

## New Records of Eulophidae (Hymenoptera: Chalcidoidea) from Georgia (Sakartvelo)

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### ABSTRACT

Altogether, 55 species belonging to 21 genera of the family Eulophidae are recorded for the fauna of Georgia (Sakartvelo) from the Lagodekhi Nature Reserve. The most species-rich genera were *Diglyphus* Walker, 1844 with 10 species, *Chrysocharis* Foerster, 1856 and *Pediobius* Walker, 1846, with 9 species each. The most common species, comprising almost 10% of all specimens collected are *Pediobius metallicus* (Nees, 1834), *Diglyphus isaea* (Walker, 1838) and *Chrysocharis nephereus* (Walker, 1839). Most of the species are distributed in subalpine forest and subalpine meadows and shrubland zones.

**Keywords:** Biodiversity, Eulophinae, Entedoninae, Entiinae, Tetrastichinae, Europe.

Yefremova, Z., Kosheleva, O., Yegorenkova, E., & Japoshvili, G. (2024). New records of Eulophidae (Hymenoptera: Chalcidoidea) from Georgia (Sakartvelo). *Journal of the Entomological Research Society*, 26(2), 303-313.

Received: January 11, 2024

Accepted: May 15, 2024

## INTRODUCTION

The Lagodekhi Protected Areas, established in 1912 is a primeval territory in a good state of preservation with various natural landscapes. It is located in Lagodekhi, in the extreme northeastern part of the southern slopes of the Caucasus and extends across an altitudinal range of 590-3500 m. The Lagodekhi Protected Areas include Lagodekhi Nature Reserve (19749 ha) and Managed Reserve (4702 ha).

As the *Sakartvelo* is an original name of Georgia in its native language and means land of Kartvelians, e.g. people living in this territories during millenniums, we would like to use it in our publications and introduce this name to the public, as it has already been done in several publications of one of the coauthors of the paper (Riedel, Diller, & Japoshvili, 2018; Riedel & Japoshvili, 2021; Riedel et al. 2023).

Specimens included in this study represent part of the material collected in Lagodekhi reserve, using malaise traps during 2014, and within the whole vegetation season, aiming to study the biodiversity of Hymenoptera in Lagodekhi protected areas.

Universal Chalcidoidea Database (Noyes, 2019) includes 22 species of Eulophid wasps previously recorded from Georgia. Tetrastichinae wasps have been studied during 2016-2019 and the true number of eulophid species recorded up to now in Georgia is 67, according to latest studies (Japoshvili, Kostjukov, & Kosheleva, 2016a, 2016b; Japoshvili, Kostjukov, Kosheleva, & Yegorenkova, 2017; Japoshvili, Kostjukov, Kosheleva, & Podvarko, 2019; Japoshvili & Kostjukov, 2016, 2017; Kostjukov & Japoshvili, 2016a, 2016b, 2018; Kostjukov, Kosheleva, & Japoshvili, 2016; Kostjukov & Japoshvili, 2018).

The aim of this study is to provide the list of the species of Eulophidae that was not studied from Lagodekhi previously. It must be noted (see below under Material and Methods).

## MATERIAL AND METHODS

The material was collected using Malaise traps, which were installed in the Lagodekhi Nature Reserve protected areas in the following vertical zonal sites (Fig. 1), by the corresponding author:

- H 1: low-altitude forest, 666 m, N 41°51.149' E 46°17.266' (Fig. 2a)
- H 2: mid-altitude forest, 847 m, N 41°51.351' E 46°17.564' (Fig. 2b)
- H 3: high-altitude forest, 1351 m, N 41°52.288' E 46°18.692' (Fig. 1)
- H 4: subalpine forest, 1841 m, N 41°52.964' E 46°19.311' (Fig. 1)
- H 4-5: subalpine forest 1902 m, N 41°53.135' E 46°19.447' (Fig. 1)
- H 5: subalpine meadows and shrublands, 2230 m, N 41°53.883' E 46°20.033' (Fig. 1)
- H 6: alpine zone, 2559 m, N 41°54.371' E 46°20.004' (Figs. 2c, d)

