Two new species of *Rohdendorfa* (Diptera: Syrphidae) from Central Asia

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Abstract. Two new species of the flower fly genus *Rohdendorfa* Smirnov, 1924 (Diptera: Syrphidae) are described, *Rohdendorfa bella* Mengual, sp. nov. and *Rohdendorfa khakimovi* Barkalov, sp. nov. A full description and images of both new species are given, as well as an identification key for the species of this genus. Molecular sequences from mitochondrial cytochrome c oxidase I (COI) gene and nuclear ribosomal 28S and 18S rRNA genes are also provided for the new species. The studied specimens of *Rohdendorfa bella* Mengual, sp. nov. are the first record of the genus *Rohdendorfa* from India and represent the first individuals collected in the state of Jammu and Kashmir.

Key words. Diptera, Syrphidae, *Rohdendorfa*, flower flies, hoverflies, new species, identification key, DNA barcode, India, Kashmir, Ladakh, Pamir, Tajikistan

Zoobank: [http://zoobank.org/urn:lsid:zoobank.org:pub:3A47B57E-D527-4F9F-8084-F0CF92C5B396](http://zoobank.org/urn:lsid:zoobank.org:pub:3A47B57E-D527-4F9F-8084-F0CF92C5B396)

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Introduction


*Rohdendorfa* species are not very abundant in collections and they are found in high altitudes usually above 2500 m a.s.l. (Barkalov & Nielsen 2010). Data on the biology, adult habitat and immature stages are known only for *R. alpina* (Barkalov & Nielsen 2010, Speight 2017). The species resemble species of the genera *Platycheirus* Le Peletier & Serville, 1828 and *Melanostoma* Schiner, 1860, and due to this great similarity *Rohdendorfa* was considered a subgenus of *Platycheirus* by some authors in the past (Thompson & Rotheray 1998). Molecular evidence supports the generic status of *Rohdendorfa* (Mengual et al. 2008, Thompson & Skevington 2014, Mengual 2015) and there are morphological characters to separate it from other closely related genera (Barkalov & Nielsen 2010, Huo 2014).

In this work two new species of *Rohdendorfa*, *R. bella* Mengual sp. nov. and *R. khakimovi* Barkalov sp. nov., are described from Central Asia, namely from the region of Ladakh, in Kashmir, and from Pamir, Tajikistan. Full descriptions of the two new species are given, as well as a modification of the identification key to *Rohdendorfa* species from Barkalov & Nielsen (2010).

Material and methods

Area of study. Specimens of *Rohdendorfa bella* Mengual sp. nov. were collected near the Tso Moriri lake (32°54′ N 78°18′ E) in the region of Ladakh, northwest India in the Jammu and Kashmir State. Flower flies were collected using a hand net between 5050 and 5749 m a.s.l. (around 32°59′ N 78°26′ E).

Specimens of *Rohdendorfa khakimovi* Barkalov sp. nov. were sampled on Koi-Tezek mountain ridge, Pamir, Tajikistan (37°29′ N 72°47′ E), circa 4300 m a.s.l. (Fig. 1).

Taxonomy protocols. Most of the collected specimens were pinned in the field. Some adults were kept in alco-
hol and brought to the laboratory, where they were dried using an automated Critical Point Dryer (CPD) Leica EM CPD300 after being studied, and a few specimens were kept in alcohol for further DNA analyses. Male genitalia were detached before the drying process with the CPD. These specimens were glued to cardboard pieces for their preservation and further study.

Morphological terminology follows THOMPSON (1999) and THOMPSON et al. (2010). To identify the collected specimens, THOMPSON & ROTHERAY (1998) and THOMPSON & SKEVINGTON (2014) were used to determine the genus. Then, the work by BARKALOV & NIELSEN (2010) was used to key out the species. In addition, material of this genus deposited in the Institute of Systematics and Ecology of Animals (ISEA) and the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK) collections and the original descriptions of the Rohdendorfa species were used to compare our material with the already described and known species of this genus.

