HISTORIA NATURALIS BULGARICA

ISSN 2603-3186 (online) · ISSN 0205-3640 (print)

Volume **45** · Issue **4**

NATURA
ET SCIENTIA

Contents

National Museum of Natural History — Bulgarian Academy of Sciences
Sofia · 2023

Published online **6 April 2023** by:
National Museum of Natural History, Bulgarian Academy of Sciences
1 Tsar Osvoboditel Blvd, 1000 Sofia, Bulgaria
https://www.nmnhs.com/historia-naturalis-bulgarica/

Historia naturalis bulgarica 45 (4): 57–82
ISSN 2603-3186 (online) | ISSN 0205-3640 (print) · nmnhs.com/historia-naturalis-bulgarica
https://doi.org/10.48027/hnb.45.041
Publication date [online]: 6 April 2023

Research article

Moth flies (Diptera: Psychodidae) of Abkhazia (western Caucasus, Georgia) with some additional faunistic data from Armenia, Georgia, and Russia

Jan Ježek[1], Jozef Oboňa[2], Peter Manko[3]

(1) Department of Entomology, National Museum, Cirkusová 1740, CZ – 193 00 Prague 9 – Horní Počernice, Czech Republic, jan.jezek@o2active.cz; https://orcid.org/0000-0001-5993-4287
(2) [Corresponding author] Department of Ecology, Faculty of Humanities and Natural Sciences, University of Prešov, 17. novembra 1, SK – 081 16 Prešov, Slovakia, jozef.obona@unipo.sk; https://orcid.org/0000-0002-1185-658X
(3) Department of Ecology, Faculty of Humanities and Natural Sciences, University of Prešov, 17. novembra 1, SK – 081 16 Prešov, Slovakia, peter.manko@unipo.sk; https://orcid.org/0000-0003-1862-9117

Abstract: This paper attempts to fill the knowledge gaps in biodiversity of non-biting moth flies in the Caucasus (especially in Abkhazia) and create a suitable basis for subsequent (not only) ecological studies. In total, records of 65 Psychodidae (Sycoracinae – one sp., Psychodinae 64 spp., altogether 33 genera) species/subspecies are presented based on specimens collected mainly in Abkhazia, with some additional data from Armenia, Georgia, and Russia (12 new records). The Psychodidae fauna of Abkhazia now comprises 57 species, 31 of which are newly listed here. The Caucasus region (including the territory of Abkhazia presented here) should be considered the most biologically rich and most endangered region in the world, with an exceptional richness of endemic and endangered species also from the point of view of psychodids biodiversity. Sixteen extremely rare species in this family (probably Caucasus or highland endemics) which need to be given increased attention, whether from the point of view of island ecology or biodiversity protection, have been herein confirmed.

Keywords: Abkhazia, biodiversity, checklist, distribution, faunistics, moth flies, new records, Palaearctic Region, Transcaucasia, western great Caucasus, zoogeography

Introduction

Taxonomy is an essential tool for understanding biodiversity. It is also essential in biodiversity conservation and in addressing many critical and current nature conservation issues (e.g. McNeely, 2002; Kociolek & Stoermer, 2001; Schlick-Steiner et al., 2010). Therefore, much recent research in ecology and biodiversity conservation has been based mainly on taxonomic and faunal works. However, the availability of these data varies considerably from a spatial, temporal, and often taxonomic point of view. This creates gaps in biodiversity information (Amano et al., 2016). Particularly large gaps in biodiversity research can be observed in the Caucasus countries (Wetzel et al., 2018), and Diptera, specifically the family Psychodidae, are a good example of this (see Oboňa et al. (2017, 2019a, b); Ježek et al. (2018, 2021a) and supplemented checklist here. In particular, the low intensity of research is the reason why part of the entomofauna of the Caucasus is still unknown.

Many papers have presented the characteristics of Caucasian mountains of Abkhazia; they are listed, e. g., in the book Priroda Abchazii (The Nature of Abkhazia) – Kuftyreva et al. (1961). Some important entomological papers (Diptera: Psychodidae) concerning the countries of Transcaucasia have been published in the last several decades: Wagner (1981, 1990); Vaillant & Joost (1983); Oboňa et al. (2017, 2019a, b); Ježek et al. (2018, 2021a) as well as some added accounts with non-western Caucasian species included, incl. neighbouring countries – Ježek (1992a, 1995b, 1999). However, the Psychodidae of Abkhazia are still rather poorly known. In particular, data on non-phlebotomine

Received: 13 March 2023; accepted: 21 March 2023 · Editor: Mario Langourov

moth flies have been scattered in various papers and never summarised. New faunistic records and new taxa from the Abkhazian mountains (Western Caucasus) and their foothills were reported in following papers: *Parajungiella abchazica* Ježek, 1985 in Ježek (1985); *Yomormia achalshenica* Ježek, 1987, *Y. afonensis* Ježek, 1987, *Y. furva* (Tonnoir, 1940) and *Mormia ckvitariorum* Ježek, 1987 in Ježek (1987); *Seoda svanetica* (Ježek, 1989) in Ježek (1989); *Psychodocha cinerea* (Banks, 1894), *P. gemina* (Eaton, 1904) and *Psychodula minuta* (Banks, 1894) in Ježek (1990a); *Paramormia* (*P.*) *polyascoidea* (Krek, 1971) in Ježek (1990b); *Sycorax caucasica* Ježek, 1990 in Ježek (1990c); *Philosepedon clouense* Ježek, 1994 in Ježek (1994); *Kvazbamormia pskhuensis* Ježek, 1995 in Ježek (1995a); *Threticus petrosus* Ježek, 1997 and *Tonnoiriella arcuata* Ježek, 1997 in Ježek (1997); *Szaboiella hibernica* (Tonnoir, 1940) in Ježek (2004a); *Lepimormia georgica* (Wagner, 1981), *Peripsychoda auriculata* (Haliday in Curtis, 1839), *Philosepedon* (*Trichosepedon*) *balkanicum* Krek, 1971, *Threticus balkaneoalpinus* Krek, 1972, *T. negrobovi* Vaillant, 1972, *Chodopsycha lobata* (Tonnoir, 1940), *Logima erminea* (Eaton, 1893), *Pericoma* (*Pachypericoma*) *blandula* Eaton, 1893, *P.* (*P.*) *fallax* Eaton, 1893 and *Pneumia g. gracilis* (Eaton, 1893) in Ježek (2004b – *balkaneoalpinus* as well in 1995c); *Pneumia nubila* (Meigen, 1818) and *P. palustris* (Meigen, 1804) in Ježek & Hájek (2007, erratum).

As it is very important to fill these knowledge gaps, the presented research is devoted to expanding knowledge (filling the knowledge gap) of the biodiversity of non-biting Psychodidae of the Caucasus (especially from Abkhazia), thus creating a suitable basis for subsequent, not only ecological, studies.

Material and methods

Moth flies (for concise characteristics and biology, see e.g. Ježek et al., 2019, 2021b) were collected by the first author in Abkhazia (Fig. 1) the summer seasons of 1983, 1985 and 1988 by sweep-netting from vegetation growing in swamps, source areas and along watercourses and water reservoirs, alpine and subalpine habitats, as well as lowland biotopes. P. Chvojka, J. Dlabola and J. Šumpich (National Museum, Prague, Department of Entomology) provided extensive additional material from Georgia, Russia and Armenia.

The captured specimens were preserved in 75% ethanol in the field, and the Psychodidae specimens (cleared in chlorophenol, treated in xylol, and mounted on glass slides in Canada balsam) were identified by J. Ježek in a laboratory and deposited at the National Museum (Natural History Museum), Department of Entomology, Prague, Czech Republic. The slides are numbered with two separate series of numbers: INS = Inventory Slide Number of the family Psychodidae, and Cat. No. = Catalogue Numbers of slides of types and historical specimens of Diptera and are included in the Diptera collection (National Museum Prague collections – NMPC, see Tkoč et al., 2014).

Identification keys used: Vaillant (1971–1983); Szabó (1983); Withers (1989) and numerous unnamed original papers by different authors with descriptions of new species. The nomenclature is modified from Vaillant (1971–1983) and Wagner (1990, 2019) using the classifications of e.g. Ježek & van Harten (2005, 2009); Ježek (2007); Krek (1999); Omelková & Ježek (2012); Oboňa & Ježek (2014); Kvifte (2014); Kroča & Ježek (2019) and Ježek et al. (2019, 2021a).

The List of localities section contains the following data: transcript of the site name from the site label, locality number (in parentheses), the currently used site name (if available) and country, more detailed characteristics of the collection habitat, approximate collection coordinates (found according to site descriptions), approximate altitude, habitat vegetation inventory (if available).

The Unpublished records section contains the following data: country, transcript of the site name from the site label, locality number (in parentheses), the number and sex of the samples examined, date, collector's name and collection method (if available) and slides numbers.

The map presented in Fig. 1 is prepared using QGIS software (version: 3.10.10-A Coruña), data derived from the USGS/NASA SRTM providing seamless continuous topography surfaces (Jarvis et al., 2008), and from Natural Earth (free vector and raster map data @ naturalearthdata.com).

List of localities
(recorded species are summarised in Table 1)

1 Achalsopeli (Akhalsopeli – Georgia (Abkhazia)), wet small meadow, 43°00'N 41°06'E, 140 m a.s.l., veg.: *Alnus, Alisma, Scirpus, Carex, Mentha*.

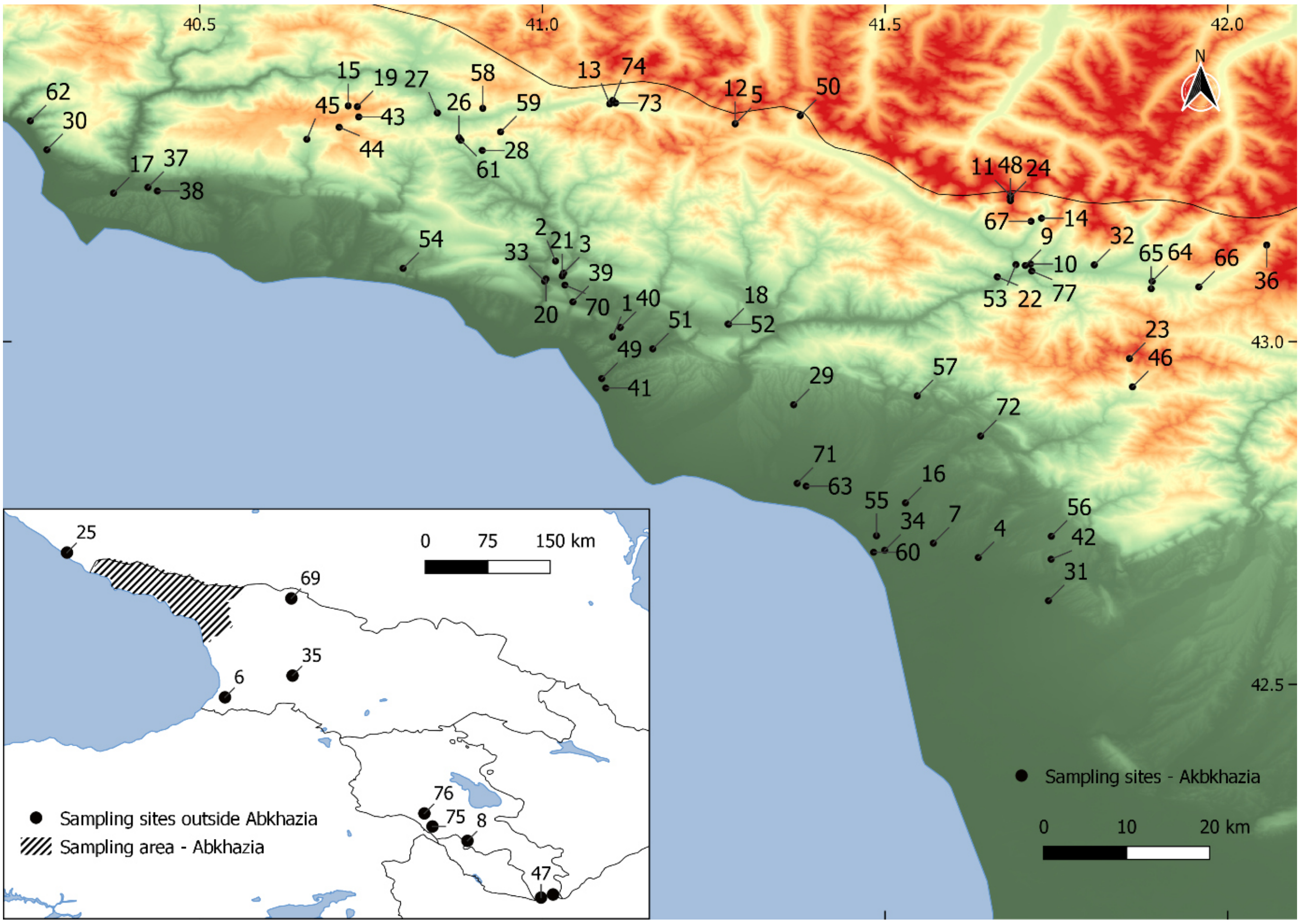


Fig. 1. Maps of sampling sites in Abkhazia (larger map with coloured elevation) and outside Abkhazia (a map showing the boundaries and shaded sampling area in Abkhazia).

2 Achalseni (Akhalsheni – Georgia (Abkhazia)), village env. Sukhumi, farms, wet road banks, rocks, swamps near crossways, 43°07'N 41°01'E, 490 m a.s.l., veg.: *Acer, Alnus, Corylus, Rubus, Hedera, Fragaria*, Marchantiopsida, Musci.

3 Achalseni near Sroma (Akhalsheni near Shroma – Georgia (Abkhazia)), Sukhumi environs, Vostočnaja Gumista River, rillets near a stone crusher, 43°05'N 41°01'E, 200 m a.s.l., veg.: *Alnus, Sambucus, Rubus*.

4 Acigvara (Achigvara – Georgia (Abkhazia)), Gali environs, muddy brook in tea plantations, 42°41'N 41°38'E, 40 m a.s.l., veg.: *Alnus, Pteris, Polygonum, Rubus, Camellia*.

5 Adanga Pass (Adange – Georgia (Abkhazia)), a basin with swamps, small brook from the pass, big stones, 43°19'N 41°16'E, 2470 m a.s.l., veg.: *Fagus, Picea, Rhododendron, Petasites, Caltha, Scirpus, Rumex, Luzula, Orchis*, Pteropsida.

6 Adjaria (Georgia), Mtirala NP, Chakvistavi ca. 20 km NE of Batumi, left and right tributaries of Chakvistskali River, brooks, streams, springs, 41°40'N 41°51'E, 250–410 m a.s.l., Chvojka leg.

7 Anaria (Anaria – Georgia (Abkhazia)), 7 km E of Ilori, spring area, 42°42'N 41°34'E, 30 m a.s.l., veg.: *Alnus, Sambucus, Robinia, Polygonum*, Marchantiopsida.

8 Areni (Armenia), Noravank monastery environs, rocky steppe, 39°41'N, 45°12'E, 1330 m a.s.l., Šumpich leg.

9 Azgara (Azhara – Georgia (Abkhazia)), environs of Levyj Ptys, forest brook, wet road banks, Alnetum, muddy pasture near river, 43°06'N 41°42'E, 920 m a.s.l., veg.: *Alnus, Carpinus, Fagus, Picea, Corylus, Rubus, Fragaria, Leonurus, Juncus, Hieracium, Urtica, Impatiens, Valeriana, Petasites*, Musci, Pteropsida.

10 Azgara – Narzan (Azhara – Georgia (Abkhazia)), larger environs of Maruch Pass, wet bank or slope of a road near a river, Alnetum, marshes, tea plantations, montane stream, 43°06'N 41°42'E, 940 m a.s.l., veg.: *Alnus, Fagus, Picea, Eucalyptus, Rubus, Rumex, Inula, Scirpus, Caltha, Carex*, Pteropsida.
11 Baskacara (Georgia (Abkhazia)), Levyj Ptys environs, swamps, small forest brooks near river, Alnetum, streams below glaciers, 43°12'N 41°40'E, 3330 m a.s.l., veg.: *Alnus, Fagus, Picea, Rubus, Fragaria, Juncus, Scirpus, Trollium, Urtica, Lycopodium, Inula, Petasites*, Musci, Pteropsida.
12 Below Adanga Pass (Adange Pass – Georgia (Abkhazia)), 8 km from the pass, marches, small forest brook, Azgara River, clump of alders, slope, 43°19'N 41°16'E, 2470 m a.s.l., veg.: *Alnus, Fagus, Picea, Petasites, Scirpus, Luzula, Orchis, Rumex, Fragaria, Caltha*, Pteropsida.
13 Below Chimsa Pass – River Ubus (Ubusch R.– Georgia (Abkhazia)), small sources, 43°20'N 41°05'E, 1590 m a.s.l., veg.: *Rhododendron, Salix, Alchemilla*, Pteropsida.
14 Below Maruch Pass (Georgia (Abkhazia)), Levyj Ptys environs, spring areas, small brooks in Alnetum near river, high alder forest, fountain, marches, 43°10'N 41°43'E, 1150 m a.s.l., veg.: *Alnus, Fagus, Picea, Abies, Rubus, Petasites, Asperula, Rumex, Ranunculus, Urtica, Scirpus, Alisma*, Musci, Pteropsida.
15 Below Ulm Pass (Georgia (Abkhazia)), rills of marches, 43°20'N 40°42'E, 1880 m a.s.l., veg.: *Rhododendron, Salix, Alchemilla*, Pteropsida.
16 Beslachuba (Beslakhuba – Georgia (Abkhazia)), Ocamcira environs, large pools near road, swamps in the vicinity of a churchyard, 42°45'N 41°31'E, 55 m a.s.l., veg.: *Alnus, Populus, Sambucus, Rubus, Polygonum, Urtica*, Pteropsida.
17 Bzyb (Bzipi – Georgia (Abkhazia)), river 2–7 km from source area, Baskacara environs, small brooks in beech wood, sometimes with mineral water, marches, clump of alders, 43°13'N 40°22'E, 30 m a.s.l., veg.: *Alnus, Fagus, Picea, Rubus, Petasites, Rumex, Asperula, Oxalis, Ranunculus, Caltha*, Pteropsida.
18 Cebelda (Tsebelda – Georgia (Abkhazia)), arable land, fields, canals of irrigation, wet meadows, dried Alnetum, 43°01'N 41°16'E, 470 m a.s.l., veg.: *Alnus, Sambucus, Salix, Rubus, Scirpus, Typha, Fragaria, Pteris, Lythrum, Urtica*.
19 Chimsa near Ulm (Georgia (Abkhazia)), Bzybskyj Chrebet comb (Bzybskiy Khrebet), waterfalls, subalpine meadows in vicinity of passes, 43°20'N 40°43'E, 2300 m a.s.l., veg.: *Rhododendron, Alchemilla*, Pteropsida.
20 Cimuri (Georgia (Abkhazia)), larger environs of Sukhumi, Bzybskij Chrebet comb (Bzybskiy Khrebet), glades, marches in Alnetum, hygropetric rocky walls, spring areas, rotten wood, Vostočnaja Gumista River, stream below a bridge, rocks, gate to NR, 43°05'N 41°00'E, 85 m a.s.l., veg.: *Alnus, Fagus, Carpinus, Juglans, Rhododendron, Sambucus, Hedera, Rumex, Juncus*, Pteropsida, Marchantiopsida, Musci.
21 Cimuri near Achalseni (nr. Akhalsheni – Georgia (Abkhazia)), Sukhumi district, pastures, sources almost without plants, 43°05'N 41°01'E, 150 m a.s.l., veg.: *Fagus, Fragaria*.
22 Cchalta (Chkhalta – Georgia (Abkhazia)), marches near river, spring areas, 43°05'N 41°39'E, 720 m a.s.l., veg.: *Juglans, Alnus, Sambucus, Geranium, Polygonum, Leonurus, Urtica, Persicaria*, Marchantiopsida.
23 Clou – Kodorskij Chrebet comb (Kodorskiy Khrebet – Georgia (Abkhazia)), gorge, brook, hygropetric rocky walls, 42°58'N 41°51'E, 2330 m a.s.l., veg.: *Alnus, Rhododendron, Rosa, Rubus, Petasites, Hepatica, Phyllitis, Urtica, Inula*, Pteropsida, Marchantiopsida, Musci.
24 Cerna Voda (Georgia (Abkhazia)), Baskacara environs, river, small brooks with flocculated Fe, marches, beech wood, 43°12'N 41°40'E, 3430 m a.s.l., veg.: *Alnus, Fagus, Picea, Rubus, Caltha, Petasites, Ranunculus*.
25 Dagomys (Dagomys – Krasnodar Krai, Russia), settlement, 13 km NW from Sochi, 43°40'N 39°40'E, 20 m a.s.l., Dlabola leg.
26 Dou Pass (Dou Pass – Georgia (Abkhazia)) – small brook, 43°17'N 40°52'E, 1390 m a.s.l., veg.: *Fagus, Rhododendron, Alnus, Juglans, Prunus, Urtica*, Pteropsida.
27 Dou near Bzyb (Dou Pass near Bzipi – Georgia (Abkhazia)), slope glade on the way from the pass to river, small brook, 43°20'N 40°50'E, 580 m a.s.l., veg.: *Fagus, Rhododendron, Alnus, Juglans, Prunus, Urtica*, Pteropsida.
28 Dvurecje near Dou (Georgia (Abkhazia)), slope habitat 1200–1350 m below pass, path course to Dou River, plant liana strings above water, Bryophyta of flow stones, glade with small brook

and gamekeeper's lodge, fallen branches, hygropetric rocky walls, small streams, 43°16'N 40°54'E, 1100 m a.s.l., veg.: *Fagus*-forest, *Rhododendron, Alnus, Phyllitis, Asplenium, Alchemilla, Viola, Pteris*, Pteropsida, Musci.

29 Dzgerda (Jgerda – Georgia (Abkhazia)), Kodorskij Chrebet comb, small forest brook, pastures, impervious fences, rills, fluvials, 42°54'N 41°21'E, 176 m a.s.l., veg.: *Alnus, Fraxinus, Fagus, Crataegus, Ilex, Rhododendron, Rubus, Hedera, Pteris*, Marchantiopsida.

30 Gagra (Gagra – Georgia (Abkhazia)), town spring areas, gardens, 43°16'N 40°16'E, 125 m a.s.l., veg.: *Salix, Ficus, Sambucus, Rubus*.

31 Gali (Gali – Georgia (Abkhazia)), rivulet, swamps, Camellia hedgerows, 42°37'N 41°44'E, 60 m a.s.l., veg.: *Alnus, Pteris, Polygonum, Scirpus, Camellia*.

32 Gencvici (Gentsvishi – Georgia (Abkhazia)), river, brook, swamps in Alnetum, paludal habitats, 43°06'N 41°48'E, 895 m a.s.l., veg.: *Alnus, Picea, Urtica, Polygonum*, Musci.

33 GES – Sukhumi (Georgia (Abkhazia)), district town environs, hydroelectric power station, monkey farm env. River Gumista nr. Achalseni (Akhalsheni) (6 km from Sukhumi), branches of Corylus over footpath, 43°05'N 41°00'E, 90 m a.s.l., veg.: *Sambucus, Rhododendron, Urtica*.

34 Ilori (Ilori – Georgia (Abkhazia)), creek, turning from main flow to Pokveš (Pokvesh), marches in Alnetum, 42°41'N 41°29'E, 13 m a.s.l., veg.: *Alnus, Rubus, Polygonum*.

35 Imereli (Georgia), prov., Baghdati near Saime, Tsablarastskali River, 41°58' N, 42°47' E, 385 m a.s.l., Chvojka leg.

36 Juznyj Prijut Pass (Georgia (Abkhazia)), waterfalls, hygropetric rocky walls, 43°08'N 42°03'E, 1940 m a.s.l., veg.: *Alnus, Rhododendron*.

37 Kaldachvara (Kaldakhvara – Georgia (Abkhazia)), eastern border of the settlement, town Bzyb (Bzipi) region, tunnel below road, small brook in Alnetum, 43°13'N 40°25'E, 80 m a.s.l., veg.: *Alnus, Sambucus, Corylus, Hedera, Urtica, Rubus*, Pteropsida, Musci.

38 Kaldachvara near Mjusoera (Kaldakhvara near Myussera – Georgia (Abkhazia)), crossways, swamps in Alnetum, 43°13'N 40°26'E, 130 m a.s.l., veg.: *Typha, Alisma, Juncus, Mentha*.

39 Kaman (Kamani – Georgia (Abkhazia)), village env. Sukhumi, well in glade with small brook, white stones, 43°03'N 41°02'E, 230 m a.s.l., veg.: *Carpinus, Sambucus, Zea*, Pteropsida, Marchantiopsida, Musci.

40 Kelasuri (Kelasuri – Georgia (Abkhazia)), river and settlement env. Sukhumi, Kodorskij Chrebet comb (Kodorskiy Khrebet), Alnetum, swamps near riverbed, small brook, pastures, clough, hydropetric rocky walls, 43°01'N 41°06'E, 200 m a.s.l., veg.: *Alnus, Carpinus, Rhododendron, Sambucus, Hedera, Rubus, Phyllitis, Petasites, Alisma, Impatiens*, Pteropsida, Marchantiopsida, Musci.