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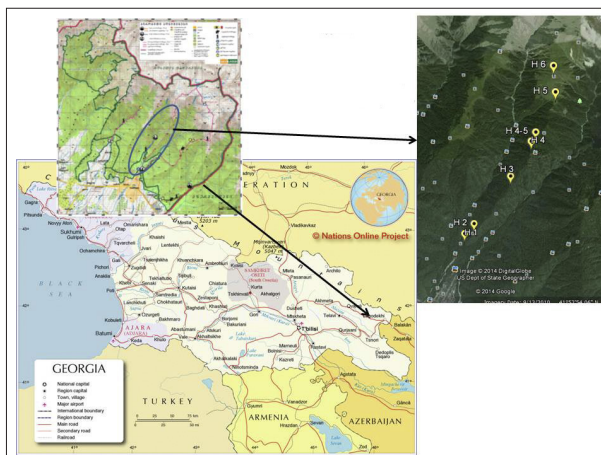


Figure 1. Georgia. Nature Reserve, vertical zones.

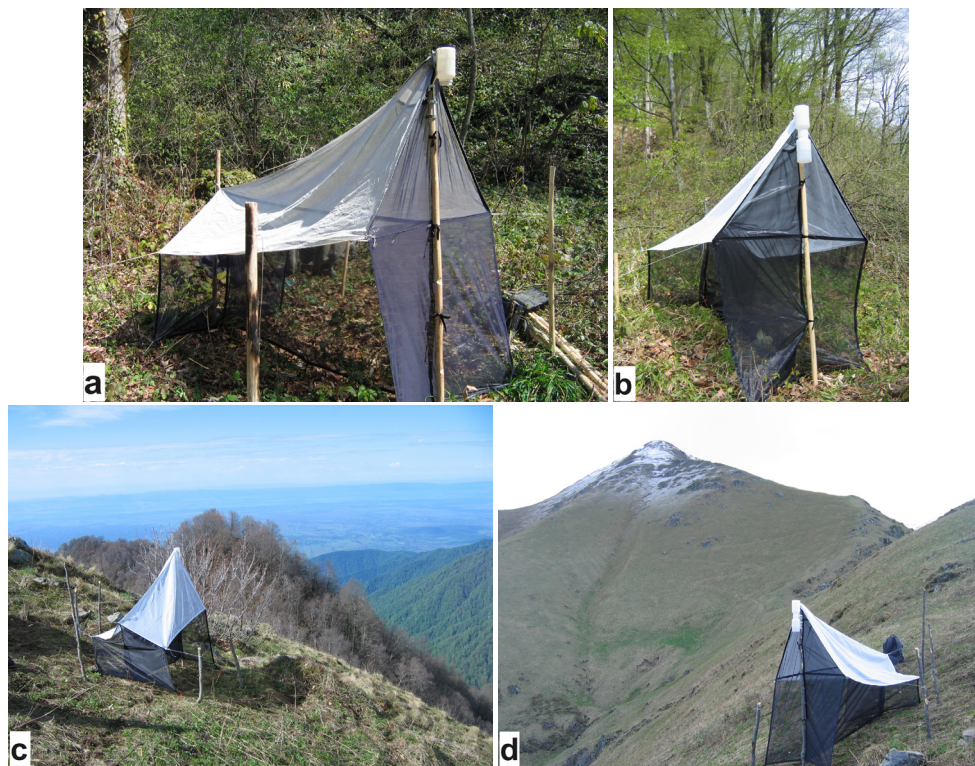


Figure 2. Malaise trap at different elevations. a) low-altitude forest, 666 m., b) mid-altitude forest, 847 m., c) alpine zone, 2559 m., d) alpine zone, 2559 m.

Malaise traps were obtained from B & N Entomological services (<http://www.entomology.org.uk/>).

Collecting began on 2 April 2014 and lasted until 7 November 2014, although in alpine and subalpine areas collecting began later (subalpine 5 May 2014; alpine 23 May 2014) and completed earlier (6 October 2014), due to climate conditions at higher altitudes. Containers were filled with 80% ethanol and species were collected every 10 ( $\pm$  2) days and placed in 96% ethanol, and afterwards they were sorted, dried and mounted according Noyes (2019). During this study, more than 120 containers have been collected. Collecting efforts were conducted by the corresponding author.

