









Research Article

First record of 15 species of Hemiptera (Hexapoda, Insecta) in Georgia

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Abstract

During the fieldworks conducted within the CaBOL project in 2020–2023, 14 new species of Heteroptera belonging to seven families, and a new species of Auchenorrhyncha were collected in Georgia for the first time: *Trypetimorpha occidentalis* Huang & Bourgoïn, 1993 (Tropiduchidae), *Dimorphopterus blissoides* (Baerensprung, 1859) (Blissidae), *Europiella decolor* (Uhler, 1893), *Tuponia mixticolor* (A. Costa, 1862), *Deraeocoris ventralis* Reuter, 1904, *Orthocephalus brevis* (Panzer, 1798) (Miridae), *Alloeorhynchus flavipes* (Fieber, 1836) (Nabidae), *Holcogaster fibulata* (Germar, 1831), *Vilpianus galii* Wolff, 1802 (Pentatomidae), *Holotrichius bergrothi* Reuter, 1891, *Reduvius ciliatus* Jakovlev, 1879, *Oncocephalus squalidus* (Rossi, 1790) (Reduviidae), *Pterotmetus staphyliniformis* (Germar, 1831), *Diomphalus hispidulus* Fieber, 1864 (Rhyparochromidae), and *Psacasta neglecta* (Herrich-Schäffer, 1837) (Scutellaridae). The present study provides distributional, genetic, and collecting information on the newly recorded species followed by remarks.

Key words: Auchenorrhyncha, CaBOL, entomology, faunistics, Heteroptera, new records, South Caucasus



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Introduction

Suborder Heteroptera Latreille, 1810, is one of the diverse groups of insects with approximately 45,000 species worldwide, of which up to 9,000 are distributed in the Palaearctic region (Aukema et al. 2013; Henry 2017). Around 700 species of true bugs are known to occur in Georgia (Tarkhnishvili et al. 2013), with the most recent additions being an overview of aquatic bugs of the Javakheti Highland (Shapovalov et al. 2019), the review of water bugs of the Caucasus ecoregion (Berchi et al. 2023), the first record of the family Leptopodidae by Chitadze et al. (2023), and the first records of bat-associated *Cimex lectularius* Linnaeus, 1758 (Ghazarayan et al. 2023). The main contribution to the study of hemipterans in Georgia was made by Zaitseva (1964, 1966a, 1966b, 1967, 1968, 1971, 1973, 1974a, 1974b, 1974c, 1975a, 1975b, 1977a, 1977b, 1977c, 1981, 1984, 1998), who laid the foundation for future researchers devoting nu-

merous works to the zoogeographic and faunistic diversity of bugs in various regions of Georgia.

The main sources on the species diversity of Auchenorrhyncha in Georgia are online databases (Tarkhnishvili et al. 2013; Dmitriev et al. 2023) and catalogs (Nast 1972), according to which there are currently about 500 species in the country out of approximately 4,000 species known from the Palaearctic region (Nast 1972). *Trypetimorpha fenestrata* Costa, 1862 (Tropiduchidae) was previously reported in Georgia (Sokhumi) (Logvinenko 1975), and the record of *T. occidentalis* is new for the fauna of Georgia. Despite the presence of recent studies on this peculiar group of insects in Georgia and the Caucasus overall (Karavin et al. 2011; Emeljanov 2012, 2015; Tishechkin 2014; Liang et al. 2023), the main emphasis was placed on the presence of alien and potentially dangerous pests for agriculture (Nast 1987) and methods of dealing with them. The present study aims to provide information on the first records of 15 species of Hemiptera previously unknown to Georgia.

