An updated checklist of the millipedes of Iran (Diplopoda), with special emphasis on the fauna of Hircania, including noteworthy records of three species from its easternmost part

Современный контрольный список двупарноногих многоноожек (Diplopoda) Ирана с особым вниманием к фауне Гиркании, включая примечательные находки трех видов в самой ее восточной части

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ABSTRACT. The fauna of Diplopoda of Iran is summarized, presently comprising 56 species from 27 genera, 13 families and eight orders. Special attention is paid to the fauna of Hircania (at least 33 species, largely endemic, but without any endemic genera), this being prompted by a small collection from a relict Parrotia and Carpinus forest patch in Golestan Province, Iran. It contains only three identifiable species: Brachydesmus kalischewskyi Lignau, 1915, very similar to morph D, Nopoiulus martensi Enghoff, 1984, and Leptoiulus astrabadensis Lohmander, 1932. All these basically Caucasian species are illustrated and currently represent the easternmost records in Hircania. The former species is polymorphous and pan-Caucasian in distribution, whereas the latter two are endemic to Hircania.

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Перевод.

REЗЮМЕ. Представлен новый контрольный список Diplopoda фауны Ирана, насчитывающий теперь 56 видов из 27 родов, 13 семейств и восьми отрядов. Особое внимание уделено фауне Гиркании (по меньшей мере 33 вида, большинство эндемичных, но без единого эндемичного рода) в связи с обработкой небольшой коллекции из участка реликтового леса из Parrotia и Carpinus в провинции Голестан (Иран). Сборы содержат лишь три определяемых вида: Brachydesmus kalischewskyi Lignau, 1915, очень похож на morphi D, Nopoiulus martensi Enghoff, 1984 и Leptoiulus astrabadensis Lohmander, 1932. Все эти три в целом кавказских вида снабжены фотографиями и в настоящее время представляют собой самые восточные находки в Гиркании. Первый из видов полиморфен и распространен по всему Кавказу, тогда как оба последних вида – эндемики Гиркании.

Introduction

The Caucasus is a vast, mostly mountainous region situated between the Black Sea and the Caspian Sea and mainly occupied by Armenia, Azerbaijan, Georgia, and parts of southern Russia and northwestern
Iran. It is home to the Caucasus Mountains, including
the Greater Caucasus Mountain Range, or the Cauca-
sus Major, which has historically been considered a
natural barrier between Eastern Europe and western
Asia. On the southern side, the Lesser Caucasus, or the
Caucasus Minor, includes the Javakheti Plateau and
grows into the Armenian highlands, part of which is
located in Turkey (https://en.wikipedia.org/wiki/Cau-
casus).

The Caucasus region is divided into the North Cau-
casus and South Caucasus, although the Western Cau-
casus also exists as a distinct geographic space within
the North Caucasus. The Caucasus Major in the north
is mostly shared by Russia and Georgia, as well as the
northernmost parts of Azerbaijan. The Caucasus Minor
in the south is occupied by several independent states,
mostly by Armenia, Azerbaijan, and Georgia, but also
extending to parts of northeastern Turkey and northern
Iran (e.g., Abdurakhmanov [2017]; https://
en.wikipedia.org/wiki/Caucasus).

In spite of limited geography and mostly temperate
climate, the diversity of natural landscapes, plant and
animal species, and cultivated plants in the Caucasus is
unusually high. For these reasons, the Caucasus has
long been included in the list of global biodiversity
hotspots. The proportion of endemic species of higher
plants and terrestrial vertebrates varies between 15–
30% for individual groups, according to different au-
thors, with a vast majority of some taxonomic groups
such as the poorly vagile terrestrial snails, wingless
beetles etc. exceeding 80% [Abdurakhmanov, 2017].

Similarly, according to the most recent estimates,
the millipede fauna of the Caucasus is known to com-
prize > 160 species, > 50 genera, 14 families, and eight
orders. Endemism at the species level is overwhelm-
ing, amounting to > 85%, while as many as 25 milli-
pede genera are endemic or subendemic to the Cauca-
sus. All families and orders they belong to, however,
are widely distributed at least across the Euro-Medit-
erranean Realm [Vagalinski, Golovatch, 2021].