Since the corresponding author had a collaboration with Dr. V. Kostjukov, a great portion of the material was sent to him. Unfortunately, following his illness and later his death, the whereabouts of this material are unknown to us.

After sorting the rest of the material to family level, the Eulophidae were sent to different taxonomists: Zoya Yefremova, Oksana Kosheleva and Ekaterina Yegorenkova who screened, sorted and prepared the specimens for further determination.

Parasitoids were identified using the following keys: for *Pediobius*, Bouček, 1965 and Cao, LaSalle, & Zhu, 2017, for *Chrysocharis*, Hansson, 1985, 1987 and compared with specimens identified by Hansson in 2013, and for *Omphale*, Hansson & Shevtsova, 2012, for *Diglyphus* (Yefremova *et al.* 2011), *Elasmus* (Yefremova and Strachova 2009). Distributional data for each species are based on Noyes (2019).

Voucher specimens are deposited in the collection at the Institute of Entomology, Agricultural University of Georgia, Tbilisi, Georgia (IEAUG) and at The Steinhardt Museum of Natural History, Tel Aviv University, Tel Aviv, Israel (SMNH-TAU). Voucher locations are given under each species. New records for Georgia are marked with one (\*) and for Transcaucasia with two (\*\*) asterisks.

## RESULTS

### Taxa recorded in Georgia

#### Subfamily Entiinae Hedqvist 1974

*Astichus* Förster, 1856\*\*

*Astichus arithmeticus* (Förster, 1851)\*\*

**Material examined:** 1 ♀, H1, 2-12. 04. 2014; 2 ♀, H3, 3. 05. 2014 (det. O. Kosheleva) (IEAUG); 1 ♀, H1, 2 ♀, H3, 12-23. 04. 2014 (det. Z. Yefremova) (SMNH-TAU).

#### Subfamily Eulophinae Westwood, 1829

*Cirrospilus* Westwood, 1832

*Cirrospilus lyncus* Walker, 1838\*

**Material examined:** 1 ♂, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (IEAUG).

*Cirrospilus curvineurus* Askew, 1965\*\*

**Material examined:** 1 ♀, H2, 4. 05. 2014 (det. O. Kosheleva) (IEAUG).

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*Diglyphus* Walker, 1844\*

*Diglyphus albiscapus* Erdős, 1951\*\*

**Material examined:** 1 ♂, H5, 25. 06.-4. 07. 2014 (1 ♂) (det. O. Kosheleva) (IEAUG); 2 ♀, H5, 25. 06.-5. 07. 2014, Japoshvili (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus chabrias* (Walker, 1838)\*

**Material examined:** 4 ♀, H5, 25. 05.-4. 07. 2014 (det. O. Kosheleva) (IEAUG); 1 ♀, 1 ♂, H5, 25. 06. - 5. 07. 2014 (det. Yefremova) (SMNH-TAU).

*Diglyphus crassinervis* Erdős, 1958\*\*

**Material examined:** 3 ♀, H5, 25. 06. -5. 07. 2014; 1 ♀, H6, 25. 05.-4. 06. 2014; 1 ♀, H6, 26. 07. -5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus isaea* (Walker, 1838)\*

**Material examined:** 9 ♀, 3 ♂, H5, 25. 05.- 4. 07. 2014 (det. O. Kosheleva) (IEAUG) 11 ♀, 3 ♂, H6, 15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus minoeus* (Walker, 1838)\*\*

**Material examined:** 4 ♀, H5, 25. 06.-5. 07. 2014, 1 ♀, H6, 15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus poppoea* Walker, 1848\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus pulchripes* (Crawford, 1912)\*\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Diglyphus pusztensis* (Erdős & Novicky, 1951)\*

**Material examined:** 2 ♀, H5, 25. 05.-4. 07. 2014 (det. O. Kosheleva) (IEAUG); 1 ♀, H5, 25. 06.-5. 07. 2014; 1 ♀, H6, 25. 05.-4.06. 2014 (det. Yefremova) (SMNH-TAU).

