (Ankara), Antalya, Ardahan, Boroçka (Artvin), Bayburt, Bilecik, Bitlis, Burdur, Bursa, Çankırı, Alaca (Çorum), Denizli, Harput, Kovancılar (Elazığ), Kemah, İlç (Erzincan), Pınarhisar, Horasan, Köprükoy, Hınıs, Ağ kale, Oltu, Olur, Tortum, Namık, Pazaryolu, İspir (Erzurum), Sivrihisar (Eskişehir), Gümüşhane, İğdır, Hakkari, Hatay, Eğirdir, Kėçiörör, Gelendost (İsparta), İçel, Karaman, Sarıkamış, Digor, Kağızman (Kars), Kayseri, Kırıkale, Akşehir, Iğdır, Gümüşmir (Konya), Malatya, Zelve, Uğrûp (Nevşehir), Niğde, Sivas, Tokat, Tunceli, Van, Yozgat (Özbek, 2000).

Megabombus (Thoracocobus) mlokosieitzi Rad., 1877

Female

Body of the queen 16-21 mm, worker 10-13 mm; head moderately long, queen 4.58 ± 0.43 mm, worker 3.52 ± 0.33 mm; head with mixed black and white hairs, white ones shorter; labral hollow deep and narrow; surface of the clypeus hardly visible and rare punctuated; malar area long, queen 0.95 ± 0.12 mm, worker 0.73 ± 0.13 mm; collar and scutellum with white hairs, interalar band with black ones; in queens T1-T2 with reddish brown hairs, T3 with black hairs, T4-T6 with reddish brown hairs; the color dispersion of the worker’s body hairs is nearly the same as that in queens but sometimes with rare and white hairs on T1-T4, with reddish brown ones on T5-T6.

Male

11-15 mm; head moderately long, 3.56 ± 0.27 mm; F1 slightly longer than F2, both shorter than F3; malar area long, 0.84 ± 0.15 mm; head with mixed black and white hairs, white ones shorter; collar and scutellum with white hairs, interalar band with black ones; T1-T2 with reddish brown hairs medially and white laterally, T3 with black, T4-T6 with tile-red hairs.

Genitalia: Lacinia with three projections, first one short and apically pointed, second with quadrangular end, third one short and pointed; squama with a spin-like process medio-proximally curved upwards through the sagitta; spatha long; lateral surface of sagitta smooth and without any projecting part, distal part lightly turned out through squama like a small hook (Figure 3).


General Distribution: Turkey, Caucasus (Rasmont, 1983).

Distribution in Turkey: Bursa (Reinig, 1968); Yalnızca Dağları (Ardahan), Kuruçay (Reinig, 1973); Ardahan, Erzurum (Özbek, 1983); Amasya, Ardahan, Artvin, Bayburt, Bolu, Bursa, Çankırı, Erzincan, Erzurum, Gümüşhane, Kars, Samsun, Sinop, Tokat, Trabzon (Özbek, 2000).
Megabombus (Thoracobombus) humilis Illiger, 1806

Syn. Bombus solstitialis Jurine, 1807, Bombus helferanus Seidl, 1837, Bombus variabilis Schmiedeknecht, 1878

Male

12-15 mm; head moderately long, 3.91 ± 0.25 mm; F₁ slightly shorter than F₂, F₂ is nearly half of F₁; malar area long, 0.84 ± 0.09 mm; head with mixed black and light yellow hairs, black ones rare; in some specimens collar and scutellum with yellow hairs, interalar band with black ones while in other all thorax with camel or fully black hairs; if collar and scutellum with yellow hairs then T₁-T₅ also with yellow hairs, T₆ with black ones; if all the thoracic hairs are camel then T₁ with yellow or reddish brown hairs, T₂-T₄ with black hairs at distal end with yellow ones at proximal end; if all the thoracic hairs are black then T₁-T₅ also with black hairs, T₆ with yellow ones and T₇ with orange hairs.

Genitalia: Lacinia basally broad, distally narrower, apical part pointed; squama with two process projecting through the sagitta, the one at medio-distal part pointed at apex, the other one is triangular; spatha short, proximally narrower, apically blunt; distal surface of sagitta smooth and globular, curved through the squama (Figure 4).

Material examined: 8-VII-1998, Ayas (Ankara), 4♀, 5♂, 4♀♀ (1058 m); 15-VII-1998, Şarkışla (Sivas), 1♂ (1100 m); 9-VIII-1998, Kızılcahamam (Ankara), 2♀, 2♂, 6♀♀ (1900 m); 7-VII-1999, Çiftlik (Niğde), 2♀, 2♂, 2♀♀ (1400 m); 14-VII-1999, Çerkeş (Çankırı), 4♀♀ (900 m); 5-IX-1999, Uzunseki (Sivas), 2♀, 3♂ (1400 m); 19-IX-2000, Gülşehir (Nevşehir), 1♀, 2♀, 3♀♀ (800 m).