The Caucasus comprises two main hygro- to meso-
phytic biogeographic provinces, the larger Colchidan,
spanning along the eastern and southeastern coasts of
the Black Sea in the west, and the smaller Hyrcanian,
stretched along the southwestern and southern coasts
of the Caspian Sea. Both are divided by the montane,
mostly far more xerophytic Caucasus Minor (e.g., Wulff
[1944]; Gulisashvili [1964]; Abdurakhmanov [2017]).

Hyrcania has long been acknowledged to host a
very ancient, peculiar, relict and highly endemic biota
(e.g., Wulff [1944]). The western part of the province
lies in the Republic of Azerbaijan, while the remaining,
southwestern and southern parts belong to Iran. The
diplodop fauna of Iran presently comprises 56 species
from 27 genera, 13 families and eight orders [Enghoff,
Moravvej, 2005; Reboleira et al., 2015; Short, 2015;
Antia, Makarov, 2016; Golovatch et al., 2015, 2016;
Vagalinski, Lazanja, 2018; Short et al., 2020; Vagali-
nski, 2020; Vagalinski, Golovatch, 2021], with >80%
species and only one genus, Chiraziulus Mauriès, 1982,
being confined to the country. At least 33 species, 17
genera, 11 families and six orders appear to occur in
Hyrcania, with most (21) species, but none of the high-
ger taxa, being endemic or subendemic to the Hyrcanian
biogeographic province (Table). At present, perhaps
the most widespread subendemic Hyrcanian diplodop
species seems to be Brachydesmus pigmentifer At-
tems, 1951, which ranges from the Talysh Mountains
and lowland Hyrcania within the Republic of Azer-
baijan, through the Elburz and Zagros mountains in
Iran, to the western Kopetdagh Mountains, Turkmeni-
stan in the east [Golovatch et al., 2016].

The present contribution puts on record the identi-
fiable part of a small collection of Diplodopa from
Iran’s Golestan Province, the easternmost Hyrcania,
amassed in 2019 and 2020. Altogether, the collection
contained five species, of which only three could firm-
ly be identified because the samples comprised male
material. The remaining two were represented by fe-
males and/or juveniles alone, making their identifi-
cation only provisional.

Material and methods

The material underlying the present contribution, all
stored in 75% ethanol, has been fully donated to the col-
clection of the Zoological Museum of the Moscow State Univer-
sity (ZMUM), Russia. Pictures were taken with a Canon
EOS 5D digital camera and stacked using Zerene Stacker
software.

The Shast-klateh Parrotia & Carpinus Forest Dr. Bahr-
annia near the city of Gorgan, Golestan Province, Iran
represents an experimental plot of the Experimental and Educa-
tional Forest of Gorgan University of Agricultural Sciences
and Natural Resources, where, among other subjects and
objects, soils and soil fauna are being studied [Izadi et al.,
2017]. Collections of soil macrofauna effectuated there by
hand before 2019 also contained Diplodopa, albeit closer
unidentified [Izadi et al., 2017].

Taxonomy and faunistics

Order Polydesmida
Family Polydesmidae

Brachydesmus kalischewskyi Lignau, 1915

Figs 1–7.

MATERIAL. 1 ♀ (ZMUM), Iran, Golestan Prov., Shast-klateh
Parrotia persica & Carpinus betulus Forest Dr. Bahrannia, N36°
46′30″, E54°22′30″, 450 m a.s.l., leaf litter, 20.IV.2019; 15 juv.
(ZMUM), same place, same date; 1 ♀, 1 ♂ (ZMUM), same place,
9.II.2020; 5 ♀♀ (ZMUM), same place, 19.II.2020 (ZMUM), all M.
Izadi leg.

REMARKS. A very common, polymorphous and wide-
spread pan-Caucasian species [Golovatch et al., 2016]. The
above new sample from Iran quite vividly resembles morph
D which is typical of Hyrcania and the Talysh Mountains
within the Republic of Azerbaijan. The species, albeit with-
out morph identifications, has been encountered in the adja-
cent parts of Turkey and Iran [Golovatch et al., 2016], more
specifically, southeast to the East Azerbaijan Province of
Iran [Enghoff, Moravvej, 2005; Golovatch et al., 2016].
Figs 1–7. *Brachydesmus kalischewskyi* Lignau, 1915, ♂ ca 10 mm long, very similar to morph D. 1–3 — habitus, dorsal, ventral and lateral views, respectively; 4–7 — left gonopod, anteromesal, anterior, posterior and lateral views, respectively. Photographs by K.V. Makarov, taken not to scale.

