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NEW LOCALITY RECORDS AND ADDITIONAL INFORMATION ON THE *BOMBUS* (HYMENOPTERA: APIDAE) FAUNA OF TURKEY

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Background. The article presents the results of the research on bumblebees (Hymenoptera: Apidae: *Bombus*) housed in the Lodos Entomological Museum (Ege University, Izmir, Turkey). Bumblebees play a key role in ecosystems as pollinators. However, these insects are under threat due to changes in land use and agricultural practices, habitat fragmentation and the effects of pesticides. There are 47 *Bombus* species occurring on the territory of Turkey. The aim of this study is to present new locality records of the material on the *Bombus* fauna of Turkey preserved in the Lodos Entomological Museum, Turkey.

Materials and Methods. The objects of our research were bumblebees collected from different localities of Turkey between 1975 and 2016 and housed in the Lodos Entomological Museum. Insects were collected by researchers, students and amateurs. We used stereoscopic microscope MBS-2 and specialized keys for bumblebee identification. The classification of bumblebees follows P. H. Williams.

Results. We analyzed 121 specimens of bumblebees that belong to six species (*Bombus terrestris*, *B. argillaceus*, *B. hortorum*, *B. campestris*, *B. fragrans*, *B. ruderarius*) and *Bombus lucorum*-complex (including two very similar species *Bombus cryptarum* and *B. lucorum*). The information on the specimens' location and brief notes on the plants on which they were foraging is provided. Five of the analyzed species and *Bombus lucorum*-complex are listed in the category "Least Concern" of the IUCN Red List. *Bombus fragrans* is listed as "Endangered" and is under threat from the intensification of agriculture, habitat shifting and alteration, climate change (droughts, temperature extremes), besides this species is also subject to commercial collection.

Conclusions. We found new locality records for three *Bombus* species: *B. campestris* recorded from Izmir for the first time, *B. terrestris* – from Kocaeli and *B. hortorum* from Antalya, Aydın, Eskişehir and Izmir provinces. Further studies aiming to improve the knowledge on *Bombus* fauna should focus on collecting in little-known areas and some specific habitats of Turkey.

Keywords: Hymenoptera, Apidae, *Bombus*, fauna, species diversity, LEMT, Turkey

INTRODUCTION

Pollinators play a key role in ecosystems. It is known that more than 80 % of all species of wild plants [4] and more than 80 % of crops [24] depend on, or benefit from, insect pollination. Among them bumblebees (Apidae: Apinae: *Bombus*) are one of the most important pollinators (often even better than honey bees) because of their long flight period, generalism in the choice of foraging plants and ability to buzz-pollinate [10, 23]. At the same time, bumblebees are very sensitive to environmental changes, mainly to changes in land use and agricultural practices, habitat fragmentation and the effects of pesticides [6, 9]. Consequently, the research of bumblebees is very important and topical today.

A number of studies on *Bombus* fauna of Turkey have been conducted by many foreign and native researchers for the past 35 years. Among the most known of these are works of H. Özbek [11–16], P. Rasmont *et al.* [18] and N. Barkan & A. Aytekin [3]. In addition, during the faunistic studies conducted in recent years some *Bombus* species were listed from different parts of Turkey by S. Tezcan & E. Yıldırım [20], S. Tezcan *et al.* [21], S. Anlaş *et al.* [1], A. Üzüm *et al.* [22], R. Günalp [5] and B. Özgişi Daşer & F. Dikmen [17].

According to P. Rasmont *et al.* [18], there are 47 bumblebee species known from the territory of Turkey. The aim of this study is to present new locality records of the material on the *Bombus* fauna of Turkey preserved in the Lodos Entomological Museum, Turkey.

MATERIALS AND METHODS

The objects of our research were bumblebees (Hymenoptera: Apidae: Bombini) collected from different parts of Turkey between the years of 1975–2016. The material collected and granted as a gift to the LEMT, Ege University (Izmir, Turkey) by researchers, students and amateurs has also been included in this study (except the material housed in the LEMT and evaluated in a few publications [1, 20, 21, 22] earlier).

We used stereoscopic microscope MBS-2 and specialized keys [2, 7, 8, 18] for bumblebee identification, and the classification of bumblebees follows P. H. Williams [25, 26].

RESULTS AND DISCUSSION

In this study, 121 specimens of bumblebees that belong to six species and *Bombus lucorum*-complex were examined. We provided the information on the specimens' location and brief notes on the plants on which they were foraging below.

