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Bumblebees Collected by the Kyushu University Expeditions to Central Asia (Hymenoptera, Apidae, Genus *Bombus*)

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Abstract. The Kyushu University Expeditions to Kyrgyzstan, Kazakhstan, and China (Xinjiang) between 2000 and 2004 collected 757 bumblebees, which are interpreted here as representing 22 species. Males and females are re-associated between *Bombus makarjini* and *B. turkestanicus*. The material is listed by species and compared with earlier lists of bumblebees from Central Asia.

Key words: Hymenoptera, Apidae, *Bombus*, bee taxonomy, bee systematics, pollinators, hotspots

Introduction

Bumblebees are important pollinators for both crops and natural ecosystems, especially in mountainous areas (Dias et al. 1999; Winter et al. 2006). Unfortunately, although bumblebees are well collected, they remain poorly known because they are morphologically homogeneous (Michener 2007) and because different species often variable but mimic one another closely (Williams 2007).

Outside China, one of the richest bumblebee faunas world-wide is in the mountains of Central Asia (Williams et al. 2009: their fig. 1). The major encompassing review of the Central Asian fauna is by Skorikov (1931), although other important contributions from parts of the region have been made by Reinig (1930) and Yefremova (2001). Access to the area has improved in recent years, so a re-assessment is now possible. Between 2000 and 2004, five Kyushu University Expeditions (KUE) visited Kyrgyzstan, Kazakhstan, and neighbouring parts of China (Xinjiang), as part of a programme of research into measures to combat desertification (Tadauchi 2005). This paper gives an account of the bumblebee specimens they collected, using an updated nomenclature, as part of a series of papers on the bees from the KUE (e.g. Tadauchi 2006; Mitai & Tadauchi 2008; Tadauchi 2008; Kuhlmann 2009).

Methods

Locality and food-plant data are copied from labels with minimal interpretation. The subgeneric system follows Williams et al. (2008). The status of some of the taxa as species is re-assessed from cox1 'barcode' data as part of the BEE-BOL campaign to barcode the bees of the world (Packer 2008). Barcoding and analytical procedures followed here are described by Williams et al. (in press) and references therein. Material is deposited in the collection of Kyushu University.

Results

Bombus (Mendacibombus) makarjini Skorikov

Bombus mendax ssp. *makarjini* Skorikov 1910:329

Most of the Central Asian species of *Mendacibombus* were described by Skorikov (1910) in a key to females. Illustrations of male genitalia were then associated with these names in a later paper (Skorikov 1931: his figs 16-18). Skorikov (1931:213) commented that associating the sexes in Turkestan was difficult because there are three species with broadly overlapping distributions, so that his proposals were provisional. I have examined a series of females and males with Skorikov's species determination labels from the Institute of Zoology

collection, St Petersburg, and can confirm that they match his publications.

In the original descriptions, the darker females of *B. makarjini* were diagnosed by having the pile of the sterna black, whereas this pile is light yellow for *B. turkestanicus*. However, the KUE darker males with black hairs on the anterior margin of the hind tibia have the genitalia with a narrower penis valve, as illustrated for '*B. turkestanicus*' by Skorikov (1931: his fig. 16, in contrast to his fig. 18 for '*B. makarjini*'). I infer that in this case the males were incorrectly associated with the name-bearing female types and I am associating here the darker females and the darker males (with dark hind tibial fringes and a narrow penis valve) with the name *B. makarjini*, and the lighter females and the lighter males (with very light hind tibial fringes and a broad penis valve) with the name *B. turkestanicus*.

Unfortunately none of the 19 specimens of *B. makarjini* from this collection yielded sequences for *cox1* barcodes. However, the few barcode results below supporting the re-association of male and female specimens of *B. turkestanicus* support indirectly the interpretation presented here for *B. makarjini* from colour-pattern evidence. Further data will be required to test this more definitively.

Material examined (19 specimens, 950-2060m). **CHINA** (Xinjiang): 2♂♂, Sayram lake, Ili, 2030-2060m, 25.08.2002 (O Tadauchi); 1♂, Sayram lake, Ili, 2030m, 25.08.2002 (R Miyanaga). **KAZAKHSTAN**: 1ww, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi); 1♂, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi); 1ww, big Almaty lake, 2000m, 19.06.2003 (O Tadauchi); 1♂, big Almaty lake, 2030m, 31.08.2002 (R Miyanaga); 3♂♂, big Almaty lake, 2040m, 31.08.2002 (R Murao). **KYRGYZSTAN**: 1ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 2♂♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 950m, 22.08.2003 (O Tadauchi); 3ww, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O Tadauchi); 2♂♂, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O Tadauchi).

Food-plant record. *Cirsium* sp.

Bombus (Mendacibombus) turkestanicus
Skorikov

Bombus mendax ssp. *turkestanicus* Skorikov 1910:329

See the comments on *B. makarjini*. Only three of the 11 specimens of *B. turkestanicus* from this collection yielded sequences for *cox1* barcodes: one worker and two

males (see the database at boldsystems.org). Genetic similarity shows that the two males are more different from one another (0.77% divergence, calculated using tools at boldsystems.org) than either is from the worker (0.15%, 0.61%), which is interpreted provisionally as supporting the inference that the worker and males are indeed conspecific as *B. turkestanicus*. This supports the association of the sexes proposed here on the basis of a shared pale colour pattern (see the comments on *B. makarjini*). Data from more specimens will be required to test this more definitively.

Material examined (11 specimens, 950-2060m). **CHINA** (Xinjiang): 1♂, Sayram lake, Ili, 2030-2060m, 25.08.2002 (O Tadauchi); 1♂, Sayram lake, Ili, 2030m, 25.08.2002 (A Dawut). **KAZAKHSTAN**: 1♂, Aksu Valley, 950m, 06.09.2002 (R Murao); 2♂♂, Kashy-Kaindy, Jabagly, 1700m, 05.09.2002 (R Murao); 1ww, Kashi-Ulken-Kaindy, Jabagly, 1700-2000m, 15.06.2003 (K Mitai); 1♂, Ul'ken-Kaindy, Jabagly, 1800m, 05.09.2002 (O Tadauchi). **KYRGYZSTAN**: 3ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 1♂, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O Tadauchi).

Food-plant record. *Cirsium* sp.