General Distribution: England, Scotland, Ireland (Alford, 1975); Finland (Pekkarinen and Teräs, 1977); Belgium, Holland, Germany, Poland, Switzerland, France, Turkey, Caucasus (Rasmont, 1983); North Korea (Ito, 1985b); Holland (Blom, 1989); England, Wales, Scotland, Ireland, Denmark, Norway, Sweden, Finland, Russia (Pekkarinen and Teräs, 1993); Germany (Cölln and Schlüter, 1996); Poland (Pawlikowski, 1996).

Distribution in Turkey: Uludağ (Bursa) (Reinig, 1967); İsfendiyar Dağları, İlgaz Dağı (Kastamonu), Isfendiyar Dağları, İlgaz Dağı (Kastamonu), Isfendiyar Dağları, İlgaz Dağı (Kastamonu), Isfendiyar Dağları, İlgaz Dağı (Kastamonu).
Subgenus *Rhodobombus* Dalla Torre, 1880

*Syn. Pomobombus* Vogt, 1911, *Fervidobombus* Skorikov, 1922

*Megabombus* (*Rhodobombus*) *mesomelas* (Gersteacker, 1869)

*Syn. Bombus elegans* Seidl, 1837

**Female**

Body of the queen 16-21 mm, worker 11-14 mm; head long, queen 4.93 ± 0.41 mm, worker 3.53 ± 0.30 mm; head with black hairs; labral hollow moderately deep and narrow; surface of the clypeus little and rare punctuated, clearly convex and bright; malar area long, queen 1.03 ± 0.30 mm, worker 0.72 ± 0.13 mm; collar and scutellum with white hairs, interalar band with black ones; T1 with white hairs, T2-T5 with light yellow ones, T6 with black hairs.

Material examined: 9-VII-1996, Beynam (Ankara), 6♀, 10♂, 11♂ (1100 m); 25-VI-1997, Kilbasan (Karaman), 3♀ (1010 m); 6-VI-1999, Develi (Kayseri), 2♀ (1600 m); 4-VIII-1999, Bozkır (Konya), 2♀, 4♂ (1000 m); 5-IX-1999, Uzunseki (Sivas), 2♀, 3♂ (1400 m).

General Distribution: Balkans, Turkey, Caucasia, Iran (Rasmont, 1983); Poland (Pawlikowski, 1996).

Distribution in Turkey: Rize, Kop, Eleşkirt, Van, Trabzon, Yozgat (Reinig, 1971); Yalnızçam Dağları (Ardahan) (Reinig, 1973); Erzurum, Muş, Tortum, Oltu, Ispir, Ardahan (Özbek, 1983); Ankara (Ayetkin and Çağatay, 1999); Ağrı, Aksaray, Ankara, Ardahan, Artvin, Bayburt, Bingöl, Elazığ, Erzincan, Erzurum, Kars, Muş, Nevşehir, Niğde, Sivas, Yozgat, Tunceli (Özbek, 2000).

*Male*

13-16 mm; head moderately long, 3.87 ± 0.18 mm; F1 and F2 nearly the same, F3 is nearly half of F1; malar area long, 0.88 ± 0.08 mm; head with black hairs; collar and scutellum with yellow hairs, interalar band with black ones; T1-T7 with yellow hairs, rarely in some specimens, T7 with black ones.

Genitalia: Lacinia basally broad, distally narrower, apical part triangular, dorsal part curved upwards; squama with two projecting parts, distal part process a sharp triangle through sagitta while the other pointed at apex and longer; spatha short, distal end rounded; sagitta slightly curved through squama, proximal part pointed (Figure 5).

Material examined: 5-VI-1996, Çerkeş (Çankırı), 3♂ (900 m); 9-VII-1996, Beynam (Ankara), 1♀ (1100 m); 25-VI-1997, Kilbasan (Karaman), 3♂ (1010 m); 6-VI-1999, Develi (Kayseri), 2♀ (1000 m); 6-VI-1999, Bor (Niğde), 1♀, 1♂, 2♂ (900 m); 14-VII-1999, Çerkeş (Çankırı), 2♀, 1♂ (900 m); 4-VIII-1999, Bozkır (Konya), 2♀, 4♂ (1000 m); 5-IX-1999, Uzunseki (Sivas), 2♀, 3♂ (1400 m).