Identification and location labels are indicated with quotation marks (“”), and each line on the label is separated by a double forward slash (/). Handwritten information on labels is indicated in italics. At the end of each record, between square brackets ([ ]) and separated by a comma, the number of specimens and sex, the holding institution, and the unique identifier or number are given.

The EVENHUIS (2009) standard acronyms were used for the following entomological collections:

- **CNC** Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada;
- **ISEA** Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia;
- **ZFMK** Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

Google Earth ® version 7.3.0 (Google Inc., 2017) was used to get the geographic coordinates of the type locality. All measurements are in millimeters and were taken using a reticule in a Leica M165 C and Steini 2000–C microscopes. Photographs were composed using the Zerene Stacker 1.04 (Richland, Washington, USA) software, based on images of pinned specimens taken with a Canon EOS 7D camera mounted on a P–51 Cam-Lift (Dun Inc., VA, USA) and with the help of Adobe Lightroom (version 5.6). Body length was measured from the anterior oral margin to the posterior end of the abdomen, in lateral view. Wing length was measured from the wing tip to the basicosta.

**DNA sequences.** One to two legs or the entire specimen from the ethanol preserved or dry pinned specimens were used for DNA extraction. Extractions were carried out using the NucleoSpin Tissue DNA Extraction kit (Macherey-Nagel, Düren, Germany) following the manufacturer’s instructions; samples were resuspended in 100 μl ultra-pure water. Entire specimens or remnants of specimens were preserved and labelled as DNA voucher specimens for the purpose of morphological studies and deposited at the ZFMK, as listed in ‘Examined material’ below.

**DNA primers and PCR amplification protocols for** the mitochondrial protein-coding cytochrome c oxidase subunit I (COI) gene, the D2–3 region of the nuclear ribosomal 28S rRNA gene and a small fragment of the nuclear ribosomal 18S rRNA gene were the same as described in MENGUAL et al. (2008, 2012). Amplified DNA was electrophoresed on 1.5% agarose gels for visual inspection of amplified products. PCR products were enzymatically treated with ExoSap-IT (USB, Cleveland, OH, USA) and then sequenced (using the PCR primers) in both directions. The sequences were edited for base-calling errors and assembled using Geneious R7 (version 7.1.3, Biomatters Ltd.). All new sequences were submitted to GenBank (see ‘Genetics’ section below for the accession numbers).
**Taxonomy**

**Rohdendorfia bella Mengual, sp. nov.** (Figs 2–8, 9–11)

**Type locality.** India, Jammu and Kashmir State, Ladakh, near Tso Moriri (lake), 32°54′N 78°18′E, 5333 m a.s.l.

**Type material.** HOLOTYPE: "INDIA: Jammu and Kashmir State, // Ladakh, near Tso Moriri (lake), // 32°54′N 78°18′E, 5333 m, // 25–28.viii.2010. // Leg: I. Abela-Hofbauerová: “DNA voucher specimen // ZFMK, Lab code // D268 // Bonn, Germany” “HOLOTYPE // Rohdendorfia // bella // Mengual 2018” [red label] “ZFMK DIP // 00027140” [barcode] [ZFMK]. PARATYPES: INDIA: Jammu and Kashmir State, Ladakh, near Tso Moriri (lake), Leg. I. Abela-Hofbauerová (all specimens): 8 ♀♂, 5052 m, 25–28.viii.2010 [ZFMK, ZFMK-DIP-00027162, ...27163, ...27164, ...27165, ...27166, ...27167, ...27168, ...27206–DNA voucher D305]; 4 ♀♂, 5053 m, 25–28.viii.2010 [ZFMK, ZFMK-DIP-00027208]; 5 ♀♂, 5333 m, 25–28.viii.2010 [ZFMK, ZFMK-DIP-00027209]; 4 ♀♂, near the camp site, 5330 m, 25–28.viii.2010 [ISEA, ZFMK-DIP-00027148, ...27149, ...27150, ...27151, ...27152, ...27153, ...27154, ...27155, ...27156, ...27157, ...27158, ...27159, ...27217]; ZFMK-DIP-00027169, ...27170, ...27171, ...27172, ...27173, ...27174, ...27176, ...27177, ...27178, ...27121, ...27216]; 4 ♀♂, 5050 m, 25–28.viii.2010 [ZFMK, ZFMK-DIP-00027179, ...27180, ...27181, ...27182]; 5 ♀♂, 5333 m, 25–28.viii.2010 [CNC, ZFMK-DIP-00027145, ZFMK-DIP-00027146, ...27147, ...27121, ...27207–DNA voucher D307]; 5 ♀♂, 5330 m, 25–28.viii.2010 [CNC, ZFMK-DIP-00027204; ISEA, ZFMK-DIP-00027184, ...27185, ...27186, ...27187, ...27188, ...27189, ...27190–DNA voucher D271]; 5 ♀♂, 5333 m, 25–28.viii.2010 [CNC, ZFMK-DIP-00027206; MH282900, specimen ZFMK-DIP-00027190), COI gene (MH282897, specimen ZFMK-DIP-00027210; MH282898, specimen ZFMK-DIP-00027219; MH282899, specimen ZFMK-DIP-00027207). All the obtained COI sequences were identical, with only one nucleotide change in the specimen ZFMK-DIP-00027210 compared to the other three specimens. The two 28S rDNA sequences and the two 18S rDNA sequences were identical, respectively.