Bombus (Kallobombus) soroensis (Fabricius)

Apis soroensis Fabricius 1777:246

All individuals have the *soroensis* s. str. colour pattern with yellow bands and a white tail, so queens and workers resemble *B. lucorum*.

Material examined (40 specimens, 950-2400m). **KAZAKHSTAN**: 1♀, big Almaty lake, 1360-1560m, 22.05.2004 (O Tadauchi); 2♀♀, big Almaty lake, 2000m, 19.06.2003 (O Tadauchi); 2♀♀ 1♂, big Almaty lake, 2000-2050m, 01.09.2002 (R Murao); 1ww, big Almaty lake, 2400m, 31.08.2002 (O Tadauchi); 7ww, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi); 1♂, big Almaty lake, 2030m, 31.08.2002 (R Miyanaga); 1ww, Medeu [as Medew], 24.05.2000 (O Tadauchi); 1♂, Ul'ken-Kaindy, Jabagly, 1800m, 05.09.2002 (O Tadauchi). **KYRGYZSTAN**: 1♀, Aksuu, near Karakol, east of lake Issik-Kol, 2000m, 25.08.2004 (O Tadauchi); 4ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 8ww, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 5ww, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 2ww, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O Tadauchi); 2ww, Issik-Ata, near

Bishkek, 950m, 22.08.2003 (O Tadauchi); 1♂, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi).

Food-plant records. *Cirsium* sp., *Solidago* sp., *Taraxacum* sp.

***Bombus (Subterraneobombus) melanurus*
Lepeletier**

Bombus melanurus Lepeletier de Saint-Fargeau [1835]: 469

Both individuals have the typical *melanurus* s. str. colour pattern with no black spot or band on the thorax dorsally between the wing bases.

Material examined (2 specimens, 2030m). **CHINA** (Xinjiang): 2♂♂, Sayram lake, Ili, 2030m, 25.08.2002 (R Miyanaga).

Food-plant record. *Saussurea* sp.

***Bombus (Megabombus) hortorum* (Linnaeus)**

Apis hortorum Linnaeus 1761:424

Material examined (29 specimens, 950-2000m). **KAZAKHSTAN**: 2♀♀, 1ww, big Almaty lake, 1360-1560m, 22.05.2004 (O Tadauchi); 1♂, big Almaty lake, 1360m, 01.09.2002 (O Tadauchi); 1♂, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi). **KYRGYZSTAN**: 1♀ 1ww 2♂♂, Aksuu, near Karakol, east of lake Issik-Kol, 2000m, 25.08.2004 (O Tadauchi); 2ww 2♂♂, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 1ww 3♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 3ww 3♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 5♂♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 950m, 22.08.2003 (O Tadauchi).

No food-plant records.

***Bombus (Thoracobombus) armeniacus*
Radoszkowski**

Bombus armeniacus Radoszkowski 1877:202

Material examined (53 specimens, 950-2000m). **KAZAKHSTAN**: 1♂, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi); 1♀, big Almaty lake, 2000m, 19.06.2003 (O Tadauchi); 1♀, Koktobe, 21.05.2004 (R

Murao); 1ww, near Sternjak, Kochetav district, 23.06.2002 (V Kazenas, A Jdanko, V Rascheev); 3ww 6♂♂, Aksu valley, 950m, 06.09.2002 (O Tadauchi, R Murao); 1♀, Jabagly, 1180-1250m, 14.06.2003 (O Tadauchi); 1♀, Jabagly, 1180-1250m, 28.05.2003 (O Tadauchi); 4♀♀ 1ww, Karaalma, near Jabagly, 1210m, 17.06.2003 (O Tadauchi, R Mitai); 3ww 5♂♂, Ul'ken-Kaindy, Jabagly, 1800m, 05.09.2002 (O Tadauchi, R Murao). **KYRGYZSTAN**: 2ww 1♂, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 2ww 8♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 9♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 1♀ 1ww, Issik-Ata, near Bishkek, 1300m, 27.05.2000 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi).

Food-plant records. *Cirsium* sp., *Leguminosae* sp., *Mentha asiatica*, *Trifolium pratense*.

***Bombus (Thoracobombus) laesus* Morawitz**

Bombus laesus Morawitz in Fedtschenko 1875:3

Bombus Mocsáryi Kriechbaumer 1877:253

[*Agrobombus (Laesobombus) laesus* subsp. *mocsáryi* var. *maculidorsis* Skorikov 1922:23, infrasubspecific]

Bombus (Laesobombus) tianschanicus Panfilov 1956: 1327

Bombus (Laesobombus) maculidorsis Panfilov 1956: 1328

Individuals with the *laesus* s. str. colour pattern, with the thoracic dorsum extensively orange and yellow, resemble *B. muscorum* closely. Distinguishing these two species by morphological criteria may be unreliable for some workers. Other individuals with similar morphology show the *tianschanicus* colour pattern, with black hair on the thoracic dorsum between the wing bases and no orange hair. This black marked colour pattern resembles *B. armeniacus*.

Of eight specimens from this collection extracted for *cox1* barcodes, only four provided sequences. Preliminary analysis of these data in comparison with others for *laesus* and *tianschanicus* in the BOLD database (bold-systems.org) shows: (1) that there is very little *cox1* divergence between individuals with these two colour patterns; and (2) that specimens of *laesus* and *tianschanicus* do not appear to form monophyletic groups. Consequently, at present *laesus* and *tianschanicus* can be considered conspecific, following earlier interpretations from morphological evidence (e.g. Williams et al. 2009).

Material examined (41 specimens, 560-1900m).