41 Kingdi – vicinity of Gulripši (Gulripshi – Georgia (Abkhazia)), Alnetum near road, marches, 42°55'N 41°05'E, 7 m a.s.l., veg.: *Alnus, Carpinus, Corylus, Sambucus, Scirpus, Hedera, Urtica*, Pteropsida, Musci.

42 Kochora (Kokhora – Georgia (Abkhazia)), 3 km NW of Gali, swamps in Alnetum near road, 42°40'N 41°44'E, 140 m a.s.l., veg.: *Alnus, Rhododendron, Rubus, Polygonum*.

43 Kot – Kot (Georgia (Abkhazia)), a pastoral community of grazing management approximately 2350 m a.s.l., Bzybskij Chrebet comb (Bzybskiy Khrebet), nr. peak Khimsa (3033 m a.s.l.), 43°19'N 40°43'E, 1880 m a.s.l., veg.: *Hieracium, Alchemilla, Polygonum*, Pteropsida.

44 Kot – Kot near Cimuri (Georgia (Abkhazia)), a pastoral community in Bzybskij Chrebet comb. (Bzybskiy Khrebet), Sukhumi distr., glade, forest zone, lakes, small brooks, pools, trickling rocky slopes, peat and swamp bogs, river, marches, beech wood, 43°18'N 40°42'E, 2070 m a.s.l., veg.: *Alnus, Acer, Picea, Sambucus, Carpinus, Robinia, Sorbus, Fagus, Rhododendron, Petasites, Caltha, Juncus, Scirpus, Impatiens, Rumex, Inula, Asperula, Hieracium, Alchemilla, Polygonum, Sphagnum, Lemna*, Pteropsida, Musci.

45 Kot – Kot near Ulm Pass (Georgia (Abkhazia)), Bzybskij Chrebet (Bzybskiy Khrebet) comb behind Ulm Pass, pastoral community, glades, lakes, swamps, 43°17'N 40°39'E, 1000 m a.s.l., veg.: *Fagus, Alnus, Acer, Sorbus, Juncus, Rumex, Petasites, Caltha*, Pteropsida.

46 Kutol Kodorskij Chrebet comb (Kodorskiy Khrebet – Georgia (Abkhazia)), village, small meadow, fountain, 42°56'N 41°51'E, 1300 m a.s.l., veg.: *Alnus, Polygonum*.

47 Lehvaz (Armenia), environs, 3 km NWW of Meghri, Arevik NP, rocky steppe, gorge, 38°54'N 46°13'E, 844 m a.s.l., Šumpich leg.

48 Levyj Ptys (Georgia (Abkhazia)), spring area near river, fallen branches, trickling banks of road, brook, 43°12'N 41°40'E, 3430 m a.s.l., veg.: *Alnus, Fagus, Juglans, Corylus, Polygonum, Lythrum, Fragaria, Leonurus*, Pteropsida, Marchantiopsida, Musci.

49 Macara (Machara – Georgia (Abkhazia)), Sukhumi distr., mandarin garden plantation (day as well as night collecting), walled WC, river, irrigation canal, village rill, shallow stony riverbed, almost dried ditch in building site, 42°56'N 41°05'E, 10 m a.s.l., veg.: *Citrus, Pinus, Alnus, Populus, Prunus, Corylus, Rubus, Alisma, Mentha, Typha, Hedera, Urtica*.

50 Maruch near Adanga (Marukhi Pass Georgia (Abkhazia)), small brook near footpath in the vicinity of both passes, 43°20'N 41°22'E, 2140 m a.s.l., veg.: *Alnus, Acer, Corylus, Picea, Rumex, Petasites*.

51 Mercheuli (Merkheuli – Georgia (Abkhazia)), 8 km from Macara (bridge), Sukhumi district, houses, brook, marches, hills, hygropetric rocky wells, conglomerate rocks, 42°59'N 41°09'E, 60 m a.s.l., veg.: *Alnus, Rubus*, Pteropsida, Marchantiopsida, Musci.

52 Mramba – Cebelda (Tsebelda – Georgia (Abkhazia)), environs, sheer slope, pasture, well, muddy pools of domestic pigs, stream, branches of oak and hazel shrubs above water, 43°01'N 41°16'E, 450 m a.s.l., veg.: *Quercus, Corylus, Alnus, Pteris, Urtica, Mentha*.

53 Niznaja Zemo – Azara) (Azhara – Georgia (Abkhazia)), marches near village, rubbish, crocks, 43°06'N 41°41'E, 560 m a.s.l., veg.: *Alnus, Polygonum, Leonurus*.

54 Novyj Afon near Anuchva (54) (Akhali Atoni – Georgia (Abkhazia)), Psyrccha River, riverbed, spring areas, fountain, small brooks, rocks, 43°06'N 40°47'E, 230 m a.s.l., veg.: *Sambucus, Carpinus, Ficus, Buxus, Rubus, Asplenium*, Marchantiopsida.

55 Ocamcira (Ochamchire – Georgia (Abkhazia)), refuse in ditches, 42°43'N 41°29'E, 10 m a.s.l., veg.: *Alnus, Carpinus, Rhododendron, Rubus, Polygonum, Urtica, Pteris*.

56 Okumi (Okumi – Georgia (Abkhazia)), 2–4 km SW of the village, Tkvarceli env., S of Kodorskij Chrebet comb (Kodorskiy Khrebet), brook, pastures, marches, runnel in tenuous pine wood, 42°42'N 41°44'E, 170 m a.s.l., veg.: *Alnus, Pinus, Larix, Robinia, Rubus, Luzula, Carex, Polygonum, Pteris, Mentha*.

57 Otap (Otapi – Georgia (Abkhazia)), Kodorskij Chrebet comb (Kodorskiy Khrebet), slope, pasture, wet places, branches of alders above stream, swamps near way and in hillside, brook, thorny fences, 42°55'N 41°32'E, 230 m a.s.l., veg.: *Alnus, Salix, Sambucus, Lythrum, Polygonum*.

58 Pskhu (nr. P'skhus Nakrdzali – Georgia (Abkhazia)), a beautiful green valley, alluvial zone and wet places on banks of the River Bzyb (Bzipi), (2.5 km from the settlement, approximately 1400 m a.s.l. – southern and northern border), marshes, swamps, pools, pastures, clearings, tenuous alder forest, shaded sources by different plants, small forest brooks, streams, rills, (trickling southern slopes incl. regional airport), farming residents 100 m from Bzyb (Bzipi) River, small meadows, fenced gardens, branches of alders above flows, 43°20'N 40°54'E, 1830 m a.s.l., veg.: *Alnus, Fagus, Juglans, Sambucus, Corylus, Rubus, Inula, Carex, Equisetum, Juncus, Mentha, Pteris, Hedera, Poaceae, Fragaria, Hepatica, Urtica, Impatiens, Plantago, Mentha, Alisma, Trollius, Lythrum*, Pteropsida, Musci, Marchantiopsida.

59 Pskhu near Dou (nr. P'skhus Nakrdzali near Dou Pass – Georgia (Abkhazia)), southern footpath from border of the village to Dou Pass, farming residents, small brooks, spring areas, 43°18'N 40°56'E 1900 m a.s.l., veg.: *Juglans, Corylus, Rubus, Inula, Impatiens, Urtica, Mentha*.

60 Reka near Gali – Ilori environs (Georgia (Abkhazia)), crossways, 42°41'N 41°29'E, 2 m a.s.l., veg.: *Alnus, Polygonum*.

61 Resava) (Georgia (Abkhazia)) environs, ca. 1300 m below Dou Pass, swamps in beech forest, fallen tree branches, 43°17'N 40°52'E, 1390 m a.s.l., veg.: *Fagus, Alnus, Corylus, Juncus, Carex*, Pteropsida.

62 Rica (Georgia (Abkhazia)), larger Gagra environs, dried canal with wet places, road, small rocky brook, lake, 43°19'N 40°15'E, 120 m a.s.l., veg.: *Acer, Carpinus, Picea, Petasites, Inula, Asplenium, Urtica, Fragaria, Stachys*.

63 Sagra near Tamys (Tsagera near Tamishi – Georgia (Abkhazia)), road to Ocamcira (Sukhumi environs), arable land, fields, ditch in tea plantations, 42°47'N 41°23'E, 20 m a.s.l., veg.: *Eucalyptus, Alnus, Rubus, Juncus, Zea, Camellia*.

64 Saken (Sakeni – Georgia (Abkhazia)), 90 km from Sukhumi, river, small montane brooks with pools,

swamps in alder forest, 43°05'N 41°53'E, 990 m a.s.l., veg.: *Alnus, Corylus, Geranium, Leonurus, Urtica*, Musci.

65 Saken – Narzan (nr. Sakeni – Georgia (Abkhazia)), montane chalets near peaks above settlement, spring areas, small brooks, river, lush alder growth, forest marches and swamps, pasture muddy sections, slopes, glade streams, tributaries of lakes, branches of alders above water flows, fallen tree branches, collecting as well in night (22:00), 43°04'N 41°53'E, 1170 m a.s.l., veg.: *Alnus, Fagus, Acer, Picea, Corylus, Juglans, Prunus, Sambucus, Rubus, Equisetum, Juncus, Impatiens, Fragaria, Inula, Ranunculus, Trollius, Petasites, Alchemilla, Myosotis, Aquilegia, Heracleum, Rumex, Geranim*, Pteropsida, Musci.

66 Saken near Juznyj Prijut Pass (Sakeni – Georgia (Abkhazia)), marches near road (crossways), small brook, Alnetum, 43°04'N 41°57'E, 1300 m a.s.l., veg.: *Alnus, Geranium, Leonurus, Urtica*.

67 Serbista (Georgia (Abkhazia)), larger environs of the Maruch Pass, alder forest, small brooks, muddy pasture, 43°10'N 41°42'E, 1410 m a.s.l., veg.: *Alnus, Petasites, Rumex, Caltha, Inula*.

68 Shvanidzor (Armenia), environs, Arevik NP, rocky steppe, 38°56'N 46°22'E, 780 m a.s.l., Šumpich leg.

69 Svanetia (Georgia), SE, N and W of Mestia, left brook (stream) tributary of Mulkhura River, and Dolra River (left tributary of) above Ushkhvan, source area, 43°02'N 42°46'E, 1370–1700 m a.s.l., Chvojka leg.

70 Sroma (Shroma – Georgia (Abkhazia)), Sukhumi distr., hills, sources near stone crusher, 43°04'N 41°01'E, 240 m a.s.l., veg.: *Alnus, Robinia, Rubus, Juncus, Mentha*.

71 Tamys (Tamishi – Georgia (Abkhazia)), vicinity of Sukhumi, alder growth near road, brook, swamps, tea plantations, 42°47'N 41°22'E, 15 m a.s.l., veg.: *Alnus, Eucalyptus, Rubus, Scirpus, Caltha, Camellia*.

72 Tkvarceli (Tkvarcheli – Georgia (Abkhazia)), 3 km E of the settlement, stream near Galidzga (Ghalidzga) river, limestone areas, branches of alders above water, 42°51'N 41°38'E, 160 m a.s.l., veg.: *Alnus, Buxus*.

73 Ubus) (Ubusch – Georgia (Abkhazia)), river as tributary of Bzyb (Bzipi) flow (in a distance 3–5 km), wet slopes and small brooks in beech wood, pasture, glade, grazing banks, 43°20'N 41°06'E, 1390 m a.s.l., veg.: *Fagus, Alnus, Picea, Petasites, Rumex, Inula, Caltha*, Pteropsida.

74 Ubus near Bzyb (Ubusch near Bzipi – Georgia (Abkhazia)), confluence of rivers, clearings in riverbed, 43°21'N 41°06'E, 1340 m a.s.l., veg.: *Alnus, Heracleum, Caltha*.

75 Vedi (Armenia), Goravan village environs, Goravan sands, Sanctuary sandy steppe, 39°53'N 44°43'E, 956 m a.s.l., Šumpich leg.

76 Yerevan (Armenia), 13 km SE of the town, Hatsavan nr. Azat Reservoir, steppe, 40°06'N 44°50'E, 1071 m a.s.l., Šumpich leg.

77 Zemo – Azara (Kvemo Azhara – Georgia (Abkhazia)), swamps in Alnetum near river, brook, stream, small flows, spring area, branches of alders above flows, grazing banks, swamps, old pots, 43°06'N 41°42'E, 540 m a.s.l., veg.: *Alnus, Sambucus, Rhododendron, Corylus, Buxus, Rubus, Fragaria, Leonurus, Geranium, Polygonum, Urtica*, Marchantiopsida, Musci.

Results

List of species

Sycorax caucasica Ježek, 1990 – Published records: Ježek (1990c): Azgara (9), Južnj Prijut Pass (36), Levyj Ptys (48), Mercheuli (51), Saken (64), Saken – Narzan (65), Serbista (67), Zemo – Azara (77). Unpublished records: Georgia: Adjaria (6), 2 ♂♂, 30.vi.2013, Chvojka leg., SW, INS 30708 and 30794. Abkhazia: Azgara – Narzan (10), 2 ♂♂, 1.viii.1985, INS 30601 and 30602. Clou (23), 3 ♂♂, 8.viii.1988, INS 2584, 30112 and 30308. Dou near Bzyb (27), 1 ♂, 22.vii.1988, INS 30113. Dvurecje near Dou (28), 5 ♂♂, 20. and 21.vii.1988, INS 30109, 30110, 30111 30307 and 30310. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30408. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30309. Pskhu (58), 2 ♂♂, 26.vii.1988, INS 2625 and 2626. Resava (61), 1 ♂, 22.vii.1988, INS 30201. Distribution: Transcaucasian species known for tree decades only from Abkhazia (Ježek, 1990c), newly from Georgia, another country than Abkhazia (Oboňa et al., 2019; Ježek et al., 2021a).

Kvazbamormia pskhuensis Ježek, 1995 – Published record: Ježek (1995a): Pskhu (58). Distribution: This species and genus are known so far only from the original description (Ježek, 1995a) from Abkhazia (single locality). See also Oboňa et al. (2019).

Lepimormia georgica (Wagner, 1981) – Published record: Ježek (2004b): Pskhu (58). Unpublished records: Abkhazia: Mercheuli (51), 1 ♂, 5.vii.1983, INS 30524. Pskhu (58), 4 ♂♂, 27. – 29.vii.1988, INS 30031, 30032, 30322 and 30323. Distribution: Transcaucasian species, known from the original description from Georgia (Wagner, 1981) and Abkhazia (Ježek, 2004b).

Mormia ckvitariorum Ježek, 1987 – Published records: Ježek (1987): Achalseni (2), Kaman (39), Kelasuri (40) and Novyj Afon near Anuchva (54). Unpublished records: Abkhazia: Clou (23), 1 ♂, 8.viii.1988, INS 2587. GES – Sukhumi (33), 1 ♂, 3.viii.1988, INS 30116. Macara (49), 2 ♂♂, 5.vii.1983, INS 30513 and 30515. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30514. Otap (57), 1 ♂, 10.viii.1988, INS 30117. Tkvarceli (72), 1 ♂, 11.viii.1988, INS 30204. Distribution: Species of Greater Caucasus: Abkhazia and Azerbaijan (Ježek, 1987; Ježek et al., 2021a).

Promormia silesiensis Ježek, 1983 – Unpublished record: Georgia: Adjaria (6), 1 ♂, 30.vi.2013, Chvojka leg., SW, INS 30832. Distribution: European species, known from Czech Republic, Germany, Greece, Poland, Slovakia, Slovenia (Kroča & Ježek, 2015) and penetrates into Transcaucasia – Azerbaijan (Ježek et al., 2021a). New for Georgia.

Psychomormia vaillanti (Wagner, 1977) – Unpublished record: Abkhazia: Azgara (9), 1 ♂, 21.vii.1983, INS 30564. Distribution: A very rare European species thus far known only from Germany and the Czech Republic so far (Ježek et al., 2019). New for Abkhazia and Transcaucasia.

Yomormia achalshenica Ježek, 1987 – Published records: Ježek (1987): Achalseni (2) and Novyj Afon near Anuchva (54). Unpublished records: Abkhazia: Macara (49), 1 ♂, 4.vii.1983, INS 30482. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30483. Zemo – Azara (77), 1 ♂, 14.vii.1983, INS 30569. Armenia: Shvanidzor (68), 1 ♂, 26.ix.2018, Šumpich leg., SW, INS 30673. Vedi (75), 1 ♂, 30.ix.2018, Šumpich leg., SW, INS 30674. Distribution: This species was thus far known only by its original description (Ježek, 1987) from Abkhazia. New for Armenia.

Yomormia afonensis Ježek, 1987 – Published records: Ježek (1987): Novyj Afon near Anuchva (54). Unpublished records: Abkhazia: Kaldachvara (37), 1 ♂, 1.viii.1988, INS 30083. Macara (49), 1 ♂, 4.vii.1983, INS 30484. Otap (57), 1 ♂, 10.viii.1988, INS 30082. Pskhu (58), 2 ♂♂, 28.vii.1988, INS 30279 and 30280. Distribution: This species was thus far known only by its original description (Ježek, 1987) from Abkhazia.

Yomormia furva (Tonnoir, 1940) – Published records: Ježek (1987): Novyj Afon near Anuchva (54) and Zemo – Azara (77). Unpublished records: Georgia: Adjaria (6), 1 ♂, 1.vii.2013, Chvojka leg., SW, INS 30796. Abkhazia: Azgara (9), 1 ♂, 21.vii.1983, INS 30518. Azgara – Narzan (10), 1♂, 1.viii.1985, INS 30605. Baskacara (11), 2 ♂♂, 18.vii.1983, INS 30209 and 30520. Dvurecje near Dou (28), 1 ♂, 20.vii.1988, INS 30121. Gencvici (32), 2 ♂♂, 7.vii.1983, INS 30212 and 30712. Levyj Ptys (48), 1 ♂, 22.vii.1983, INS 30019. Pskhu (58), 1 ♂, 25.vii.1988, INS 30319. Saken (64), 1 ♂, 8.vii.1983, INS 30711. Saken – Narzan (65), 5 ♂♂, 9. and 12.vii.1983, INS 30021, 30022, 30210, 30211 and 30713. Saken near Juznyj Prijut Pass (66), 2 ♂♂, 8.vii.1983, INS 30521 and 30715. Zemo – Azara (77), 3 ♂♂, 10. and 14.vii.1983, INS 30320, 30519 and 30714. Distribution: Western European species (Wagner, 1990, 2019), penetrates into Abkhazia (Ježek, 1987). New for Georgia.

Parajungiella abchazica Ježek, 1985 – Published record: Ježek (1985): Saken – Narzan (65). Unpublished records: Abkhazia: Achalsopeli (1), 1 ♂, 1.viii.1988, INS 30066. Achalseni near Sroma (3), ♂, 15.viii.1985, INS 30468. Acigvara (4), 1 ♂, 6.viii.1988, INS 2599. Anaria (7), 1 ♂, 7.viii.1988, INS 30068. Azgara (9), 2 ♂♂, 21.vii.1983, INS 30480 and 30565. Below Maruch Pass (14), 1 ♂, 16.vii.1983, INS 30474. Beslachuba (16), 2 ♂♂, 11.viii.1988, INS 29070 and 30171. Cebelda (18), 2 ♂♂, 4.viii.1988, INS 2609 and 30072. Cimuri (20), 4 ♂♂, 13.viii.1985, INS 1375, 1381, 30368 and 30371. Cchalta (22), 3 ♂♂, 15. and 22.vii.1983, INS 30477, 30478 and 30765. Clou (23), 3 ♂♂, 8.viii.1988, INS 2585, 30069 and 30270. Dvurecje near Dou (28), 2 ♂♂, 20.vii.1988, INS 30074 and 30075. Dzgerda (29), 2 ♂♂, 2.viii.1988, INS 30067 and 30166. Gencvici (32), 2 ♂♂, 7.vii.1983, INS 30170 and 30670. Ilori (34), 1 ♂, 7.viii.1988, INS 29072. Kaldachvara (37), 1 ♂, 1.viii.1988, INS 30077. Kaldachvara near Mjusoera (38), 1 ♂, 1.viii.1988, INS 2603. Kelasuri (40), 2 ♂♂, 25.viii.1985, INS 30370 and 30467. Kingdi (41), 3 ♂♂, 24.viii.1985, INS 30366, 30567 and 30665. Kochora (42), 1 ♂, 6.viii.1988, INS 30073. Kutol (46), 1 ♂, 2.viii.1988, INS 30273. Levyj Ptys (48), 3 ♂♂, 21. – 22.vii.1983, INS 29071, 29074 and 30465. Macara (49), 4 ♂♂, 4.vii.1983 and 18.viii.1985, INS 30367, 39470, 30476 and 30669. Mercheuli (51), 2

♂♂, 5.vii.1983, INS 30277 and 30768. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30274. Novyj Afon near Anuchva (54), 1 ♂, 19.viii.1985, INS 29076. Okumi (56), 2 ♂♂, 9.viii.1988, INS 30071 and 30079. Otap (57), 5 ♂♂, 10.viii.1988, INS 2605, 30070, 30076, 30080 and 30172. Pskhu (58), 22 ♂♂, 25. – 29.vii.1988, INS 2571, 2614, 2621, 29065, 29066, 29067, 29068, 29069, 29073, 29079, 30065, 30081, 30265, 30266, 30268, 30269, 30275, 30276, 30667, 30766 and 30767. Pskhu near Dou (59), 2 ♂♂, 25.vii.1988, INS 29077 and 29078. Reka near Gali (60), 1 ♂, 7.viii.1988, INS 2606. Sagra near Tamys (63), 1 ♂, 21.viii.1985, INS 30479. Saken (64), 4 ♂♂, 8.vii.1983, INS 30165, 30234, 30668 and 30672. Saken – Narzan (65), 10 ♂♂, 9. and 12.vii.1983, INS 29075, 30167, 30168, 30271, 30272, 30473, 30566, 30666, 30671 and 30769. Saken near Juznyj Prijut Pass (66), 1 ♂, 8.vii.1983, INS 30471. Serbista (67), 1 ♂, 2.viii.1985, INS 30369. Sroma (70), 1 ♂, 15.viii.1985, INS 30472. Tamys (71), 1 ♂, 21.viii.1985, INS 30365. Tkvarceli (72), 1 ♂, 11.viii.1988, INS 30169. Ubus (73), 1 ♂, 7.viii.1985, INS 30568. Zemo – Azara (77), 6 ♂♂, 10. and 15.vii.1983, INS 30267, 30469, 30475, 30481, 30770 and 30771. Distribution: This species was thus far known only by its original description (Ježek, 1985) from Abkhazia and additionally from Armenia (Ježek et al., 2018).

Paramormia (*Paramormia*) *polyascoidea* (Krek, 1971) – Published record: Ježek (1990b): Saken – Narzan (65). Unpublished records: Abkhazia: Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30648. Cchalta (22), 1 ♂, 15.vii.1983, INS 30824. Gali (31), 1 ♂, 6.viii.1988, INS 30154. Gencvici (32), 2 ♂♂, 7.vii.1983, INS 30246 and 30748. Kutol (46), 1 ♂, 2.viii.1988, INS 30354. Levyj Ptys (48), 1 ♂, 21.vii.1983, INS 30547. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30356. Novyj Afon near Anuchva (54), 2 ♂♂, 19.viii.1985, INS 30060 and 30646. Pskhu (58), 5 ♂♂, 28. and 29.vii.1988, INS 30062, 30064, 30153, 30353 and 30357. Pskhu near Dou (59), 2 ♂♂, 25.vii.1988, INS 30061 and 30063. Saken (64), 2 ♂♂, 8.vii.1983, INS 30247 and 30750. Saken – Narzan (65), 5 ♂♂, 9. and 12.vii.1983, INS 30059, 30245, 30355, 30747 and 30749. Saken near Juznyj Prijut Pass (66), 1 ♂, 8.vii.1983, INS 30546. Sroma (70), 1 ♂, 15.viii.1985, INS 30549. Zemo – Azara (77), 2 ♂♂, 14. and 15.vii.1983, INS 30548 and 30647. Distribution: European and west Siberian species, known also from Abkhazia and Armenia (Ježek et al., 2018, 2019, 2020, 2021b).

Paramormia (*Duckhousiella*) *ustulata* (Walker, 1856) – Unpublished records: Abkhazia: Ocamcira (55), 1 ♂, 21.viii.1985, INS 30463. Armenia: Areni (8), F, 29.ix.2018, Šumpich leg., SW, INS 30833. Lehvaz (47), F, 24.ix.2018, Šumpich leg., SW, INS 30764. Shvanidzor (68), F, 26.ix.2018, Šumpich leg., SW, INS 30763. Yerevan (76), 1 ♂, 1.x.2018, Šumpich leg., SW, INS 30834. Distribution: Holarctic species, newly known also Transcaucasia (Armenia, Azerbaijan, Georgia) – Ježek et al. (2018, 2021a), Oboňa et al. (2019). New for Abkhazia.

Peripsychoda auriculata (Haliday in Curtis, 1839) – Published records: Ježek (2004b): Kaldakhvara near Mjusoera (38) and Otshamtshira (55). Unpublished records: Abkhazia: Achalsopeli (1), 1 ♂, 1.viii.1988, INS 30094. Cchalta (22), 1 ♂, 5.vii.1983, INS 30781. Kingdi (41), 3 ♂♂, 24.viii.1985, INS 30394, 30582 and 30690. Kutol (46), 1 ♂, 2.viii.1988, INS 30290. Okumi (56), 1 ♂, 9.viii.1988, INS 30095. Otap (57), 1 ♂, 10.viii.1988, INS 30185. Distribution: European species, penetrates into Transcaucasia – Abkhazia, Armenia, Georgia (Wagner, 1981; Ježek, 2004b; Ježek et al., 2018, 2021b).