Family: Apidae Latreille, 1802
Subfamily: Apinae Latreille, 1802
Genus: *Bombus* Latreille, 1802

Bombus lucorum*-complex*[*Bombus (Bombus) cryptarum* (Fabricius, 1775)
and *Bombus (Bombus) lucorum* (Linnaeus, 1761)]**

Note: *Bombus cryptarum* and *B. lucorum* are very similar to each other and it is possible to distinguish between them only by queens. For this reason, materials belonging to this group are given as *Bombus lucorum*-complex in this study. Both species are listed in the International Union for Conservation of Nature Red List of Threatened Species (hereinafter – IUCN RL) in the category “Least Concern” [9].

Material examined: Antalya: Kumluca, 11.VII.2007, 1 female; 20.VIII.2012, 1 female.

Çanakkale: Central province, 14.VI.2009, weeds, 1 worker.

Eskişehir: Central province, 21.VII.2009, weeds, 1 worker, 23.VIII.2009, weeds, 1 male.

Izmir: Balçova, 22.X.1999, asteraceous plants, 1 female, 2 workers. Bornova, 04.VI.1976, *Lavandula angustifolia*, 2 males; 16.IV.1984, weeds, 1 male; 14.V.1984, *Rosa* sp., 1 female; 18.V.1984, ornamental plants, 2 workers; 29.IV.2000, weeds, 1 female; 01.I.2002, leguminosaeous plants, 1 female; 29.V.2002, *Trifolium* sp., 2 workers; 30.V.2002, *Cirsium arvense*, 1 worker; 01.VI.2002, leguminosaeous plants, 1 worker; 16.III.2003, weeds, 1 female; 24.V.2003, weeds, 1 female; 17.X.2005, weeds, 1 male; 27.VII.2007, *Solanum lycopersicum*, 1 male; 05.IV.2012, 2 workers; 13.IV.2012, 2 workers; 24.V.2015, weeds, 1 worker; 12.V.2016, weeds, 1 worker. Bornova, Belkahve, 15.V.1984, *Matricaria chamomilla*, 1 female. Bornova, Ege University Campus, 02.VI.2016, *Lavandula angustifolia*, 1 worker. Dikili, Bademli, 03.VII.2001, *Rubus fruticosus*, 1 worker. Karaburun, 01.V.2004, weeds, 1 worker; 24.IV.2010, weeds, 3 males. Karaburun, Mordoğan, 10.IV.2010, weeds, 1 worker. Karşıyaka, Karagöl, 27.V.2008, weeds, 1 male. Kemalpaşa, 17.VI.2005, bait trap, 1 worker; 14.IV.2010, weeds, 1 worker; 03.VI.2015, *Carduus* sp. 1 worker; 19.V.2016, weeds, 1 worker. Menderes, 19.V.2004, *Papaver rhoeas*, 2 workers. Menemen, 16.V.2016, weeds, 1 worker; 13.V.2015, *Salvia officinalis*, 2 workers. Ödemiş, 16.VI.2010, weeds, 1 worker. Seferihisar, 12.IV.1984, weeds, 1 worker; 19.IV.2010, *Triticum aestivum*, 1 female, 2 workers. Torbali, 11.VIII.1983, *Rosa* sp., 1 worker. Urla, 21.III.1984, *Raphanus sativus*, 1 worker; 24.IV.1984, weeds, 1 worker.

Manisa: Central province, 18.VIII.1985, weeds, 1 male. Salihli, Tekelioğlu, 05.IV.2016, weeds, 1 worker.

Mersin: Silifke, 28.V.1984, aerial collector, 1 worker.

Muğla: Fethiye, 03.II.2012, 1 male, 1 worker.

Totally 61 specimens.

***Bombus (Bombus) terrestris* (Linnaeus, 1758)**

Note: Previously recorded from Antalya, Çanakkale, Istanbul, Izmir, Muğla and Yalova by H. Özbek [13]. Reported from Kocaeli province for the first time (**Fig. 1**).

The species is listed in the category “Least Concern” in the IUCN RL [9].

Material examined: Antalya: Central province, 10.VIII.1999, *Solanum lycopersicum*, 1 female. Kumluca, 20.V.2012, aerial collector, 1 worker.

Çanakkale: Central province, 13.VI.2009, 1 male; 17.VI.2009, weeds, 1 male.

Istanbul: Kavacık, 15.VI.1990, 1 female, 3 workers. Yeniköy, 11.V.2009, 1 female.