CHINA (Xinjiang): 1ww, Jeminay county, Altay, 27.08.2002 (R Miyanaga); 1ww, Jeminay county, Altay, 960m, 27.08.2002 (R Murao); 2ww, Jeminay county, Altay, 800m, 27.08.2002 (R Murao). **KAZAKHSTAN**: 2♀♀, Almaty city, 29.05.2000 (O Tadauchi); 1ww, big Almaty lake, 1360m, 01.09.2002 (O Tadauchi); 2♀♀, Kortobe, Almaty, 21.05.2004 (R Murao); 4♀♀, Medeu-Almaty, 21.05.2004 (O Tadauchi); 1♀, Aksu valley, 950m, 06.09.2002 (O Tadauchi); 1ww, east of Chimkent, 560m, 30.05.2003 (O Tadauchi); 3♀♀, Jabagly, 1080-1200m, 27.05.2003 (O Tadauchi, K Mitai); 1♂, Jabagly, 1200-1250m, 04.09.2002 (R Murao); 2♀♀, Karaalma, near Jabagly, 1210m, 17.06.2003 (K Mitai); 1♀, Shayan-Birlik, 08.06.2003 (K Mitai). **KYRGYZSTAN**: 2ww 1♂, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 3ww, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 2♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 2ww 1♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 2♀♀, Issik-Ata, 1300m, 27.05.2000 (O Tadauchi); 4♀♀, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi); 1♀, Issik-Ata, near Bishkek, 1300m, 22.08.2003 (O Tadauchi); 1♀, Krasnayarichika, 800m, 27.05.2000 (D Ahmatjan); 2ww, Tamga, south of lake Issik-Kol, 1580m, 26.08.2004 (O Tadauchi).

Food-plant records. *Ixioliron tataricum*, Leguminosae sp., *Rosa kokanica*, *Trifolium pratense*, *Vicia* sp.

***Bombus (Thoracobombus) muscorum* (Linnaeus)**

Apis muscorum Linnaeus 1758:579

See the comments on *B. laesus*. Of four specimens from this collection extracted for *cox1* barcodes, none provided sequences, so it has not been possible to test the identifications from morphological evidence.

Material examined (53 specimens, 760-1700m). **CHINA** (Xinjiang): 2ww, east of Jeminay, Altay, 1300m, 28.08.2002 (R Murao); 1ww, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut). **KAZAKHSTAN**: 2♀♀, Almaty city, 26.05.2000 (D Ahmatjan); 1♂, Almaty city, 760m, 31.08.2002 (O Tadauchi); 1♀, Kemertogan, 26.05.2000 (D Ahmatjan); 1ww, near Sternjak, Kochetav district, 30.06.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 25.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 05.07.2002 (V Kazenas, A Jdanko, V Rascheev). **KYRGYZSTAN**: 2ww, Chon-Aksuu, north of Lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi);

26ww 13♂♂, Kemin, near Bishkek, 1000m, 23.08.2003 (O Tadauchi); 1♂, Semonovka, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi).

Food-plant records. *Brassica* sp., *Chondrilla* sp., *Taraxacum* sp., *Trifolium repens*.

***Bombus (Thoracobombus) veteranus* (Fabricius)**

Apis veterana Fabricius 1793:324

Material examined (13 specimens, 1850-1900m). **KYRGYZSTAN**: 5ww 2♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 2ww 4♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi).

No food-plant records.

***Bombus (Thoracobombus) ruderarius* (Müller)**

Apis ruderaria Müller 1776:165

Bombus montanus Lepeletier de Saint-Fargeau [1835]: 463

All individuals have the *montanus* colour pattern with yellow bands.

Material examined (6 specimens, 1700-1900m). **KAZAKHSTAN**: 2♂♂, near Sternjak, Kochetav district, 20.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 23.06.2002 (V Kazenas, A Jdanko, V Rascheev). **KYRGYZSTAN**: 1ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 1ww, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 1♂, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi).

No food-plant records.

***Bombus (Thoracobombus) humilis* Illiger**

Bombus humilis Illiger 1806:171

Material examined (2 specimens, 800m). **CHINA** (Xinjiang): 1♂, Jeminay county, Altay, 800m, 27.08.2002 (O Tadauchi). **KAZAKHSTAN**: 1♂, near Sternjak, Kochetav district, 02.08.2002 (V Kazenas, A Jdanko, V Rascheev).

No food-plant records.

Bombus (Thoracobombus) pascuorum* (Scopoli)Apis pascuorum* Scopoli 1763:306

Material examined (2 specimens, 800m). **CHINA** (Xinjiang): 1ww, Jeminay county, Altay, 800m, 27.08.2002 (O Tadauchi); 1♂, Jeminay county, Altay, 27.08.2002 (R Miyanaga).

Food-plant record. *Cirsium* sp.

Bombus (Psithyrus) morawitzianus* (Popov)Psithyrus morawitzianus* Popov 1931:148, 183

Material examined (3 specimens, 1800-2040m). **KAZAKHSTAN**: 1♀, big Almaty lake, 2040m, 31.08.2002 (R Murao); 1♂, big Almaty lake, 2030m, 31.08.2002 (R Miyanaga). **KYRGYZSTAN**: 1♀, Issik-Ata, 1800m, 27.05.2000 (D Ahmatjan).

Food-plant records. *Cirsium* sp., *Trifolium repens*.

Bombus (Psithyrus) bohemicus* SeidlBombus bohemicus* Seidl 1837:73

Material examined (14 specimens, 1700-2000m). **KAZAKHSTAN**: 3♀♀, big Almaty lake, 2000m, 19.06.2003 (O Tadauchi); 1♀, Kashi-Ulken-Kaindy, Jabagly, 1700-2000m, 15.06.2003 (K Mitai); 2♀♀, Kashi-Kaindy, Jabagly, 1700m, 15.06.2003 (O Tadauchi); 1♂, Kashi-Kaindy, Jabagly, 1700m, 05.09.2002 (R Murao). **KYRGYZSTAN**: 7♀♀, Issik-Ata, 1800m, 27.05.2000 (O Tadauchi).

Food-plant records. *Mentha asiatica*, *Taraxacum* sp.

Bombus (Pyrobombus) subtypicus* (Skorikov)Pratobombus leucopygos* var. *subtypicus* Skorikov 1914: 294

Material examined (13 specimens, 1230-1900m). **KAZAKHSTAN**: 1♂, big Almaty lake, 1230m, 01.09.2002 (R Murao). **KYRGYZSTAN**: 2ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 2ww, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 2ww, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 1300m, 22.08.2003 (O Tadauchi); 1ww 1♂, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi); 2ww 1♂, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O

Tadauchi).

Food-plant record. *Chondrilla* sp.