Seoda ambigua (Eaton, 1893) – Unpublished records: Georgia: Adjaria (6), 2 ♂♂, 30.vi. and 1.vii. 2013, Chvojka leg., SW, INS 30775 and 30776. Distribution: Western Europe (Wagner, 1990, 2019), new for Georgia and Transcaucasia.

Seoda carthusiana (Vaillant, 1972) – Unpublished record: Abkhazia: Saken – Narzan (65), 1 ♂, 9.vii.1983, INS 30795. Distribution: Rather rare species in Europe, locally abundant (Ježek et al., 2019). New for Abkhazia and Transcaucasia.

Seoda svanetica (Ježek, 1989) – Published record: Ježek (1989): Juznyj Prijut Pass (36). Unpublished records: Abkhazia: Baskacara (11), 2 ♂♂, 18.vii.1983, INS 30261 and 30559. Below Maruch Pass (14), 1 ♂, 17.vii.1983, INS 30560. Saken – Narzan (65), 3 ♂♂, 12. and 13.vii.1983, INS 29053, 30362 and 30561. Distribution: A species known only from Transcaucasia: Abkhazia and Georgia (Ježek, 1989; Ježek et al., 2021a).

Philosepedon (*Trichosepedon*) *clouense* Ježek, 1994 – Published record: Ježek (1994): Clou (23). Unpublished records: Abkhazia: Baskacara (11), 3 ♂♂, 18.vii.1983, INS 30205, 30206 and 30516. Clou (23), 1 ♂, 8.viii.1988, INS 30312. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30409. Distribution: Greater Caucasus – Abkhazia (Ježek, 1994) and Georgia (Oboňa et al., 2019).

Philosepedon (*Trichosepedon*) *balkanicum* Krek, 1971 – Published record: Ježek (2004b): Rica (62). Unpublished records: Georgia: Adjaria (6), 1 ♂, 30.vi.2013, Chvojka leg., light, INS 30591, 1 ♂, 12.vii.1983, INS 30004. Distribution: Known from Western and Central Europe, as well from Abkhazia (Ježek, 2004b). New for Georgia.

Threticus balkaneoalpinus Krek, 1972 – Published records: Ježek (1995c, 2004b): Bzyb (17), Cimuri (20), Pskhu (58), Rica (62) and Zemo – Azara (77). Unpublished records: Georgia: Adjaria (6), 4 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30694, 30782, 30785 and 30786. Abkhazia: Azgara (9), 5 ♂♂, 16. and 21.vii.1983, INS 29095, 29096, 30496, 30497 and 30499. Azgara – Narzan (10), 4 ♂♂, 1.viii.1985, INS 30585, 30586, 30587 and 30702. Baskacara (11), 6 ♂♂, 18.vii.1983, INS 30001, 30002, 30192, 30194, 30195 and 30502. Below Adanga Pass (12), 4 ♂♂, 3. and 4.viii.1985, INS 30395, 30399, 30501 and 30691. Below Maruch Pass (14), 6 ♂♂, 17.vii.1983, and 3.viii.1985, INS 29091, 30000, 30297, 30504, 30505 and 30589. Bzyb (17), 2 ♂♂, 5.viii.1985, INS 30397 and 30506. Clou (23), 2 ♂♂, 8.viii.1988, INS 30098 and 30301. Cerna Voda (24), 4 ♂♂, 5.viii.1985, INS 30379, 30390, 30400 and 30698. Dvurecje near Dou (28), 2 ♂♂, 20.vii.1988, INS 30096 and 30099. Kot – Kot near Cimuri (44), 4 ♂♂, 11. and 12.viii.1985, INS 30401, 30583, 30590 and 30695. Levyj Ptys (48), 3 ♂♂, 21. and 22.vii.1983, INS 29090, 29098 and 30495. Maruch near Adanga (50), 1 ♂, 3.viii.1985, INS 30584. Otap (57), 2 ♂♂, 10.viii.1988, INS 30100 and 30189. Pskhu (58), 11 ♂♂, 25. – 29.vii.1988, INS 29093, 30097, 30102, 30190, 30291, 30292, 30293, 30294, 30296, 30693 and 30784. Pskhu near Dou (59), 3 ♂♂, 25.vii.1988, INS 29094, 29097and 30302. Resava (61), 1 ♂, 22.vii.1988, INS 30188. Rica (62), M, 5.viii.1988, INS 30101. Saken (64), 2 ♂♂, 8.vii.1983, INS 30187 and 30699. Saken – Narzan (65), 14 ♂♂, 9. – 13.vii.1983, INS 29092, 29099, 30003, 30191, 30193, 30295, 30299, 30300, 30500, 30503, 30696, 30700, 30701 and 30783. Serbista (67), 2 ♂♂, 2.viii.1985, INS 30398 and 30692. Tkvarceli (72), 1 ♂, 11.viii.1988, INS 30186. Ubus (73), 3 ♂♂, 7.viii.1985, INS 30396, 30588 and 30697. Zemo – Azara (77), 2 ♂♂, 10. and 15.vii.1983, INS 30298 and 30498. Distribution: Known from Western and Central Europe, as well from Abkhazia (Ježek 1995c, 2004b), from Georgia s. str. (Ježek et al., 2021a).

Threticus negrobovi Vaillant, 1972 – Published records: Ježek (2004b): Pskhu (58), Rica (62). Unpublished records: Abkhazia: Mercheuli (51), 1 ♂, 5.vii.1983, INS 30810. Pskhu (58), 1 ♂, 25.vii.1988, INS 30047. Distribution: Abkhazia, Czech Republic, Russia, Slovakia, Slovenia (Wagner, 1990; Ježek, 2004b; Ježek et al., 2021b, appendix).

Threticus petrosus Ježek, 1997 – Published record: Ježek (1997): Kot – Kot (43). Unpublished records: Abkhazia: Baskacara (11), 3 ♂♂, 18.vii.1983, INS 30056, 30237 and 30542. Below Adanga Pass (12), 1 ♂, 3.viii.1985, INS 30444. Kot – Kot near Cimuri (44), 4 ♂♂, 10. and 11.viii.1985, INS 30445, 30541, 30543 and 30643. Kot – Kot near Ulm Pass (45), 1 ♂, 10.viii.1985, INS 30540. Serbista (67), 1 ♂, 2.viii.1985, INS 30744. Ubus (73), 1 ♂, 7.viii.1985, INS 30743. Distribution: This species was known so far only by its original description (Ježek, 1997) from Abkhazia (single locality).

Trichopsychoda hirtella (Tonnoir, 1919) – Unpublished record: Abkhazia: Kaman (39), 1 ♂, 15.viii.1985, INS 30530. Distribution: European species, more details see Ježek et al. (2020). New for Abkhazia and Transcaucasia.

Chodopsycha buxtoni (Withers, 1988) – Unpublished records: Abkhazia: Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30597. Cimuri (20), 1 ♂, 13.viii.1985, INS 30407. Dzgerda (29), 1 ♀, 2.viii.1988, INS 30108. Levyj Ptys (48), 1 ♀, 21.vii.1983, INS 30200. Pskhu (58), 2 ♀♀, 25. and 27.vii.1988, INS 30008 and 30107. Saken – Narzan (65), 2 ♂♂, 13.vii.1983, INS 29080 and 30106. Distribution: European rare species (Great Britain, Czech Republic, and Slovakia only – Ježek et al., 2021b). New for Abkhazia and Transcaucasia.

Chodopsycha lobata (Tonnoir, 1940) – Published record: Ježek (2004b): Rica (62). Unpublished records: Abkhazia: Azgara (9), 1 ♀, 21.vii.1983, INS 30229. Azgara – Narzan (10), 1 ♂, 3 ♀♀, 1.viii.1985, INS 30626, 30627, 30629 and 30730. Baskacara (11), 3 ♂♂, 2 ♀♀, 18.vii.1983, INS 30041, 30227, 30228, 30232 and 30233. Below Maruch Pass (14), 1 ♀, 3.vii.1985, INS 30628. Bzyb (17), 1 ♀, 5.viii.1985, INS 30533. Dvurecje near Dou (28), 1 ♀, 21.vii.1988, INS 30044. Kelasuri (40), 1 ♀, 25.viii.1985, INS 30433. Kot – Kot (43), 1 ♀, 11.viii.1985, INS 30431. Kot – Kot near Cimuri (44), 2 ♀♀, 12.viii.1985, INS 30625 and 30729. Kot – Kot near Ulm Pass (45), 1 ♂, 11.viii.1985, INS 30432. Saken – Narzan (65), 3 ♂♂, 2 ♀♀, 9., 12. and 13.vii.1983, INS 30042, 30043, 30136, 30230 and 30231. Serbista (67), 1 ♀, 2.viii.1985, INS 30430. Ubus (73), 2 ♂♂, 7.viii.1985, INS 30411 and 30731. Distribution: Common European species, Transcaucasian sites represent Abkhazia and Georgia s. str. More information in detail see Ježek et al. (2021a, b).

Copropsychoda brevicornis (Tonnoir, 1940) – Unpublished records: Abkhazia: Sagra near Tamys (63), 1 ♂, 21.viii.1985, INS 30511. Saken – Narzan (65), 1 ♂, 9.vii.1983, INS 30199. Tamys (71), 1 ♀, 21.viii.1985, INS 30406. Distribution: Palaearctic species (Wagner, 1990, 2019; Ježek et al., 2020), known from Georgia (Ježek et al., 2021a). New for Abkhazia.

Logima albipennis (Zetterstedt, 1850) – Unpublished records: Armenia: Areni ARM (8), 1 ♀, 21.ix.2018, Šumpich leg., SW, INS 30571. Yerevan (76), 1 ♀, 1.x.2018, Šumpich leg., SW, INS 30772. Abkhazia: Baskacara (11), M, 4 ♀♀, 18.vii.1983, INS 29081, 29082, 30173, 30181 and 30486. Below Adanga Pass (12), 1 ♀, 4.viii.1985, INS 30485. Below Maruch Pass (14), 2 ♀♀, 2 ♂♂, 17.vii.1983 and 3.viii.1985, INS 30175, 30179 30180 and 30572. Cimuri (20), 1 ♀, 10.viii.1985, INS 30487. Dou Pass (26), 1 ♂, 21.vii.1988, INS 29083. Rica (62), 1 ♀, 5.viii.1988, INS 2591. Saken – Narzan (65), 5 ♀♀, 1 ♂, 9., 12. and 13.vii.1983, INS 29080, 30084, 30174, 30176, 30177 and 30178. Ubus (73), F, 7.viii.1985, INS 30675. Distribution: A cosmopolitan species, data in details with a new report for Georgia see Ježek et al. (2021a). Known from Armenia and Azerbaijan (Ježek et al., 2018). New for Abkhazia.

Logima erminea (Eaton, 1893) – Published records: Ježek (2004b): Tshlou (23), Pskhu (58). Unpublished records: Abkhazia: Beslachuba (16), 1 ♀, 11.viii.1988, INS 30208. Clou (23), 1 ♀, 8.viii.1988, INS 30314. Kelasuri (40), 1 ♀, 25.viii.1985, INS 30413. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30017. Novyj Afon near Anuchva (54), 1 ♀, 19.viii.1985, INS 30015. Pskhu (58), 2 ♂♂, 1 ♀, 25. and 28.vii.1988, INS 30016, 30316 and 30317. Pskhu near Dou (59), 1 ♂, 1 ♀, 25.vii.1988, INS 30018 and 30315. Zemo – Azara (77), 1 ♂, 15.vii.1983, INS 30207. Distribution: Palaearctic species, known from Western, Northern and Central Europe, North Africa, Thaiwan, Japan, penetrates into Abkhazia in Transcaucasia (Ježek, 2004b; Ježek et al., 2021b).

Logima satchelli (Quate, 1955) – Unpublished records: Armenia: Areni (8), 1 ♀, 29.ix.2018, Šumpich leg., SW, INS 30828. Georgia: Adjaria (6), 2 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30829 and 30830. Abkhazia: Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30659. Below Adanga Pass (12), 1 ♀, 4.viii.1985, INS 30553. Below Maruch Pass (14), 1 ♂, 3.viii.1985, INS 30658. Dvurecje near Dou (28), 1 ♀, 20.vii.1988, INS 30155. Saken – Narzan (65), 2 ♂♂, 13.vii.1983, INS 29051 and 30156. Serbista (67), 1 ♂, 2.viii.1985, INS 30455. Distribution: Holarctic species, known also from Azerbaijan (Ježek et al., 2018, 2019, 2020, 2021a, b), new for Abkhazia, Armenia, and Georgia.

Logima zetterstedti Ježek, 1983 – Unpublished records: Abkhazia: Below Maruch Pass (14), 1♂, 17.vii.1983, INS 30260. Serbista, ABK (67), 1 ♂, 2.viii.1985, INS 30464. Distribution: In the first place European and west Siberian species; however, in the case of a verification probably cosmopolitan species (Ježek et al., 2019, 2021b). New for Abkhazia and Transcaucasia.

Psycha grisescens (Tonnoir, 1922) – Unpublished records: Abkhazia: Below Adanga Pass (12), 1 ♂, 3.viii.1985, INS 30420. Kaman (39), F, 15.viii.1985, INS 30526. Kelasuri (40), 1 ♀, 25.viii.1985, INS 30419. Kot – Kot near Cimuri (44), 1 ♂, 12.viii.1985, INS 30609. Saken – Narzan (65), 4 ♂♂, 13.vii.1983, INS 30036, 30127, 30128 and 30225. Ubus (73), 1 ♂, 7.viii.1985, INS 30718. Distribution: European species, registered in Central Anatolia and North Africa, penetrates into Transcaucasia (Azerbaijan) (Oboňa et al., 2019; Ježek et al., 2021a). New for Abkhazia.

Psychoda alticola Vaillant, 1973 – Unpublished records: Abkhazia: Baskacara (11), 1 ♂, 18.vii.1983, INS 30489. Below Adanga Pass (12), 1 ♂, 3.viii.1985, INS 30375. Levyj Ptys (48), 1 ♂, 22.vii.1983, INS 30183. Serbista (67), 1 ♂, 2.viii.1985, INS 30376. Ubus (73), 1 ♂, 7.viii.1985, INS 30679. Distribution: West and Central European species (Wagner, 1990, 2019; Ježek et al., 2021b, appendix). New for Abkhazia and Transcaucasia.

Psychoda crassipennis Tonnoir, 1940 – Unpublished records: Abkhazia: Saken – Narzan (65), 1 ♂, 13.vii.1983, INS 30119. Serbista (67), M, 2.viii.1985, INS 30710. Distribution: Western, Northern and Central Europe (Ježek, 2009; Ježek et al., 2019). New for Abkhazia and Transcaucasia.

Psychoda phalaenoides (Linnaeus, 1758) – Unpublished records: Abkhazia: Adanga Pass (5), 1 ♂, 4.viii.1985, INS 30745. Baskacara (11), 1 ♀, 18.vii.1983, INS 30239. Below Adanga Pass (12), 1 ♂, 4.viii.1985, INS 30544. Below Maruch Pass (14), 2 ♂♂, F, 17.vii.1983 and 3.viii.1985, INS 30242, 30244 and 30644. Bzyb (17), 1 ♀, 5.viii.1985, INS 30446. Clou (23), F, 8.viii.1988, INS 30351. Dou Pass (26), 1 ♀, 22.vii.1988, INS 30151. Kaman (39), 1 ♂, 15.viii.1985, INS 30545. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30447. Mercheuli (51), 1 ♀, 5.vii.1983, INS 30057. Mramba (52), 1 ♀, 4.viii.1988, INS 30152. Saken – Narzan (65), 4 ♂♂, 1 ♀, 12. and 13.vii.1983, INS 30058, 30149, 30150, 30241 and 30243. Serbista (67), 1 ♂, 1 ♀, 2.viii.1985, INS 30448 and 30746. Ubus (73), 1 ♂, 7.viii.1985, INS 30449. Zemo – Azara (77), 1 ♀, 10.vii.1983, INS 30238. Georgia: Svanetia (69), 1 ♀, 5.vii.2013, Chvojka leg., at light, INS 30822. Distribution: Holarctic species, known from Azerbaijan and Georgia, as well; for details see Oboňa et al. (2019) and Ježek et al. (2020, 2021a, b). New for Abkhazia.

Psychoda uniformata Haseman, 1907 – Unpublished records: Abkhazia: Ocamcira (55), 1 ♀, 21.viii.1985, INS 30461. Pskhu near Dou (59), 1 ♂, 25.vii.1988, INS 29064. Tamys (71), 1 ♀, 21.viii.1985, INS 30462. Distribution: Holarctic species, also newly known from Transcaucasia (Armenia, Azerbaijan) (Ježek et al., 2018, 2021b; Oboňa et al., 2019). New for Abkhazia.

Psychodocha cinerea (Banks, 1894) – Published record: Ježek (1990a): Cimuri (20). Unpublished records: Russia: Dagomys (25), 1 ♀, 1. – 5.ix.1982, Dlabola leg., SW, INS 30009. Abkhazia: GES – Suchumi (33), 1 ♀, 3.viii.1988, INS 30202. Kaldachvara (37), 1 ♀, 1.vii.1988, INS 30114. Kaman (39), 1 ♀, 15.viii.1985, INS 30512. Mramba (52), 1 ♂, 4.viii.1988, INS 30115. Novyj Afon near Anuchva (54), 1 ♀, 19.viii.1985, INS 30603. Pskhu (58), 1 ♀, 29.vii.1988, INS 30010. Saken – Narzan (65), 1 ♀, 12.vii.1983, INS 30203. Distribution: Cosmopolitan species, published as well from Russia (Siberia – Ježek, 1992b), detailed information incl. Abkhazia (Ježek, 1990a), Georgia and Armenia (Ježek et al., 2021a).

Psychodocha gemina (Eaton, 1904) – Published records: Ježek (1990a): Cimuri (20) and Juznyj Prijut Pass (36). Unpublished records: Abkhazia: Achalseni (2), 1 ♀, 14.viii.1985, INS 30522. Baskacara (11), 1 ♂, 6 F, 17. and 18.vii.1983, INS 30023, 30024, 30027, 30214, 30218, 30219 and 30224. Below Maruch Pass (14), 2 ♀♀, 17.vii.1983 and 3.viii.1985, INS 30215 and 30606. Cebelda (18), 2 F, 4.viii.1988, INS 2612 and 30216. Cchalta (22), 1 ♀, 15.vii.1983, INS 30025. Gencvici (32), 1 ♀, 7.vii.1983, INS 30026. Kaman (39), 1 ♀, 15.viii.1985, INS 30523. Kot – Kot near Cimuri (44), 1 ♂, 12.viii.1985, INS 30607. Levyj Ptys (48), F, 21.vii.1983, INS 30222. Mramba (52), 1 ♂, 4.viii.1988, INS 30124. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30029. Pskhu (58), 1♀, 1 ♂, 26. and 27.vii.1988, INS 2728 and 30123. Rica (62), 1 ♂, 2 ♀♀, 5.vii.1988, INS 2594, 2597 and 30125. Saken (64), 1 ♀, 8.vii.1983, INS 30220. Saken – Narzan (65), 4 ♀♀, 4 ♂♂, 11. – 13.vii.1983, INS 30020, 30028, 30030, 30122, 30213, 30217, 30221 and 30223. Serbista (67), 2 ♀♀, 2.viii.1985, INS 30416 and 30716. Distribution: European species, also penetrates into Transcaucasia (Abkhazia, Azerbaijan, Georgia) – (Wagner, 1990, 2019; Ježek et al., 2021a).

Psychodula minuta (Banks, 1894) – Published record: Ježek (1990a): Cimuri (20). Unpublished records: Georgia: Adjaria (6), 1 ♀, 1.vii.2013, Chvojka leg., SW, INS 30802. Abkhazia: Baskacara (11), 1 ♀, 18.vii.1983, INS 30045. Kot – Kot near Cimuri (44), 1 ♀, 12.viii.1985, INS 30630. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30046. Tamys (71), 1 ♂, 21.viii.1985, INS 30434. Distribution: Holarctic species, from Europe penetrates into Transcaucasia (Abkhazia), more details see Ježek et al. (2020, 2021b). New for Georgia.

Psychomora trinodulosa (Tonnoir, 1922) – Unpublished records: Abkhazia: Achalseni (2), 1 ♀, 14.viii.1985, INS 30562. Acigvara (4), 1 ♀, 6.viii.1988, INS 2600. Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30761. Below Maruch Pass (14), 1 ♂, 3.viii.1985, INS 30662. Cebelda (18), 2 ♀♀, 4.viii.1988, INS 30164 and 30258. Clou (23), 2 ♀♀, 8.viii.1988, INS 2588 and 30364. Gali (31), 1 ♂, 6.viii.1988, INS 30162. Gencvici (32), 1 ♀, 7.vii.1983, INS 29061. Kaman (39), 1 ♀, 15.viii.1985, INS 30563. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30460. Mercheuli (51), 1 ♂, 5.vii.1983, INS 29056. Mramba (52), 1 ♀, 4.viii.1988, INS 30163. Niznaja Zemo – Azara (53), 1 ♀, 15.vii.1983, INS 29063. Novyj Afon near Anuchva (54), 1 ♂, 19.viii.1985, INS 29057. Okumi (56), 3 ♂♂, 9.viii.1988, INS 30160, 30161 and 30253. Pskhu (58), 1 ♂, 26.vii.1988, INS 29055. Pskhu near Dou (59), 1 ♀, 1 ♂, 25.vii.1988, INS 29058 and 30363. Reka near Gali (60), 1 ♂, 7.viii.1988, INS 2607. Sagra near Tamys (63), 1 ♀, 21.viii.1985, INS 30459. Saken (64), 1 ♂,1 ♀F, 8.vii.1983, INS 29062 and 30251. Saken – Narzan (65), 2 ♂♂, 2 ♀♀, 9., 11. and 12.vii.1983, INS 30159, 30252 30254 and 30256. Serbista (67), 1 ♂, 2.viii.1985, INS 30762. Zemo – Azara (77), 3 ♂♂, 3 ♀♀, 10., 14. and 15.vii.1983, INS 29054, 29059, 29060, 30250, 30255 and 30257. Distribution:

Holarctic species, known from Azerbaijan and Georgia; see some details e. g. in Ježek et al. (2019, 2020, 2021a, b) and Oboňa et al. (2019). New for Abkhazia.

Tinearia alternata (Say, 1824) – Unpublished records: Armenia: Areni (8), 2 ♀♀, 21. and 29.ix.2018, Šumpich leg., SW, INS 30573 and 30773. Shvanidzor (68), 1 ♀, 26.ix.2018, Šumpich leg., SW, INS 30677. Yerevan (76), 1 ♀, 1.x.2018, Šumpich leg., SW, INS 30774. Abkhazia: Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30678. Cebelda (18), F, 4.viii.1988, INS 2611. Cimuri (20), 2 ♀♀, 10. and 13.viii.1985, INS 1378 and 30488. Gali (31), 1 ♂, 6.viii.1988, INS 30085. Macara (49), 1 ♂, 5 ♀♀, 5. and 24.vii.1983, 17. and 18.viii.1985, 3. and 10.viii.1988, INS 29084, 29086, 30090, 30182, 30374 and 30676. Mercheuli (51), 1 ♀, 5.vii.1983, INS 29085. Mramba (52), 2 ♀♀, 4.viii.1988, INS 30088 and 30089. Ocamcira (55), 1 ♀, 21.viii.1985, INS 30372. Okumi (56), 1 ♂, 9.viii.1988, INS 30087. Pskhu (58), 2 ♂♂, 26. and 27.vii.1988, INS 2619 and 30281. Reka near Gali (60), 1 ♂, 7.viii.1988, INS 2608. Tamys (71), F, 21.viii.1985, INS 30373. Distribution: A cosmopolitan species, known from Armenia and Azerbaijan (Ježek et al., 2018), data from Georgia see Oboňa et al. (2019) and Ježek et al. (2021a). New for Abkhazia.

Tinearia lativentris (Berdén, 1952) – Unpublished record: Armenia: Areni (8), 1 ♀, 29.9.2018, Šumpich leg., SW, INS 30801. Distribution: Holarctic species, for detailed information see Ježek et al. (2021b). New for Armenia and Transcaucasia.

Ypsydocha setigera (Tonnoir, 1922) – Unpublished record: Abkhazia: Azgara (9), 1 ♂, 21.vii.1983, INS 30262. Baskacara (11), 1 ♂, 18.vii.1983, INS 29052. Kot – Kot near Ulm Pass (45), 1 ♂, 11.viii.1985, INS 30456. Saken – Narzan (65), 5 ♀♀, 9. – 13.vii.1983, INS 30157, 30158, 30249, 30263 and 30264. Serbista (67), 1 ♀, 2.viii.1985, INS 30457. Ubus (73), 1 ♀, 7.viii.1985, INS 30458. Distribution: Holarctic species, known from Georgia (Oboňa et al., 2019), some additional information in Ježek et al. (2019, 2021b). New for Abkhazia.

