

New data on the millipede genus *Shearia* Mikhaljova, 2000
from the Russian and Mongolian Altai (Diplopoda:
Chordeumatida: Diplomaragnidae)

Новые сведения о двупарноногих многоножках рода *Shearia*
Mikhaljova, 2000 с Русского и Монгольского Алтая (Diplopoda:
Chordeumatida: Diplomaragnidae)

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КЛЮЧЕВЫЕ СЛОВА: Diplopoda, Diplomaragnidae, *Shearia*, фауна, новые находки, Сибирь, Россия, Монголия.

ABSTRACT. Based on fresh and re-examined material from SW Siberia, the distributions of five diplomaragnid millipede species of *Shearia* Mikhaljova, 2000 have been supplemented, refined and updated. The range limits of the following species are expanded: *S. khakassica* Mikhaljova, 2000 is new to be recorded from the Republic of Altai, *S. longa* Mikhaljova, 2012 is reported from outside its type locality for the first time, whereas the distribution area of *S. oiskaya* Mikhaljova, 2000 is limited to the south of the Krasnoyarsk Province. Descriptions of the posterior gonopods of *S. calycina* Mikhaljova, 2000 and *S. khakassica*, as well as the diagnosis of the genus in general are supplemented. The distributions of all *Shearia* species encountered are mapped. A key to all known species of the genus is given.

РЕЗЮМЕ. По новому и повторно изученному коллекционному материалу с юга Западной Сибири дополнены, уточнены и обновлены области распространения для пяти видов диплопод-нитеносцев рода *Shearia* Mikhaljova, 2000. Расширены ареалы указанных ниже видов: *S. khakassica* Mikhaljova, 2000 впервые отмечен в Республике Алтай, *S. longa* Mikhaljova, 2012 — впервые вне типовой территории, между тем как ареал *S. oiskaya* Mikhaljova, 2000 оказался ограниченным югом Красноярского края. Дополнены описания задних гоноподов *S. calycina* Mikhaljova, 2000 и *S. khakassica*, а также диагноз рода в целом. Для всех включённых в настоящую

статью видов *Shearia* выполнено картирование ареалов. Составлен ключ для всех известных видов этого рода.

Introduction

The millipede genus *Shearia* Mikhaljova, 2000 is currently known to be represented by eight species, which mainly occur in the south of western and central Siberia, as well as western Mongolia [Mikhaljova, 2000, 2012, 2017]. This genus differs from other genera of Diplomaragnidae Attems, 1907 mainly in a (sub)cyathiform shape of the colpocoxites of the posterior gonopods.

SEM micrographs were prepared at the Laboratory of Aquatic Ecology, Institute for Water and Environmental Problems, Siberian Branch, Russian Academy of Sciences, Barnaul, Russia (IWEP), using a Hitachi S-3400N scanning electron microscope. Mounts for SEM were made through air-drying, mounting on stubs, and coating with platinum. SEM material was removed from stubs and returned to alcohol after examination. Digital images were prepared with the help of Helicon Focus 6 image stacking software. The distribution maps were composed using QGIS 3.4.4.

The material treated herein has been deposited in the collection of the Altai State University, Barnaul, Russia (ASU). Literature references to the species concern their distribution areas.

Taxonomic part

Class Diplopoda

Family DIPLOMARAGNIDAE

Shearia calycina Mikhaljova, 2000

Figs 1–7.

Shearia calycina Mikhaljova, 2000: 166, 167: figs.*Shearia calycina* — Mikhaljova, Golovatch, 2001: 110; Mikhaljova, 2004: 163, figs, 164: map; 2017: 200, 201: figs, 134: map; Nefediev, Nefedieva, 2007: 162; Mikhaljova et al., 2008: 53.MATERIAL EXAMINED. 5 ♂♂, 1 ♀, 8 juv., Russia, **Republic of Altai**, Kosh-Agach District, 26 air-km NNW of Belyashi (Dzhazator), floodplain of Karagem River, on left bank near bridge, 49.88593°N, 87.19024°E, valley *Populus* forest with *Larix sibirica*, ca 1355 m a.s.l., in litter, 29.VII.2018, leg. P.S. Nefediev.

DISTRIBUTION. This species inhabits SE districts of the Republic of Altai only (Fig. 1).