Material and methods

The material was collected within the framework of the BMBF-funded project Caucasus Barcode of Life (CaBOL) (<https://ggbc.eu/>). The specimens were collected by hand and sweep-net, fixed in 96% ethanol, and later stored in a freezer under -22°C for further DNA barcoding at Ilia State University, Institute of Ecology. The specimens were determined using various keys (Wagner 1964; Kerzhner 1968, 1981; Péricart 1987, 1990, 2001; Huang and Bourgoin 1993; Moulet 2006; Ribes and Gapon 2006; Putshkov and Moulet 2009; Drapolyuk 2017; Lock 2018; Luthi and Dioli 2020; Khazaei et al. 2020; Moulet 2020; Carapezza and Rădac 2021; Fent et al. 2023). The following species were identified via **COI Barcoding**. *Trypetimorpha occidentalis* Huang & Bourgoin, 1993, *Europiella decolor* (Uhler, 1893), *Deraeocoris ventralis* Reuter, 1904, *Alloeorhynchus flavipes* (Fieber, 1836), *Holcogaster fibulata* (Germar, 1831), *Vilpianus galii* Wolff, 1802, and *Pterotmetus staphyliniformis* (Germar, 1831).

Photos of the specimens were taken using a Canon EOS 90D camera with a Canon EF-S 60 mm f/2.8 Macro USM lens. The digital images were prepared using Zerene Stacker image stacking software and Adobe Photoshop CS6. In addition, pictures of the specimens/species not included in the main article are provided in the Suppl. material 1.

DNA processing

Genomic DNA was extracted from tissue samples using the Quick-DNA Mini-prep Plus Kit (Zymo Research) (for 25 mg of tissue). Partial sequences of cytochrome oxidase subunit I (COI) were amplified by polymerase chain reaction (PCR) using the primer pairs LCOI490-JJ and HCO2198- JJ (Astrin and Stüben 2008). Thermal conditions included denaturation at 95°C for 1 min, followed by the first cycle set (15 cycles): 94°C for 30 sec., annealing at 55°C for 1 min (-1°C per cycle), and extension at 72°C for 1:30 min. Second cycle set (25 cycles): 94°C for 35 sec., 45°C for 1 min. 72°C for 1:30 min, followed by 1 cycle at 72°C for 3 min and the final extension step at 72°C for 5 min. PCR amplicons were visualized on 1% agarose gels using 1.7 µl of PCR product.

Sequencing of the unpurified PCR products in both directions was conducted at the Beijing Genomics Institute (Hong Kong, CN) by using the amplification primers. Sequence analysis was performed using Geneious Prime 2022.1.1 (<http://www.geneious.com>). Extracted DNA was deposited in the scientific collections of Ilia State University, Tbilisi, Georgia, and aliquots will be deposited at LIB Biobank at Museum Koenig, Bonn, Germany, while the sequences have been submitted to Barcode of Life Data System (BOLD) databases. The newly obtained DNA barcodes of COI sequences were checked against the BOLD Systems database (<http://www.boldsystems.org/index.php>). Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) for the sequenced taxa and their nearest neighbor in BOLD Systems (if they had a BIN) are also given. For the evaluation of sequence differentiation, we used p -distance as calculated in the BOLD Systems.

Results

Order Hemiptera

Suborder Auchenorrhyncha

Family Tropiduchidae Stål, 1866

Genus *Trypetimorpha* Bierman, 1910

Trypetimorpha occidentalis Huang & Bourgoin, 1993

For the image, see Suppl. material 1

Material examined. GEORGIA • 3 specimens; Dighomi park (Tbilisi); 41.7695, 44.7737; 426 m a.s.l.; 31 Jul. 2021; leg. A. Seropian; in vegetation near the ground; CaBOL-IDs 1011721, 1011733, 1011745.

Barcoding. Three barcodes were obtained from the specimens with CaBOL-IDs 1011721, 1011733, and 1011745 (BOLD:ACP5742, maximum p -distance 0.15%), with the nearest neighbor in BOLD Systems being *T. occidentalis* from Kazakhstan (BOLD:ACP5742) (mean p -distance 0.61%).

Remarks. From the neighboring countries, *T. occidentalis* was previously reported from Turkey, Armenia, and Russia (Rostov Area) (Tishechkin 2003; Karavin et al. 2021). The species is broadly distributed in the Palaearctic biogeographic realm (Huang and Bourgoin 1993; Bourgoin 2019).

Suborder Heteroptera

Family Blissidae Stål, 1862

Genus *Dimorphopterus* Stal, 1872

Dimorphopterus blissoides (Baerensprung, 1859)

Fig. 1

Material examined. GEORGIA • 4 specimens; Dighomi park (Tbilisi); 41.7686, 44.7740; 428 m a.s.l.; 3. October 2021; leg. A. Seropian; on *Phragmites* sp.; CaBOL-IDs 1010339, 1010342, 1010399, 1010425.