Berdeniella caucasica Wagner, 1981 – Unpublished records: Abkhazia: Gencvici (32), 1 ♂, 7.vii.1983, INS 30707. Saken – Narzan (65), 1 ♂, 13.vii.1983, INS 30598. Ubus (73), 1 ♂, 7.viii.1985, INS 30600. Zemo – Azara (77), 1 ♂, 10.vii.1983, INS 30599. Distribution: Known only from the original description (Wagner, 1981) from the western Caucasus (Russian village Taberda). New for Abkhazia.

Berdeniella manicata (Tonnoir, 1920) – Unpublished record: Abkhazia: Pskhu (58), 1 ♂, 27.vii.1988, INS 30332. Distribution: European species, penetrates into Transcaucasia (Georgia) – see Oboňa et al. (2019) and Ježek et al. (2020, 2021b). New for Abkhazia.

Berdeniella schumpkanica Vaillant & Joost, 1983 – Unpublished records: Abkhazia: Adanga Pass (5), 1 ♂, 4.viii.1985, INS 30556. Baskacara (11), 2 ♂♂, 18.vii.1983, INS 30361 and 30759. Below Chimsa Pass (13), 1 ♂, 8.viii.1985, INS 30555. Below Ulm Pass (15), 1 ♂, 9.viii.1985, INS 30661. Chimsa near Ulm (19), 1 ♂, 11.viii.1985, INS 30664. Juznyj Prijut Pass (36), 1 ♂, 7.vii.1983, INS 30557. Saken – Narzan (65), 1 ♂, 12.vii.1983, INS 30558. Ubus (73), 2 ♂♂, 7.viii.1985, INS 30663 and 30760. Ubus near Bzyb (74), 1 ♂, 7.viii.1985, INS 30554. Zemo – Azara (77), 2 ♂♂, 10.vii.1983, INS 30660 and 30758. Georgia: Svanetia (69), 1 ♂, 5.vii.2013, Chvojka leg., SW, INS 30831. Distribution: A species described from northern adjacent Caucasian slope in Russia (Vaillant & Joost, 1983 – Terskol + stream Schumka). New for Abkhazia and Georgia.

Clytocerus (*Boreoclytocerus*) *grusinicus* Wagner, 1981 – Unpublished records: Georgia: Adjaria (6), 2 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30721 and 30800. Svanetia (69), 1 ♂, 4.vii.2013, Chvojka leg., SW, INS 30617. Abkhazia: Azgara (9), 1♂, 21.vii.1983, INS 30612. Azgara – Narzan (10), 4 ♂♂, 1.viii.1985, INS 30611, 30615, 30619 and 30723. Baskacara (11), 1 ♂, 18.vii.1983, INS 30725. Cchalta (22), 2 ♂♂, 15. and 22.vii.1983, INS 30326 and 30719. Clou (23), 2 ♂♂, 8.viii.1988, INS 30134 and 30330. Dvurecje near Dou (28), 2 ♂♂, 20.vii.1988, INS 30132 and 30133. Gagra (30), 1 ♂, 23.viii.1985, INS 30614. Gencvici (32), 1 ♂, 7.vii.1983, INS 30724. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30422. Levyj Ptys (48), 4 ♂♂, 21. and 22.vii.1983, INS 30421, 30423, 30427 and 30528. Macara (49), 1 ♂, 18.viii.1985, INS 30426. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30613. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30610. Otap (57), 2 ♂♂, 10.viii.1988, INS 30130 and 30226. Pskhu (58), 5 ♂♂, 27. – 29.vii.1988, INS 30038, 30129, 30131, 30327 and 30722. Pskhu near Dou (59), 2 ♂♂, 25.vii.1988, INS 30037 and 30039. Saken (64), 3 ♂♂, 8.vii.1983, INS 30424, 30527 and 30618. Zemo – Azara (77), 6 ♂♂, 10., 14. and 15.vii.1983, INS 30328, 30425, 30616, 30720, 30726 and 30799. Distribution: Transcaucasian species known from

Georgia (the original description of Wagner, 1981; for the second record, see Oboňa et al., 2019). New for Abkhazia.

Pericoma (*Pericoma*) *bunae* Krek, 1979 – Unpublished records: Armenia: Areni (8), 3 ♂♂, 21. and 29.ix.2018, Šumpich leg., SW, INS 30596, 30792 and 30793. Lehvaz (47), 1 ♂, 24.ix.2018, Šumpich leg., SW, INS 30706. Distribution: Bosnia and Herzegovina, Montenegro (Krek, 1999), Azerbaijan (Ježek et al., 2018). New for Armenia.

Pericoma (*Pericoma*) *exquisita* Eaton, 1893 – Unpublished records: Abkhazia: Kaman (39), 1 ♂, 15.viii.1985, INS 30517. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30415. Macara (49), 1 ♂, 5.vii.1983, INS 30318. Mercheuli (51), 1 ♂, 5.vii.1983, INS 30604. Okumi (56), 1 ♂, 9.viii.1988, INS 30120. Distribution: Species widespread in Europe, North Africa, and Transcaucasia (Armenia, Azerbaijan, Georgia) – Ježek et al. (2018, 2021a); Oboňa et al. (2019). New for Abkhazia.

Pericoma (*Pericoma*) *inopinata* Ježek, Oboňa & Manko, 2021 – Unpublished records: Abkhazia: Cimuri near Achalseni (21), 1 ♂, 13.viii.1985, INS 30532. Kaman (39), 1 ♂, 15.viii.1985, INS 30531. Mercheuli (51), 2 ♂♂, 5.vii.1983, INS 30623 and 30624. Mramba (52), 1 ♂, 4.viii.1988, INS 30135. Novyj Afon near Anuchva (54), 2 ♂♂, 19.viii.1985, INS 30040 and 30621. Zemo – Azara (77), 1 ♂, 15.vii.1983, INS 30622. Distribution: Trancaucasian species known only from the original description from Azerbaijan and Georgia (Ježek et al., 2021c). New for Abkhazia.

Pericoma (*Pericoma*) *motasi motasi* Vaillant, 1978 – Unpublished records: Georgia: Adjaria (6), 3 ♂♂, 30.vi.2013, Chvojka leg., SW, INS 30732, 30807 and 30808. Svanetia (69), 1 ♂, 5.vii.2013, Chvojka leg., SW, INS 30809. Abkhazia: Zemo – Azara (77), 1 ♂, 10.vii.1983, INS 30631. Distribution: Species described from the Carpathian Mountains (Romania) by Vaillant (1978), from Bulgaria reported by Wagner & Joost (1988). Known from Georgia now (Oboňa et al., 2019). New for Abkhazia.

Pericoma (*Pericoma*) *pannonica* Szabó, 1960 – Unpublished record: Armenia: Areni (8), 1 ♂, 29.ix.2018, Šumpich leg., SW, INS 30821. Distribution: European species (Wagner, 1990, 2019; Ježek et al., 2020, 2021b; appendix). New for Armenia and Transcaucasia.

Pericoma (*Pericoma*) *pseudexquisita* Tonnoir, 1940 – Unpublished records: Georgia: Adjaria (6), 1 ♂, 30.vi.2013, Chvojka leg., SW, INS 30825. Abkhazia: Baskacara (11), 1 ♂, 17.vii.1983, INS 30826. Cchalta (22), 1 ♂, 22.vii.1983, INS 30358. Levyj Ptys (48), 1 ♂, 22.vii.1983, INS 30550. Zemo – Azara (77), 3 ♂♂, 14. and 15.vii.1983, INS 30450, 30751 and 30827. Distribution: A species registered in Western, Central and Southern Europe, known from Georgia (Ježek et al., 2020, 2021a, b). New for Abkhazia.

Pericoma (*Pachypericoma*) *blandula* Eaton, 1893 – Published records: Ježek (2004b): Tshlou (23), Pskhu (58). Unpublished records: Georgia: Adjaria (6), 4 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30704, 30787, 30789 and 30790. Svanetia (69), 1 ♂, 5.vii.2013, Chvojka leg., SW, INS 30788. Tkvarčeli, ABK (72), 1 ♂, 11.viii.1988, INS 30197. Abkhazia: Achalseni near Sroma (3), 1 ♂, 15.viii.1985, INS 30510. Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30592. Cimuri (20), 1 ♂, 13.viii.1985, INS 30509. Clou (23), 2 ♂♂, 8.viii.1988, INS 30104 and 30304. Gencvici (32), 1 ♂, 7.vii.1983, INS 30705. GES – Sukhumi (33), 1 ♂, 3.viii.1988, INS 30196. Kaldachvara (37), 2 ♂♂, 1.viii.1988, INS 30007 and 30103. Kaman (39), 1 ♂, 15.viii.1985, INS 30508. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30403. Levyj Ptys (48), 2 ♂♂, 22.vii.1983, INS 30402 and 30507. Mercheuli (51), 2 ♂♂, 5.vii.1983, INS 30593 and 30595. Novyj Afon near Anuchva (54), 2 ♂♂, 19.viii.1985, INS 30006 and 30594. Otap (57), 1 ♂, 10.viii.1988, INS 30105. Pskhu (58), 4 ♂♂, 25. – 28.vii.1988, INS 30005, 30198, 30303 and 30306. Saken – Narzan (65), 2 ♂♂, 12.vii.1983, INS 30305 and 30703. Zemo – Azara (77), 2 ♂♂, 14. and 15.vii.1983, INS 30405 and 30791. Armenia: Lehvaz (47), 1 ♂, 24.ix.2018, Šumpich leg., SW, INS 30404. Distribution: Known from Western and Central Europe, North Africa, and Transcaucasian Georgia (Wagner, 1990); as well from Abkhazia (Ježek, 2004b), Armenia and Azerbaijan (Ježek et al., 2018).

Pericoma (*Pachypericoma*) fallax Eaton, 1893 – Published record: Ježek (2004b): Tshlou (23). Distribution: Europaen and West-Siberian species, also known as well from Transcaucasia (Abkhazia, Azerbaijan and Georgia) – Oboňa et al. (2019); Ježek et al. (2021a).

Pneumia compta (Eaton, 1893) – Unpublished record: Abkhazia: Bzyb (17), 1 ♂, 5.viii.1985, INS 30412. Distribution: Western and Central European species (Wagner, 1990, 2019, Ježek et al., 2021b – appendix). New for Abkhazia and Transcaucasia.

Pneumia gracilis gracilis (Eaton, 1893) – Published records: Ježek (2004b): Bzyb (17), Pskhu (58). Unpublished records: Abkhazia: Cimuri (20), 1 ♂, 13.viii.1985, INS 30417. Cimuri near Achalseni (21), 1 ♂, 13.viii.1985, INS 30525. Levyj Ptys (48), 1 ♂, 22.vii.1983, INS 30418. Pskhu (58), 9 ♂♂, 25. – 29.vii.1988, INS 2572, 2617, 30033, 30035, 30126, 30321, 30325, 30717 and 30797. Pskhu near Dou (59), 1 ♂, 25.vii.1988, INS 30034. Zemo – Azara (77), 2 ♂♂, 10. and 15.vii.1983, INS 30608 and 30798. Distribution: European species (Wagner, 1990, 2019), penetrates into Great Caucasus. Detailed information in Ježek et al. (2019).

Pneumia nubila (Meigen, 1818) – Published records: Ježek & Hájek (2007, erratum): Akhalsheni (2), Atshigvara (4), Bzyb (17), Cebelda (18), Cimuri (20), Pskhu (58). Unpublished records: Georgia: Adjaria (6), 4 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30740, 30811, 30812 and 30813. Imereli (35), 1 ♂, 7.vii.2013, Chvojka leg., SW, INS 30814. Abkhazia: Achalseni (2), 1 ♂, 3.viii.1988, INS 30146. Anaria (7), 1 ♂, 7.viii.1988, INS 30137. Azgara (9), 1 ♂, 21.vii.1983, INS 30818. Azgara – Narzan (10), 2 ♂♂, 1.viii.1985, INS 30641 and 30742. Below Adanga Pass (12), 1 ♂, 3.viii.1985, INS 30435. Beslachuba (16), 1 ♂, 11.viii.1988, INS 30051. Cimuri (20), 1 ♂, 13.viii.1985, INS 30441. Cchalta (22), 1 ♂, 22.vii.1983, INS 30333. Clou (23), 1 ♂, 8.viii.1988, INS 30340. Dvurecje near Dou (28), 2 ♂♂, 20.vii.1988, INS 30138 and 30147. Dzgerda (29), 1 ♂, 2.viii.1988, INS 30235. Gagra (30), 1 ♂, 23.viii.1985, INS 30639. Gencvici (32), 2 ♂♂, 7.vii.1983, INS 30436 and 30735. Kaldachvara (37), 1 ♂, 1.viii.1988, INS 30144. Kaman (39), 1 ♂, 15.viii.1985, INS 30535. Kingdi (41), 3 ♂♂, 24.viii.1985, INS 30440, 30634 and 30734. Kot – Kot near Cimuri (44), 2 ♂♂, 12. and 13.viii.1985, INS 30438 and 30635. Kot – Kot near Ulm Pass (45), 1 ♂, 10.viii.1985, INS 30539. Kutol (46), 1 ♂, 2.viii.1988, INS 30338. Levyj Ptys (48), 2 ♂♂, 21. and 22.vii.1983, INS 30537 and 30538. Macara (49), 5 ♂♂, 4. and 5.vii.1983, 18.viii.1985, INS 30344, 30439, 30442, 30642 and 30737. Mercheuli (51), 3 ♂♂, 5.vii.1983, INS 30633, 30638 and 30736. Mramba (52), 1 ♂, 4.viii.1988, INS 30139. Niznaja Zemo – Azara (53), 1 ♂, 15.vii.1983, INS 30632. Ocamcira (55), 1 ♂, 21.viii.1985, INS 30437. Okumi (56), 2 ♂♂, 9.viii.1988, INS 30140 and 30145. Otap (57), 1 ♂, 10.viii.1988, INS 30141. Pskhu (58), 13 ♂♂, 27. – 29.vii.1988, INS 30049, 30050, 30054, 30142, 30143, 30336, 30337, 30341, 30346, 30347, 30739, 30816 and 30819. Pskhu near Dou (59), 4 ♂♂, 25. vii.1988, INS 30048, 30052, 30053 and 30342. Saken (64), 4 ♂♂, 8.vii.1983, INS 30165, 30234, 30668 and 30738. Saken – Narzan (65), 6 ♂♂, 9., 11. and 12.vii.1983, INS 30334, 30335, 30339, 30343, 30443 and 30820. Saken near Juznyj Prijut Pass (66), 1 ♂, 8.vii.1983, INS 30817. Sroma (70), 1 ♂, 15.viii.1985, INS 30536. Tamys (71), 1 ♂, 21.viii.1985, INS 30640. Tkvarceli (72), 1 ♂, 11.viii.1988, INS 30236. Zemo – Azara (77), 6 ♂♂, 10., 14. and 15.vii.1983, INS 30345, 30636, 30637 30733, 30741and 30815. Distribution: European species, known as well from Transcaucasia (Abkhazia, Armenia, Azerbaijan, and Georgia (details see Ježek et al., 2018, 2020, 2021a).

Pneumia palustris (Meigen, 1804) – Published records: Ježek & Hájek (2007, erratum): Bzyb (17) and Pskhu (58). Unpublished records: Abkhazia: Pskhu (58), 3 ♂♂, 25. and 27.vii.1988, INS 30148, 30348 and 30350. Pskhu near Dou (59), 2 ♂♂, 25.vii.1988, INS 30055 and 30349. Distribution: European species, registered also in Transcaucasia (Abkhazia and Georgia), more information in Ježek et al. (2019, 2020, 2021a) and Oboňa et al. (2019).

Pneumia pilularia (Tonnoir, 1940) – Unpublished records: Armenia: Areni (8), 2 ♂♂, 29.ix.2018, Šumpich leg., SW, INS 30645 and 30823. Abkhazia: Below Maruch Pass (14), 1 ♂, 17.vii.1983, INS 30352. Distribution: A species known almost throughout Europe. It has also been recorded also from Transcaucasia (central Caucasus – Terskol in Russia, Armenia, Azerbaijan, Georgia and Tajikistan) (Ježek et al., 2018, 2021a, b; Oboňa et al., 2019). New for Abkhazia.

Pneumia trivialis (Eaton, 1893) – Unpublished record: Abkhazia: Tkvarceli (72), 1 ♂, 11.viii.1988, INS 30259. Distribution: Ubiquitous European species, known newly as well from Transcaucasia (Azerbaijan and Georgia) (Ježek et al., 2021a, b). New for Abkhazia.

Saraiella ressli Wagner, 1981 – Unpublished records: Abkhazia: Azgara (9), 1 ♂, 21.vii.1983, INS 30649. Azgara – Narzan (10), 3 ♂♂, 1.viii.1985, INS 30651, 30654 and 30752. Baskacara (11), 1 ♂, 18.vii.1983, INS 29050. Below Adanga Pass (12), 1 ♂, 3.viii.1985, INS 30452. Chimsa near Ulm (19), 2 ♂♂, 9. and 11.viii.1985, INS 30552 and 30652. Levyj Ptys (48), 1 ♂, 22.vii.1983, INS 30453. Resava (61), 1 ♂, 22.vii.1988, INS 30248. Saken (64), 3 ♂♂, 8.vii.1983, INS 30451, 30551 and 30650. Saken – Narzan (65), 2

♂♂, 9. and 12.vii.1983, INS 30359 and 30755. Serbista (67), 1 ♂, 2.viii.1985, INS 30454. Zemo – Azara (77), 6 ♂♂, 10., 14. and 15.vii.1983, INS 30360, 30653, 30655, 30753, 30754 and 30756. Distribution: Species known from Iran, Armenia, Azerbaijan, Georgia and Russia (Wagner & Joost, 1983; Ježek et al., 2018, 2021a). New for Abkhazia.

Saraiella rotunda (Krek, 1970) – Unpublished records: Abkhazia: Azgara (9), 1 ♂, 16.vii.1983, INS 30757. Azgara – Narzan (10), 2 ♂♂, 1.viii.1985, INS 30656 and 30657. Distribution: European species, penetrates into Azerbaijan and Georgia; for information in detail, see Krek (1999) and Ježek et al. (2021a, b). New for Abkhazia.

Szaboiella hibernica (Tonnoir, 1940) – Published record: Ježek (2004a): Kot – Kot (43). Unpublished records: Abkhazia: Baskacara (11), 2 ♂♂, 18.vii.1983, INS 30429 and 30727. Below Adanga Pass (12), 1 ♂, 4.viii.1985, INS 30728. Dvurecje near Dou (28), 1 ♂, 21.vii.1988, INS 30331. Kot – Kot near Cimuri (44), 3 ♂♂, 11.viii.1985, INS 30428, 30529 and 30620. Distribution: European species, penetrates into Transcaucasia (Abkhazia), for details, see Ježek et al. (2021b).

Thornburghiella montana Ježek, Oboňa & Manko, 2021 – Unpublished records: Abkhazia: Baskacara (11), 1 ♂, 17.vii.1983, INS 30806. Saken – Narzan (65), 1 ♂, 12.vii.1983, INS 30534. Georgia: Svanetia (69), 3 ♂♂, 5.vii.2013, Chvojka leg., SW, INS 30803, 30804 and 30805. Distribution: Transcaucasian species known only from the original description from Georgia (Ježek et al., 2021c). New for Abkhazia.

Tonnoiriella arcuata Ježek, 1997 – Published record: Ježek (1997): Pskhu (58). Unpublished records: Georgia: Adjaria (6), 4 ♂♂, 30.vi. and 1.vii.2013, Chvojka leg., SW, INS 30684, 30778, 30779 and 30780. Svanetia (69), 1 ♂, 5.vii.2013, Chvojka leg., SW, INS 30388. Abkhazia: Azgara (9), 1 ♂, 16.vii.1983, INS 30683. Azgara – Narzan (10), 3 ♂♂, 1.viii.1985, INS 30577, 30578 and 30688. Baskacara (11), 1 ♂, 18.vii.1983, INS 30681. Below Adanga Pass (12), 4 ♂♂, 3. and 4.viii.1985, INS 30385, 30386, 30490 and 30686. Below Maruch Pass (14), 1 ♂, 17.vii.1983, INS 30393. Bzyb (17), 2 ♂♂, 5.viii.1985, INS 30379 and 30390. Cimuri (20), 2 ♂♂, 10. and 13.viii.1985, INS 30384 and 30493. Clou (23), 1 ♂, 8.viii.1988, INS 30285. Dou Pass (26), 1 ♂, 21.vii.1988, INS 30283. Dvurecje near Dou (28), 2 ♂♂, 20.vii.1988, INS 30091 and 30093. Gencvici (32), 1 ♂, 7.vii.1983, INS 30680. Kelasuri (40), 1 ♂, 25.viii.1985, INS 30391. Levyj Ptys (48), 4 ♂♂, 22.vii.1983, INS 30377, 30382, 30392 and 30492. Mercheuli (51), 2 ♂♂, 5.vii.1983, INS 30576 and 30579. Novyj Afon near Anuchva (54), 1 ♂, 19.viii.1985, INS 29088. Pskhu (58), 2 ♂♂, 25. and 27.vii.1988, INS 29089 and 30284. Pskhu near Dou (59), 3 ♂♂, 25.vii.1988, INS 29086, 29087 and 30288. Resava (61), 1 ♂, 22.vii.1988, INS 30184. Saken (64), 3 ♂♂, 8.vii.1983, INS 30380, 30491 and 30575. Saken – Narzan (65), 8 ♂♂, 9. and 12.vii.1983, INS 30282, 30286, 30289, 30387, 30494, 30574, 30580 and 30682. Serbista (67), 1 ♂, 2.viii.1985, INS 30389. Ubus (73), 2 ♂♂, 7.viii.1985, INS 30378 and 30687. Zemo – Azara (77), 7 ♂♂, 10., 14. and 15.vii.1983, INS 30287, 30381, 30383, 30581, 30685, 30689 and 30777. Distribution: This species was known so far only by its original description (Ježek, 1997) from Abkhazia. Now known from Georgia and Azerbaijan, as well (Oboňa et al., 2019; Ježek et al., 2021a).

Ulomyia cognata (Eaton, 1893) – Unpublished records: Georgia: Adjaria (6), 1 ♂, 30.vi.2013, Chvojka leg., SW, INS 30709. Abkhazia: Adanga Pass (5), 1 ♂, 4.viii.1985, INS 30014. Azgara – Narzan (10), 1 ♂, 1.viii.1985, INS 30012. Baskacara (11), 1 ♂, 18.vii.1983, INS 30313. Bzyb (17), 2 ♂♂, 5.viii.1985, INS 30013 and 30410. Kot – Kot (43), 1 ♂, 11.viii.1985, INS 30414. Ubus (73), 1 ♂, 7.viii.1985, INS 30011. Distribution: European species (Wagner 1990, 2019), known also from Armenia and Georgia (Ježek et al., 2018, 2021a). New for Abkhazia.

Summary of the results and conclusion

Psychodids fauna, mainly from Abkhazia and rarely from adjacent countries, such as Armenia, Georgia and Russia, is presented. Altogether 65 species were found from 33 genera. The most species-rich localities include the following: site 65 – Saken – Narzan (26 species), 58 – Pskhu (22 spp.), 77 – Zemo – Azara (20 spp.), and these localities, with a large diversity of plants and interesting different landscape morphology, were the mostly frequently sampled. On the other hand, the localities with the lowest species diversity (usually with a minimum diversity of plants and almost dried former wet habitats) were sites with just one species (localities 13 – Below Chimsa Pass, 15 – Below Ulm Pass, 24 – Cerna Voda, 34 – Ilori) and with two species (sites 1 – Achalsopeli, 3 – Achalseni near Sroma, 7 – Anaria, 30 – Gagra). The

Table 1. List of localities with recorded species.