Bombus (Pyrobombus) biroï* VogtBombus biroï* Vogt 1911:51

Material examined (13 specimens, 1360-2400m). **KAZAKHSTAN**: 1♀, big Almaty lake, 1360m, 01.09.2002 (R Miyanaga); 1♀ 2♂♂, big Almaty lake, 2000-2050m, 01.09.2002 (R Murao); 4♂♂, big Almaty lake, 2030m, 31.08.2002 (R Miyanaga); 1♂, big Almaty lake, 2400m, 01.09.2002 (O Tadauchi); 1♂, big Almaty lake, 2400m, 31.08.2002 (O Tadauchi). **KYRGYZSTAN**: 1ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 2ww, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi).

Food-plant record. *Cirsium* sp.

Bombus (Bombus) terrestris* (Linnaeus)Apis terrestris* Linnaeus 1758:578

Material examined (133 specimens, 560-1970m). **CHINA** (Xinjiang): 17♂♂, east of Jeminay, Altay, 1300m, 28.08.2002 (O Tadauchi, R Murao); 5ww, Guozigou, 1230m, 25.08.2002 (O Tadauchi, R Murao); 8ww, Jeminay county, Altay, 27.08.2002 (O Tadauchi, R Miyanaga, R Murao,); 10♂♂, Jeminay county, Altay, 800m, 27.08.2002 (O Tadauchi, R Murao); 6♂♂, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut); 2♂♂, Jeminay county, Altay, 1050m, 27.08.2002 (O Tadauchi, R Murao); 5♂♂, Jeminay county, Altay, 27.08.2002 (R Miyanaga); 3♂♂, near Sayram lake, Ili, 1970m, 25.08.2002 (R Miyanaga); 3♂♂, old Jeminay, Altay, 27.08.2002 (O Tadauchi); 2♂♂, Sayram lake, Ili, 2030m, 25.08.2002 (R Miyanaga). **KAZAKHSTAN**: 2ww, Almaty city, 29.05.2000; 1ww 2♂♂, Kordai, 1080m, 27.08.2004 (O Tadauchi); 1ww, near Sternjak, Kochetav district, 10.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1♂, near Sternjak, Kochetav district, 20.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1♂, near Sternjak, Kochetav district, 25.07.2002 (V Kazenas, A Jdanko, V Rascheev); 4ww 4♂♂, Aksu valley, 950m, 06.09.2002 (O Tadauchi, R Murao); 2♂♂, Aksu valley, 560m, 06.09.2002 (O Tadauchi, R Murao); 1♀, Jabagly, 1180-1250m, 28.05.2003 (K Mitai); 2♀♀, Jabagly, 1180-1250m, 14.06.2003 (O Tadauchi); 1♀, Jabagly, 1180-1250m, 28.05.2003 (O Tadauchi); 2ww 8♂♂, Jabagly, 1200-1250m, 04.09.2002 (O Tadauchi, R Murao); 1ww, Jabagly, 1180m, 07.09.2002 (O Tadauchi); 2♀♀, Karaalma, near Jabagly, 1210m, 17.06.2003 (O Tadauchi); 2ww 5♂♂,

Karaalma, near Jabagly, 1210m, 07.09.2002 (O Tadauchi, R Murao); 1♀ 3ww 5♂♂, Kashi-Kaindy, near Jabagly, 1700m, 05.09.2002 (O Tadauchi, R Murao); 1♀, Medeu, 1600m, 21.05.2004 (R Murao); 3ww 8♂♂, Ul'ken-Kaindy, near Jabagly, 1800m, 05.09.2002 (O Tadauchi, R Murao). **KYRGYZSTAN:** 1♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 3ww, Issik-Ata, near Bishkek, 950m, 22.08.2003 (O Tadauchi); 1♂, Kemin, near Bishkek, 1000m, 23.08.2003 (O Tadauchi); 1ww, Tamga, south of lake Issik-Kol, 1580m, 26.08.2004 (O Tadauchi); 1ww 2♂♂, Ton, south of lake Issik-Kol, 1580m, 26.08.2004 (O Tadauchi).

Food-plant records. *Achillea* sp., *Ageratum* sp., *Aster canescens*, *Chondrilla* sp., *Cichorium intybus*, *Cichorium* sp., *Cirsium* sp., *Compositae* sp., *Cosmos sulphureus*, *Echinops* sp., *Geranium* sp., *Hibiscus* sp., *Hypochaeris* sp., *Leguminosae* sp., *Mentha asiatica*, *Origanum tyttanthium*, *Rosaceae* sp., *Saussurea* sp., *Serophularia* sp., *Solidago* sp., *Trifolium pratense*, *Trifolium repens*, *Vicia* sp.

***Bombus (Bombus) lucorum* (Linnaeus) complex**

Apis lucorum Linnaeus 1761:425

Apis cryptarum Fabricius 1775:379

From *cox1* barcode evidence, this species complex appears to include several genetically recognisable species in Europe (Murray *et al.* 2008). However, as yet they cannot be recognized reliably by morphology, especially in Asia, and consequently the group globally has been treated as an unresolved complex in morphological studies as a temporary measure (Williams *et al.* 2009). Of 19 specimens from this collection extracted for *cox1* barcodes, only one provided a sequence, so it has not been possible to assess identifications thoroughly. This single worker from Medeu, South Kazakhstan, is identified provisionally to *B. cryptarum*. Other material in this collection shows substantial variation in colour pattern, so other taxa may be present.

Material examined (133 specimens, 800-2060m). **CHINA** (Xinjiang): 4♂♂, east of Jeminay, Altay, 1300m, 28.08.2002 (O Tadauchi, A Dawut, R Murao); 1ww, Jeminay county, Altay, 800m, 27.08.2002 (O Tadauchi); 1ww, Jeminay county, Altay, 27.08.2002 (R Miyanaga); 6♂♂, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut); 2♂♂, Jeminay county, Altay, 800m, 27.08.2002 (O Tadauchi, R Murao); 1ww, near Sayram lake, Ili, 1970m, 25.08.2002 (O Tadauchi); 1♂, old Jeminay, Altay, 27.08.2002 (O Tadauchi); 1♀ 1ww 14♂♂, Sayram lake, Ili, 2030m, 25.08.2002 (O Tadauchi, A Dawut, R