Barcoding. A single barcode was obtained from the specimen with CaBOL-ID 1010399 (BOLD:AFZ7676), with the nearest neighbor in BOLD Systems being *Dimorphopterus spinolae* (Signoret, 1857) from Austria with a private status

(*p*-distance 3.21%). There are no barcodes of *D. blissoides* available in BOLD Systems as we submitted the first one.

Remarks. From the neighboring countries, *D. blissoides* has been previously reported from Armenia, Azerbaijan, Turkey, and the Russian Federation (Neimarovets 2010; Grebennikov and Anikin 2020; Kment et al. 2023). The distribution of the species covers the Ponto-Mediterranean region (Linnavuori 1995; Kment et al. 2023). It is associated with common reeds (*Phragmites australis*) in the sheaths of dry leaves and in the cavities of broken stems, where adults and larvae of older stages hibernate. In the spring, the bugs move to the growing young shoots, gathering 2-6 or more in the sheaths of the leaves of the preapical node or among the semi-opened leaves at the top of the shoots, where they remain until the end of their lives (Putshkov 1969; Kment et al. 2023).

Miridae Hahn, 1831

Genus *Europiella* Reuter, 1909

***Europiella decolor* (Uhler, 1893)**

For the image, see Suppl. material 1

Material examined. GEORGIA • 1 specimen; Tbilisi; 41.7709, 44.7668; 449 m a.s.l.; 05. December 2021; leg. A. Seropian; on *Artemisia* sp., steppe; CaBOL-ID 1020718. • 2 specimens; Tbilisi; 41.7707, 44.7671; 449 m a.s.l.; 22. May 2022; leg. N. Bulbulashvili; on *Artemisia* sp. in steppe; CaBOL-IDs 1025480, 1025481.

Barcoding. Two identical barcodes were obtained from the specimens with CaBOL-IDs 1020718 and 1025481 (**BOLD:ACY0805**), identical to *E. decolor* from the Netherlands with a private status in BOLD Systems.

Remarks. From the neighboring countries, *E. decolor* has been previously reported from Iran (Linnavuori and Modarres 1999; Linnavuori 2007). Its range extends from Western Europe (including Great Britain, France, and Spain) to Western Asia (including Iran), and its distribution is considered to be Holarctic in general (Kerzhner and Josifov 1999; Aukema et al. 2013). The species is found on *Artemisia*, commonly referred to as a host plant (Linnavuori 2007; Protić 2020).