1	Achalsopeli (Abkhazia)	*abchazica, auriculata*
2	Achalseni (Abkhazia)	*achalshenica, ckvitariorum, gemina, nubila, trinodulosa*
3	Achalseni near Sroma (Abkhazia)	*abchazica, blandula*
4	Acigvara (Abkhazia)	*abchazica, nubila, trinodulosa*
5	Adanga Pass (Abkhazia)	*cognata, phalaenoides, schumpkanica*
6	Adjaria (Georgia)	*ambigua, arcuata, balkaneoalpinus, balkanicum, blandula, caucasica* (*S.*), *cognata, furva, grusinicus, minuta, m. motasi, nubila, pseudexquisita, satchelli, silesiensis*
7	Anaria (Abkhazia)	*abchazica, nubila*
8	Areni (Armenia)	*albipennis, alternata, bunae, lativentris, pannonica, pilularia, satchelli, ustulata*
9	Azgara (Abkhazia)	*abchazica, arcuata, balkaneoalpinus, caucasica* (*S.*), *furva, grusinicus, lobata, nubila, ressli, rotunda, setigera, vaillanti*
10	Azgara – Narzan (Abkhazia)	*alternata, arcuata, balkaneoalpinus, blandula, buxtoni, caucasica* (*S.*), *cognata, furva, grusinicus, lobata, nubila, polyascoidea, ressli, rotunda, satchelli, trinodulosa*
11	Baskacara (Abkhazia)	*albipennis, alticola, arcuata, balkaneoalpinus, clouense, cognata, furva, gemina, grusinicus, hibernica, lobata, minuta, montana, petrosus, phalaenoides, pseudexquisita, ressli, schumpkanica, setigera, svanetica*
12	Below Adanga Pass (Abkhazia)	*albipennis, alticola, arcuata, balkaneoalpinus, grisescens, hibernica, nubila, petrosus, phalaenoides, ressli, satchelli*
13	Below Chimsa Pass (Abkhazia)	*schumpkanica*
14	Below Maruch Pass (Abkhazia)	*abchazica, albipennis, arcuata, balkaneoalpinus, gemina, lobata, phalaenoides, pilularia, satchelli, svanetica, trinodulosa, zetterstedti*
15	Below Ulm Pass (Abkhazia)	*schumpkanica*
16	Beslachuba (Abkhazia)	*abchazica, erminea, nubila*
17	Bzyb (Abkhazia)	*arcuata, balkaneoalpinus, cognata, compta, g. gracilis, lobata, nubila, palustris, phalaenoides*
18	Cebelda (Abkhazia)	*abchazica, alternata, gemina, nubila, trinodulosa*
19	Chimsa near Ulm (Abkhazia)	*ressli, schumpkanica*
20	Cimuri (Abkhazia)	*abchazica, albipennis, alternata, arcuata, balkaneoalpinus, blandula, buxtoni, cinerea, gemina, g. gracilis, minuta, nubila*
21	Cimuri near Achalseni (Abkhazia)	*g. gracilis, inopinata*
22	Cchalta (Abkhazia)	*abchazica, auriculata, gemina, grusinicus, nubila, polyascoidea, pseudexquisita*
23	Clou (Abkhazia)	*abchazica, arcuata, balkaneoalpinus, blandula, caucasica* (*S.*), *ckvitariorum, clouense, erminea, fallax, grusinicus, nubila, phalaenoides, trinodulosa*
24	Cerna Voda (Abkhazia)	*balkaneoalpinus*
25	Dagomys (Russia)	*cinerea*
26	Dou Pass (Abkhazia)	*albipennis, arcuata, phalaenoides*
27	Dou near Bzyb (Abkhazia)	*caucasica* (*S.*)
28	Dvurecje near Dou (Abkhazia)	*abchazica, arcuata, balkaneoalpinus, caucasica* (*S.*), *furva, grusinicus, hibernica, lobata, nubila, satchelli*
29	Dzgerda (Abkhazia)	*abchazica, buxtoni, nubila*

Table 1 continued…

30	Gagra (Abkhazia)	*grusinicus, nubila*
31	Gali (Abkhazia)	*alternata, polyascoidea, trinodulosa*
32	Gencvici (Abkhazia)	*abchazica, arcuata, blandula, caucasica* (*B.*), *furva, gemina, grusinicus, nubila, polyascoidea, trinodulosa*
33	GES – Sukhumi (Abkhazia)	*blandula, cinerea, ckvitariorum*
34	Ilori (Abkhazia)	*abchazica*
35	Imereli (Georgia)	*nubila*
36	Juznyj Prijut Pass (Abkhazia)	*caucasica* (*S.*), *gemina, schumpkanica, svanetica*
37	Kaldachvara (Abkhazia)	*abchazica, afonensis, blandula, cinerea, nubila*
38	Kaldachvara near Mjusoera (Abkhazia)	*abchazica, auriculata*
39	Kaman (Abkhazia)	*blandula, cinerea, ckvitariorum, exquisita, gemina, grisescens, hirtella, inopinata, nubila, phalaenoides, trinodulosa*
40	Kelasuri (Abkhazia)	*abchazica, arcuata, blandula, caucasica* (*S.*), *ckvitariorum, clouense, erminea, exquisita, grisescens, grusinicus, lobata, phalaenoides, trinodulosa*
41	Kingdi (Abkhazia)	*abchazica, auriculata, nubila*
42	Kochora (Abkhazia)	*abchazica*
43	Kot – Kot (Abkhazia)	*cognata, hibernica, lobata, petrosus*
44	Kot – Kot near Cimuri (Abkhazia)	*balkaneoalpinus, gemina, grisescens, hibernica, lobata, minuta, nubila, petrosus*
45	Kot – Kot near Ulm Pass (Abkhazia)	*lobata, nubila, petrosus, setigera*
46	Kutol (Abkhazia)	*abchazica, auriculata, nubila, polyascoidea*
47	Lehvaz (Armenia)	*blandula, bunae, ustulata*
48	Levyj Ptys (Abkhazia)	*abchazica, alticola, arcuata, balkaneoalpinus, blandula, buxtoni, caucasica* (*S.*), *furva, gemina, g. gracilis, grusinicus, nubila, polyascoidea, pseudexquisita, ressli*
49	Macara (Abkhazia)	*abchazica, achalshenica, afonensis, alternata, ckvitariorum, exquisita, grusinicus, nubila*
50	Maruch near Adanga (Abkhazia)	*balkaneoalpinus*
51	Mercheuli (Abkhazia)	*abchazica, achalshenica, alternata, arcuata, blandula, caucasica* (*S.*), *ckvitariorum, erminea, exquisita, georgica, grusinicus, inopinata, minuta, negrobovi, nubila, phalaenoides, trinodulosa*
52	Mramba (Abkhazia)	*alternata, cinerea, gemina, inopinata, nubila, phalaenoides, trinodulosa*
53	Niznaja Zemo – Azara (Abkhazia)	*abchazica, caucasica* (*S.*), *gemina, grusinicus, nubila, polyascoidea, trinodulosa*
54	Novyj Afon near Anuchva (Abkhazia)	*abchazica, achalshenica, afonensis, arcuata, blandula, cinerea, ckvitariorum, erminea, furva, inopinata, polyascoidea, trinodulosa*
55	Ocamcira (Abkhazia)	*alternata, auriculata, nubila, uniformata, ustulata*
56	Okumi (Abkhazia)	*abchazica, alternata, auriculata, exquisita, nubila, trinodulosa*
57	Otap (Abkhazia)	*abchazica, afonensis, auriculata, balkaneoalpinus, blandula, ckvitariorum, grusinicus, nubila*
58	Pskhu (Abkhazia)	*abchazica, afonensis, alternata, arcuata, balkaneoalpinus, blandula, buxtoni, caucasica* (*S.*), *cinerea, erminea, furva, gemina, georgica, g. gracilis, grusinicus, manicata, negrobovi, nubila, palustris, polyascoidea, pskhuensis, trinodulosa*

Table 1 continued…

59	Pskhu near Dou (Abkhazia)	*abchazica, arcuata, balkaneoalpinus, erminea, g. gracilis, grusinicus, nubila, palustris, polyascoidea, trinodulosa, uniformata*
60	Reka near Gali (Abkhazia)	*abchazica, alternata, trinodulosa*
61	Resava (Abkhazia)	*arcuata, balkaneoalpinus, caucasica* (*S*.), *ressli*
62	Rica (Abkhazia)	*albipennis, balkaneoalpinus, balkanicum, gemina, lobata, negrobovi*
63	Sagra near Tamys (Abkhazia)	*abchazica, brevicornis, trinodulosa*
64	Saken (Abkhazia)	*abchazica, arcuata, balkaneoalpinus, furva, gemina, grusinicus, nubila, polyascoidea, ressli, trinodulosa*
65	Saken – Narzan (Abkhazia)	*abchazica, albipennis, arcuata, balkaneoalpinus, blandula, brevicornis, buxtoni, carthusiana, caucasica* (*B*.), *caucasica* (*S*.), *cinerea, crassipennis, furva, gemina, grisescens, lobata, montana, nubila, phalaenoides, polyascoidea, ressli, satchelli, schumpkanica, setigera, svanetica, trinodulosa*
66	Saken near Juznyj Prijut Pass (Abkhazia)	*abchazica, furva, nubila, polyascoidea*
67	Serbista (Abkhazia)	*abchazica, alticola, arcuata, balkaneoalpinus, caucasica* (*S*.), *crassipennis, gemina, lobata, petrosus, phalaenoides, ressli, satchelli, setigera, trinodulosa, zetterstedti*
68	Shvanidzor (Armenia)	*achalshenica, alternata, ustulata*
69	Svanetia (Georgia)	*arcuata, blandula, grusinicus, montana, m. motasi, phalaenoides, schumpkanica*
70	Sroma (Abkhazia)	*abchazica, nubila, polyascoidea*
71	Tamys (Abkhazia)	*abchazica, alternata, brevicornis, minuta, nubila, uniformata*
72	Tkvarceli (Abkhazia)	*abchazica, balkaneoalpinus, blandula, ckvitariorum, nubila, trivialis*
73	Ubus (Abkhazia)	*abchazica, albipennis, alticola, arcuata, balkaneoalpinus, caucasica* (*B*.), *cognata, grisescens, lobata, petrosus, phalaenoides, schumpkanica, setigera*
74	Ubus near Bzyb (Abkhazia)	*schumpkanica*
75	Vedi (Armenia)	*achalshenica*
76	Yerevan (Armenia)	*albipennis, alternata, ustulata*
77	Zemo – Azara (Abkhazia)	*abchazica, achalshenica, arcuata, balkaneoalpinus, blandula, caucasica* (*B*.), *caucasica* (*S*.), *erminea, furva, g. gracilis, grusinicus, inopinata, m. motasi, nubila, phalaenoides, polyascoidea, pseudexquisita, ressli, schumpkanica, trinodulosa*

most common species in this study include *Parajungiella abchazica* Ježek, 1985 (41 sites), *Pneumia nubila* (Meigen, 1818) (36), *Tonnoiriella arcuata* Ježek, 1997 (24), and *Threticus balkaneoalpinus* Krek, 1972 (22). Some species are known so far, unfortunately, from only the holotype locality – one specimen (*Kvazbamormia pskhuensis* Ježek, 1995) in contrast to species with a generally large distribution and registered here infrequently by accident: e.g. *Seoda carthusiana* (Vaillant, 1972), *Pneumia compta* (Eaton, 1893), *Pericoma* (*Pachypericoma*) *fallax* Eaton, 1893, *Trichopsychoda hirtella* (Tonnoir, 1919), *Berdeniella manicata* (Tonnoir, 1920), *Pneumia trivialis* (Eaton, 1893) and *Psychomormia vaillanti* (Wagner, 1977).

New records for Abkhazia (31 species) were ascertained: *Logima albipennis* (Zetterstedt, 1850), *Tinearia alternata* (Say, 1824), *Psychoda alticola* Vaillant, 1973, *Copropsychoda brevicornis* (Tonnoir, 1940), *Chodopsycha buxtoni* (Withers, 1988), *Seoda carthusiana* (Vaillant, 1972), *Berdeniella caucasica* Wagner, 1981, *Ulomyia cognata* (Eaton, 1893), *Pneumia compta* (Eaton, 1893), *Psychoda crassipennis* Tonnoir, 1940, *Pericoma* (*Pericoma*) *exquisita* Eaton, 1893, *Psycha grisescens* (Tonnoir, 1922), *Clytocerus* (*Boreoclytocerus*) *grusinicus* Wagner, 1981, *Trichopsychoda hirtella* (Tonnoir, 1919), *Pericoma* (*Pericoma*) *inopinata* Ježek, Oboňa & Manko, 2021, *Berdeniella manicata* (Tonnoir, 1920), *Thornburghiella montana* Ježek, Oboňa & Manko, 2021, *Pericoma* (*Pericoma*) *m. motasi* Vaillant, 1978, *Psychoda phalaenoides* (Linnaeus, 1758), *Pneumia pilularia* (Tonnoir, 1940), *Pericoma* (*Pericoma*) *pseudexquisita* Tonnoir, 1940, *Saraiella ressli* Wagner, 1981, *Saraiella rotunda* (Krek, 1970), *Logima satchelli* (Quate, 1955), *Berdeniella schumpkanica* Vaillant & Joost, 1983, *Ypsydocha setigera* (Tonnoir, 1922), *Psychomora trinodulosa* (Tonnoir, 1922), *Pneumia trivialis* (Eaton, 1893, *Psychoda uniformata* Haseman, 1907, *Paramormia* (*Duckhousiella*) *ustulata* (Walker, 1856), *Psychomormia vaillanti* (Wagner, 1977) and *Logima zetterstedti* Ježek, 1983.

Several species from neighbouring countries were identified in this paper, e.g. *Tonnoiriella arcuata* Ježek, 1997, *Clytocerus* (*Boreoclytocerus*) *grusinicus* Wagner, 1981, *Threticus balkaneoalpinus* Krek, 1972, *Thornburghiella montana* Ježek, Oboňa & Manko, 2021, *Pericoma* (*Pericoma*) *motasi motasi* Vaillant, 1978, *Pneumia nubila* (Meigen, 1818), *Psychoda phalaenoides* (Linnaeus, 1758) and *Pericoma* (*Pericoma*) *pseudexquisita* Tonnoir, 1940, however, all mentioned species were published already from Georgia (Wagner 1981, Oboňa et al., 2019 and Ježek et al., 2021c), from territory other than Abkhazia. For all that, *Seoda ambigua* (Eaton, 1893), *Philosepedon* (*Trichosepedon*) *balkanicum* Krek, 1971, *Yomormia furva* (Tonnoir, 1940), *Psychodula minuta* (Banks, 1894), *Berdeniella schumpkanica* (Vaillant & Joost, 1983) and *Promormia silesiensis* Ježek, 1983, are new for Georgia.

Logima albipennis (Zetterstedt, 1850), *Tinearia alternata* (Say, 1824), *Paramormia* (*Duckhousiella*) *ustulata* (Walker, 1856) and *Pneumia pilularia* (Tonnoir, 1940) were published from Armenia (Ježek et al., 2018), however, *Yomormia achalshenica* Ježek, 1987, *Pericoma* (*Pericoma*) *bunae* Krek, 1979, *Tinearia lativentris* (Berdén, 1952) and *Pericoma* (*Pericoma*) *pannonica* Szabó, 1960, are new for Armenia.

Pericoma (*Pachypericoma*) *blandula* Eaton, 1893, was registered from Georgia and Armenia (Ježek et al., 2018, 2021a), nevertheless, *Logima satchelli* (Quate, 1955) represents a new record for both Georgia and Armenia.

Psychodocha cinerea (Banks, 1894) was published from Russia (Siberia – Ježek, 1992b) and *Berdeniella schumpkanica* Vaillant & Joost, 1983, is also known from Russia (see Vaillant & Joost, 1983: Terskol + stream Schumka).

The Caucasus region (Armenia, Azerbaijan, and Georgia) is considered to be the most biologically rich and most endangered region in the world, a so-called "Biodiversity hotspot" with an exceptional richness of endemic and endangered species (Myers et al., 2000; Krever et al., 2001; Williams et al., 2011; Mumladze et al., 2020). But there was only scarce information about the Psychodidae family from here. As there are also many, extremely rare species in this family in the Caucasus (probably Caucasus or highland endemics) (e.g. *Sycorax caucasica, Kvazbamormia pskhuensis, Lepimormia georgica, Mormia ckvitariorum, Yomormia achalshenica, Yomormia afonensis, Parajungiella abchazica, Seoda svanetica, Philosepedon* (*Trichosepedon*) *clouense, Threticus petrosus, Berdeniella caucasica, Berdeniella schumpkanica, Clytocerus* (*Boreoclytocerus*) *grusinicus, Pericoma* (*Pericoma*) *inopinata, Saraiella ressli, Thornburghiella montana*), it is appropriate to perceive this area as being the most biologically rich and most endangered region in the world also in terms of biodiversity of the Psychodidae family. However, it needs to be given increased attention not only for these rare species, but, for example, from the point of view of island ecology or biodiversity protection.

Research in this area can also contribute to understanding the spread of different species and may contribute to the understanding of the factors that limit this spread.

Knowledge about the biodiversity of the Caucasus is crucial for the protection not only of local nature, but also insects, especially Diptera; extremely "unaesthetic" epidemiological/economic groups are unimportant and given only marginal attention. Also, the ecological significance of insects is often overlooked. Their main ecological functions and ecosystem services in ecosystems include nutrient recycling, pollination, predation/parasitism and decomposition of biological material (Samways, 1993; Kim, 1993; Naeem et al., 2021).

Acknowledgements

We thank in particular friends Mr K. Ckvitaria (Abkhazia, Sukhumi – Makhara) and Mr P. Kvazba (Abkhazia, Pskhu) as well as their families for the accommodation and support of field works of the first author in montane and submontane Caucasian areas. We are grateful to P. Chvojka, J. Dlabola and J. Šumpich (National Museum, Prague, Department of Entomology) for providing extensive additional material from Armenia, Georgia, and Russia. We would especially like to thank the anonymous reviewers for providing constructive comments and for improving the manuscript. This work was supported by the Ministry of Culture of the Czech Republic (DKRVO 2019–2023/5.I.e, National Museum, 00023272) and by the Slovak Scientific Grant Agency, contract no. VEGA-1/0012/20.

References

Amano T., Lamming J.D.L., Sutherland W.J. 2016 Spatial gaps in global biodiversity information and the role of citizen science. Bioscience 66 (5): 393–400. https://doi.org/10.1093/biosci/biw022

Jarvis A., Reuter H.I., Nelson A., Guevara E. 2008 Hole-filled seamless SRTM data V4. International Centre for Tropical Agriculture (CIAT). https://srtm.csi.cgiar.org (accessed 5 March 2023)

Ježek J. 1985 Three new species of moth flies (Diptera, Psychodidae) from the Palaearctic region. Acta Entomologica Bohemoslovaca 82: 49–58.

Ježek J. 1987 Descriptions of new Mormiine moth-flies (Diptera, Psychodidae) from Abkhazia. Acta Entomologica Bohemoslovaca 84: 261–272.

Ježek J. 1989 Contribution to the taxonomy of the genus *Telmatoscopus* Eat. (Diptera, Psychodidae). Sborník Národního Muzea v Praze B 44 (1988): 75–104.

Ježek J. 1990a Redescriptions of nine common Palaearctic and Holarctic species of Psychodini End. (Diptera: Psychodidae). Acta Entomologica Musei Nationalis Pragae 43: 33–83.

Ježek J. 1990b Contribution to the taxonomy of some genera of Paramormiine moth flies (Diptera, Psychodidae) with description of a new genus *Karakovounimerus*. Acta Entomologica Musei Nationalis Pragae 43: 129–157.

Ježek J. 1990c Descriptions of new Sycoracine and Trichomyine moth flies (Diptera, Psychodidae) from the Palaearctic Region. Acta Entomologica Musei Nationalis Pragae 43: 203–219.

Ježek J. 1992a New and little known Palaearctic *Thornburghiella*-species (Diptera, Psychodidae). Acta Entomologica Bohemoslovaca 89: 367–382.

Ježek J. 1992b Siberian moth flies (Diptera, Psychodidae) – new faunistic records. Časopis Národního Muzea, Řada přírodovědná 160: 63–64.

Ježek J. 1993 *Thornburghiella kovari* sp. n. (Diptera, Psychodidae, Psychodinae) from Tajikistan. Časopis Národního Muzea, Řada Přírodovědná 161 (1992): 32–34.

Ježek J. 1994 Three new species of moth flies (Diptera, Psychodidae) from Asia. Dipterologica Bohemoslovaca 6: 69–78.

Ježek J. 1995a New taxa of moth flies (Diptera, Psychodidae) from the Palaearctic Region. Nové taxóny koutulovitých (Diptera, Psychodidae) z Palearktické oblasti. Časopis Národního Muzea, Řada přírodovědná 162 (1994): 55–62.

Ježek J. 1995b Catalogue of Holarctic and Afrotropical Mormiina End. (Diptera, Psychodidae, Psychodinae, Mormiini). Katalog taxónů aterial Mormiina End. Holarktické a Ethiopské oblasti (Diptera, Psychodidae, Psychodinae, Mormiini). Časopis Národního Muzea, Řada přírodovědná 162 (1994): 63–66.

Ježek J. 1995c Occasional paper on some interesting Palaearctic moth flies (Diptera, Psychodidae). Dipterologica Bohemoslovaca 7: 85–96.

Ježek J. 1997 New and interesting taxa of moth flies (Diptera, Psychodidae) from different moist biotopes of the Palaearctic Region. Časopis Národního Muzea, Řada přírodovědná 166: 105–122.

Ježek J. 1999 Rare and new Palaearctic *Tonnoiriella*-species (Diptera, Psychodidae). Časopis Národního Muzea, Řada přírodovědn, 168: 7–18.

Ježek J. 2004a New and interesting moth flies (Diptera, Psychodidae) from protected and underestimated natural areas of the Czech Republic. Časopis Národního Muzea, Řada přírodovědná 173: 113–128.

Ježek J. 2004b New faunistic data of non-phlebotomine moth flies (Diptera, Psychodidae) from the Palaearctic Region. Dipterologica Bohemoslovaca, Vol. 11. Folia Facultatis Scientiarium Naturalium Universitatis Masarykianae Brunensis, Biologia 109: 141–151.

Ježek J. 2007 New records of moth flies (Diptera, Psychodidae) from Poland with description of

Apsycha gen. nov. Acta Zoologica Universitatis Comenianae 47 (2): 145–160.

Ježek J. 2009 Further new faunistic records of moth flies (Insecta, Diptera, Psychodidae) from the Czech Republic and Slovakia. Folia Faunistica Slovaka 14 (15): 101–105.

Ježek J., Hájek J. 2007 Psychodidae (Diptera) of the Orlické hory Protected Landscape Area and neighbouring areas with descriptions of two new species from the Czech Republic. Acta Entomologica Musei Nationalis Pragae 47: 237–285.

Ježek J., Manko P., Oboňa J. 2018 Checklist of known moth flies and sand flies (Diptera, Psychodidae) from Armenia and Azerbaijan. ZooKeys 798: 109–133. https://doi.org/10.3897/zookeys.798.26543

Ježek J., Manko P., Oboňa J. 2020 Synopsis of the Psychodidae (Diptera) fauna of Bulgaria. Zootaxa 4877 (2): 201–240. https://doi.org/10.11646/zootaxa.4877.2.1

Ježek J., Manko P., Oboňa J. 2021a Psychodidae (Diptera) of Azerbaijan and Georgia – faunistics with biodiversity notes. ZooKeys 1049: 15–42. Added: Supplementary material I – List of localities with altitudes and coordinates, 6 pp. https://doi.org/10.3897/zookeys.1049.66063

Ježek J., Oboňa J., Manko P. 2021a Two new Palaearctic species of moth flies (Diptera, Psychodidae, Psychodinae) from the Caucasus Mts. Zootaxa 4985: 582–594. https://doi.org/10.11646/zootaxa.4985.4.11

Ježek J., Oboňa J., Manko P., Trýzna M. 2021b Moth flies (Diptera: Psychodidae) of the northern Hercynian Mountains and adjacent localities (Czech Republic). Acta Musei Silesiae, Scientiae Naturales 70: 135–182. https://doi.org/10.2478/cszma-2021-0011

Ježek J., Oboňa J., Přikryl I., Mikátová B. 2019 Moth flies (Diptera: Psychodidae) of the western Hercynian mountains, Sokolov open-cast coal mines and dumps (Czech Republic). Acta Musei Silesiae, Scientiae Naturales 67 (2018): 193–292. https://doi.org/10.2478/cszma-2018-0015

Ježek J., van Harten A. 2005 Further new taxa and little known species of non-biting moth flies (Diptera, Psychodidae) from Yemen. Acta Entomologica Musei Nationalis Pragae 45: 199–220.

Ježek J., van Harten A. 2009 Order Diptera, Family Psychodidae. Subfamily Psychodinae (non-biting moth flies), pp. 686–711. In: van Harten A. (ed.) Arthropod Fauna of the United Arab Emirates, Vol. 2. Dar Al Ummah Printing, Publishing, Distribution and Advertising, Abu Dhabi, 786 pp.

Kim K.C. 1993 Biodiversity, Conservation and Inventory: Why Insects Matter. Biodiversity & Conservation 2: 191–214. https://doi.org/10.1007/BF00056668

Kociolek J.P., Stoermer E.F. 2001 Taxonomy and ecology: a marriage of necessity. Diatom Research 16 (2): 433–442. https://doi.org/10.1080/0269249X.2001.9705529

Krek S. 1999 Psychodidae (Diptera Insecta) Balkanskog Poluotoka. Federacija Bosne I Hercegovine, Ministarstvo Obrazovanja, Nauke, Kulture I Sporta, Studentska Štamparija Univerziteta Sarajevo, Sarajevo, 417 pp.

Krever V., Zazanashvili N., Jungius H., Williams L., Petelin D. 2001 Biodiversity of the Caucasus ecoregion. An analysis of biodiversity and current threats and initial investment portfolio. World Wildlife Fund for Nature, Baku, Erevan, Gland, Moscow, Tbilisi, 132 pp.

Kroča J., Ježek J. 2019 Moth flies (Psychodidae: Diptera) of the Moravskoslezské Beskydy Mts and Podbeskydská pahorkatina Upland (Czech Republic), II. Acta Musei Silesiae, Scientiae Naturales 68: 201–232.