Miyanaga); 8♂♂, Sayram lake, Ili, 2060m, 25.08.2002 (R Murao); 2♂♂, Sayram lake, Ili, 2030-2060m, 25.08.2002 (O Tadauchi). **KAZAKHSTAN:** 1ww, Almaty city, 29.05.2000 (D Ahmatjan); 2ww, Almaty city, 29.05.2000 (O Tadauchi); 1♀, Almaty city, botanical garden, 25.05.2003 (K Mitai); 3ww, big Almaty lake, 1360-1560m, 22.05.2004 (O Tadauchi, R Murao); 3♂♂, big Almaty lake, 2400m, 01.09.2002 (O Tadauchi); 5♂♂, big Almaty lake, 2000-2050m, 01.09.2002 (O Tadauchi, R Murao); 7♂♂, big Almaty lake, 2400m, 31.08.2002 (O Tadauchi); 2♂♂, big Almaty lake, 2030m, 31.08.2002 (R Miyanaga); 1♂, south of Almaty, 1580m, 31.08.2002 (O Tadauchi); 7ww, Kordai, 1080m, 27.08.2004 (O Tadauchi); 3ww, near Sternjak, Kochetav district, 30.06.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 05.07.2002 (V Kazenas, A Jdanko, V Rascheev); 3ww, Aksu valley, 950m, 06.09.2002 (O Tadauchi, R Murao); 1ww, Jabagly, 1180m, 07.09.2002 (R Murao); 1♂, Karaalma, near Jabagly, 1210m, 17.09.2002 (O Tadauchi); 1♀ 5ww, Medeu, 24.05.2000 (O Tadauchi); 1♀, 1ww, Medeu, 1600m, 21.05.2004 (R Murao). **KYRGYZSTAN:** 2♂♂, Aksuu, near Karakol, east of lake Issik-Kol, 2000m, 25.08.2004 (O Tadauchi); 7ww 11♂♂, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 1ww, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 2♂♂, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 1♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi); 8ww, Issik-Ata, near Bishkek, 950m, 22.08.2003 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 1800m, 27.05.2000 (O Tadauchi); 7♂♂, Issik-Ata, near Bishkek, 1800m, 22.08.2003 (O Tadauchi); 1♂, Issik-Ata, near Bishkek, 950m, 22.08.2003 (O Tadauchi); 1♂, Issik-Ata, near Bishkek, 1300m, 22.08.2003 (O Tadauchi).

Food-plant records. *Chondrilla* sp., *Cichorium intybus*, *Cirsium* sp., *Compositae* sp., *Cosmos sulphureus*, *Crataegus* sp., *Mentha asiatica*, *Saussurea* sp., *Taraxacum* sp., *Trifolium repens*, *Vicia* sp.

***Bombus (Melanobombus) keriensis* Morawitz**

Bombus keriensis Morawitz 1887:199

Bombus separandus Vogt 1909:61

The queen and most workers have the *separandus* colour pattern, in which the pale bands are almost white, although a few of the workers are more yellow.

Material examined (60 specimens, 760-2060m). **CHINA** (Xinjiang): 3ww 1♂, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut); 13ww 2♂♂, near Sayram

lake, Ili, 1970m, 25.08.2002 (O Tadauchi, R Murao); 3ww 6♂♂, Sayram lake, Ili, 2030m, 25.08.2002 (R Miyanaga); 4ww 2♂♂, Sayram lake, Ili, 2030-2060m, 25.08.2002 (O Tadauchi); 3ww 1♂, Sayram lake, Ili, 2060m, 25.08.2002 (R Murao). **KAZAKHSTAN:** 1ww, Almaty city, 760m, 31.08.2002 (O Tadauchi); 1♀, big Almaty lake, 1360-1560m, 22.05.2004 (R Murao); 2ww, big Almaty lake, 1360m, 01.09.2002 (O Tadauchi); 3ww 1♂, big Almaty lake, 2000-2050m, 01.09.2002 (O Tadauchi, R Murao); 2ww, big Almaty lake, 1600-1850m, 28.08.2004 (O Tadauchi); 1ww 2♂♂, big Almaty lake, 2400m, 31.08.2002 (O Tadauchi); 2♂♂, big Almaty lake, 2040m, 31.08.2002 (R Murao); 3ww, south of Almaty, 1580m, 31.08.2002 (O Tadauchi); 2ww, Ul'ken-Kaindy, near Jabagly, 1800m, 05.09.2002 (O Tadauchi, R Murao). **KYRGYZSTAN:** 1ww, Aksuu, near Karakol, east of lake Issik-Kol, 2000m, 25.08.2004 (O Tadauchi); 1ww, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi).

Food-plant records. *Cichorium intybus*, *Cirsium* sp., Compositae sp., *?Hypochoeris* sp., Leguminosae sp., *Melilotus suaveolens*, *Mentha asiatica*, *Saussurea* sp., *Trifolium repens*.

***Bombus (Sibiricobombus) sibiricus* (Fabricius)**

Apis sibirica Fabricius 1781:478

Material examined (9 specimens, 960-1300m). **CHINA** (Xinjiang): 2ww 5♂♂, east of Jeminay, Altay, 1300m, 28.08.2002 (O Tadauchi, R Murao, R Miyanaga); 1ww 1♂, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut).

Food-plant records. *Chondrilla* sp., *?Hypochoeris* sp.

***Bombus (Sibiricobombus) asiaticus* Morawitz**

Bombus hortorum var. *asiatica* Morawitz in Fedtschenko 1875:4

The queens have the tails black. In contrast, the workers have the tails white, as in the *asiaticus* s. str. colour pattern.

Material examined (12 specimens, 670-2050m). **KAZAKHSTAN:** 1ww, big Almaty lake, 2000-2050m, 01.09.2002 (R Murao); 5ww, Alga, near Koradai, 18.06.2003 (K Mitai); 2♀♀, Achisai, Karatau mountains, 670-700m, 06.06.2003 (K Mitai). **KYRGYZSTAN:** 1ww, Ala-Archa, near Bishkek, 1700-1800m, 21.08.2003 (O Tadauchi); 1ww, Issik-Ata, near Bishkek, 1300m, 22.08.2003 (O Tadauchi); 2ww, Issik-Ata, near Bishkek,

1800m, 22.08.2003 (O Tadauchi).

No food-plant records.