Genus *Tuponia* Reuter, 1865

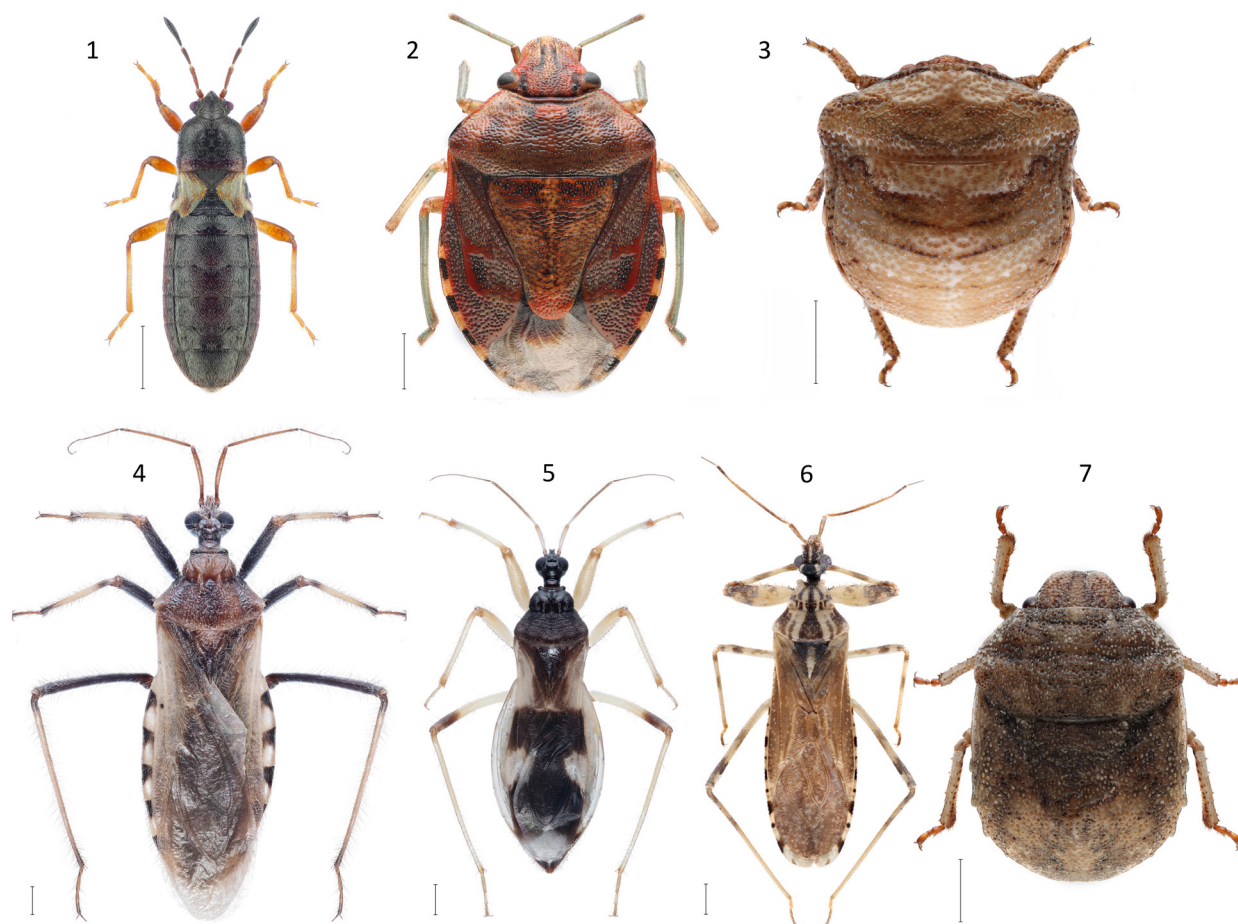
***Tuponia mixticolor* (A. Costa, 1862)**

For the image, see Suppl. material 1

Material examined. GEORGIA • 3 specimens; Kumisi lake vicinity; 41.6027, 44.8163; 494 m a.s.l.; 24. September 2021; leg. A. Seropian; on *Tamarix* sp.; CaBOL-IDs 1016838, 1016839, 1016840.

Barcoding. Three barcodes were obtained from the specimens with CaBOL-IDs 1016838, 1016839, and 1016840 (**BOLD:AFX3631**; maximum within-barcode *p*-distance 0.15%), with the nearest neighbor in BOLD Systems being *Campylomma* sp. from Austria with a private status (mean *p*-distance 5.96%). There are no barcodes of *T. mixticolor* in BOLD systems as we submit the first ones.

Remarks. From the neighboring countries, *T. mixticolor* has been previously reported from Iran and Russia (Astrakhan) (Drapolyuk 1980; Linnavuori 2007, 2010). The species is distributed in Western Palaearctic and tropical Africa



Figures 1–7. *Dimorphopterus blissoides* (1). *Holcogaster fibulata* (2). *Vilpianus galii* (3). *Holotrichius bergrothi* (4). *Reduvius ciliatus* (5). *Oncocephalus squalidus* (6). *Psacasta neglecta* (7). Scale bars: 1 mm.

(Cabo Verde, Sudan) (Aukema and Rieger 1999). *T. mixticolor* is found on the *Tamarix* species (Gravestain 1978; Aukema et al. 2019).

Genus *Deraeocoris* Kirschbaum, 1856

Deraeocoris ventralis ventralis Reuter, 1904

For the image, see Suppl. material 1

Material examined. GEORGIA • 3 specimens; Tbilisi; 41.7707, 44.7671; 449 m a.s.l.; 22. May 2022; leg. N. Bulbulashvili; on *Artemisia* sp.; CaBOL-IDs 1025469, 1025470, 1025471.