*Diglyphus sensilis* Yefremova 2011\*\*

**Material examined:** 5 ♀, 2 ♂, H6, 15-25. 06. 2014, 2 ♀, H5, 5-15. 08. 2014; 1 ♂, H6, 25. 05.-4. 06. 2014; 1 ♀, 2 ♂, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (IEAUG).

*Diglyphus sabulosus* Erdős, 1951\*\*

**Material examined:** 1 ♀, H5, 25. 05.-4. 06. 2014, G. Japoshvili (det. O. Kosheleva) (IEAUG)

*Elachertus* Spinola, 1811

*Elachertus isadas* (Walker, 1839)\*\*

**Material examined:** 1 ♀, H5, 25. 05.-4. 06. 2014 (det. O. Kosheleva) (IEAUG)

*Elachertus fenestratus* Nees, 1834\*\*

**Material examined:** 1 ♀, H6, 23. 05.-13. 06. 2014 (det. Z. Yefremova) (IEAUG)

*Elasmus* Westwood, 1833

*Elasmus rufiventris* Ferrière, 1947

**Material examined:** 1 ♀, H1, 2-12. 04. 2014 (det. Z. Yefremova) (IEAUG).

Comment. Has already been recorded from Georgia (Zagulajev 1979). Holotype and paratype examined by Yefremova and Strakhova (2010).

*Eulophus* Goeffroy, 1762

*Eulophus thespius* Walker, 1939\*\*

**Material examined:** 2 ♀, H1, 23. 04.-3. 05. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Hemiptarsenus* Westwood, 1833

*Hemiptarsenus ornatus* (Nees, 1834)\*\*

**Material examined:** 2 ♀, H6, 15-27. 09. 2014 (det. Z. Yefremova) (SMNH-TAU); 1 ♀, H5, 15-27. 09. 2014 (det. Z. Yefremova) (IEAUG).

*Hyssopus* Girault, 1916\*

*Hyssopus nigritulus* (Zetterstedt, 1838)\*

**Material examined:** 1 ♂, H1, 23. 04.-3. 05. 2014; 1 ♂, H3, 23. 04.-3. 05. 2014; 3 ♀, H6, 25. 05.-4. 06. 2014; 1 ♀, H6, 15-25.06. 2014 (det. Z. Yefremova) (IEAUG); 1 ♀, H5, 25. 06.-5. 07. 2014; 2 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Microlycus* Thomson, 1878\*\*

*Microlycus heterocerus* Thomson, 1878\*\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014 (slide mounted) (IEAUG).

*Necremnus* Thomson, 1878\*\*

*Necremnus folia* (Walker, 1839)\*\*

**Material examined:** 1 ♀, H1, 23. 04.-3. 05. 2014 (SMNH-TAU).

*Pnigalio* Schrank, 1802

*Pnigalio agraules* (Walker, 1839)\*\*

**Material examined:** 1 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (IEAUG).

*Pnigalio epilobii* Bouček, 1966\*\*

**Material examined:** 1 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pnigalio nemati* (Westwood, 1838)\*\*

**Material examined:** 2 ♀, H6, 5. 07.-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pnigalio pectinicornis* (Linnaeus, 1758) \*\*

**Material examined:** 1 ♀, 3 ♂, H6, 5. 07.-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU); 3 ♂, H6, 23. 05.-13. 06. 2014; 1 ♂, H6, 15-27.09. 2014 (det. Z. Yefremova) (SMNH-TAU).

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*Pnigalio soemius* (Walker, 1839) \*\*

**Material examined:** 3 ♀, 1 ♂, H5, 25. 06.-05. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Sympiesis* Förster, 1856\*

*Sympiesis gordius* (Walker, 1939)\*\*

**Material examined:** 2 ♀, H3, 12-23. 04. 2014; 2 ♂, H6, 5-15.07. 2014 (det. Z. Yefremova) (IEAUG); 3 ♀, 1 ♂, H6, 15-25. 08. 2014; 3 ♀, H6, 5-15. 07. 2014; 3 ♀, H5, 5-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU)).