**Variation.** Some male paratypes have 2 smaller yellow maculae on tergum 2 and/or basal yellow fascia on tergum 5. Size of abdominal yellow maculae varies among specimens studied.

**Length** (n=5). Body: 7.9 mm (7.5–8.1); wing: 6.1 mm (5.5–6.2).

**Genetics.** The GenBank accession numbers for this species are: 28S rRNA gene (MH282902, specimen ZFMK-DIP-00027140; MH282903, specimen ZFMK-DIP-00027190), 18S rRNA gene (MH282904, specimen ZFMK-DIP-00027140; MH282905, specimen ZFMK-DIP-00027190), COI gene (MH282897, specimen ZFMK-DIP-00027210; MH282898, specimen ZFMK-DIP-00027219; MH282899, specimen ZFMK-DIP-00027207). All the obtained COI sequences were identical, with only one nucleotide change in the specimen ZFMK-DIP-00027210 compared to the other three specimens. The two 28S rDNA sequences and the two 18S rDNA sequences were identical, respectively.

**Differential diagnosis.** This new species is very similar to *R. khakimovi* Barkalov sp. nov. Males of *R. bella* Mengual sp. nov. have short pile on protibiae, and metafemur with some long pale pile medially, but shorter than metafemur width. They can be distinguished from males of *R. montivaga* and *R. khakimovi* Barkalov sp. nov. by the shape of the male genitalia (see Figs 9–14) and from the males of *R. dimorpha* by the pilosity of the metafemur and by the male genitalia. As stated by BARKALOV & NIELSEN (2010) and corroborated by the present study, females of *R. montivaga* and *R. dimorpha* are sometimes indistinguishable, and the presence of conspecific males may help to identify them. Females of *R. bella* Mengual sp. nov. are very similar to those of *R. montivaga* and *R. dimorpha*, and they can only be separated from them using the distribution of the specimens, DNA barcodes, or conspecific males. Females of *R. khakimovi* Barkalov sp. nov. can be distinguished from females of these three taxa using the grey pollinosity on frons as stated in the key.

**Eymology.** The specific epithet is derived from the Latin *bella* meaning pretty, lovely (BROWN 1956: 130). Species epithet to be treated as an adjective.
Figs 2–8. *Rohdendorfia bella* Mengual, sp. nov. 2–3 – holotype male (ZFMK-DIP-00027140). 2 – dorsal view; 3 – lateral view. 4–5 – paratype female (ZFMK-DIP-00027194); 4 – dorsal view; 5 – lateral view. 6 – holotype male, frontal view. 7 – paratype female (ZFMK-DIP-00027194), frontal view. 8 – holotype male, metaleg, lateral view. Scale bars: 2–5 – 1 mm, 6–8 – 0.5 mm.
Biology. Some paratypes were collected in areas with *Potentilla pamirica* Th. Wolf, *Arenaria bryophylla* Fernald, *Thylacospermum* sp., and *Astragalus confertus* Bunge.