Izmir: Balçova, 22.X.1990, asteraceous plants, 1 worker. Bornova, 16.III.2003, weeds, 1 female; 03.IV.2003, *Vicia* sp., 1 worker; 18.VIII.2006, weeds, 1 female; 10.VII.2008,

Solanum lycopersicum, 1 female; 13.V.2011, 1 female; 05.V.2012, weeds, 1 female; 11.V.2012, 1 female; 16.V.2015, weeds, 1 worker; 25.IX.2015, weeds, 1 worker; 12.V.2016, weeds, 2 males. Bornova, Ege University Campus, 05.V.2012, weeds, 1 female; 02.VI.2016, *Lavandula angustifolia*, 1 male. Foça, 13.VI.2003, *Rosa* sp., 1 female. Kemalpaşa, 24.IV.2005, *Prunus avium*, 1 female; 10.V.2016, weeds, 1 worker; 19.V.2016, weeds, 1 male. Menderes, 02.V.2009, weeds, 1 female. Menemen, 01.V.2015, *Salvia officinalis*, 1 worker; 16.V.2015, weeds, 1 worker. Torbali, 19.IV.2010, weeds, 1 worker. Urla, 24.IV.1984, weeds, 1 worker.

Kocaeli: Gölcük, 07.VI.2005, *Lonicera* sp., 1 female.

Muğla: Fethiye, 03.II.2012, 2 females.

Yalova: Central province, 01.VI.2003, *Anthemis* sp., 1 worker.

Totally 27 specimens.



Fig. 1. Female of *Bombus terrestris* (Linnaeus, 1758)

Рис. 1. Самка *Bombus terrestris* (Linnaeus, 1758)

***Bombus (Megabombus) argillaceus* (Scopoli, 1763)**

Note: Previously reported from Eskişehir by H. Özbek [16] and B. Özgişi Daşer & F. Dikmen [17] and recorded from Izmir (Bozdağ) by S. Anlaş *et al.* [1].

The species is listed in the category “Least Concern” in the IUCN RL [9].

Material examined: Eskişehir: Central province, 25.VII.2009, weeds, 1 female.

Izmir: Balçova, 04.V.1984, *Papaver florans*, 1 female. Kemalpaşa, 14.IV.2010, weeds, 1 female.

Totally 3 specimens.

***Bombus (Megabombus) hortorum* (Linnaeus, 1761)**

Note: Reported from Antalya, Aydın, Eskişehir and Izmir provinces for the first time (Fig. 2).

The species is listed in the category “Least Concern” in the IUCN RL [9].

Material examined: Antalya: Kumluca, 20.VIII.2012, 1 worker; Manavgat, 06.VII.1985, *Gossypium hirsutum*, 1 male.

Aydın: Söke, 02.V.2010, weeds, 1 worker.

Eskişehir: Central province, 25.VII.2009, weeds, 1 worker.

Izmir: Bayındır, 16.V.2009, weeds, 2 workers; 11.IX.2009, weeds, 1 female. Bornova, 18.V.1984, ornamental plants, 2 workers; 02.II.2003, *Vicia* sp., 1 female. Bornova, Ege University Campus, 01.VI.2002, leguminosaeous plants, 1 worker; 02.VI.2016, *Lavandula angustifolia*, 1 worker. Karaburun, Mordoğan, 10.IV.2010, weeds, 1 female; 19.IV.2010, weeds, 1 female. Kemalpaşa, 17.VI.2005, bait trap, 2 workers; 03.V.2015, *Carduus* sp., 1 female. Menemen, 13.V.2015, *Salvia officinalis*, 1 female. Seferihisar, 19.IV.2010, *Triticum aestivum*, 1 female, 1 worker. Urla, 24.IV.1984, weeds, 1 female; 18.VII.2008, weeds, 1 female, 02.V.2010, weeds, 2 workers.

Totally 24 specimens.



Fig. 2. Female of *Bombus hortorum* (Linnaeus, 1761)

Рис. 2. Самка *Bombus hortorum* (Linnaeus, 1761)

***Bombus (Psithyrus) campestris* (Panzer, 1801)**

Note: Previously recorded from Ankara by R. Günalp [5]. Reported from Izmir province for the first time (Fig. 3).

The species is listed in the category “Least Concern” in the IUCN RL [9].

Material examined: Ankara: Nallıhan, Sarıyar, 04.VII.1975, 1 female.

Izmir: Bornova, 13.VI.2008, *Solanum lycopersicum*, 1 female; 14.V.2008, weeds, 1 female. Bornova, Pınarbaşı, 25.VIII.1983, weeds, 1 female.

Totally 4 specimens.

***Bombus (Subterraneobombus) fragrans* (Pallas, 1771)**

Note: Previously reported from Konya by H. Özbek [16].

The species is listed in the category “Endangered” in the IUCN RL [9, 19]. *Bombus fragrans* is under threat from the intensification of agriculture, habitat shifting and alteration, climate change (droughts, temperature extremes), besides this species is also subject to commercial collection [19].