REMARKS. Endemic to the Russian Altai. Neither the gonopods nor coxae 10, nor coxae 11 of this species have ever been shown using SEM. Therefore, they are given here (Figs 2–7). An examination of males of the species from the ASU collection has revealed a small, two-branched anterior process (**ap**) on each angiocoxite of the posterior gonopods. This character is well visible in a SEM micrograph (Fig. 4), but it was not specified in the original description [see Mikhaljova, 2000]. Hence, this structure must be included into the description of *S. calycina*.*Shearia densecava* (Gulička, 1972)

Figs 1, 8–13.

Altajosoma densecavum Gulička, 1972: 38, 37: fig.*Altajosoma densecavum* — Lokšina, Golovatch, 1979: 382; Nefediev, Nefedieva, 2008a: 117.*Diplomaragna densecava* — Shear, 1990: 38; Mikhaljova, 1993: 22.*Shearia densecava* — Mikhaljova, 2000: 165, 166: figs; 2004: 165, figs, 164: map; 2013: 7; 2017: 201, 202: figs, 140: map; Mikhaljova, Golovatch, 2001: 110; Mikhaljova, Nefediev, 2003: 86; Nefediev, Nefedieva, 2007: 162; 2008b: 62; 2013: 87; Mikhaljova et al., 2008: 53; Nefedieva, Nefediev, 2008: 123.MATERIAL EXAMINED. 1 ♂, Russia, **Republic of Altai**, Ulagan District, ca 15 air-km NNW of Aktash, Lake Taldu-Kiol, 50.442703°N, 87.535550°E, *Larix sibirica* forest, ca 1840 m a.s.l., 17–18.VII.2006, leg. P.S. Nefediev, J.S. Nefedieva; 2 ♂♂, same Republic and District, Kuraiskii Mt. Range, watershed of Korumduairy and Yarlyamry rivers, 50°20'N, 87°43'E, *Pinus sibirica* forest, in stumps, ca 2000 m a.s.l., 7.VIII.2016, leg. Yu.V. Dyachkov; 1 ♂, 2 ♀♀, 1 juv., same Republic, Shebalino District, 3.5 air-km SE of Topuchaya, 51.11189°N, 85.63219°E, *Betula pendula*, *Larix sibirica*, *Pinus sibirica* and *Picea obovata* forest with *Alnus*, *Lonicera*, *Ribes nigrum* and tall grass vegetation on hummocks, along brook, 1435 m a.s.l., hand sampling, sifted leaf litter, pitfall traps, 20–22.VII.2018, leg. P.S. Nefediev, V.I. Gusarov, M.F. Maurstad, V. Løvang.

DISTRIBUTION. This species is known only from the Republic of Altai, occurring in its northern, central and SE districts (Fig. 1).