Geographical distribution. Only known from the Ladakh region, in northwest India. The studied specimens are the first records of the genus *Rohdendorfa* collected in India, and the first individuals from the state of Jammu and Kashmir.

*Rohdendorfa khakimovi* Barkalov, sp. nov.

(Figs 1, 12–14, 18–24, 35)

Type locality. Tajikistan, Gorno-Badakshan Autonomous Region, Pamir, mountain pass Koi-Tezek, 37°29′ N 72°47′ E, 4370 m a.s.l. (Fig. 1).

Type material. HOLOTYPE: ♂, “Tajikistan, Gorno-Badakhshan // Autonomous Region // Pamir, pass Koi-Tezek // 4370 m asl, 37°29′ N 72°47′ E // 17.ii.2018 (Leg. A. Barkalov) // *Rohdendorfa* // khakimovi // Barkalov sp. n.” // Holotype” [ISEA]. PARATYPES: 5 ♂♂ 28 ♀♀, same place and date as holotype, Leg. A. Barkalov [ISEA]; 7 ♀♀, same place and date
as holotype, Leg. V. Zinchenko [ISEA]; 1 ♀ 2 ♀, same place and date as holotype, Leg. A. Barkalov [ZFMK, ZFMK-DIP-00055236–DNA voucher D412, ...55237,...15937–DNA voucher D410]; 2 ♀ ♀, TA- 

Description. Male. Head (Figs 18–19, 22). Face black, with distinct facial tubercle, concave below antennal insertion, pale pilose, with two stripes of grey dusting laterally, central part and lower part shiny. Mouth edge protruding, shiny. Gena low, shiny, black, with short black pilosity. Labula black, shiny. Frontal triangle black, black and white pilose, shiny medially, with dense grey silver pollinosity laterally on eye margin. Eyes bare, connected for distance as long as vertical triangle. Vertical triangle distinctly upraised, black shiny, black pilose. Antenna black, with dense grey pollinosity, baso- 
scutellar fringe with pale pile. Pleuron shiny with short white and longer black 
medially, covered with yellow and black long pile, shorter than metafemur width (Fig. 24). 

Thorax (Figs 18–19). Scutum and scutellum black, shiny with short white and longer black fine pile; post- 
pronotum bare; subscutellar fringe with pale pile. Pleuron 
black, shiny, pale pilose; metaepisternum and metasternum bare; calypter white; halter pedicel dark brown, capitulum white. Wing hyaline, entirely microtrichose; stigma dark brown. Alula brown, broader than costal cell. Legs simple, 
entirely black, with short pile; metatarsum finely swollen medi ally, covered with yellow and black long pile, shorter than metafemur width (Fig. 24).

Abdomen (Figs 18–19, 24). Unmarginned, parallel-sided, with short, erect pale pile, longer on sides of terga 1–2. Tergum 1 black; tergum 2 black with two small yellow ma-
culae; terga 3–4 mostly orange-yellow with black anterior and posterior margins; tergum 5 mostly black with orange lateral sides. Male genitalia as in Figs 12–14.

Female (Figs 20–21, 23, 35). Similar to male except for sexual dimorphism and: frons comparatively broad (Fig. 23) with black pile medially and pale pile laterally; scutum with pile of equal length; pile on swollen central part of metatarsum shorter than in male and adpressed; tergum 2 orange with narrow black fascia anteriorly and posteriorly (Figs 20–21). 

Variation. Some male specimens have completely black basoflagellomere.

Length (n=5). Body: 4.8–7.2 mm; wing: 4.1–5.7 mm. 