Material examined: Konya: Kadınhanı, 09.V.2012, weeds, 1 female. Totally 1 specimen (Fig. 4).



Fig. 3. Female of *Bombus campestris* (Panzer, 1801)

Рис. 3. Самка *Bombus campestris* (Panzer, 1801)



Fig. 4. Female of *Bombus fragrans* (Pallas, 1771)

Рис. 4. Самка *Bombus fragrans* (Pallas, 1771)

***Bombus (Thoracobombus) ruderarius* (Müller, 1776)**

Note: Previously reported from Eskişehir by B. Özgüşi Daşer & F. Dikmen [17].
The species is listed in the category “Least Concern” in the IUCN RL [9].

Material examined: Eskişehir: Central province, 21.VII.2009, weeds, 1 worker.
Totally 1 specimen.

CONCLUSIONS

According to P. Rasmont *et al.* [18], the number of *Bombus* species occurring in Turkey is 47. A total of six species and material belonging to *Bombus lucorum*-complex was presented in this study.

There are new locality records for three *Bombus* species: *B. campestris* recorded from Izmir for the first time, *B. terrestris* – from Kocaeli and *B. hortorum* from Antalya, Aydın, Eskişehir and Izmir provinces.

Amongst those species, *Bombus fragrans* is endangered while others are least concern in the IUCN Red List categories [9, 19]. We believe that further studies aiming to improve our knowledge on *Bombus* fauna should focus on collecting in little-known areas and some specific habitats of Turkey.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Human Rights: This article does not contain any studies with human subjects performed by any of the authors.

Animal Studies: All institutional, national and institutional guidelines for the care and use of laboratory animals were followed.

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НОВІ ЗНАХІДКИ ЛОКАЛІТЕТІВ І ДОДАТКОВА ІНФОРМАЦІЯ ПРО ДЖМЕЛІВ РОДУ *BOMBUS* (HYMENOPTERA: APIDAE) ФАУНИ ТУРЕЧЧИНИ

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Вступ. У цій статті представлено результати досліджень джмелів (Hymenoptera: Apidae: *Bombus*), котрі зберігаються у Лодоському ентомологічному музеї (Егейський університет, Ізмір, Туреччина). Джмелі відіграють ключову роль у екосистемах як запилювачі. Проте цим комахам загрожують зміни у землекористуванні та сільськогосподарській діяльності, фрагментація середовища існування та вплив пестицидів. На території Туреччини трапляються 47 видів джмелів. Метою дослідження є презентувати нові знахідки локалітетів джмелів (з матеріалів Лодоського ентомологічного музею) у фауни Туреччини.

Матеріали та Методи. Об'єктом досліджень були джмелі, зібрані з різних регіонів Туреччини впродовж 1975–2016 років науковцями, студентами й аматорами. Зараз ці комахи зберігаються у Лодоському ентомологічному музеї. Для визначення джмелів використовували стереоскопічний мікроскоп МБС-2 і спеціальні визначники. Класифікація джмелів подана за П. Вільямсом.

Результати. Протягом досліджень ми проаналізували 121 особину джмелів, котрі належать до шести видів (*Bombus terrestris*, *B. argillaceus*, *B. hortorum*, *B. campestris*, *B. fragrans*, *B. ruderarius*) і комплексу *Bombus lucorum*-complex (котрий включає два дуже близьких види *Bombus cryptarum* і *B. lucorum*). У публікації подано інформацію про місця знахідок кожного зразка та коротку інформацію про рослини, на котрих ці комахи фуражували. Серед досліджуваних комах п'ять видів і *Bombus lucorum*-complex занесені у Червоний список МСОП у категорію "Найменший ризик". *Bombus fragrans* числиться у категорії "Зникаючий": популяціям

цього виду загрожують інтенсифікація сільського господарства, зміна середовища існування, зміна клімату (посухи, екстремальні температури), крім того, вид є об'єктом комерційного колекціонування.

Висновки. Для трьох видів джмелів виявили нові локалітети: *Bombus campestris* уперше виявлений з території провінції Ізмір, *B. terrestris* – з провінції Коджаелі та *B. hortorum* – з провінцій Анталія, Айдин, Ескішехір та Ізмір. На нашу думку, подальші дослідження, спрямовані на поглиблення знань про фауну джмелів, мають бути акцентовані на збори і вивчення комах на малодосліджених територіях Туреччини та їхніх специфічних біотопах.

Ключові слова: Hymenoptera, Apidae, *Bombus*, фауна, видове різноманіття, LEMT, Туреччина