Kuftyreva N.S., Laščhija Š.V., Mgeladze K.G. 1961 Priroda Abchazii. [The nature of Abkhazia]. Abgosizdat, Suchumi, 341 pp. (In Russian)

Kvifte G.M. 2014 Nomenclature and taxonomy of *Telmatoscopus* Eaton and *Seoda* Enderlein; with a discussion of parameral evolution in Paramormiini and Pericomaini (Diptera: Psychodidae, Psychodinae). Zootaxa 3878 (4): 390–400. https://doi.org/10.11646/zootaxa.3878.4.5

McNeely J.A. 2002 The role of taxonomy in conserving biodiversity. Journal for Nature Conservation 10 (3): 145–153. https://doi.org/10.1078/1617-1381-00015

Mumladze L., Japoshvili B., Anderson E.P. 2020 Faunal biodiversity research in the Republic of Georgia: a short review of trends, gaps, and needs in the Caucasus biodiversity hotspot. Biologia 75 (9): 1385–1397. https://doi.org/10.2478/s11756-019-00398-6

Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B., Kent J. 2000 Biodiversity

hotspots for conservation priorities. Nature 403: 853–858.
https://doi.org/10.1038/35002501

Oboňa J., Dvořak L., Haenni J.-P., Hrivniak Ľ., Japoshvili B., Ježek J., Kerimova I., Máca J., Muranyi D., Rendoš M., Słowińska I., Snegovaya N., Starý J., Manko P. 2019a New and interesting records of Diptera from Azerbaijan and Georgia. Zoosystematica Rossica 28 (2): 277–295.
https://doi.org/10.31610/zsr/2019.28.2.277

Oboňa J., Dvořak L., Haenni J.-P., Hrivniak Ľ., Japoshvili B., Ježek J., Kerimova I., Máca J., Muranyi D., Rendoš M., Słowińska I., Snegovaya N., Starý J., Manko P. 2019b Checklists of the Diptera families Anisopodidae, Blephariceridae, Campichoetidae, Dixidae, Drosophilidae, Limoniidae, Lonchopteridae, Pediciidae, Psychodidae, and Scatopsidae of Azerbaijan and Georgia. Electronic supplementary material 2 to the article Oboňa J., Dvořak L., Haenni J.-P., Hrivniak Ľ., Japoshvili B., Ježek J., Kerimova I., Máca J., Muranyi D., Rendoš M., Słowińska I., Snegovaya N., Starý J., Manko P. 2019a New and interesting records of Diptera from Azerbaijan and Georgia. Zoosystematica Rossica 28 (2): 300–310.
https://doi.org/10.31610/zsr/2019.28.2.277

Oboňa J., Ježek J. 2014 Prodromus of moth flies (Diptera: Psychodidae) from Slovakia. Acta Musei Silesiae, Scientiae Naturales 63: 193–251.
https://doi.org/10.2478/cszma-2014-0020

Oboňa J., Ježek J., Manko P. 2017 A new Palaearctic *Thornburghiella* from Transcaucasia (Diptera: Psychodidae). Acta Entomologica Musei Nationalis Pragae 57 (1): 205–214.
https://doi.org/10.1515/aemnp-2017-0069

Omelková M., Ježek J. 2012 Two new species of *Pneumia* Enderlein (Diptera, Psychodidae, Psychodinae) from the Palaearctic Region. Zootaxa 3180: 1–18.
https://doi.org/10.11646/zootaxa.3180.1.1

Schlick-Steiner B.C., Steiner F.M., Seifert B., Stauffer C., Christian E., Crozier R.H. 2010 Integrative taxonomy: a multisource approach to exploring biodiversity. Annual Review of Entomology 55: 421–438.
https://doi.org/10.1146/annurev-ento-112408-085432

Szabó J. 1983 10. család: Psychodidae – Lepkeszúnyogok. Fauna Hungariae 156: 1–78.

Tkoč M., Pecharová M., Ježek J. 2014 Catalogue of the type specimens of Diptera deposited in the Department of Entomology, National Museum, Prague, Czech Republic. Moth flies (Psychodidae). Acta Entomologica Musei Nationalis Pragae 54 (2): 789–837.

Vaillant F. 1971–1983 Psychodidae–Psychodinae (not finished). In: Lindner E. (ed.) Die Fliegen der palaearktischen Region, Stuttgart, 287 (1971), 291 (1972), 292 (1972), 305 (1974), 310 (1975), 313 (1977), 317 (1978), 320 (1979), 326 (1981) & 328 (1983), pp. 1–48, 49–78, 79–108, 109–142, 143–182, 183–206, 207–238, 239–270, 271–310, 311–357.

Vaillant F., Joost W. 1983 On a small collection of Diptera Psychodidae from Caucasus (USSR) and Bulgaria. Reichenbachia 21 (15): 95–106.

Wagner R. 1981 Some Psychodidae (Diptera) from the Southern Caucasus and Iran. Aquatic Insects 3 (1): 45–56.

Wagner R. 1990 Family Psychodidae. In: Soós A., Papp L. (eds) Catalogue of Palaearctic Diptera. Vol. 2. Akademiai Kiado, Budapest, pp. 11–65.

Wagner R. 2019 Fauna Europaea: Psychodidae. In: De Jong H. (ed.) Fauna Europaea: Diptera Nematocera. Fauna Europaea version 2014.
https://fauna-eu.org
(accessed 2 October 2018)

Wetzel F.T., Bingham H.C., Groom Q., Haase P., Kőljalg U., Kuhlmann M., Martin C.S., Penev L., Robertson T., Saarenmaa H., Schmeller D.S., Stoll S., Tonkin D.T., Häuser Ch.L. 2018 Unlocking biodiversity data: Prioritization and filling the gaps in biodiversity observation data in Europe. Biological Conservation 221: 78–85.
https://doi.org/10.1016/j.biocon.2017.12.024

Williams K.J., Ford A., Rosauer D., De Silva N., Mittermeier R., Bruce C., Larsen F.W., Margules C. 2011 Forests of East Australia: the 35th biodiversity hotspot. In: Zachos F.E., Habel J.C. (eds) Biodiversity hotspots: distribution and protection of conservation priority areas, 11 pp.
https://doi.org/10.1007/978-3-642-20992-5_16

Withers P. 1989 Moth Flies. Diptera: Psychodidae. Dipterists Digest 4: 1–83.

Checklist of species of the family Psychodidae from selected areas of Transcaucasia

Species new for country are marked with an asterisk (*). Abbreviations: Arm – Armenia, Aze – Azerbaijan, Geo – Georgia, (Abk) – Abkhazia (see in Ježek et al., 2018, 2021 and Oboňa et al., 2019).

Subfamily Phlebotominae	
Phlebotomus (*Adlerius*) *balcanicus* Theodor, 1958	Aze, Geo
Phlebotomus (*Adlerius*) *brevis* Theodor et Mesghali, 1964	Aze, Geo
Phlebotomus (*Adlerius*) *chinensis tauriae* Perfiliew, 1966	Geo
Phlebotomus (*Adlerius*) *halepensis* Theodor, 1958	Arm, Aze, Geo
Phlebotomus (*Adlerius*) *longiductus* Parrot, 1928	Geo
Phlebotomus (*Adlerius*) *simici* Nitzulescu, 1931	Arm, Aze, Geo
Phlebotomus (*Larroussius*) *kandelaki* Shurenkova, 1929	Arm, Aze, Geo
Phlebotomus (*Larroussius*) *major syriacus* Adler et Theodor, 1931	Arm, Aze, Geo
Phlebotomus (*Larroussius*) *perfiliewi perfiliewi* Parrot, 1930	Geo
Phlebotomus (*Larroussius*) *perfiliewi transcaucasicus* Perfiliew, 1937	Aze, Geo
Phlebotomus (*Larroussius*) *perniciosus* Newstead, 1911	Aze
Phlebotomus (*Larroussius*) *tobbi* Adler et Theodor in Adler, Theodor et Lourie, 1930	Arm, Aze, Geo
Phlebotomus (*Larroussius*) *wenyoni* Adler et Theodor in Adler, Theodor et Lourie, 1930	Geo
Phlebotomus (*Paraphlebotomus*) *alexandri* Sinton, 1928	Arm Aze, Geo
Phlebotomus (*Paraphlebotomus*) *caucasicus* Marzinovsky, 1917	Arm, Aze, Geo
Phlebotomus (*Paraphlebotomus*) *jacusieli* Theodor, 1947	Aze, Geo
Phlebotomus (*Paraphlebotomus*) *mongolensis* Sinton, 1928	Aze, Geo
Phlebotomus (*Paraphlebotomus*) *sergenti* Parrot, 1917	Arm, Aze, Geo
Phlebotomus (*Paraphlebotomus*) *similis* Perfiliew, 1963 sensu Artemiev et Neronov, 1984	Arm, Aze, Geo
Phlebotomus (*Phlebotomus*) *papatasi* (Scopoli, 1786)	Arm, Aze, Geo
Sergentomyia (*Neophlebotomus*) *pawlowskyi* (Perfiliew, 1933)	Arm, Aze, Geo
Sergentomyia (*Parrotomyia*) *palestinensis* (Adler et Theodor, 1927)	Arm, Aze, Geo
Sergentomyia (*Sergentomyia*) *dentata* (Sinton, 1933)	Aze, Geo
Subfamily Sycoracinae	
Sycorax caucasica Ježek, 1990	Geo (Abk)
Subfamily Trichomyiinae	
Trichomyia urbica Haliday in Curtis, 1839	Aze
Subfamily Psychodinae	
Apsycha pusilla (Tonnoir, 1922)	Aze
Bazarella centiretinacula Wagner, 1981	Geo
Berdeniella manicata (Tonnoir, 1920)	Geo (Abk*)
Berdeniella caucasica Wagner, 1981	Geo (Abk*)
Berdeniella schumpkanica Vaillant & Joost, 1983	Geo* (Abk*)
Copropsychoda brevicornis (Tonnoir, 1940)	Geo (Abk*)
Feuerborniella obscura (Tonnoir, 1919)	Geo
Chodopsycha lobata (Tonnoir, 1940)	Geo (Abk)
Chodopsycha buxtoni (Withers, 1988)	Geo (Abk*)
Clogmia albipunctata (Williston, 1893)	Arm, Aze, Geo
Clytocerus (*Boreoclytocerus*) *grusinicus* Wagner, 1981	Aze, Geo (Abk*)
Joostiella caucasica Vaillant, 1983	Arm
Kvazbamormia pskhuensis Ježek, 1994	Geo (Abk)
Lepimormia georgica (Wagner, 1981)	Geo (Abk)

Logima albipennis (Zetterstedt, 1850)	Arm, Aze, Geo (Abk*)
Logima erminea (Eaton, 1893)	Geo (Abk)
Logima satchelli (Quate, 1955)	Arm*, Aze, Geo* (Abk*)
Logima sigma (Kincaid, 1899)	Aze
Logima zetterstedti Ježek, 1983	Geo (Abk*)
Mormia ckvitariorum Ježek, 1987	Aze, Geo (Abk)
Mormia malickyi Vaillant, 1974	Geo
Parajungiella abchazica Ježek, 1985	Arm, Geo (Abk)
Parajungiella serbica (Krek, 1985)	Aze
Parajungiella monikae (Wagner & Joost, 1986)	Arm
Panimerus denticulatus Krek, 1971	Aze, Geo
Paramormia (*Duckhousiella*) *ustulata* (Walker, 1856)	Arm, Aze, Geo (Abk*)
Paramormia (*Paramormia*) *fratercula* (Eaton, 1893)	Arm
Paramormia (*Paramormia*) *polyascoidea* (Krek, 1971)	Arm, Geo (Abk)
Parabazarella joosti lalehzarica Ježek, 1990	Geo
Pericoma (*Pachypericoma*) *blandula* Eaton, 1893	Arm, Aze, Geo (Abk)
Pericoma (*Pachypericoma*) *fallax* Eaton, 1893	Aze, Geo (Abk)
Pericoma (*Pachypericoma*) *nielseni* Kvifte, 2010	Aze, Geo
Pericoma (*Pericoma*) *bosniaca* Krek, 1966	Arm, Aze, Geo
Pericoma (*Pericoma*) *bunae* Krek, 1979	Arm*, Aze
Pericoma (*Pericoma*) *exquisita* Eaton, 1893	Arm, Aze, Geo (Abk*)
Pericoma inopinata Ježek, Oboňa & Manko 2021	Aze, Geo (Abk*)
Pericoma (*Pericoma*) *kariana* Vaillant, 1978	Aze
Pericoma (*Pericoma*) *motasi motasi* Vaillant, 1978	Aze, Geo (Abk*)
Pericoma (*Pericoma*) *pannonica* Szabó, 1960	Arm*
Pericoma (*Pericoma*) *pseudexquisita* Tonnoir, 1940	Geo (Abk*)
Pericoma platystyla Wagner, 1986	Arm
Peripsychoda auriculata (Haliday in Curtis, 1839)	Arm, Geo (Abk)
? *Philosepedon* (*Philosepedon*) *wagneri* Omelková et Ježek, 2012	? Geo (see Note in Oboňa et al., 2021b)
? *Philosepedon* (*Trichosepedon*) *atschitaricum* Vaillant et Joost, 1983	? Geo (see Note in Oboňa et al., 2021b)
Philosepedon (*Trichosepedon*) *balkanicum* Krek, 1971	Geo* (Abk)
Philosepedon (*Trichosepedon*) *clouense* Ježek, 1994	Geo (Abk)
Pneumia canescens (Meigen, 1804)	Arm, Aze
Pneumia compta (Eaton, 1893)	Geo (Abk*)
Pneumia fuehzulii Ježek, Oboňa & Manko 2022	Aze
Pneumia gracilis gracilis (Eaton, 1893)	Aze, Geo
Pneumia gracilis kandavanica (Ježek 1990)	Aze
Pneumia nubila (Meigen, 1818)	Arm, Aze, Geo (Abk)
Pneumia joosti (Wagner, 1981)	Arm
Pneumia palustris (Meigen, 1804)	Geo
Pneumia pilularia (Tonnoir, 1940)	Arm, Aze, Geo (Abk*)
Pneumia trivialis (Eaton, 1893)	Aze, Geo (Abk*)
Promormia silesiensis (Ježek, 1983)	Aze, Geo*
Psycha grisescens (Tonnoir, 1922)	Aze, Geo (Abk*)
Psychoda alticola Vaillant, 1973	Geo (Abk*)
Psychoda crassipennis Tonnoir, 1940	Geo (Abk*)
Psychoda phalaenoides (Linné, 1758)	Aze, Geo (Abk*)
Psychoda uniformata Haseman, 1907	Arm, Aze, Geo (Abk*)
Psychodocha cinerea (Banks, 1894)	Arm, Aze, Geo (Abk)
Psychodocha gemina (Eaton, 1904)	Aze, Geo (Abk)
Psychodula minuta (Banks, 1894)	Geo* (Abk)
Psychomora mycophila (Vaillant, 1988)	Aze
Psychomora trinodulosa (Tonnoir, 1922)	Aze, Geo (Abk*)
Psychomormia vaillanti (Wagner, 1977)	Geo (Abk)*

Saraiella ressli Wagner, 1981	Arm, Aze, Geo (Abk*)
Saraiella rotunda (Krek, 1970)	Aze, Geo (Abk*)
Seoda ambigua (Eaton, 1893)	Geo*
Seoda carthusiana (Vaillant, 1972)	Geo (Abk*)
Seoda svanetica (Ježek, 1989)	Geo (Abk)
Szaboiella hibernica (Tonnoir, 1940)	Geo (Abk)
Thornburghiella montana Ježek, Oboňa & Manko 2021	Geo (Abk*)
Thornburghiella veve Oboňa & Ježek, 2017	Arm, Aze
Thornburghiella salihi Ježek, Oboňa & Manko 2022	Aze, Geo
Threticus balkaneoalpinus Krek, 1972	Geo (Abk)
Threticus negrobovi Vaillant, 1972	Geo (Abk)
Threticus petrosus Ježek, 1997	Geo (Abk)
Trichopsychoda hirtella (Tonnoir, 1919)	Geo (Abk*)
Tinearia alternata (Say, 1824)	Arm, Aze, Geo (Abk*)
Tinearia lativentris (Berdén, 1952)	Arm*
Tonnoiriella arcuata Ježek, 1997	Aze, Geo
Ulomyia cognata (Eaton, 1893)	Arm, Geo (Abk*)
Yomormia petrovi Ježek, 1985	Arm
Yomormia achalshenica Ježek, 1987	Arm*,Geo (Abk)
Yomormia afonensis Ježek, 1987	Aze, Geo (Abk)
Yomormia furva (Tonnoir, 1940)	Geo* (Abk)
Ypsydocha setigera (Tonnoir, 1922)	Geo (Abk*)

Summary: Arm (36 + 5*), Aze (61), Geo (88 + 7*) (Abk) (26 + 31*).

Historia naturalis bulgarica 45 (4): 83–88
ISSN 2603-3186 (online) | ISSN 0205-3640 (print) · nmnhs.com/historia-naturalis-bulgarica
https://doi.org/10.48027/hnb.45.042
Publication date [online]: 6 April 2023

Research article

Winter activity of the snake-eyed lizard *Ophisops elegans* (Reptilia: Lacertidae) in the northwesternmost part of its range

Georgi Krastev[1], Emiliya Vacheva[2], Borislav Naumov[3]

(1) [Corresponding author] Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria, georgikrastevherp@gmail.com; https://orcid.org/0000-0003-0184-761X
(2) Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria, emilia.vacheva@gmail.com; https://orcid.org/0000-0002-3008-6648
(3) Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria, herpetologybg@gmail.com; https://orcid.org/0000-0003-2146-208X

Abstract: There is a lack of information for potential winter activity of the snake-eyed lizard *Ophisops elegans* in Europe, where it has a limited distribution. To test the hypothesis that this species can be active during the winter months, two locations in Bulgaria were chosen. The visits were conducted in January, February and December 2022 near the village of Meden Buk and in December 2022 above the village of Mezek. A total of 19 individuals of *O. elegans* were recorded. In addition, we confirmed foraging behaviour based on faecal sample collection. To our knowledge, this is the northernmost record of winter activity in the snake-eyed lizard and the first consecutive observation of year-round activity for this species in Europe.

Keywords: Balkan Peninsula, hibernation, phenology, Sauria

Winter activity in lacertid lizards in temperate zones across Europe is rarely observed. In this area lizards normally are induced to hibernate during winter and show great ability to survive low temperatures (Grenot et al., 2022). In lowlands (up to 500 m a.s.l.) lizards usually hibernate between mid-October to early April, while at higher altitude this period may be prolonged from September to May (Stojanov et al., 2011; Zamora-Camacho et al., 2013) and some species may be active in hot days during this period or can escape earlier from hibernacula (Rugiero, 1995; Vongrej et al., 2008; Piccoli & De Lorenzis, 2018). These assumptions are general for all lacertids in Europe, but indeed there is lack of information for some species, like the snake-eyed lizard *Ophisops elegans* Ménétries, 1832.

The genus *Ophisops* Ménétries, 1832 includes at least eleven species, distributed across Southeast Europe, North Africa, the Middle East, and the Indian subcontinent including Sri Lanka (Bozkurt et al., 2022; Uetz et al., 2022). *Ophisops elegans* is the only European representative of the genus. It occurs from Algeria across North Africa, Asia Minor and Iran to West Pakistan, as well as in Southeast Europe (north-eastern Greece, south-eastern Bulgaria, the islands along the Aegean coast, European Turkey and partially in the Caucasus region) (Ananjeva et al., 2006; Stojanov et al., 2011). In Bulgaria, the species has very limited distribution assigned to the easternmost part of the Rhodopes Mts up to 650 m a.s.l. (Tzankov, 2004, 2015). This area also represents the most north-western part of the species range in general. Here, *O. elegans* inhabits extremely dry and warm habitats with bare ground, stones and scarce xerophytic vegetation, rare shrubs (*Juniperus* sp.) and scattered wood (Beshkov & Nanev, 2006; Stojanov et al., 2011).

For the purpose of this study (testing the hypothesis that *Ophisops elegans* exhibits activity during the winter months) we choose two sites in Bulgaria where the presence of the species was previously known: (1) the area of Meden Buk Village (N 41.3805°, E

Received: 23 February 2023; accepted: 27 March 2023 · Editor: Mario Langourov

Fig. 1. A general view of the habitat at the area of Meden Buk Village from February 2022.

Fig. 2. A general view of the habitat at the area above Mezek Village from December 2022.

26.0230°, 120–200 m a.s.l.) – a south-southwest facing slope covered with rocks, stones and scarce vegetation, mainly *Juniperus* shrubs (Fig. 1); (2) the area above Mezek Village (N 41.7183°, E 26.0636°, 460–520 m a.s.l.) – an area near abandoned frontier post on a south-southeast ridge of the hill, containing dry and open area with scarce vegetation surrounded with xerophylic oak forest and scarp near a dirt road (Fig. 2).

Table 1. Data and time of the observation of winter activity in *Ophisops elegans* in the two sites. Age, sex and snout-vent length (SVL) for each specimen were recorded, as well as temperatures and weather (TB, TA, and TS refer respectively to body, air, and substrate temperature in ºC).

Date	Time	Locality	Age & sex	SVL	TB	TA	TS	Weather
January 3	13:00	Meden Buk	ad. M	n/a	n/a	18.9	21.1	Sunny
February 19	11:47	Meden Buk	subad. M	40	31.1	19.4	20.4	Sunny
February 19	13:10	Meden Buk	ad. F	51	34.3	20.7	16.2	Sunny
February 19	13:52	Meden Buk	ad. M	42	29.8	20.2	n/a	Sunny
February 19	14:38	Meden Buk	ad. M	48	31.7	21.4	n/a	Sunny
February 19	15:04	Meden Buk	ad. M	42	28.4	19.2	n/a	Sunny
February 19	16:06	Meden Buk	ad. M	47	27.1	16.9	21.3	Sunny
February 20	11:59	Meden Buk	subad. M	40	22.8	16.9	26.2	Sunny
February 20	13:11	Meden Buk	subad. M	36	24.5	24.6	21.1	Sunny
February 20	13:51	Meden Buk	subad. F	40	26.5	21.6	25.5	Sunny
February 20	14:49	Meden Buk	ad. M	51	23.0	18.7	21.4	Sunny
February 20	15:10	Meden Buk	ad. F	42	20.6	17.8	20.6	Sunny
December 29	13:03	Meden Buk	ad. F	42	23.3	16.5	21.8	Sunny
December 29	13:16	Meden Buk	ad. F	47	26.1	15.4	25.9	Sunny
December 29	13:21	Meden Buk	ad. undet.	n/a	n/a	n/a	n/a	Sunny
December 29	13:26	Meden Buk	ad. M	n/a	n/a	n/a	n/a	Sunny
December 29	14:35	Meden Buk	ad. F	n/a	23.3	16.0	19.6	Sunny
December 30	13:34	Mezek	ad. M	43	29.1	19.0	26.3	Sunny
December 30	13:40	Mezek	ad. F	52	29.6	16.2	24.3	Sunny

The first site was visited three times (January, February and December 2022), and the second – only in December 2022. Individual visits lasted two days, taking into account the following factors: body, air and substrate temperatures (using a digital thermometer with probe – Multi Thermometer, Möller-Therm, with 1.0°C precision) and snout–vent length (SVL) of caught individuals; in several cases, faecal samples were also collected (preserved in ethanol and examined later under a stereomicroscope; for a more detailed description of the methodology see Vacheva & Naumov, 2020).

As a result of the conducted research, a total of 19 *Ophisops elegans* (8 males, 6 females, 1 indeterminate adult and 4 subadults) were recorded, respectively 1 in January, 11 in February and 7 in December (Table 1; Fig. 3). The body temperature of the captured lizards varied between 20.6 and 34.3°C, and the temperature of the air and substrate (at the place and time of registration of each individual) – between 15.4 and 24.6°C and 16.2 and 26.3°C, respectively. All individuals were registered in the afternoon, between 11:30 and 16:00 h. No other reptile species were observed, with the exception of one juvenile *Lacerta viridis* (Laurenti, 1768), spotted on January 3 at the site of Meden Buk. The analysis of the contents of the collected fecal samples (from 5 individuals from February and 1 from December) showed the presence of remains from the following invertebrate groups: order Araneae (in 5 individuals), order Opiliones (in 1

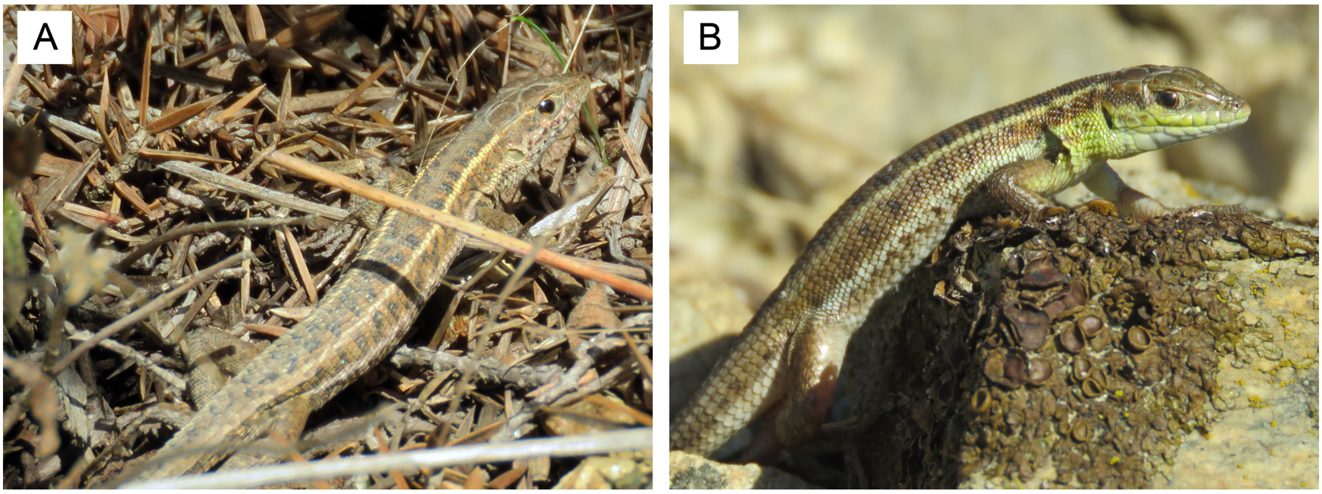


Fig. 3. Two of the observed *O. elegans:* A – adult male (3.01.2022); B – adult female (19.02.2022).

individual), order Diptera (in 1 individual), and order Hemiptera (in 2 individuals).