Genetics. The GenBank accession numbers for this species are: COI gene (MK415827, specimen ZFMK-DIP-00015937; MK415828, specimen ZFMK-DIP-00055236). The two obtained COI sequences were almost identical, with only one nucleotide change between specimens ZFMK-DIP-00015937 and ZFMK- 

Differential diagnosis. See the diagnosis of R. bella Meng-
gual sp. nov. Males of R. khakimovi Barkalov sp. nov. and R. bella Mengual sp. nov. can be distinguished by the shape of the male genitalia. Females of R. khakimovi Barkalov sp. nov. have triangular grey pollinose maculae on frons. 

Etymology. The species is named in honor of the director of the Institute of Zoology and Parasitology of the Academy of Sciences of the Republic of Tajikistan, Dr. Fayzali R. Khakimov, who organized the expedition to the Pamir region. 

Biology. Adult flies were resting on stones and from time to time, they flew short distances of approximately 30–50 m. There were no flowers in this locality, and adult flies were concentrated in a small gorge, probably due to the absence of wind. Most of the adult flies were females, but some males, which look slightly different in the field, were also collected. 

Geographical distribution. Only known from the type locality. 

Other examined taxa

Rohdendorfia alpina Sack, 1938


Rohdendorfia dimorpha Smirnov, 1924

Material examined. KIRGYZSTAN: 1 ♂ ♀, Alajskij range, environs of Taldyk Pass, 3620–3750 m, 16.vii.2003, V. Zinchenko [ZFMK, ZFMK- 

DIP-00019931, ...,19932]. TAJIKISTAN: 64 ♂ ♀, Varzobskoe 
gorge, 4 km NE kishlak Kalon, 3375 m, 39.08°N 68.86°E, 6.vii.2017, A. Barkalov & V. Zinchenko [ISEA].

Rohdendorfia montivaga Violovith, 1984


Key to species of the genus Rohdendorfia

(Modified from Barkalov & Nielsen 2010).

1 Eyes widely separated on frons: females (Figs 4, 7, 20, 
23) ............................................................................................... 6

- Eyes meeting on frons: males (Figs 2, 6, 19, 22). ........... 2

2 Protibia with long pile ventrally (Fig. 25). Male genitalia 
as in Figs 15–17. Distribution: European Alps, northern 
Caucasus, Altai, Sayan. .................. R. alpina Sack, 1938
3 Protibia with short pile ventrally (Figs 6, 22). .......... 3

3 Metafemur only with dark short (mostly adpressed) pile, without long erect pile anteroventrally (Fig. 27). Male genitalia as in Figs 28–29. Distribution: Pamirs, Alai. ............................ 4

R. dimorpha Smirnov, 1924

– Metafemur with long pile anteroventrally (Figs 8, 24, 26). ......................................................... 4

– Metafemur with long erect pile anteroventrally, as long as width of metafemur (Fig. 26). Male genitalia as in Figs 30–32: in lateral view, surstylus with broad basal part and strong curvature medially (Fig. 31); in dorsal view, surstylus broad basally, narrows towards apical part (Fig. 30). Distribution: Tian Shan, Kyrgyz Kashgaria, Dzungarian Alatau. ............................

R. montivaga Violovitsh, 1984

– Metafemur with some long pale pile anteroventrally, shorter than width of metafemur (Figs 8, 24). Male genitalia not as above (Figs 9–14). ............................ 5

– Surstylus in lateral view with long, curved posterodorsal lobe (Fig. 13), in dorsal view with posterodorsal lobe bent in apical third (Fig. 12). Distribution: West Pamir. ............................ 5

R. khakimovi Barkalov, sp. nov.

– Surstylus in lateral view with slightly curved, medially narrowed posterodorsal lobe (Fig. 10), in dorsal view with posterodorsal lobe not bent (Fig. 9). Distribution: Ladakh. ............................ 6

R. bella Mengual, sp. nov.

– Face without vittae of grey pollinosity, OR at most with triangular maculae of grey pollinosity on dorsal part of face, joint with pollinosity along eye margin (Fig. 33). Black fascia on posterior margin of abdominal terga 3–4 narrows and sometimes completely peters out towards lateral margin. Distribution: European Alps, northern Caucasus, Altai, Sayan. ..........