**Megabombus** (*Rhodobombus*) *armeniacus* (Rad., 1877)

*Syn. Bombus scythes* Skorikov, 1925

Figure 5. *Megabombus armeniacus* male genitalia (dorsal view).
m); 11-IX-2000, Beytepe (Ankara), 2dd (900 m); 15-IX-2000, Kızılcabamam (Ankara), 19, 4dd (1400 m); 17-IX-2000, Sulakıyrıt (Kırıkkale), 299, 1d (750 m); 20-IX-2000, Felahiye (Kayseri), 3W, 3dd (1200 m).

General Distribution: Bulgaria (Atanassov, 1975); Yugoslavia, Greece, Romania, Turkey, Caucasia, Iran, USSR (Rasmont, 1983); Poland (Pawlikowski, 1996).

Distribution in Turkey: Sultan Dağ (Konya) (Reinig, 1967); Çankırı, Baba Dağ (Zonguldak) (Reinig, 1968); Rize, Kop, Hamur, Van, Hattuşaş (Yozgat), Afyon (Reinig, 1971); Urğüp (Nevşehir), Develi (Kayseri) (Reinig, 1973); Konya, Maden, Ulkuşla (Niğde) (Reinig, 1974); Erzurum, Pasinler, Tercan, Palandöken, Olur, Tortum (Özbek, 1983); Ankara (Ayetekin and Çağatay, 1999); Adana, Afyon, Ağrı, Aksaray, Ankara, Antalya, Ardahan, Artvin, Bayburt, Bingöl, Bitlis, Burdur, Çankırı, Çorum, Elazığ, Erzincan, Erzurum, Eskişehir, Gümüşhane, Iğdır, Isparta, Içel, Kahramamaraş, Karaman, Kars, Kayseri, Konya, Malatya, Nevşehir, Niğde, Samsun, Sivas, Tokat, Tunceli, Van, Yozgat (Özbek, 2002).

Morphometric analysis

Phenograms of samples from eight species were constructed using the Mahalanobis distances among centroids of groups in a discriminant function by UPGMA, using 39 morphometric characters’ averages. The clusters were divided into two groups according to sex, males (Figure 6) and females (Figure 7).

Figure 6. UPGMA phenogram of species from three subgenera based on Mahalanobis distances among centroids of groups in discriminant function analysis (males).

Figure 7. UPGMA phenogram of species from three subgenera based on Mahalanobis distances among centroids of groups in discriminant function analysis (females).

Discussion

The genus Megabombus is distinguished from other genera by the presence of a pointed exterior distal corner of the mid basitarsus and a well-developed sulcus obliquus in females. The males have a curved squama and a very long and oblique flagellum. The subgenus Megabombus species can be distinguished from each other by their coat colors. In M. argillaceus, females have a clypeal line that reaches 1/2 of the clypeus and in queens there are abdominal terga with black hairs. In M. portchinsky and M. hortorum this line reaches 1/3 of the clypeus and queens have yellow, white and black hairs in the abdominal terga. M. portchinsky differs from M. hortorum by a tangent passing the supra-orbital line to the lateral ocellus; in the latter this line cuts the ocellus in the middle. Males have a very similar morphology and genitalia. These data are generally consistent with those given by previous authors (Özbek, 1983; Prys-Jones and Corbet, 1987; Pawlikowski, 1999). Morphometric analysis of the females and males showed similar clusters and it seems that M. portchinsky and M. hortorum are more closely related to each other than to M. argillaceus. This is in agreement with the morphology data.

For M. humilis different authors have described different coat colors. In Özbek (1983), the collar and scutellum have yellow hairs, while T1–T5 have yellow ones and T6 with black ones. Özbek recognised these specimens as M. humilis insipidus Rad. Pawlikowski
(1999) described the same species with very different coat colors, especially in females. Rasmont and Flagothier (1996) examined them as four different subspecies from Turkey with very different coat colors again. In Central Anatolia three of them were found in nearby areas. Most probably this species occurs as two subspecies in Turkey: *M. humilis insipidus* and *M. humilis aurantiacus*. DNA and geometric morphometric analyses are urgently needed to understand the systematics of this species. Especially in males, *M. mlokosievitzii* did not cluster with *M. humilis* and *M. zonatus*, the high intraspecific variability of *M. humilis* and the low specimen number of *M. mlokosievitzii* possibly affected the data. The interesting distribution pattern of *M. humilis* is another factor (Özbek, 2000).

Detailed morphometrical analysis is needed for the subgenera *Thoracobombus* to show the naturality of this group, which seems to be partly unnatural (Aytekin and Çağatay, 2002). The same thing can also be stated for *Rhodobombus*. Therefore, more morphometrical data and especially studies on biochemical taxonomy are necessary.

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