Barcoding. Three identical barcodes were obtained from the specimens with CaBOL-IDs 1025469, 1025470, and 1025471 (BOLD:AFB2062), with the nearest neighbor in BOLD Systems being *D. ventralis* from Austria with a private status (mean *p*-distance 0.92%).

Remarks. From the neighboring countries, *D. ventralis* has been previously reported from Turkey, Russia (Central European Territory, East Siberia, South European Territory, West Siberia), Armenia, and Azerbaijan (Aukema and Rieger 1999; Yazici et al. 2019; Vinokurov and Rudoï 2020). The species is considered to be Euro-Siberian (Vinokurov and Rudoï 2020).

Genus *Orthocephalus* Fieber, 1858

Orthocephalus brevis (Panzer, 1798)

For the image, see Suppl. material 1

Material examined. GEORGIA • 2 specimens; Telovani (12 km E of Tbilisi); 41.8023, 44.6768; 923 m a.s.l.; 27. May 2023; leg. N. Bulbulashvili; in vegetation, meadow; CaBOL-IDs 1035525, 1035526.

Remarks. From the neighboring countries, *O. brevis* has been previously reported from Russia (Central European Territory, East Siberia, South European Territory, West Siberia, North European Territory), Armenia, Azerbaijan, and Turkey (Hoberlandt 1955; Aukema and Rieger 1999; Namyatova and Konstantinov 2009). This species has a European-Caucasian-Siberian range.

Nabidae Costa, 1853

Genus *Alloeorhynchus* Fieber, 1860

Alloeorhynchus flavipes (Fieber, 1836)

For the image, see Suppl. material 1

Material examined. GEORGIA • 1 specimen; Gori; 41.9848, 44.1389; 696 m a.s.l.; 24. October 2021; leg. N. Bulbulashvili; under rocks in heathland; CaBOL-ID 1018766. • 1 specimen; Telovani; 41.8112, 44.6911; 995 m a.s.l.; 15. August 2021; leg. A. Seropian; under a rock at the edge of the forest, deciduous forest; CaBOL-ID 1012590. • 1 specimen; Gori; 41.9701, 44.0921; 803 m a.s.l.; 18. September 2021; leg. A. Seropian; under rocks in steppe; CaBOL-ID 1016910.

Barcoding. Two barcodes were obtained from the specimens with CaBOL-IDs 1012590 and 1016910 (BOLD:AGA5866: maximum within-barcode p-distance 0.17%), with the nearest neighbor in BOLD Systems being *A. flavipes* from Austria with a private status (mean p-distance 7.03%). Such large differences between sequences may be due to misidentification of the Austrian specimen or the species identification via COI subunit is not possible.

Remarks. From the neighboring countries, *A. flavipes* has been previously reported from Turkey, Azerbaijan, and Russia (South European Territory) (Hoberlandt 1955; Fent and Aktaç 2007; Ghahari et al. 2010; Dursun and Fent 2015). The species' general distribution is in Europe, the eastern Mediterranean, and Iran (Kerzhner 1996).

Pentatomidae Leach, 1815

Genus *Holcogaster* Fieber, 1861

Holcogaster fibulata (Germar, 1831)

Fig. 2

Material examined. GEORGIA • 1 specimen; Tbilisi; 41.7671, 44.7708; 432 m a.s.l.; 21. August 2021; leg. A. Seropian and N. Bulbulashvili; on a tree trunk in the deciduous forest; CaBOL-ID 1012528. • 1 specimen; Tbilisi; E41.7063, 44.7508; 739 m a.s.l.; 08. May 2021; leg. A. Seropian and N. Bulbulashvili; on *Pinus* sp. CaBOL-ID 1011717 and 1012528.

Barcoding. Two identical barcodes were obtained from the specimens with CaBOL-IDs 1012528 and 1011717 (**BOLD:ACS3305**), with the nearest neighbor in BOLD Systems being *H. fibulata* from France (**BOLD: ACS3305**, *p*-distance 0.31%).

Remarks. From the neighboring countries, *H. fibulata* has been previously reported in Turkey, and Iraq (Ribes and Gapon 2006; Matocq et al. 2014; Çerçi and Özgen 2021; Fent and Dursun 2022). The species is originally Holomediterranean, currently spreading, e.g., in central Europe (Ribes and Pagola-Carte 2013).