***Bombus (Cullumanobombus) cullumanus* (Kirby)**

Apis cullumana Kirby 1802:359

Bombus serrisquama Morawitz 1888:224

Most individuals have the *serrisquama* colour pattern with yellow bands, although a few have the yellow bands much reduced and so approach the *cullumanus* s. str. colour pattern. There is very little recent material of *cullumanus* s. str. (from western Europe), but from a single specimen kindly provided by P. Rasmont, the *cox1* barcode sequence is very closely similar to *serrisquama* (0.16% divergence), providing no evidence that the two are not conspecific (following the interpretation of morphology in Williams 1998).

Material examined (96 specimens, 130-2060m). **CHINA** (Xinjiang): 1ww, east of Jeminay, Altay, 1300m, 28.08.2002 (R Murao); 2ww, Jeminay county, Altay, 960m, 27.08.2002 (A Dawut); 5ww, near Sayram lake, Ili, 1970m, 25.08.2002 (O Tadauchi, R Murao, Miyanaga); 3ww 2♂♂, Sayram lake, Ili, 2030m, 25.08.2002 (A Dawut, R Miyanaga); 1♂, Sayram lake, Ili, 2030-2060m, 25.08.2002 (O Tadauchi). **KAZAKHSTAN:** 1♀, Alga, near Koradai, 18.06.2003 (K Mitai); 1ww, near Sternjak, Kochetav district, 15.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 29.07.2002 (V Kazenas, A Jdanko, V Rascheev); 1ww, near Sternjak, Kochetav district, 03.08.2002 (V Kazenas, A Jdanko, V Rascheev); 3♀♀, Aksu valley, 16.06.2003 (K Mitai); 2♀♀, Aksu valley, 130-560m, 16.06.2003 (K Mitai); 7♀♀, Jabagly, 1180-1250m, 14.06.2003 (O Tadauchi, K Mitai); 1♂, Jabagly, 1200-1250m, 4.09.2002 (O Tadauchi); 4♀♀, Karaalma, near Jabagly, 1210m, 17.06.2003 (O Tadauchi, K Mitai); 4♀♀, Kashi-Ulken-Kaindy, Jabagly, 1700-2000m, 15.06.2003 (K Mitai); 9♀♀, Kashi-Kaindy, Jabagly, 1700m, 15.06.2003 (O Tadauchi); 1♂, Kashi-Kaindy, Jabagly, 1700m, 05.09.2002 (R Murao); 1ww 11♂♂, Ul'ken-Kaindy, Jabagly, 1800m, 05.09.2002 (O Tadauchi); 1♀ 1ww, Ul'ken-Kaindy, Jabagly, 1850-2000m, 15.06.2003 (O Tadauchi). **KYRGYZSTAN:** 2ww, Aksuu, near Karakol, east of lake Issik-Kol, 2000m, 25.08.2004 (O Tadauchi); 2♂♂, Aksuu valley, 950m, 06.09.2002 (O Tadauchi, R Murao); 2♀♀ 11ww 1♂, Arashan, near Karakol, east of lake Issik-Kol, 1850m, 25.08.2004 (O Tadauchi); 5ww, Arashan, near Karakol, east of lake Issik-Kol, 1850-1900m, 25.08.2004 (O Tadauchi); 1♀ 6ww 1♂, Chon-Aksuu, north of lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi);

Table 1. Comparison of lists of bumblebee species recorded from Central Asia. Names are shown as used in the original publications. Where these are in parenthesis and/or separated by commas, they are regarded as synonyms (see Williams 1998).

simplified subgenera (Williams <i>et al.</i> 2008)	Reinig (1930) Tajikistan	Skorikov (1931) China (Xinjiang), Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan	Yefremova (2001) Kazakhstan	Kyushu University Expeditions China (Xinjiang), Kazakhstan, Kyrgyzstan	combined species list
<i>Mendacibombus</i>		<i>defector</i> , (?=margreiteri) <i>makarjini/turkestanicus</i> <i>turkestanicus/makarjini</i> <i>marussinus</i>	(?=altaicus)		<i>defector</i>
	(= <i>mendax macarjini</i>)			<i>makarjini</i> <i>turkestanicus</i>	<i>makarjini</i> <i>turkestanicus</i> <i>marussinus</i>
	(= <i>mendax marussinus</i>)				
<i>Kallobombus</i>		<i>soroeensis</i>	<i>soroeensis</i>	<i>soroeensis</i>	<i>soroeensis</i>
<i>Subterraneobombus</i>	<i>fedtschenkoi</i>	<i>fedtschenkoi</i>			<i>fedtschenkoi</i>
	<i>melanurus</i> (= <i>melanurus griseofasciatus</i>)	<i>melanurus</i> <i>difficillimus</i>	<i>fragrans</i> <i>melanurus</i>	<i>melanurus</i>	<i>fragrans</i> <i>melanurus</i> <i>difficillimus</i>
		<i>subterraneus</i> <i>distinguendus</i>	<i>subterraneus</i> <i>distinguendus</i>		<i>subterraneus</i> <i>distinguendus</i>
<i>Megabombus</i>		<i>hortorum</i> <i>sushkini</i>	<i>hortorum</i>	<i>hortorum</i>	<i>hortorum</i> <i>sushkini</i>
<i>Thoracobombus</i>	(= <i>elegans</i>)	(= <i>dumoucheli</i>)	<i>armeniacus</i> , (= <i>dumoucheli</i>)	<i>armeniacus</i>	<i>armeniacus</i>
	<i>laesus</i>	<i>laesus</i> <i>muscorum</i> (= <i>equester</i>) (= <i>derhamellus</i>)	<i>muscorum</i> (= <i>derhamellus</i>) (= <i>subbaicalensis</i> , <i>solstitialis</i>) (= <i>agrorum, michnoi</i>)	<i>laesus</i> <i>muscorum</i> <i>veteranus</i> <i>runderarius</i> <i>humilis</i> <i>pascuorum</i>	<i>laesus</i> <i>muscorum</i> <i>veteranus</i> <i>runderarius</i> <i>humilis</i> <i>pascuorum</i>
<i>Psithyrus</i>	<i>branickii</i> <i>rupestris</i>			<i>morawitzianus</i>	<i>branickii</i> <i>rupestris</i> <i>morawitzianus</i>
			<i>vestalis</i> <i>bohemicus</i> <i>barbutellus</i> <i>norvegicus</i> <i>sylvestris</i>	<i>bohemicus</i>	<i>vestalis</i> <i>bohemicus</i> <i>barbutellus</i> <i>norvegicus</i> <i>sylvestris</i>
<i>Pyrobombus</i>		<i>lapponicus</i> (= <i>leucopygus</i>)	(= <i>leucurus</i>) <i>hypnorum</i> <i>biroi</i> <i>jonellus</i>	<i>subtypicus</i>	<i>lapponicus</i> <i>subtypicus</i> <i>hypnorum</i> <i>biroi</i> <i>jonellus</i>
	(= <i>leucopygus</i>)				
	<i>biroi</i>	<i>biroi</i>		<i>biroi</i>	
<i>Bombus s. str.</i>			<i>terrestris</i> <i>lucorum</i>	<i>terrestris</i> <i>lucorum complex</i>	<i>terrestris</i> <i>lucorum complex</i>
	<i>lucorum</i>	<i>lucorum</i>			
<i>Melanobombus</i>	(= <i>separandus</i>)	<i>keriensis</i> , (= <i>alagesianus</i> , <i>separandus</i> , <i>incertoides</i> , <i>anargumentosus</i>)	<i>keriensis</i> , (= <i>kozlovi</i> , <i>separandus</i>) <i>sichelii</i>	<i>keriensis</i>	<i>keriensis</i> <i>sichelii</i>
<i>Sibiricobombus</i>	<i>morawitzi</i> <i>oberti</i>	<i>morawitzi</i> <i>oberti</i> , (= <i>pamirus</i>)	<i>morawitzi</i>		<i>morawitzi</i> <i>oberti</i>
	(= <i>regeli</i>)	<i>asiaticus</i> , (= <i>miniatocaudatus</i>)	<i>sibiricus</i> <i>asiaticus</i>	<i>sibiricus</i> <i>asiaticus</i>	<i>sibiricus</i> <i>asiaticus</i>
<i>Cullumanobombus</i>	(= <i>silantjewi</i>)	(= <i>serrisquama</i>)	(= <i>serrisquama</i>)	<i>cullumanus</i>	<i>cullumanus</i>
Total species	17	26	29	22	42