R. alpina Sack, 1938

– Face with two longitudinal vittae of grey pollinosity, from frons to mouth edge (Figs 7, 23, 34). Black maculae or fascia on posterior margin of abdominal terga broadened towards lateral margin (Figs 4, 5, 20, 21). ........ 6

R. montivaga Violovitsh, 1984

– Face with grey pollinose vittae widen dorsally, forming triangular macula on each side (Figs 23, 35). ....

R. khakimovi Barkalov, sp. nov.

– Frons with grey pollinose vittae narrow, not forming triangular maculae (Figs 7, 34, 36). ............................. 7

7 Distribution: Pamirs, Alai. ............................

R. dimorpha Smirnov, 1924

– Distribution: Tian Shan, Kyrgyz Kashgaria, Dzungarian Alatau. ............................

R. montivaga Violovitsh, 1984

– Distribution: Ladakh. ............................

R. bella Mengual, sp. nov.

Discussion

Two new species of *Rohdendorfia* are described from Central Asia, one of the highest regions on Earth. The studied type specimens of *R. bella* Mengual sp. nov. are the first records of the genus *Rohdendorfia* for India and for the state of Jammu and Kashmir. From the Indian state of Jammu and Kashmir, including the former Indian administered areas now under the Chinese and Pakistani control and the highlands of Ladakh, Ghorpadé (2014) listed a total of 92 species, plus four species likely to be present. In his checklist, *Rohdendorfia dimorpha* was listed from this Indian state based on Clausen (1988), but later Ghorpadé (2015) questioned the presence of *R. dimorpha* from Jammu and Kashmir as there is no verified record from this Indian state. Clausen (1988) only summarized the ideas of Lambeck & Brink (1973), who considered *R. dimorpha* a faunal element of the Pamirian oreal centre. The only records of *R. dimorpha* from Central Asia are given by Doesburg (1955) and Bankowska (1968). Doesburg (1955) reported three female specimens of *R. dimorpha* from the Aghil Mountains (5220 m a.s.l.), northern Karakorum in the Xinjiang Uyghur Autonomous Region of China, and Bankowska (1968) reported one female from Sarekanda (4200 m a.s.l.), Badakhshan Province in northeastern Afghanistan, and two more females from a pass near Kabul (1740 m a.s.l.), eastern Afghanistan. As stated by Barkalov & Nielsen (2010), without male specimens from this region it is not possible to confirm the presence of *R. dimorpha* in these territories.

*Rohdendorfia* females are difficult to be distinguished as they present many variable characters (Clausen 1988, Barkalov & Nielsen 2010). The distribution or the presence of conspecific males may help with the identification, but we support the use of molecular characters in these cases to link sexes. DNA barcoding has been already used to link sexes (Jordaens et al. 2015) and life stages (Andric et al. 2014). Thus, we have sequenced a few genes (COI, 28S and 18S rRNA) from the holotype of *R. bella* Mengual sp. nov. and from some paratypes of *R. bella* Mengual sp. nov. and *R. khakimovi* Barkalov sp. nov. to help with further identifications of this genus based on molecular characters, especially females. When we compared the COI sequences of the two new species with the sequences published in GenBank for this genus (*R. alpina*, accession number KF919082), we did not find a very broad uncorrected pairwise distance among them as the three species differ from 0.463% to 1.235% (see Table 1). There is another published COI sequence for *R. alpina* (GenBank accession number EF127338), but it refers to the 3′end of the COI gene and it cannot be compared with the barcode sequences of the 5′end of the COI gene. Nevertheless, it is interesting to point out that the two published COI sequences for *R. alpina* (KF919082 and EF127338) present many nucleotide changes in the region where they overlap and this deserves further study.

Regarding the two rRNA genes sequenced in the present study, we think they can be of little use to distinguish species due to their conservative nature, although the number of published sequences is very low and their use might improve with higher numbers of sequences. There is only one published 28S rDNA sequence of *R. alpina* (GenBank accession number EF127420) and another one for *R. dimorpha* (GenBank accession number EF127395), which do not differ from one another, but both differ in two nucleotides from the two obtained sequences of *R. bella* Mengual sp. nov., which are identical. For the 18S gene, its use for distinguishing species is also limited by its conservative nature and the low number of published sequences; only one 18S rDNA sequence for *R. alpina* is published (GenBank accession number EU431552). The 18S rDNA sequence of *R. alpina* has only one nucleotide change compared with the two identical 18S rDNA sequences here obtained for *R. bella* Mengual sp. nov.