*Sympiesis gregori* Bouček, 1959\*

**Material examined:** 8 ♀, 4 ♂, H5, 5-15. 07. 2014 (det. Z. Yefremova); 3 ♀, 1 ♂, H5, 15-25. 08. 2014; 1 ♀, H6, 23. 05.-13. 06. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Sympiesis notata* (Zetterstedt, 1838)\*\*

**Material examined:** 1 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU)).

*Sympiesis sericeicornis* (Nees, 1834)\*

**Material examined:** 1 ♂, H3, 3. 05. 2014; 1 ♀, H1, 23. 04. -3. 05. 2014; 1 ♀, H5, 25. 06. -05.07. 2014 (det. Z. Yefremova) (IEAUG).

**Subfamily Entedoninae**

*Chrysocharis* Förster, 1856\*

*Chrysocharis acoris* (Walker, 1839)\*\*

**Material examined:** 5 ♀, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis budensis* Erdős, 1954\*

**Material examined:** 4 ♀, 2 ♂, H5, 5-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis eurynota* Graham, 1963\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis nephereus* (Walker, 1839)\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014; H5, 17 ♀, 4 ♂, H5, 23.05.-13.06. 2014; 2 ♀, 2 ♂, H5, 25. 05. -4. 06. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis pilosa* Delucchi, 1954\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014; 3 ♀, H6, 5-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis pilicoxa* (Thomson, 1878)\*

**Material examined:** 4 ♀, 3 ♂, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis prodice* (Walker, 1839)\*

**Material examined:** 5 ♀, 2 ♂, H5, 5-15.08. 2014; 1 ♀, H5, 25. 05.-4. 06. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis submutica* Graham, 1963\*

**Material examined:** 9 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Chrysocharis viridis* (Nees, 1834)\*

**Material examined:** 5 ♀, H5, 5-15. 08. 2014; 1 ♀, H6, 5.07.-15.08. 2014; 5 ♀, H6, 25.05.-4.06. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Closterocerus* Wetswood, 1833\**Closterocerus lanassa* (Walker, 1839)\*

**Material examined:** 2 ♂, H5, 23. 04.-3. 05. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Derostenus* Westwood, 1833\*\**Derostenus gemmeus* Westwood, 1833\*\*

**Material examined:** 1 ♀, H5, 5-15. 07. 2014 (det. O. Kosheleva) (IEAUG).

*Euderomphale* Girault, 1916\**Euderomphale chelidonii* Erdős, 1966\*

**Material examined:** 1 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (IEAUG); 2 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Horismenus* Walker, 1843\**Horismenus specularis* (Erdős, 1954)\*

**Material examined:** 1 ♀, H5, 4-14. 09. 2014 (SMNH-TAU).

*Neochrysocharis* Kurdjumov, 1912\*\**Neochrysocharis formosus* (Westwood, 1833)\*\*

**Material examined:** 1 ♀, H6, Malaise trap, 5-15. 07. 2014; 4 ♀ 2 ♂, H6, 23. 05.-13. 06. 2014; 1 ♀, 1 ♂, H6, 25. 05.-4. 06. 2014; 3 ♀, H5, 25. 07.-5. 08. 2014; 1 ♀, H6, 26. 07.-5. 08. 2014 (det. Z. Yefremova) (IEAUG).