Genus *Vilpianus* Stål, 1860

Vilpianus galii Wolff, 1802

Fig. 3

Material examined. GEORGIA • 3 specimens; Gori; 41.9810, 44.0789; 650 m a.s.l.; 15. July 2021; leg. N. Bulbulashvili; on *Gallium* sp. in steppe; CaBOL-IDs 1011597, 1011598, 1011599.

Barcoding. A single barcode was obtained from the specimen with CaBOL-ID 1011597 (**BOLD:AGA7433**), which had the best match with the nearest neighbor in BOLD Systems being *V. galii* from Austria with a private status (*p*-distance 1.99%).

Remarks. From the adjacent territories, *V. galii* has been previously reported from Russia (Stavropol Krai), Turkey, Azerbaijan, and Armenia (Fent 2010; Kiyak and Akar 2010; Grebennikov and Anikin 2020; Fent and Dursun 2022; Iskandarov et al. 2022). The species is considered Mediterranean-Iranian-Turanian (Gapon 2014; Meral and Dursun 2022), where it's found on *Gallium* sp. Unlike the fluid movement typical for most of the pentatomids, *V. galii* locomotion is characterized by “jerky” movements (personal observation).

Reduviidae Latreille, 1807

Genus *Holotrichius* Burmeister, 1835

Holotrichius bergrothi Reuter, 1891

Fig. 4

Material examined. GEORGIA • 6 specimens (macropterous form); Mijnskure (Vashlovani National Park); 41.1113, 46.648; 94 m a.s.l.; 20. June 2022; leg. L. and A. Vähätalo; in vegetation near the ground, meadow; CaBOL-ID 1030561.

Remarks. Previously, this species was considered a sub-Turanian endemic with records from Russia (South European territory), the European part of Kazakhstan, and Turkmenistan (Aukema and Rieger 1996; Yesenbekova and Homziak 2013). This is the first record of *H. bergrothi* for the Caucasus ecoregion.

Genus *Reduvius* Fabricius, 1775

Reduvius ciliatus Jakovlev, 1879

Fig. 5

Material examined. GEORGIA • 6 specimens; Mijnskure (Vashlovani National Park); 41.1113, 46.648; 94 m a.s.l.; 20. June 2022; leg. L. and A. Vähätalo; under rocks; CaBOL-IDs 1030553, 1030554, 1030555.

Barcoding. Three nearly identical barcodes were obtained from the specimens with CaBOL-IDs 1030553, 1030554, and 1030555 (**BOLD:AFX5349**, mean *p*-distance 0.2%), which is the first one of the species that we submit to the BOLD Systems.

Remarks. This species is known from the Middle East, Iraq, and Iran, as well as from Russia (the south European part), Turkey, Armenia, and Azerbaijan adjacent to Georgia (Hoberlandt 1955; Putshkov and Putshkov 1996; Aukema et al. 2013; Dursun and Salur 2013; Musaev et al. 2022).

Genus *Oncocephalus* Klug, 1830

***Oncocephalus squalidus* (Rossi, 1790)**

Fig. 6

Material examined. GEORGIA • 1 specimen; Mijnskure (Vashlovani National Park); 41.1113, 46.648; 94 m a.s.l.; 20. June 2022; leg. L. and A. Vähätalo; under rocks.

Remarks. From neighboring countries, *O. squalidus* has previously been reported in Turkey, Armenia, Azerbaijan, and Russia (Hoberlandt 1955; Aukema and Rieger 1996). General distribution is considered to be Holomediterranean (Yildirim et al. 2010).

Rhyparochromidae Amyot and Serville, 1843

Genus *Pterotmetus* Amyot & Serville, 1843

***Pterotmetus staphyliniformis* (Germar, 1831)**

Material examined. GEORGIA • 1 specimen; Gori; 41.9684, 44.0939; 800 m a.s.l.; 17. August 2021; leg. N. Bulbulashvili and A. Seropian; under rocks in steppe; CaBOL-ID 1012409.