lww, Issik-Ata, near Bishkek, 1650m, 22.08.2003 (O Tadauchi); 1♂, Semenovka, north of Lake Issik-Kol, 1700m, 24.08.2004 (O Tadauchi).

Food-plant records. *Achillea* sp., *Aster canescens*, *Chondrilla* sp., *Cichorium intybus*, *Cirsium* sp., *Compositae* sp., *?Hypochoeris* sp., *Melilotus suaveolens*, *Mentha asiatica*, *Origanum tyttanthium*, *?Saussurea* sp., *Trifolium repens*, *Umbelliferae* sp.

Discussion

The species collected by the KUE are listed in comparison with other published lists from Central Asia in Table 1. From this table, the KUE material of *B. morawitzianus* appears as the first record of this species for the region, although the species has actually been recorded there previously (Morawitz 1875; Popov 1931; Grütte 1937). Those species listed in Table 1 but unrepresented in the KUE collection are often among the more northerly species in the combined list. This may be because there were no KUE collecting sites above 2400m. The KUE data add species of cuckoo bumblebees (a group not included by Skorikov) and the northern grassland species *B. humilis* and *B. pascuorum*, as well as recognizing the widespread *B. terrestris*.

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References

- Dias, B. S. F., A. Raw, and V. L. Imperatri-Fonseca. 1999. International Pollinators Initiative: the São Paulo declaration on pollinators. Report on the recommendations of the workshop on the conservation and sustainable use of pollinators in agriculture with emphasis on bees. Pages 79. Brazilian Ministry of the Environment, Brasília.
- Fabricius, J. C. 1775. Systema entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus. Flensburgi and Lipsiae.
- Fabricius, J. C. 1777. Genera insectorum eorumque characteres naturales secundum numerum, figuram, situm et proportionem omnium partium oris adiecta mantissa specierum nuper detectarum. Chilonii.
- Fabricius, J. C. 1781. Species insectorum exhibentes eorum differentias specificas, synonyma auctorum, loca natalia, metamorphosin adiectis observationibus, descriptionibus, Hamburg.
- Fabricius, J. C. 1793. Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adiectis synonymis, locis observationibus, descriptionibus, Hafniae.
- Fedtschenko, A. P. 1875. Reise in Turkestan. II Zoologischer Teil, Moscow.
- Grütte, E. 1937. Zur Kenntnis zentralasiatischer Arten von *Psithyrus* Lep. (Hym. Apid.). Mitt. dt. ent. Ges., 7: 103-109.
- Illiger, J. C. W. 1806. William Kirby's Familien der bienenartigen Insekten, mit Zusätzen, Nachweis. Bemerk. Mag. Insekt., 5: 28-175.
- Kirby, W. 1802. Monographia apum Angliae; or, an attempt to divide into their natural genera and families, such species of the Linnean genus *Apis* as have been discovered in England: with descriptions and observations, Ipswich.
- Kriechbaumer, J. 1877. *Bombus Mocsáryi* n. sp. Stettin. ent. Zg., 38: 253-254.
- Kuhlmann, M. 2009. Bees of the genus *Colletes* (Hymenoptera, Colletidae) from Central Asia collected by the Kyushu University Expeditions. *Esakia*, (49): 15-20.
- Lepeletier de Saint-Fargeau, A. L. M. [1835]. Histoire naturelle des insectes. Hyménoptères, Paris (1836).
- Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis, Holmiae.
- Linnaeus, C. 1761. Fauna Suecica sistens animalia Suecica regni: Mammalia, Aves, Amphibia, Pisces, Insecta, Vermes. Distributa per classes & ordines, genera & species, cum differentiis specierum, synonymis auctorum, nominibus incolarum, locis natalium, descriptionibus insectorum, Stockholmiae.
- Michener, C. D. 2007. The bees of the world. John Hopkins University Press, Baltimore.
- Mitai, K., and O. Tadauchi. 2008. The genus *Nomada* (Hymenoptera, Apidae) from Kazakhstan and Kyrgyzstan collected by the Kyushu University Expedition. *Esakia*, 48: 25-35.
- Morawitz, F. F. 1875. Bees. (Mellifera). Pages ii+160. Reise in Turkestan, A. P. Fedtschenko. II Zoologischer Teil, Moscow.
- Morawitz, F. F. 1887. Insecta in itinere cl. N. Przewalskii in Asia centrali novissime lecta. I. Apidae. *Trudy russk. ént. obshch.*, 20(1886): 195-229.
- Morawitz, F. F. 1888. Hymenoptera aculeata nova. Descriptis. *Trudy russk. ént. obshch.*, 22: 224-302.
- Müller, O. F. 1776. Zoologiae Danicae prodromus, seu animalium Danicae et Norvegiae indigenarum characteres, nomina, et synonyma imprimis popularium, Havniae.
- Murray, T. E., U. Fitzpatrick, M. J. F. Brown, and R. J. Paxton. 2008. Cryptic species diversity in a widespread bumble bee complex revealed using mitochondrial DNA RFLPs. *Cons. Genetics*, 9: 653-666.
- Packer, L. 2008. BEE-BOL Inaugural Meeting. Pages 1-13. University of York, Toronto [www.yorku.ca/bugsrus/BarcodeConference/minutes%20of%20meeting%5B1%5D].