Рис. 1–7. *Brachydesmus kalischewskyi* Lignau, 1915, ♂ около 10 мм в длину, очень близкий к морфе D. 1–3 — общий вид, соответственно сверху, снизу и сбоку; 4–7 — левый гонопод, соответственно одновременно спереди и изнутри, изнутри, сзади и сбоку. Фотографии К.В. Макарова, снято без масштаба.
Fig. 8, 9. Habitus of *Nopoiulus martensi* Enghoff, 1984 (8, ♂) and *Leptoiulus astrabadensis* Lohmander, 1932 (9, ♀), lateral views. Photographs by K.V. Makarov, taken not to scale.

The morph from the Golestan Province slightly differs in the somewhat less strongly rounded shapes of some anterior paraterga in dorsal view (Figs 1–3) and in the particularly slender and long apical hook e of the gonopodal telopodite (Figs 4–7).

**Order Julida**  
**Family Blaniulidae**  
*Nopoiulus martensi* Enghoff, 1984  

Fig. 6.  
**MATERIAL.** 1 ♂ (ZMUM), Iran, Golestan Prov., Shast-klateh *Parrotia persica* & *Carpinus betulus* Forest Dr. Bahramnia, N36°46′30″, E54°22′30″, 450 m a.s.l., leaf litter, 20.IV.2019; 1 ♀ (ZMUM), same place, 19.II.2019; 1 ♂ (ZMUM), same place, 21.XII.2019; 1 ♀ (ZMUM), same place, 22.X.2019; 1 ♂, 1 ♀ (ZMUM), same place, 19.II.2019; 1 ♀, 1 ♂ (ZMUM), same place, 21.XII.2019, all M. Izadi leg.

**REMARKS.** This species is endemic to Hyrcania within both the Republic of Azerbaijan and Iran (Enghoff, 1984, 1990), previously recorded east to Mazandaran [Enghoff, Moravvej, 2005].

**Family Julidae**  
*Leptoiulus astrabadensis* Lohmander, 1932  

Fig. 7.  
**MATERIAL.** 1 juv. (ZMUM), Iran, Golestan Prov., Shast-klateh *Parrotia persica* & *Carpinus betulus* Forest Dr. Bahramnia, N36°46′30″, E54°22′30″, 450 m a.s.l., leaf litter, 22.X.2019; 1 ♂, 1 ♀, 3 juv. (ZMUM), same place, 22.X.2019; 1 ♂, 1 ♀ (ZMUM), same place, 19.II.2019; 1 ♀, 1 ♂ (ZMUM), same place, 21.XII.2019, all M. Izadi leg.

**REMARK.** This species is endemic to Hyrcania within Iran. As it has previously been described and remains known
### Table. Fauna and chorology of the Diplopoda of Iran and Hyrcania.