Barcoding. A single barcode was obtained from the specimen with CaBOL-ID 1012409 (**BOLD:AAY9334**), with the nearest neighbor in BOLD Systems being *P. staphyliniformis* from Finland (**BOLD: AAY9334**, *p*-distance 0.46%).

Remarks. The distribution of this species in Georgia was previously questioned (Péricart 2001) and is now confirmed. From neighboring countries, *P. staphyliniformis* has previously been reported in Armenia, Azerbaijan, Turkey, and Russia (Krasnodar Krai, Republic of Adygea, Stavropol Krai, Karachay-Cherkessia, Kabardino-Balkaria, and Dagestan) (Lodos et al. 1999; Golub et al. 2014; Vinokurov et al. 2019; Grebennikov and Anikin 2020; Baymak and Kiyak 2022). The range of the species covers the Palaearctic region (Vinokurov et al. 2019). The species is found on and under various herbs: *Achillea*, *Verbascum*, *Tanacetum*, *Elytrigia*, and other Poaceae, *Sedum*, etc. (Putshkov 1969).

Genus *Diomphalus* Fieber, 1864

***Diomphalus hispidulus* Fieber, 1864**

For the image, see Suppl. material 1

Material examined. GEORGIA • 2 specimens; Chachuna Managed Reserve; 41.2500, 45.9484; 648 m a.s.l.; 15. July 2023; leg. B. Chitadze; near the ground in semidesert; CaBOL-ID 1035717.

Remarks. From the neighboring countries, *D. hispidulus* has been previously reported in Turkey, Armenia, Azerbaijan, and Russia (South European territory) (Lodos et al. 1999; Aukema and Rieger 2001). The species exhibits a wide-ranging distribution within the Palearctic realm (Aukema and Rieger 2001).

Scutellaridae Leach, 1815

Genus *Psacasta* Germar, 1839

***Psacasta neglecta* (Herrich-Schäffer, 1837)**

Fig. 7

Material examined. GEORGIA • 1 specimen; Gori; 41.970254, 44.092491; 790 m a.s.l.; 16. May 2023; leg. N. Bulbulashvili; under rocks in steppe; CaBOL-ID 1035491 (Fig. 7).

Remarks. From the neighboring countries, *P. neglecta* has been previously reported in Turkey and the North Caucasus of Russia (Putshkov 1961; Adlbauer and Heiss 1980; Fent and Aktaş 2007; Fent 2010). Common in the Balkan peninsula (Fent and Aktaş 2007). The main food plants for this species are *Lappula squarrosa*, and various species of *Echium* and *Anchusa* (Putshkov 1961).

Discussion

A total of 14 species of Heteroptera (*Dimorphopterus blissoides*, *Europiella decolor*, *Tuponia mixticolor*, *Deraeocoris ventralis*, *Orthocephalus brevis*, *Alloeorhynchus flavipes*, *Holcogaster fibulata*, *Vilpianus galii*, *Holotrichius bergrothi*, *Reduvius ciliatus*, *Oncocephalus squalidus*, *Pterotmetus staphyliniformis*, *Diomphalus hispidulus*, *Psacasta neglecta*), belonging to 7 different families, have been identified and recorded from various regions of Georgia for the first time, as well as new species of Auchenorrhyncha (*Trypetimorpha occidentalis*). Not surprisingly, Miridae outnumbered other families, as a total of four new species (*Europiella decolor*, *Tuponia mixticolor*, *Deraeocoris ventralis*, *Orthocephalus brevis*) were identified in this family. This is consistent with Miridae status as the largest heteropteran family, with more than 11,100 described species worldwide (Henry 2017).

Considering that most of these species have been previously reported from the adjacent territories, further targeted studies are expected to reveal more new records.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

BC & AS led the writing, prepared samples for genetic purposes, and identified specimens, NB, AS & L-GJ sampled the material, AD & PM identified specimens, AS prepared the figures.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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Supplementary material 1

Additional images of the mentioned barcoded specimens.

Authors: Chitadze B, Bulbulashvili N, Japaridze L-G, Drogvalenko A, Moulet P, Seropian A
Data type: (images)

Explanation note: The file contains additional photos of specimens mentioned in the main article (barcoded specimens) but does not represent the main text.

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