Our results provide strong evidence of regular activity in all winter months, as well as for foraging during winter. At least half of the captured specimens in February were fed, as well as one captured in December. This finding shows that the Snake-eyed lizards not incidentally emerge from hibernation during hot and sunny winter days, but they continue with their activities such as feeding. A similar type of activity seems to have been proven only for the İzmir Region (the Aegean Coast of Asia Minor, ca. 350 km south of Bulgarian localities), where according to Öktem (1963) it is possible to find *O. elegans* all the year round, except on rainy or cold days when the temperature is generally below 5ºC. For other parts of the range however (e.g., Central Anatolia and Armenia), the species is known to hibernate from November to March (Darewskij & Beutler, 1981 and references therein). There are a number of occasional observations on the winter activity of *O. elegans* in the more southern parts of its range (e.g. Franzen, 1986 for the southern coast of Asia Minor). Among them, the data given by Özgül et al. (2022) are the most interesting, since the observations of *O. elegans* from the Bozcaada Island are of the same dates (February 19–20, 2022) as ours from Meden Buk (ca. 170 km north of the island), and the comparison shows a similar number of observed individuals in a similar time interval: 16 individuals in Bozcaada (between 11:00 and 16:00) vs. 11 individuals in Meden Buk (between 11:00 and 16:00).

For some other lacertid species in the temperate zone, winter activity was also documented, e.g.: *Podarcis muralis* (Laurenti, 1768) (Italy: Rugiero, 1995, Piccoli & De Lorenzis, 2018; Bulgaria: authors' personal data), *Darevskia* spp. (Turkey: Franzen, 2000), *Lacerta viridis* (Slovakia: Vongrej et al., 2008), *Anatololacerta danfordi* (Günther, 1876) (Turkey: Özkan & Bülbül, 2021), etc. Most of these data represent observations only of individuals going outside during warm and sunny days (i.e., basking), while other types of behaviour, such as feeding or breeding, have been observed rarely (e.g., Sahin, 2021). It should be noted that despite the relatively large number of lacertid species that are generally found in the sites we studied (Meden Buk: 4 species according to personal observations; Mezek: 6 species according to Tzankov, 2004), during the winter months of 2022, apart from *O. elegans,* it was only one specimen of another species observed (a juvenile *L. viridis*). In all probability, this is due to a significant difference in the temperature requirements of *O. elegans* compared to the other lacertids in Bulgaria.

In conclusion, it can be stated that in the temperate zone (in the sense of geographical region defined by latitude), *Ophisops elegans* seems to be active all year round, even in the northernmost parts of its range, as long as they are at low altitude. It is possible that this is only a consequence of more intensive and targeted research (as it is for the Eastern Rhodopes Mts), but in our opinion, it is also possible that the manifestation of year-round activity is a relatively recent phenomenon, reflecting the impact of global warming on *O. elegans*.

Further research with a larger geographic scope is needed to clarify this question.

Acknowledgements

This study was partially supported by the National Science Fund of Bulgaria under Grant contract No. KP-06-M61/4 from 13.12.2022. Handling of animals was carried out in accordance with the Ministry of Environment and Water of Bulgaria's Permit No. 861/13.01.2021.

References

Ananjeva N., Orlov N., Khalikov R., Darevsky I., Ryabov S., Barabanov A. 2006 The Reptiles of Northern Eurasia. Taxonomic Diversity, Distribution, Conservation Status. Pensoft Publishers, Sofia, 245 pp.

Beshkov V., Nanev K. 2006 Amphibians and Reptiles in Bulgaria. Pensoft Publishers, Sofia–Moscow, 120 pp.

Bozkurt E., Korkmaz E.M., Ilgaz C., Yilmaz C., Üzüm N., Avci A., Doğan O., Budak M. 2022 Molecular and morphological assessment of the snake-eyed lizard, *Ophisops elegans* Menetries, 1832 (Sauria, Lacertidae) in Anatolia. Biharean Biologist 16: 98–112.

Darewskij I., Beutler A. 1981 *Ophisops elegans* Ménétries 1832 – Schlangenauge. In: Böhme W. (Hrsg.) Handbuch der Reptilien und Amphibien Europas. Band 1. Echsen (Sauria) I. Aula Verlag, Wiesbaden, pp. 461–477.

Franzen M. 1986 Zur Winterlichen Aktivität Einiger Echsen in der Südlichen Türkei. Herpetofauna 8 (45): 6–10.

Franzen M. 2000 Winteraktivität von *Darevskia*-Arten in der Nordost-Türkei. Die Eidechse, 11 (3): 77–81.

Grenot C.J., Garcin L., Dao J., Hérold J.-P., Fahys B., Tséré-Pages H. 2000 How does the European common lizard, *Lacerta vivipara,* survive the cold of winter? Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 127: 71–80.

Öktem N. 1963 Investigations on the Subspecific Division of *Ophisops elegans* Ménétriés in Turkey and its Biology in Izmir Region. Scientific Reports of the Faculty of Science, Ege University, 14: 1–47.

Özgül C.N., Kurtul D., Gül C., Tosunoglu M. 2022 Unusual Winter Activity of Some Amphibian and Reptile Species Living in Bozcaada (Çanakkale, Türkiye). Journal of Anatolian Environmental and Animal Sciences 7 (3): 244–250. https://doi.org/10.35229/jaes.1123314

Özkan H., Bülbül U. 2021 The Winter Activity of the Endemic Lizard Species, *Anatololacerta danfordi* (Günther, 1876). Journal of the Institute of Science and Technology 11 (1): 99–105. https://doi.org/10.21597/jist.775094

Piccoli A.P., De Lorenzis A. 2018 Seasonal Phenology of Reptiles in a Mediterranean Environment ("Castel di Guido" Natural Park, Northern Latium, Italy). International Journal of Environment, Agriculture and Biotechnology 3 (4): 1340–1347. https://doi.org/10.22161/ijeab/3.4.27

Rugiero L. 1995 Winter activity of a common wall lizard (*Podarcis muralis*) population in Central Italy. Russian Journal of Herpetology 2 (2): 148–152.

Sahin M.K. 2021 Unusual mating behavior of *Apathya cappadocica* in the winter season from southeastern Anatolia. Scientific Reports in Life Sciences 2 (2): 49–53. https://doi.org/10.22034/srls.2021.525110.1012

Speybroeck J., Beukema W., Bok B., Van Der Voort J. 2016 Field guide to the Amphibians and Reptiles of Britain and Europe. Bloomsbury Publishing Plc, London, 432 pp.

Stojanov A., Tzankov N., Naumov B. 2011 Die Amphibien und Reptilien Bulgariens. Chimaira, Frankfurt am Main, pp. 366–371.

Tzankov N. 2004 Symptatric distribution of six lacertid lizards. Annuarie de l'Universite de Sofia "St. Kliment Ohridski" 96 (4): 235–242.

Tzankov N. 2015 Snake-eyed Lizard *Ophisops elegans* (Ménétriés, 1832) ssp. macrodactylus Berthold, 1932. In: Golemanski V. et al. (eds) Red Data Book of the Republic of Bulgaria. Volume 2. Animals. IBEI – BAS & MOEW, Sofia, p. 297.

Uetz P., Freed P., Reyes F., Hošek J. 2022 The Reptile Database. http://www.reptile-database.org (accessed: 26 January 2023)

Vacheva E., Naumov B. 2020 Diet of the Viviparous lizard *Zootoca vivipara* (Lichtenstein, 1823) (Reptilia: Lacertidae) from its southern range.

North-Western Journal of Zoology 16 (2): 178–190.
https://doi.org/10.3897/aca.2.e46484

Vongrej V., Smolinsky R., Buláņková E., Jandzik D. 2008 Extraordinary winter activity of the Green Lizard *Lacerta viridis* (Laurenti, 1768) in southwestern Slovakia. Herpetozoa 20 (3/4): 173.

Zamora-Camacho F.J., Reguera S., Moreno-Rueda G., Pleguezuelos J.M. 2013 Patterns of seasonal activity in a Mediterranean lizard along a two thousand and two hundred meters altitudinal gradient. Journal of Thermal Biology 38 (2): 64–69.
https://doi.org/10.1016/j.jtherbio.2012.11.002

Historia naturalis bulgarica 45 (4): 89–96
ISSN 2603-3186 (online) | ISSN 0205-3640 (print) · nmnhs.com/historia-naturalis-bulgarica
https://doi.org/10.48027/hnb.45.043
Publication date [online]: 6 April 2023

Research article

Variability character of conchological features in the mollusc *Gibbulinopsis signata* (Mousson, 1873) (Gastropoda: Pupillidae) in Northwestern Uzbekistan

Intizor Avazmetova[1], Abduvayeit Pazilov[2], Abdurakhim Kuchboev[3]

(1) Department of Natural Sciences, Urgench State University, Kh. Alimdjan Street, 2201004 Urgench, Uzbekistan, intizoravazmetova2311@gmail.com; https://orcid.org/0000-0002-4596-524X
(2) Department of Biology, Gulistan State University, 4th Street, 120100 Gulistan, Uzbekistan, vahid_pazilov@mail.ru; https://orcid.org/0000-0002-2587-1377
(3) Institute of Zoology, Uzbekistan Academy of Sciences, 232b Bogishamol Street, 100053 Tashkent, Uzbekistan, abdurakhimkuchboev@gmail.com; https://orcid.org/0000-0003-2581-728X

Abstract: Analysis of the results shows that mollusc of the species *Gibbulinopsis signata* (Mousson, 1873) from the northwestern region of Uzbekistan exhibits significant variability in conchological characteristics, including variability in shell size, shape, and colour, as well as variations in aperture shape and fittings. Among these characteristics, shell height is found to be the most variable and is recognised as an ecological and biological indicator of mollusc's adaptability to habitat conditions. The results of molecular analysis, using the sequences of the gene 18S of ribosomal DNA showed that all three populations belonged to the same species.

Keywords: 18S rDNA, *Gibbulinopsis signata,* conchology, shell, terrestrial mollusc

Introduction

Despite more than 150 years of research on the molluscan fauna of Central Asia, the first information about the molluscan fauna of the northwestern part of Uzbekistan was only published in 2020 (Avazmetova, 2020; Pazilov & Avazmetova, 2020). Therefore, any research carried out on the molluscan fauna (fauna, zoogeography, ecology, and research) of this region is of significant scientific and practical importance.

Several studies have been conducted on the variability of terrestrial molluscs in Central Asia, including processes of variability by Matyokin (1959), Pazilov & Avazmetova (2020), Pazilov & Umarov (2022), and molecular genetic variability by Kuchboev et al. (2017, 2020), Kuchboev & Egamberdiev (2023). While information on the variability of conchological characteristics of terrestrial molluscs is provided by several scientists in other parts of the world, such as Harvey (1976), Bengston et al. (1979), Smet & Rompu (1984), Staykou (1999), Maltz (2007), Ozgo & Komorowska (2009), Johnson (1980), Fiorentino et al. (2008), Stankovskii (2011), and Haase et al. (2021), the processes of variation in the *Gibbulinopsis signata* (Mousson, 1873) tour have not been studied.

During the research on the species composition of *G. signata,* the variability of conchological signs in their populations was observed, which serves as the subject of this article. The main goal of this work is to study the inter-population variation of conchological features of the common species *G. signata*.

Material and methods

Material and study area

The study was conducted in agricultural areas located in the northwestern part of Uzbekistan, specifically in the Balitov, Bukantov, and Tomditov mountains (Fig.

Received: 8 February 2023; accepted: 27 March 2023 · Editor: Nikolay Simov

1). The materials used in this study were collected during the spring (April, May) and autumn (September, October) periods of 2020–2021 years. A total of 132 samples of *G. signata* were collected. The materials were collected during humid weather in the morning between 7:00 and 10:00 am, as terrestrial molluscs are typically active during this time and can be easily found.

During the collection of live molluscs, they were placed in a jar filled with cold water and covered with a rubber pad. After one day, they were removed from the water and stored in 40% alcohol. After six days, the alcohol concentration was increased to 70%, and after 14 days, it was further increased to 75%. The collected materials were stored in 50–100 ml glass bottles in the malacology collection of Gulistan State University, Uzbekistan.

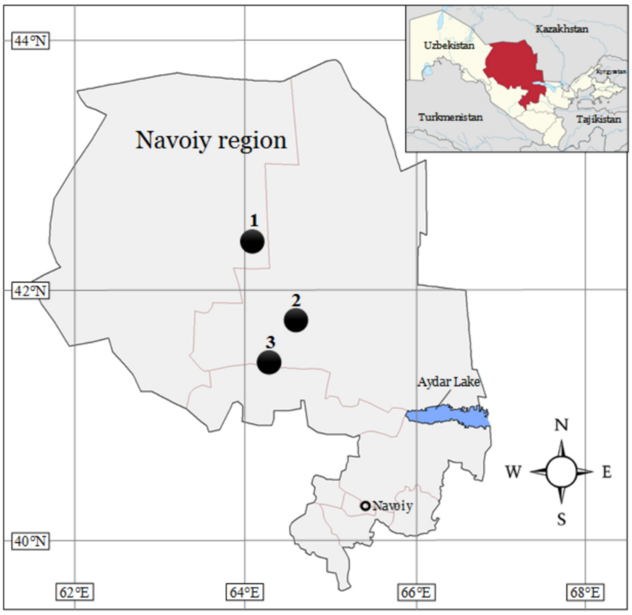


Fig. 1. Area where samples of mollusc of *Gibbulinopsis signata* are collected in Uzbekistan. Legend of sampling area: 1 – Bukantov; 2 – Tomditov; 3 – Balitov.

Morphology

The species composition of *G. signata* was determined using the methods described by Schileyko (1978, 1984) and Likharev & Wiktor (1980). The conchological characteristics of the molluscs were studied, and 30 sexually mature individuals were randomly selected from each group of molluscs to study the signs of conchological changes. Shell measurements were performed using the method described by Schileyko (1978, 1984), and the following parameters were measured: shell height (SH), width (SW), aperture height (AH), aperture width (AW), and last whorl height (LWH).

To conduct statistical analysis of the morphometric indicators for each local population, the following characteristics were calculated: arithmetic means (±), coefficient of variation (SV), and determination (r2). To compare the general variability of the under-researched shells, methods described by Terentev & Rostova (1977), Rostova (1978), and Lakin (1980) were used. Biometric processing of the data obtained from the study of shells was conducted using SPSS Statistics 17.0 and Microsoft Excel 7.0 to determine the conchological variability of molluscs.

DNA isolation, PCR and sequencing

The specimens of molluscs were analysed using molecular genetic methods. For each population of snails, a part of the foot was used for the molecular study. DNA extraction was performed using the Qiamp DNA mini kit (Qiagen, Germany), following the manufacturer's instructions. PCR was carried out in a 25 µl volume using 1xPCR buffer, 0,2 µM each dNTP, 0,25 µl (1,25 units) of Taq polymerase (Qiagen, Germany), 2 µl of extracted DNA solution and 25 pmol of each of the primers F (5'-CTGGTTGAT(CT)CTGCCAGT-3') and R (5'-CTGAGATCCAACTAGGAGCTT-3') for amplification of the domain of 18S rDNA (Winnepenninckx et al., 1998). Amplicons were analysed by electrophoresis in a 1,5% agarose gel containing ethidium bromide. The PCR products were directly sequenced in both directions with the primers used for DNA amplification (Synthol Company, Moscow). The obtained sequences were compared with sequences of terrestrial mollusks available in GenBank. The sequences have been deposited in Genbank with accession numbers ON584276, ON584352, and ON584384.

Results

Morphometrics

The variability of shell characters was studied in three populations.

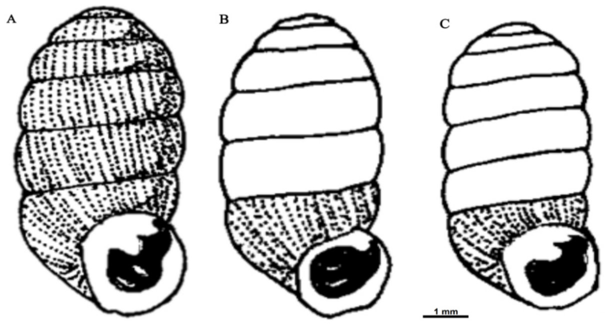


Fig. 2. Species of *Gibbulinopsis signata* shells are shown in the following figure. A – first population, B – second population, and C – third population. The scale bars are 1 mm.

The first population consists of dark brown cylindrical shell molluscs found among the tall shrubs under the rocks in Bukantov, which is 764 m above sea level. The mouth is whole with 5 teeth, with the parietal tooth connected to the angular bulge and the columellar tooth underdeveloped. There are 2 soft wrinkles, the bottom being long and the top relatively short, and the soft bulge is well-developed (Fig. 2A).

The second population consists of molluscs with round-cylindrical shells living among the tall shrubs in Tomditov, around the village of Ajritki, which is 922 m above sea level. The shells have 6 folds and are medium brown and glossy. The mouth has angular teeth and 2 soft bulges (Fig. 2B).

The third population consists of molluscs with straight cylindrical shells living in the stems of shrubs in Balitov, at high altitudes of 146 m above sea level. The shells are light brown and the mouth is whole with wide edges. There are 2 teeth in the mouth, with parietal curved teeth connected by an angular bulge (Fig. 2C).

It is worth noting that, besides the aforementioned changes, the variability of morphometric features of *G. signata* has also been investigated, including shell height (SH), shell width (SW), aperture height (AH), aperture width (AW), last whorl height (LWH), which can be diagnostically quantified. The variability of these morphometric markers among the three populations of *G. signata* is as follows. Statistical analysis of the first population revealed an arithmetic mean value of 4,12 mm for formed shell height under Bokantov conditions (Table 1), with minimum and maximum values of 3,70–4,60 mm. The variant coefficient of shell height was 5,74%, indicating relatively low variability. The shell width also exhibited low variability, with a variant coefficient of 6,80%. However, the height and width of the shell mouth had higher variability, with variant coefficients of 14,17–13,57%. According to accepted classification, these characters are moderately variable and dependent on external environmental factors.

Among the studied traits, AH (3) showed relatively strong determination in the first population (Fig. 3), indicating that its variability depends largely on the external environment. On the other hand, 1 – SH, 2 – SW, and 5 – LWH were found to be less variable and more genetically determined.

In the second population, the statistical analysis revealed that the mean shell height of molluscs in

Table 1. The variability of morphometric markers of *Gibbulinopsis signata* across the three populations. The indicators of variability of all morphometric characters are given in millimetres.

Shell marker	**Average arithmetic mean $X\pm$**			**Coefficients of variability, CV, %**			**Coefficient of determination r^2**		
	The 1st population	The 2nd population	The 3rd population	The 1st population	The 2nd population	The 3rd population	The 1st population	The 2nd population	The 3rd population
Shell height	4,12±0,04	3,53±0,07	3,52±0,07	5,74	10,18	12,24	0,299	0,300	0,144
Shell width	1,96±0,02	1,65±0,03	1,89±0,028	6,80	10,41	7,97	0,332	0,333	0,176
Aperture height	1,04±0,03	0,87±0,03	1,01±0,02	14,17	17,02	13,66	0,358	0,358	0,255
Aperture width	1,01±0,02	0,94±0,02	0,98±0,02	13,57	14,05	11,87	0,325	0,326	0,123
Last whorl height	1,55±0,02	1,68±0,02	1,54±0,02	6,96	6,58	5,88	0,318	0,319	0,069

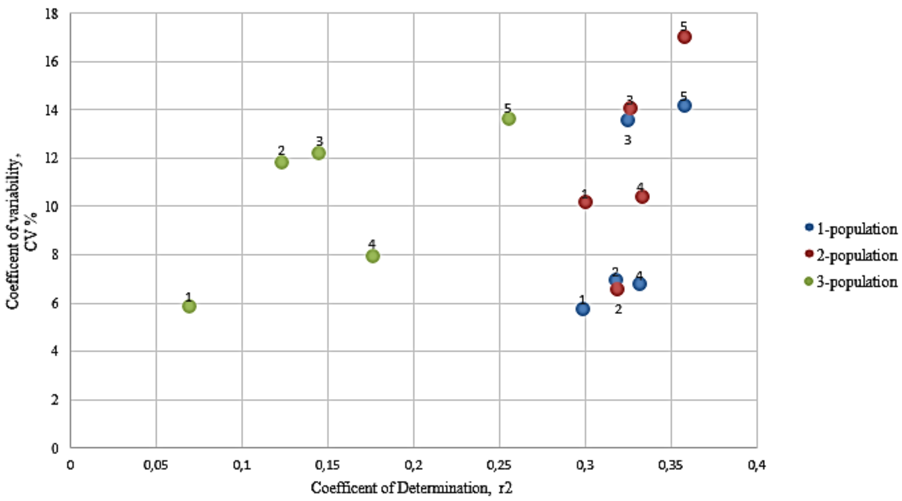


Fig. 3. The variability (CV, %) and determination (r2) markers of the *Gibbulinopsis signata* in the 3 populations. Number next to characters: 1 – SH, 2 – SW, 3 – AH, 4 – AW, 5 – LWH.

Tomditov was 3,53 mm, while it was 4,12 mm in Bokantov (Table 1). The shell height was found to be 0,59 mm lower in Tomditov than in Bokantov, with a variance ratio of 10,18%. Notably, in Bokantov, this ratio was 5,74%. Thus, the height of the shell was found to be two times less in Tomditov's conditions than in Bokantov's.

In the second population (Fig. 2), as in the first, the most strongly determined trait was MW (3), while anterior fold height (PH) was one of the less variable and moderately variable characters.

Regarding the third population, the morphometric markers of variability (Table 1, Fig. 2) showed that the coefficient of variation (CV) of SH, AH, and MW was on average 12,24%, 13,66%, and 11,87%, respectively. The variability of SW and PH was relatively low (the variant coefficient was around 5,88–7,97%). The strongest determinant was again MW (3).

The data suggest that the conchological variability of *G. signata* is best reflected in the shape, colour, oral reinforcement, and size of the shell (Table 1).

Molecular analysis

Based on comparative molecular taxonomic studies of the nucleotide sequence of 18S rDNA regions, two nucleotide differences were found between the 1st population (Bukantov), the 2nd population (Tomditov) and the 3rd population of *G. signata* (Balitov) collected from different mountains in the northwestern part of Uzbekistan. These differences were explained by the substitution of G-guanine instead of A-adenine at 458 nucleotides and T-thymine nucleotides instead of A-adenine at 562 nucleotides (Fig. 4). The total difference between the populations of *G. signata* (Bukantov) and the populations of *G. signata* (Tomditov) and *G. signata* (Balitov) was 0,3%. The similarity between the 2nd population of *G. signata* (Tomditov) and the 3rd population of *G. signata* (Balitov) was 100%. These sequences were compared with the nucleotides of the species *Cochlicopa lubrica* (Cochlicopidae) (MN022682) from the GenBank database, and the difference between them was 4,2 % (Fig. 4).