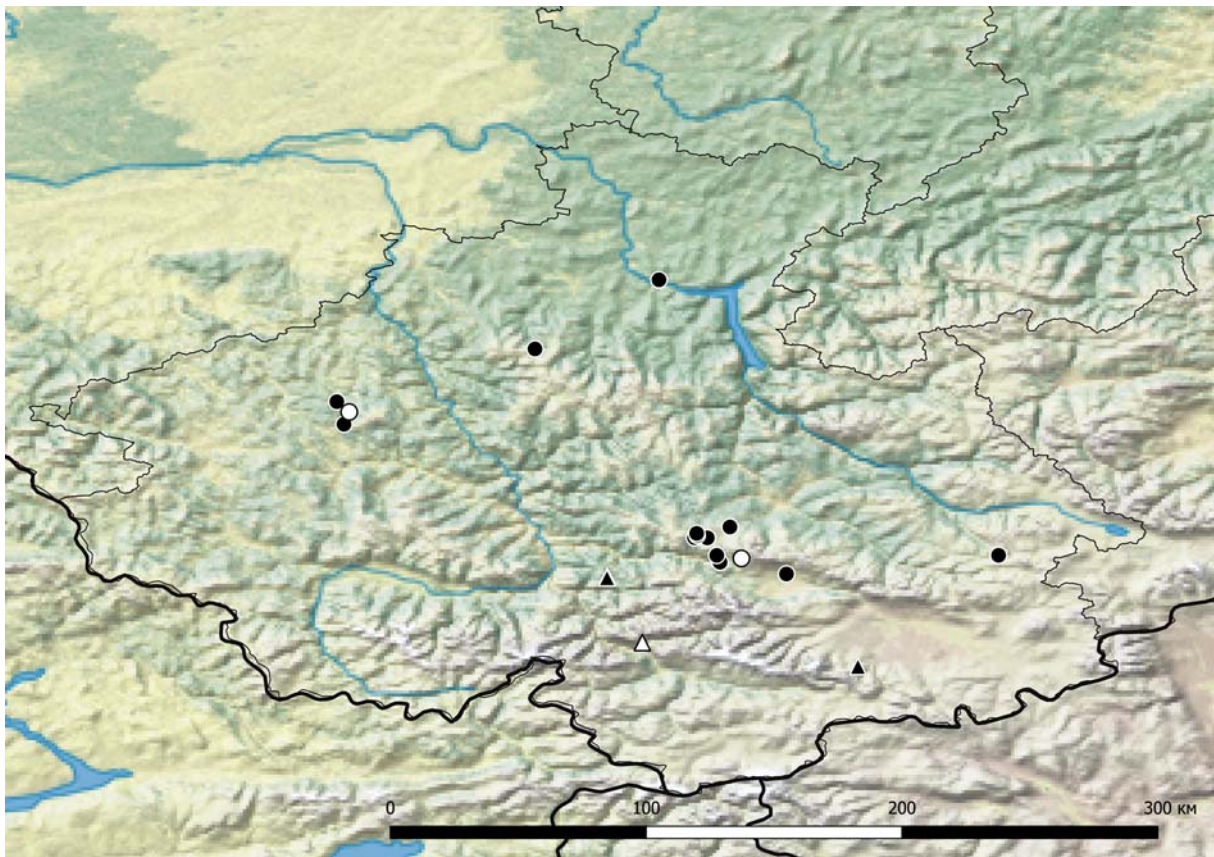


Fig. 1. Distribution of *Shearia calycina* (triangle) and *S. densecava* (circle). Previously known localities marked in black, new records given in white.

Рис. 1. Распространение *Shearia calycina* (треугольник) и *S. densecava* (круг). Чёрным отмечены ранее известные места находок, новые находки отмечены белым.

REMARKS. Endemic to the Russian Altai. Neither the gonopods nor coxae 10, nor coxae 11 of this species have ever been shown using SEM. Therefore, they are given here (Figs 8–13).

Shearia khakassica Mikhaljova, 2000
Figs 14–20.

Shearia khakassica Mikhaljova, 2000: 163, figs.