*Omphale* Haliday, 1833*Omphale brevibuccata* Szelényi, 1978\*

**Material examined:** 2 ♀, H5, 25. 06.-5. 07. 2014; 8 ♀, 1 ♂, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Omphale isander* (Walker, 1839)\*\*

**Material examined:** 1 ♀, H5, 25. 06.-5. 07. 2014; 1 ♀, H5, 4-14.09. 2014 (det. Z. Yefremova) (IEAUG).

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*Omphale phruron* (Walker, 1839)\*

**Material examined:** 2 ♀, H6, 25. 05.-4. 06. 2014; 1 ♀, H5, 25. 06.-5. 07. 2014; 4 ♀, 2 ♂, H1, 23.04.-3.05. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius* Walker, 1846\*

*Pediobius alcaeus* (Walker, 1839)\*\*

**Material examined:** 1 ♂, H6, 15-25. 06. 2014 (det. Z. Yefremova) (IEAUG); 1 ♀, H5, 5-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius cassidae* Erdős, 1958\*\*

**Material examined:** 1 ♀, H6, 5-15. 06. 2014; 3 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (IEAUG); 2 ♀, 1 ♂, H6, 23. 05.-13. 06. 2014; 3 ♀, H5, 5-15. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius crassicornis* (Thomson, 1878)\*\*

**Material examined:** 1 ♀, H6, 25. 07.-5. 08. 2014 (det. Z. Yefremova) (IEAUG).

*Pediobius epeus* (Walker, 1839) \*\*

**Material examined:** 1 ♂, H2, 5-15. 05. 2014 (det. Z. Yefremova) (IEAUG); 1 ♀, H5, 25. 06.-5. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius eubius* (Walker, 1839) \*\*

**Material examined:** 1 ♀, H5, 25. 06 -5. 07. 2014 (det. Z. Yefremova) (IEAUG).

*Pediobius flaviscapus* (Thomson, 1878) \*\*

**Material examined:** 1 ♀, H2, 5-15. 05. 2014 (det. Z. Yefremova) (IEAUG); 1 ♀, H5, Malaise trap, 25. 06.-5. 07. 2014; 1 ♀, H6, 25. 07.-5. 08. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius metallicus* (Nees, 1834)\*

**Material examined:** 1 ♀, 1 ♂, H6, 25. 05.-4. 06.2014, 1 ♀; 1 ♂, H6, 15-25. 06. 2014; 1 ♀, 1 ♂, H6, 26. 07.-15. 08. 2014; 1 ♂, H6, 15-25. 08. 2014; 1 ♀, H5, 4-14. 09. 2014 (det. Z. Yefremova) (IEAUG); 11 ♀, 1 ♂, H6, 5-15. 07. 2014; 3 ♀, H6, 26. 07.-15. 08. 2014; 4 ♀, H6, 15. 07.-25. 08. 2014; 2 ♀, H5, 25. 06.- 5. 07. 2014, 1 ♀, 1 ♂, H6, 25. 05.-4.06. 2014, 1 ♀, H6, 4. 09.-14. 09. 2014 (det. Z. Yefremova) (SMNH-TAU).

*Pediobius saulius* (Walker, 1839)\*\*

**Material examined:** 1 ♀, H6, 23. 05-13. 06. 2014 (det. Z. Yefremova) (IEAUG).

*Pediobius nigratarsis* (Thomson, 1878)\*\*

**Material examined:** 1 ♀, H6, 5-15. 07. 2014 (det. Z. Yefremova) (SMNH-TAU).

## Subfamily Tetrastchinae

*Oomyzus Rodani*, 1870\*

*Oomyzus scaposus* (Thomson, 1878)\*

**Material examined:** 1 ♀, H5, 5-15. 07. 2014 (det. O. Kosheleva) (IEAUG).

## CONCLUSION

Four genera *Astichus*, *Necremnus*, *Derostenus* and *Neochrysocharis* are recorded from Transcaucasia for the first time, therefore all (4) species belonging to these genera are new to Transcaucasia and Georgia too. Additionally, 29 species are also new for Transcaucasia and Georgia. Five genera and 7 species are new for fauna of Georgia (Sakartvelo). Most of the species from the list have a Palaearctic and Holarctic distribution (20 and 18 respectively). Thirteen species have an European distribution. Only four species are cosmopolitan. Most species diverse genera were *Diglyphus* represented with 10 species, *Pediobius* and *Chrysocharis* each with 9 species.

## ACKNOWLEDGMENT

We also thank the Shota Rustaveli National Science Foundation for financial support (project ref. FR/221/7-110/13), Mrs Sophio Injia (BSc Student), for her help in preparation of photos.

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