- doc (accessed December 2008)].
- Panfilov, D. V. 1956. Contribution to the taxonomy of bumblebees (Hymenoptera, Bombinae), including the description of new forms. *Zool. Zh.*, **35**: 1325-1334.
- Popov, V. B. 1931. Zur Kenntnis der paläarktischen Schmarotzerhummeln (*Psithyrus* Lep.). *Eos*, **7**: 131-209.
- Radoszkowski, O. 1877. Essai d'une nouvelle méthode pour faciliter la détermination des espèces appartenant au genre *Bombus*. *Byull. Mosk. obshch. ispyt. prir.*, **52**: 169-219.
- Reinig, W. F. 1930. Untersuchungen zur Kenntnis der Hummelfauna des Pamir-Hochlandes. Zoologische Ergebnisse der deutsch-russischen Alai-Pamir-Expedition der Notgemeinschaft der Deutschen Wissenschaft und der Akademie der Wissenschaften der U.d.S.S.R. *Z. Morph. Ökol. Tiere*, **17**: 68-123.
- Scopoli, J. A. 1763. *Entomologia Carniolica exhibens insecta Carnioliae indigena et distributa in ordines, genera, species, varietates*, Vindobonae.
- Seidl, W. B. 1837. Die in Böhmen vorkommenden Hummelarten. *Beitr. ges. Natur- Heilwiss.*, **2**: 65-73.
- Skorikov, A. S. 1910. [Intraspecific forms of *Bombus mendax* Gerst.] (Hymenoptera, Bombidae). *Russ. ént. Obozr.*, **9**(1909): 328-330.
- Skorikov, A. S. 1914. *Pratobombus leucopygos* [sic] (F. Mor.) et ses variations (Hymenoptera, Bombidae). *Russ. ént. Obozr.*, **14**: 293-294.
- Skorikov, A. S. 1922. [Bumblebees of the Petrograd Province.]. Pages 51. *Faunae Petropolitanae catalogus*. Petrogradskii agronomicheskii institut, Petrograd.
- Skorikov, A. S. 1931. Die Hummelfauna Turkestans und ihre Beziehungen zur zentralasiatischen Fauna (Hymenoptera, Bombidae). Pages 175-247 in V. A. Lindholm, editor. *Abhandlungen der Pamir-Expedition 1928*. Academy of Sciences of the USSR, Leningrad.
- Tadauchi, O. 2005. Field studies on wild bee fauna and pollination biology for combating desertification and planting campaigns in Asian arid areas: a report for the year 2000 to 2004. *Esakia*, **(45)**: 1-8.
- Tadauchi, O. 2006. The genus *Andrena* from Kazakhstan and Kyrgyzstan collected by the Kyushu University Expedition (Hymenoptera, Andrenidae). *Esakia*, **(46)**: 1-19.
- Tadauchi, O. 2008. The genus *Andrena* from Kazakhstan and Kyrgyzstan (Hymenoptera, Andrenidae). *Esakia*, **48**: 1-18.
- Vogt, O. 1909. Studien über das Artproblem. 1. Mitteilung. Über das Variieren der Hummeln. 1. Teil. *Sber. Ges. naturf. Freunde Berl.*, **1909**: 28-84.
- Vogt, O. 1911. Studien über das Artproblem. 2. Mitteilung. Über das Variieren der Hummeln. 2. Teil. (Schluss). *Sber. Ges. naturf. Freunde Berl.*, **1911**: 31-74.
- Williams, P. H. 1998. An annotated checklist of bumble bees with an analysis of patterns of description (Hymenoptera: Apidae, Bombini). *Bull. nat. Hist. Mus. Lond.*, **67**: 79-152 [updated at www.nhm.ac.uk/bombus/ accessed 2009].
- Williams, P. H. 2007. The distribution of bumblebee colour patterns world-wide: possible significance for thermoregulation, crypsis, and warning mimicry. *Biol. J. Linn. Soc.*, **92**: 97-118.
- Williams, P. H., J. An, and J. Huang. In press. The bumblebees of the subgenus *Subterraneobombus*: integrating evidence from morphology and DNA barcodes (Hymenoptera, Apidae, *Bombus*). *Zool. J. Linn. Soc.*
- Williams, P. H., S. A. Cameron, H. M. Hines, B. Cederberg, and P. Rasmont. 2008. A simplified subgeneric classification of the bumblebees (genus *Bombus*). *Apidologie*, **39**: 46-74.
- Williams, P. H., Y. Tang, J. Yao, and S. Cameron. 2009. The bumblebees of Sichuan (Hymenoptera: Apidae, Bombini). *Syst. Biodiv.*, **7**: 101-190.
- Winter, K., L. Adams, R. W. Thorp, D. W. Inouye, L. Day, J. Ascher, and S. Buchmann. 2006. Importation of non-native bumble bees into North America: potential consequences of using *Bombus terrestris* and other non-native bumble bees for greenhouse crop pollination in Canada, Mexico, and the United States. Pages 33. A White Paper of the North American Pollinator Protection Campaign (NAPCC), San Francisco.
- Yefremova, Z. A. 2001. Faunal and ecological notes on species of *Bombus* Latreille, 1802, and *Psithyrus* Lepeletier, 1833 (Hymenoptera: Apidae) from the Tarbagatai and Saur mountain ranges in eastern Kazakhstan. *Entomologist's Gaz.*, **52**: 269-275.