| Species                  | Chorotype | Species                  | Chorotype | Species                  | Chorotype |
|--------------------------|-----------|--------------------------|-----------|--------------------------|-----------|
| Polyxenida Lophoproctidae|           | Julida Blanulidae        |           | Omoobrachysius caucasicus (Karsch, 1881) | Ca        |
| Lophoproctus coccus Pocock, 1894 | eM | Noplosius extremus Enghoff, 1984 | H         | Sirobrachynius golovatchi Vagaliński et Lazányi, 2018 | IE        |
| Polyxenidae              |           | N. iranicus Enghoff, 1984 | He        | S. iranicus (Golovatch, 1983) | IE        |
| Proxodytes argenteus (Verhoeff, 1921) | eM | N. martensi Enghoff, 1984 | H         | Sirobrachynius astrobadeus (Lohmander, 1932) | He        |
| Glomerida Glomerididae   |           | Julidae                  |           | S. continentalis (Attems, 1903) | H         |
| Typsilognus martensi (Golovatch, 1981) | eM | Brachybelus lastanus Verhoeff, 1898 | A         | S. discolor (Lohmander, 1932) | He        |
| Glomeridae               |           | Calyptopyllium biramum Attems, 1951 | IE       | S. incarnatus (Lohmander, 1932) | He        |
| Hylobeloidis lenkora (Golovatch, 1989) | H | C. furcatum Enghoff, 1995 | IE       | Lohmander (Golovatch, 1983) | Hc        |
| Trachysphaera costata (Waga, 1857) | EuMe | C. integrum Brolemann, 1922 | IE       | S. ulvisticus (Attems, 1927) | H         |
| Platydesmidida Androgнатidae |       | C. ovobulatum Brolemann, 1922 | IE       | Polydesmidida Paradoxosomatidae |           |
| Fatoria hyrcana Golovatch, 1980 | H | Catamicrophylloides skolocopes Enghoff, 1995 | IE       | Polydesmidida Paradoxosomatidae |           |
| Callipodida Caspioptiliidae |       | Cylindrodes cf. bescheri Strasser, 1975 | H?       | Lohmanderodesmus setiger (Attems, 1951) | IE        |
| Bollmania gracilis Golovatch, 1983 | El | C. bicolor Lohmander, 1932 | Ca        | Strongylomma kordylamphron Attems, 1898 | Ca        |
| B. neomatogena (Attems, 1951) | El | C. crista Read, 1992 | He        | Lohmander (Golovatch, 1898) | Ca        |
| Schizopetaliidae         |           | C. troquiflagellum Read, 1992 | H         | S. universale Attems, 1951 | He        |
| Eurygryps phoenicus (Verhoeff, 1900) | ISe | C. truncorum (Silvestri, 1896) | A         | Odisis gracilis (C.L. Koch, 1847) | A         |
| Chordeumatida Anthroleucosomatidae |       | Iranites fagorum (Attems, 1951) | H         | Tetragonobus broelemannii (Verhoeff, 1940) | eM        |
| Allocyclus solitarius Attems, 1951 | H | Leptoirius anguillosus Lohmander, 1932 | He        | T. macracanthum (Attems, 1951) | IE        |
| Metanomastigopetrophylloides maritimi (Mauries, 1982) | H | L. arbusitanus Lohmander, 1932 | IE       | T. persicus (Humbert et de Saussure, 1869) | eM        |
| Spirostreptida Cambilidae |           | L. astrobadensis Lohmander, 1932 | He        | T. syriacam (Humbert et de Saussure, 1869) | eM        |
| Chitrazius kaiseri (Mauries, 1982) | IE | L. hastatus Lohmander, 1932 | Ca        | Polydesmididae |           |
| C. trogloburca Reboleini, Malek, Hosseini, Sadeghi et Enghoff, 2015 | IE, T | L. serpentinus Lohmander, 1932 | El       | Brachydesmidus kalischerwskyi Lignau, 1915 | Ca        |
| Ommatoxius caspius (Lohmander, 1928) | H | B. pigmeufiter Attems, 1951 | H         | Polydesmididae |           |

**Chorotypes,** from wider to increasingly narrower distributions: A — anthropochoric introduction; EuMe — Euro-Mediterranean; eM — eastern Mediterranean (including the Near East); Ca — Caucasian to pan-Caucasian; ISe — subendemic to Iran beyond Hyrcania; IE — endemic to Iran beyond Hyrcania; H — pan-Hyrcanian; He — endemic to Iranian Hyrcania; T — troglobiont.

Total: 56/27/13/8
exactly from near Gorgan (formerly Asterabad) [Lohmander, 1932], the above samples represent topotypes.

Conclusion

The above records actually represent the easternmost localities for all three species above. In addition, further two species contained in the samples, unfortunately only females and/or juveniles, could be identified but provisionally: Omobrachyiulus caucasicus (Karsch, 1881), a pan-Caucasian species (Table) already recorded from Hyrcania both within the Republic of Azerbaijan and Iran [Vagalinski, Golovatch, 2021], and a different Nopoiulus sp. Only additional, male-containing material could allow for their definitive identifications to be clarified.

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: No ethical issues were raised during our research.

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