Albeit the differences among different species for the studied genes (COI, 18S and 28S rRNA) are small, we think it is worth to obtain and publish new sequences of *Rohdendorfia* to help with the identification of males and females, either from the DNA-barcoding region or from other genes that can provide a better resolution at species level.

*Rohdendorfia* species are high alpine taxa occurring in the highest mountains on Earth, such as the Alps, Caucasus, Altai, Sayan, Tian Shan, Kashgar, Dzungarian Alatau, Pamirs, Alai and Ladakh. Their abundance may be locally high, as the type series of *R. bella* Mengual sp. nov. and *R. khakimovi* Barkalov sp. nov. prove, but usually they are not abundant in collections. Lambeck & Brink (1973) presented *R. dimorpha* as an oreal species of the Pamir. Varga (1996) defined the oreal fauna as the fauna from non-arboreal

Table 1. COI (5′end of the gene, 648 bp) uncorrected pairwise distances (% similarity) among *Rohdendorfia* specimens (GenBank accession numbers in brackets).

<table>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
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<tr>
<td><em>R. bella</em> Mengual, sp. nov. [MH282897]</td>
<td>1</td>
<td>–</td>
<td>99.84%</td>
<td>100</td>
<td>100</td>
<td>99.53%</td>
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<td><em>R. bella</em> Mengual, sp. nov. [MH282898]</td>
<td>2</td>
<td>99.84%</td>
<td>–</td>
<td>99.84%</td>
<td>99.84%</td>
<td>99.38%</td>
<td>99.22%</td>
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<tr>
<td><em>R. bella</em> Mengual, sp. nov. [MH282899]</td>
<td>3</td>
<td>100</td>
<td>99.84%</td>
<td>–</td>
<td>100</td>
<td>99.53%</td>
<td>99.38%</td>
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<tr>
<td><em>R. bella</em> Mengual, sp. nov. [MH282900]</td>
<td>4</td>
<td>100</td>
<td>99.84%</td>
<td>100</td>
<td>–</td>
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<td>99.38%</td>
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<tr>
<td><em>R. khakimovi</em> Barkalov, sp. nov. [MK415827]</td>
<td>5</td>
<td>99.53%</td>
<td>99.38%</td>
<td>99.53%</td>
<td>99.53%</td>
<td>–</td>
<td>99.84%</td>
</tr>
<tr>
<td><em>R. khakimovi</em> Barkalov, sp. nov. [MK415828]</td>
<td>6</td>
<td>99.38%</td>
<td>99.22%</td>
<td>99.38%</td>
<td>99.38%</td>
<td>99.84%</td>
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biomes (regions with low level of primary production, i.e. less than 25 q/ha per year) caused by orography without a zonal nature like tundra, for instance. Usually, theoreal elements occur in spot-like, “insular”, often highly endemic or widely separated areas (VARGA 1996), exactly as it seems the case of Rohndendorfia. According to LATTIN (1967), theoreal elements of the Palaearctic may have emerged from an ancient Palaearcticoreal fauna with a formerly wider distribution, which probably also applies to the Rohndendorfia species (CLAUSSEN 1988).

All specimens of R. bella Mengual sp. nov. were collected over 5000 m a.s.l. and the individuals of R. khakimovi Barkalov sp. nov. in a mountain range close to 4500 m a.s.l. The authors only know a few other species collected at this altitude in Central Asia and in the Andes in South America. High mountain ecosystems can be seen as oceanic islands, where climate warming may result in reduction and increased variability of precipitation, and consequently in reduction in snow-cover, changes in biophysical characteristics of rivers and mountain lakes, and shifts in the distribution and phenology of many species of plants and animals along elevation gradients (ZAMORA et al. 2017).

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