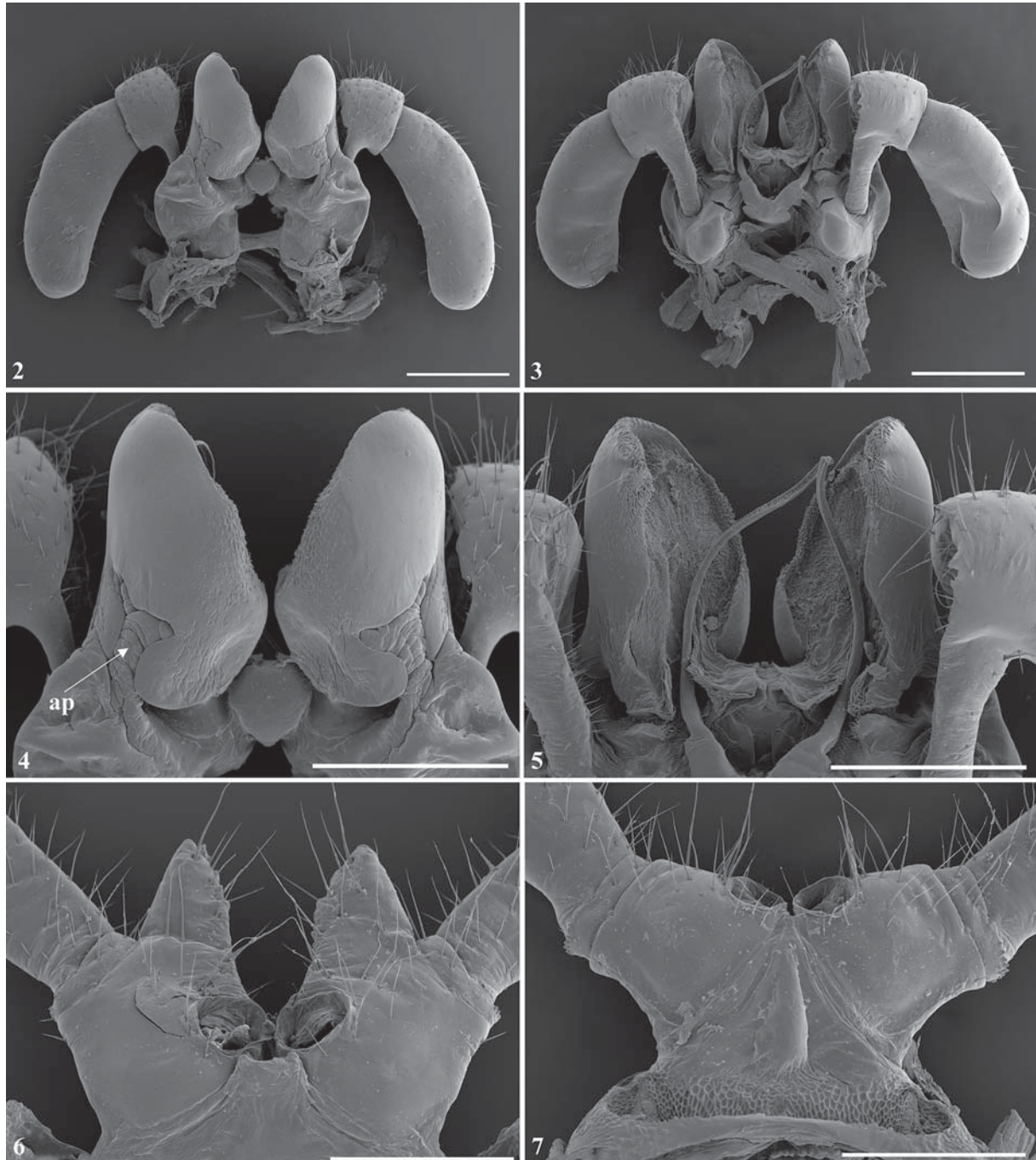
Shearia khakassica — Mikhaljova, Golovatch, 2001: 110; Mikhal-

jova, 2004: 166, 167: figs, 164: map; 2016: 13; 2017: 202, 203: figs, 140: map; Nefediev, Nefedieva, 2006: 98; 2007: 161; 2008b: 62.

Shearia oiskaya — Mikhaljova et al., 2008: 54.

NEW MATERIAL EXAMINED. 1 ♂, 7 ♀♀, 7 juv., Russia, Republic of Altai, Ulagan District, 9 km S of Lake Dzhulukul, near Lak-Yyash Lakes, *Betula rotundifolia* thicket, 50.393970°N, 89.674179°E, 2200 m a.s.l., 27.VII.2006, leg. P.S. Nefediev, J.S. Nefedieva.

MATERIAL RE-EXAMINED (specimens previously identified as *Shearia oiskaya* Mikhaljova, 2000 and published by Mikhaljo-



Figs 2–7. *Shearia calycina*, male (Republic of Altai, floodplain of Karagem River): 2–5 — gonopods; 6 — coxae 10; 7 — coxae 11; 2, 4, 6–7 — oral view; 3–5 — caudal view. Scale bars: 1 mm (2–3), 0.4 mm (4–5) and 0.3 mm (6–7). Designations explained in text.

Рис. 2–7. *Shearia calycina*, самец (Республика Алтай, пойма р. Карагем): 2–5 — гоноподы; 6 — коксы 10-й пары ног; 7 — коксы 11-й пары ног; 2, 4, 6–7 — спереди; 3–5 — сзади. Масштаб: 1 мм (2–3), 0,4 мм (4–5) и 0,3 мм (6–7). Объяснение обозначений дано в тексте.

va et al. [2008]). 7 ♂♂, 2 ♀♀, 22 juv., Russia, **Republic of Altai**, Ulagan District, 9 km S of Lake Dzhulukul, near Lak-Yyash Lakes, *Betula rotundifolia* thicket, 50.393970°N, 89.674179°E, 2200 m a.s.l., 27.VII.2006, leg. P.S. Nefediev, J.S. Nefedieva.