Discussion

The conchological variability of terrestrial molluscs has been studied by numerous foreign and local scientists, including Harvey (1976), Haase et al. (2020), and Pazilov & Avazmetova (2020). For example, studies have focused on the factors influencing shell changes in terrestrial molluscs, particularly in the genus *Cepaea* species, examining shell polymorphism (Harvey, 1976) and shell size in natural populations (Bengston et al., 1979). Other studies have explored the conchological polymorphism of shell molluscs, including shell colour and size (Smet & Rompu, 1984), as well as the dependence of shell colour on temperature, activeness, and drought resistance (Staikou, 1999). Additionally, shell

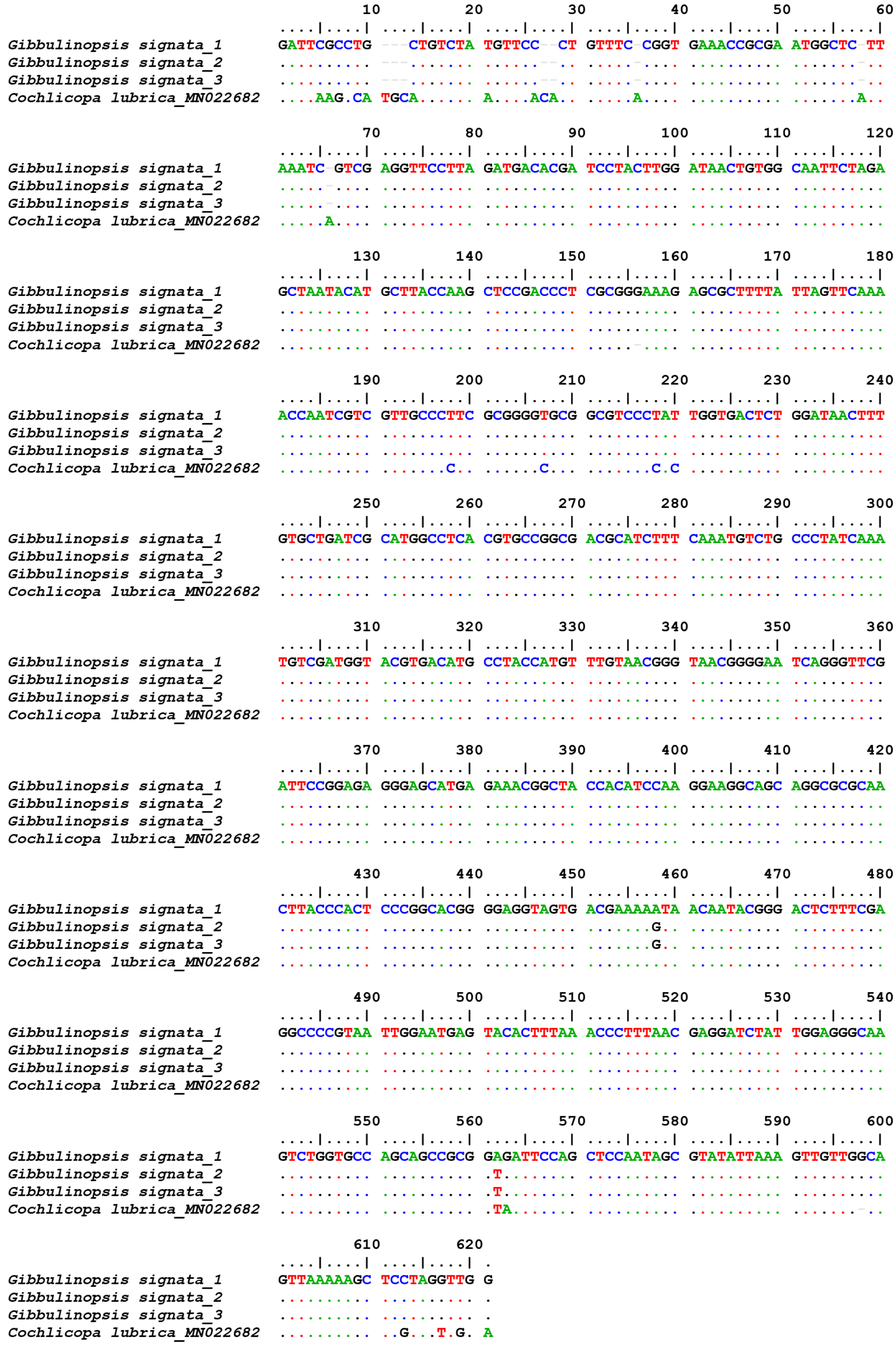


Fig. 4. Nucleotide sequences of samples mollusc from three populations of the species *Gibbulinopsis signata* (1 – Bukantov, 2 – Tomditov, 3 – Balitov) and *Cochlicopa lubrica* (MN022682) (direction from 5' to 3' end, dots indicate nucleotide bases)).

polymorphism has been determined through the megalab database (Cameron & Cook, 2012), shell circumference and habitat dependence of *Theba pisana* have been studied (Johnson, 1980), and micro-geographic variation in *Littorina striata* shell has been examined (Wolf et al., 1997).

The vast variability of Central Asian terrestrial mollusc fauna is well known, making it of interest to malacologists (Pazilov & Azimov, 2003). Variability in shell shape and size, colour, and mouth and mouth fittings can be observed. The species *G. signata* is highly drought tolerant and often forms large clusters with a density of up to 100 individuals per square metre at heights of up to 3500 metres above sea level during unfavorable times of the year. It lives under rocks, bushes, and pebbles in semi-desert and mountain-desert areas, and is widespread in Central Asia, the Eastern Caucasus, northern Iran, and Afghanistan (Matyokin, 1959).

G. signata is known to inhabit under bedding, rocks, and rock crevices. Due to its small size, the shell of *G. signata* provides some protection from accidental falls into uncomfortable conditions, which may occur due to sudden changes in air temperature and humidity. In such situations, the snails may experience significant water loss, causing them to become inactive and cling to rocks. The cylindrical shells of *G. signata,* which live in very dry rocky crevices of Bokantov, Tomditov, and Balitov mountains, provide a clear example of this behaviour.

The flexibility of terrestrial mollusks is evident in the colour of their shells. In most taxa, the assimilation of new adaptation zones, such as open dry spaces, leads to a change in shell colour. For instance, *G. signata* living under rocks and boulders in the open air tend to have light brown shells, while those living among bushes and under rocks have dark brown shells, as observed in Bukantov. This difference is attributed to the fact that mollusks living in open areas are more exposed to sunlight than those living under rocks among bushes.

Moreover, the shell structure of *G. signata* varies across its range. In particular, different levels of advanced aperture structures can be seen within the studied type. Additionally, the number of oral teeth in *G. signata* varies depending on their habitat. For instance, those living under rocks between bushes in Bukantov have five teeth in their mouth, while those living on the stems of semi-shrubs in Balitov at a height of 146 m above sea level have two teeth in their mouth.

The research results indicate that molluscs which live among rocks between bushes and never climb on plant stems (even during the wettest times of the year) have well-developed mouth teeth. Apparently, these developed oral teeth serve to clear soil particles from the surface of their feet when they retract into their shells. On the other hand, molluscs living in the lower part of semi-shrub plants do not have mouth teeth, suggesting that there is no need for their development in this habitat.

Conclusion

The conchological signs of molluscs can vary in the shape and size of their shells, colour variability, as well as in the shape of the mouth and mouth aperture. This trait can be considered a moderate biological indicator, while a high level of variability in these traits indicates a balance of growth processes in the ontogenetic process (Pazilov & Azimov, 2003). In the north-western part of Uzbekistan, the optimal ratio of shell size and energy consumption in mollusc movement can be observed, which is crucial during recurrent high drought conditions. Molecular analysis was performed on specimens from three populations (1st, 2nd, and 3rd) of the mollusc *G. signata* in Bukantov, Tomditov, and Balitov mountains in Uzbekistan. The results showed that all populations belonged to *G. signata,* and the sequences obtained from these snails were identical (99,7–100%). Further studies using more specific markers of ribosomal and mitochondrial genes are proposed to identify intraspecific boundaries of variability within these populations.

Acknowledgements

We would like to acknowledge the support of Khorezm Ma'mun Academy and Gulistan State University of Uzbekistan for funding this research. We are grateful to our colleagues who provided valuable insights and expertise that greatly assisted the research, as well as for their helpful comments that greatly improved the manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Avazmetova I.R. 2020 Initial Data on Malakofauna of Khorezm Oasis. Bulletin of Khorezm Mamun Academy 7: 20–23. (In Uzbek)

Bengston S.-A., Nilsson A., Nordström S., Rundgren S. 1979 Selection for adult shell size in natural populations of the landsnail *Cepaea hortensis* (Müll.). Annales Zoologici Fennici 16: 187–194.

Cameron R.A.D., Cook L.M. 2012 Habitat and the shell polymorphism of *Cepaea nemoralis*. Journal of Molluscan Studies 78: 179–184. https://doi.org/10.1093/mollus/eyr052

Fiorentino V., Manganelli G., Giusti F. 2008 Multiple scale patterns of shell and anatomy variability in land snails: the case of the Sicilian *Marmorana* (Gastropoda: Pulmonata, Helicidae). Biological Journal of the Linnean Society 93 (2): 359–370. https://doi.org/10.1111/j.1095-8312.2007.00940.x

Haase M., Meng S., Horsák M. 2021 Tracking parallel adaptation of shell morphology through geological times in the land snail genus *Pupilla* (Gastropoda: Stylommatophora: Pupillidae). Zoological Journal of the Linnean Society 191 (3): 720–747. https://doi.org/10.1093/zoolinnean/zlaa057

Harvey P.H. 1976 Factors influencing the shell pattern polymorphism of *Cepaea nemoralis* (L.) in east Yorkshire: A test case. Heredity 36: 1–10. https://doi.org/10.1038/hdy.1976.1

Johnson M.S. 1980 Association of shell banding and habitat in a colony of the land snail *Theba pisana*. Heredity 45: 7–14. https://doi.org/10.1038/hdy.1980.46

Kuchboev A.E., Eamberdiyev M.Kh. 2023 Morphological and Molecular Identification of Land Molluscs as Intermediate Hosts of Lungworms. Advances in Animal and Veterinary Sciences 11 (1): 57–64. http://doi.org/10.17582/journal.aavs/2023/11.1.57.64

Kuchboev A.E., Krücken J., Karimova R.R., Ruziev B.H., Pazilov A. 2017 Infection levels of protostrongylid nematodes in definitive caprine and intermediate gastropod hosts from Uzbekistan. Journal of Helminthology 91 (2): 235–243. https://doi.org/10.1017/S0022149X16000171

Kuchboev A., Egamberdiev M., Karimova R., Amirov O., Asakawa M. 2020 Occurrence of Larval *Dicrocoelium dendriticum* and *Brachylaima* sp. in Gastropod Intermediate Hosts from Fergana Valley, Uzbekistan. Pakistan Journal of Zoology 52 (3): 1157–1160. https://doi.org/10.17582/journal.pjz/20190320060356

Lakin G.F. 1980 Biometria. Vysshaia shkola, Moskva, 293 pp. (In Russian)

Likharev I.M., Wiktor A. 1980 Slizni fauny SSSR i sopredelnych stran (Gastropoda terrestria nuda). Fauna SSSR. Mollyuski III (5). Nauka, Leningrad, 437 pp. (In Russian)

Matyokin P.B. 1959 Adaptive Variability and Process of Variation of Central Asian Terrestrial Molluscs of Enidae. Zoologicheskiy Zhurnal 33 (10): 1518–1536 (In Russian)

Ożgo M., Komorowska A. 2009 Shell Banding Polymorphism in *Cepaea vindobonensis* in Relation to Habitat in Southeastern Poland. Malacologia 51 (1): 81–88. https://doi.org/10.4002/040.051.0105

Pazilov A., Avazmetova I.R. 2020 Structure and variability of conchological features terrestrial mollusk of *Cochlicopa* in north western areas of Uzbekistan. Universum: Chemistry and Biology 7 (73): 6–7. (In Russian)

Pazilov A., Azimov D.A. 2003 Terrestrial molluscs (Gastropoda, Pulmonata) in Uzbekistan and adjacent territories. FAN Publishers, Tashkent, 316 pp. (In Russian)

Pazilov A.P., Umarov F.U. 2022 Conchological variability of terrestrial mollusk *Chondrulopsina fedtschenkoi* (Ancey, 1886) (Gastropoda, Pulmonata, Enidae) from the Zarafshan range, Uzbekistan. Bulletin of the Iraq Natural History Museum 17 (1): 103–113. https://doi.org/10.26842/binhm.7.2022.17.1.0103

Rostova N.C. 1978 Correlation analysis and problems of system biological objects, regulation and functioning of biological system. Bulletin MOIP 79–82. (In Russian)

Schileyko A.A. 1978 Nazemnye mollyuski nadsemeystva Helicoidea. In: Skarlato O.A. (ed.) Fauna SSSR, Mollyuski. III (6), new series, No. 117. Nauka, Leningrad, 384 pp. (In Russian)

Schileyko, A.A. 1984 Nazemnye mollyuski podotryada Pupillina fauny SSSR (Gastropoda, Pulmonata, Geophila). In: Skarlato O.A. (ed.) Fauna SSSR, Mollyuski. III (3), new series, No. 130. Nauka, Leningrad, 399 pp. (In Russian)

Smet W.H.O., Rompu E.A.M. 1984 Shell size and thickness in adult *Cepaea nemoralis,* from the Belgian coastal dunes. Biologisch Jaarboek Dodonaea 52: 26–34.

Staikou A. 1999 Shell Temperature, Activity and Resistance to Desiccation in the Polymorphic Land Snail *Cepaea Vindobonensis*. Journal of Molluscan Studies 65 (2): 171–184. https://doi.org/10.1093/mollus/65.2.171

Terentev P.B., Rostova N.S. 1977 Praktikum po biometrii. Izdatelstvo Leningradskogo gosudarstvenogo universiteta, Leningrad, 152 pp. (In Russian)

Winnepenninckx B., Steiner G., Backeljau T., De Wachter R. 1998 Details of Gastropod Phylogeny Inferred from 18S rRNA Sequences. Molecular Phylogenetics and Evolution 9 (1): 55–63. https://doi.org/10.1006/mpev.1997.0439

Wolf H., Backeljau T., Medeiros R., Verhagen R. 1997 Microgeographical shell variation in *Littorina striata,* a planktonic developing periwinkle. Marine Biology 129: 331–342. https://doi.org/10.1007/s002270050173

Historia naturalis bulgarica 45 (4): 97–101
ISSN 2603-3186 (online) | ISSN 0205-3640 (print) · nmnhs.com/historia-naturalis-bulgarica
https://doi.org/10.48027/hnb.45.044
Publication date [online]: 6 April 2023

Research article

The first finding of a Habitats Directive species *Vertigo angustior* Jeffreys, 1830 (Mollusca: Gastropoda: Vertiginidae) from the Republic of North Macedonia

Ivaylo Dedov[1], Slavcho Hristovski[2], Trajche Mitev[3]

(1) Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria, idedov@gmail.com; https://orcid.org/0000-0003-4445-359X
(2) Institute of biology, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje, North Macedonia, hristovskis@gmail.com; https://orcid.org/0000-0002-9467-6575
(3) Dekons Ema Consultancy, 1000 Skopje, North Macedonia, trajcho.mitev@gmail.com

Abstract: Five adults and one juvenile specimens of *Vertigo angustior* Jeffreys, 1830 (narrow-mouthed whorl snail) were found near Dunjska River, Mariovo for the first time in the Republic of North Macedonia. The species is included in Annex II of the Habitats Directive, and Convention on the conservation of European wildlife and natural habitats (Bern Convention).

Keywords: Natura 2000, new locality, protected species, terrestrial snails, Western Balkans, wetland

Introduction

Vertigo (*Vertilla*) *angustior* Jeffreys, 1830 was previously unknown for the gastropod fauna of North Macedonian. The shell of *V. angustior* is sinistral, yellowish or reddish-brown, thinly and uniformly striated. The shape is oblong-ovoid, with 4.5–5 convex whorls. The aperture is heart-shaped and has 5–6 teeth – upper palatal denticle high and relatively long, the small lower palatal denticle (as tuberculum), nearly vertical columellar denticle and two parietal denticles. The shell size is: height: 1.6–1.8 mm, width 0.8–1.0 mm (Kerney & Cameron, 1996; Welter-Schultes, 2012).

V. angustior in Europe occurs in a wide range of open habitats, as grasslands, marshes, bogs, coastal salt marshes, wet depressions among dunes, etc., but the proper micro-habitats only (Pokryszko, 1990; Cameron et al., 2003; Hornung et al., 2003; Killeen, 2003; Zoltan, 2005; Cochard et al., 2006; Moorkens, 2006; Książkiewicz, 2008; Feher 2009). In Bulgaria the species occurs in dense wet deciduous forests (with dominant species of alder, hornbeam, ash, beech, oak and hawthorn), or habitats with over 75% cover of reed and rush and stable water level of the floodplain region (Antonova et al., 2015).

The species is included in Annex II of the Council Directive 92/43/EEC (Council of the European Communities, 1992). The threat status in Europe according IUCN list is Vulnerable (Moorkens et al., 2012).

Material and methods

The survey was carried out in the valley of Dunjska River, Mariovo, Republic of North Macedonia on 22.10.2021. Initially it was found in sandy sediments near the river, N41.21276 E21.71170, leg I. Dedov. Collection number – ID10924/ 3 adults and 1 juvenile specimens. The specimens were collected by soil sampling. The second collecting was conducted at the same location, among riparian vegetation on 6.05.2022. The soil sample was collected along the transect from a point N41.21926 E21.71149 to point N41.21531 E21.71082, leg I. Dedov. Collection

Received: 23 February 2023; accepted: 27 March 2023 · Editor: Mario Langourov

Fig. 1. Distribution of *V. angustior* in North Macedonia. A – map of North Macedonia with depicted Mariovo Region, B. Mariovo Region with localities of *V. angustior*.

number – ID10938/ 2 adult specimens, soil sample (Fig.1). The material is deposited in Malacological collection of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia.

Following Dedov & Antonova (2015), suitable habitats were selected after the analysis of the terrain, from which soil was collected in canvas bags. The resulting sample was immersed in a standard bucket filled about 2/3 with water. With a suitable strainer (fine raster) the fraction that floats on the surface of the water were taken and put on rectangular plexiglass plate. The content was transferred in a thin sock and allowed to dry. In the laboratory each sample was sieved through a system of sieves of different mesh sizes and the specimens of the target species were separated and counted.

Results

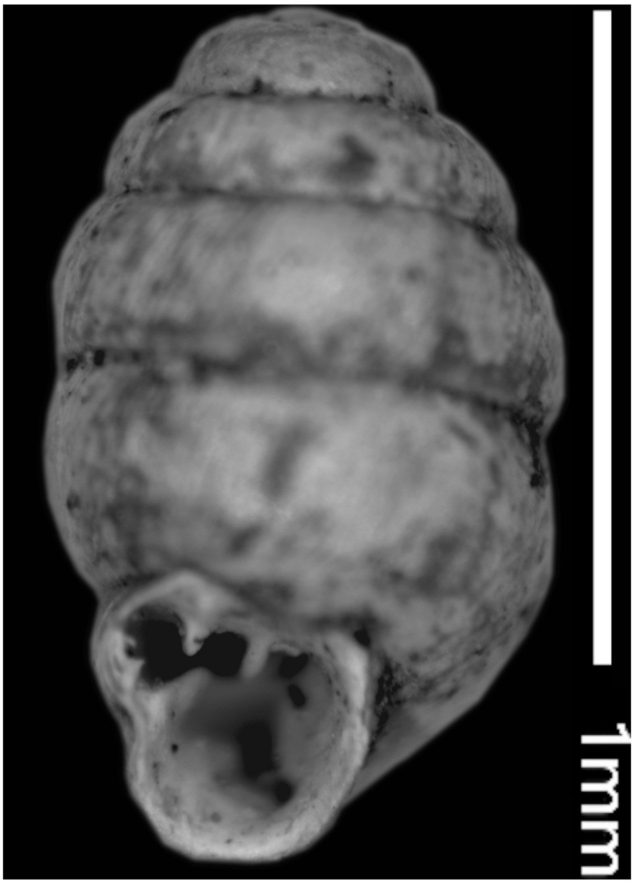
During the research conducted in Mariovo Region a total of five adults and one juvenile specimens of *Vertigo angustior* were found in the valley of Dunjska River. The specimens were collected along the river in sandy sediments and among riparian vegetation (Fig. 2). The shell characters of the specimens found fit to the published description of *V. angustior* (Kerney & Cameron, 1996; Welter-Schultes, 2012).

Discussion

Geographical aspect

Narrow-mouthed whorl snail is reported for all countries bordering North Macedonia: Albania, Bulgaria, Greek mainland, Kosovo and Serbia (Antonova et al., 2015; MolluscaBase eds., 2023). Given the presence of suitable habitats in North Macedonia, the finding of the species is not a surprise and fills an important gap in species distribution. The species is likely to be found in other localities in North Macedonia. The reason for such expectations are the relatively poorly studied wetlands of the country, as well as the possibility of *V. angustior* to spread.

Fig. 2. The area of Dunjska River, were the species *V. angustior* was found.



← Fig. 3. Adult specimens of *V. angustior,* collected along the Dunjska River.

Specimens can be transported by slugs, small mammals and by wind-blown plant debris (Cameron et al., 2003; Moorkens & Killeen, 2011).

Habitat and threats

In North Macedonia *V. angustior* was found in a narrow strip of riparian vegetation along the Dunjska River. The general habitat is not a typical *Vertigo* spot, but there appears to be a small number of suitable microhabitats where the species inhabits. We assume that abundance of the species is not large.

Mariovo is sparsely populated and remoted area (Melovski et al., 2013), and there are no direct threats to *V. angustior*. A potential threat could be the planned construction of a system of dams along the Crna River, which will inundate the newly discovered locality of the species in North Macedonia.

Acknowledgments

The work is supported by the project: “Design and implementation of biodiversity surveys in the framework of the Environmental and Social Impact Assessment (ESIA) for the Čebren Power Project, North Macedonia, WBIF IPF9 Project: Optimisation of the Energy Utilisation of the Crna Reka: Environmental and Social Impact Assessment (WB20-MKD-ENE-01)”. We also acknowledge to anonymous reviewers for their comments and recommendations.

References

Antonova V., Mitov P., Dedov I., Zapryanov L., Todorov E., Biserkov V. 2015 Inventory of *Vertigo angustior* Jeffreys, 1830 and *Vertigo moulinsiana* (Dupuy, 1849) (Gastropoda: Pulmonata) from Natura 2000 Network in Bulgaria. Acta Zoologica Bulgarica 67 (3): 365–374.

MolluscaBase eds 2023 MolluscaBase. https://www.molluscabase.org (accessed on 27 March 2023)

Cameron R.A.D., Colville B., Falkner G., Holyoak G.A., Hornung E., Killeen I.J., Moorkens E.A., Pokryszko B.M., Proschwitz T. von, Tattersfield P., Valovirta I. 2003 Species accounts for snails of the genus *Vertigo* listed in Annex II of the Habitats Directive: In: Speight M.C.D., Moorkens E.A., Falkner G. (eds) Proceedings of the Workshop on Conservation Biology of European *Vertigo* Species. Dublin, 2002. Heldia 5: 151–170.

Cochard P.O., Hesnard O., Lecaplain B., Mazurier M., Philippeau A. 2006 Le genre *Vertigo* O.F. Müller, 1773 (Gastropoda, Stylommatophora, Vertiginidae) en Normandie, premier état des connaissances. Bulletin de la Malacologie Continentale Française 2: 34–38.

Moorkens E.A., Killeen I.J. 2011 Monitoring and Condition Assessment of Populations of *Vertigo geyeri, Vertigo angustior* and *Vertigo moulinsiana* in Ireland. Irish Wildlife Manuals, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin.

Council of the European Communities 1992 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive 92/43/EEC). Official Journal of the European Communities 35: 7–50.

Dedov I.K., Antonova V. 2015 Methodology for monitoring of small terrestrial snails, Stylommatophora (1). Executive Environment Agency. Project “Field studies for species distribution / assessment of the coincidence of species and habitats for the territory of the whole country – Phase I”, Contract No. 2601 / 30. 07. 2013., 17 pp. (In Bulgarian) http://eea.government.bg/bg/bio/opos/activities-results/Stylommatophora1_Metodika_monitoring.pdf

Feher Z. 2009 Proposed protocol of monitoring *Vertigo* (Mollusca: Gastropoda: Vertiginidae) species in Hungary. Tentacle 17: 21–24.

Hornung E., Majoros G., Fehér Z., Varga A. 2003 An overview of the *Vertigo* species in Hungary: their distribution and habitat preferences (Gastropoda, Pulmonata, Vertiginidae). Heldia 5: 51–57.

Kerney M.P., Cameron R.A.D., Riley G. 1996 Land snails of Britain & North-West Europe. Collins Field Guide. Harper Collins Publishers, 288 pp.

Killeen I.J. 2003 A review of EUHSD *Vertigo* species in England and Scotland (Gastropoda: Pulmonata: Vertiginidae). In: Speight M.C.D., Moorkens E.A., Falkner G. (eds) Proceedings of the Workshop on Conservation Biology of European *Vertigo* species. Heldia 5: 73–84.

Książkiewicz Z. 2008 The Narrow-mouthed whorl snail *Vertigo angustior* (Pulmonata: Gastropoda: Vertiginidae) – distribution and habitat disturbance in Northwestern Poland. Tentacle 16: 5–6.

Melovski L., Markovski B., Hristovski S., Jovanovska D., Anastasovski V., Klincharov S., Velevski M., Velkovski N., Trendafilov A., Matevski V., Kostadinovski M., Karadelev M., Levkov Z., Kolchakovski D. 2013 Regional division of the Republic of Macedonia for the needs of biological databases. Macedonian Journal of Ecology and Environment 15 (2): 81–111.

Moorkens E.A. 2006 Irish non-marine molluscs – an evaluation of species threat status. Bulletin of the Irish Biogeographical Society 30: 348–371.

Moorkens E., Killeen I., Seddon M. 2012 *Vertigo angustior*. The IUCN Red List of Threatened Species 2012: e.T22935A16658012. https://doi.org/10.2305/iucn.uk.2012-1.rlts.t22935a16658012.en (accessed 6 December 2021)

Pokryszko B.M. 1990 The Vertiginidae of Poland (Gastropoda: Pulmonata: Pupilloidea) – a systematic monograph. Annales Zoologici (Warszawa) 43 (8): 133–257.

Welter-Schultes F.W. 2012 European non-marine molluscs, a guide for species identification: Bestimmungsbuch für europäische Land-und Süsswassermollusken. Planet Poster Editions, 674 pp.

Zoltan H. 2005 On experiences in monitoring molluscs (Mollusca) in the area of Duna-Dráva National Park. Natura Somogyensis 7: 25–34.