DISTRIBUTION. This species is rather widespread in the south of western and central Siberia (W districts of the Republic of Khakassia, S districts of the Kemerovo Area and the Krasnoyarsk Province, as well as SE districts of the Republic of Altai) (Fig. 14).

REMARKS. A restudy of specimens from near Lak-Yyash Lakes at the border of the Republic of Altai and the Republic of Tyva, previously identified as *Shearia oiskaya* Mikhaljova, 2000 by Mikhaljova et al. [2008], shows that all of them actually belong to *S. khakassica*. The above southernmost records of the species are new to the Republic of Altai. Neither the gonopods nor coxae 10, nor coxae 11 of this species have ever been shown using SEM. Hence, they



Figs 8–13. *Shearia densecava*, male: 8–11 — gonopods; 12 — coxae 10; 13 — coxae 11; 8, 10, 12–13 — oral view; 9, 11 — caudal view (8, 10, 12–13 — Republic of Altai, Lake Taldu-Kiol; 9, 11 — Republic of Altai, Kalbakaya River). Scale bars: 1 mm (8–11), 0.4 mm (12) and 0.3 mm (13).

Рис. 8–13. *Shearia densecava*, самец: 8–11 — гоноподы; 12 — коксы 10-й пары ног; 13 — коксы 11-й пары ног; 8, 10, 12–13 — спереди; 9, 11 — сзади (8, 10, 12, 13 — Республика Алтай, оз. Талду-Кель; 9, 11 — Республика Алтай, р. Калбакая). Масштаб: 1 мм (8–11), 0,4 мм (12) и 0,3 мм (13).

are given here (Figs 15–20). An examination of males of the species from the ASU collection has revealed a small posterior process (**pp**) on each angiocoxite of the posterior gonopods, as opposed to “absent” or “a small fold”, specified in the original description [see Mikhaljova, 2000]. This structure is well visible in a SEM micrograph (Fig. 18), and it must be included into the description of *S. khakassica*.

Shearia longa Mikhaljova, 2012

Fig. 14.

Shearia longa Mikhaljova, 2012: 42, 43–46: figs.

MATERIAL EXAMINED. 7 ♂♂, 2 ♀♀, **Mongolia**, Bayan-Ölgii Province (Aimag), Altai District (Somon), Tsengel Hayrhan Nuruu Mt. Range, 3 km W of Mt Elt Uul, 48°09' N; 89°14' E, screes, under stones, 2700 m a.s.l., 11.VII.2015, leg. A.A. Fomichev.

DISTRIBUTION. This species is known only from the Mongolian Altais, western Mongolia (Fig. 14).

REMARKS. Originally described from the Tsengel Somon of the Bayan-Ölgii Aimag [see Mikhaljova, 2012], this species is now recorded from outside its *terra typica* for the first time.

The following key can be proposed to *Shearia* species.

- 1(4) Anterior angiocoxal processes of posterior gonopods with very large front branches and small outer ones 2
- 2(3) Colpocoxites of posterior gonopods strongly curved

- caudad, with external lateral lobes *shushenskaya* Mikhaljova, 2000
- 3(2) Colpocoxites of posterior gonopods regularly curved caudad, without external lateral lobes *teletskaya* Mikhaljova, 2000
- 4(1) Anterior angiocoxal processes of posterior gonopods small, both branches equal in height 5
- 5(6) Colpocoxite tips of posterior gonopods with subquadrate excavations *rybalovi* Mikhaljova, 2000
- 6(5) Colpocoxite tips of posterior gonopods different 7
- 7(8) Front branches of anterior angiocoxal processes of posterior gonopods distinctly triangular in shape, with pointed tips (Fig. 17) *khakassica*
- 8(7) Front branches of anterior angiocoxal processes of posterior gonopods different, without pointed tips 9
- 9(12) Colpocoxites of posterior gonopods tapering distally, straight 10
- 10(11) Anterior gonopod telopodites very long and twisted *longa*
- 11(10) Anterior gonopod telopodites shorter, not twisted .. *calycina*
- 12(13) Colpocoxites of posterior gonopods broad, concave 13
- 13(14) Mesal sheath plate small *densecava*
- 14(13) Mesal sheath plate very large *oiskaya* Mikhaljova, 2000



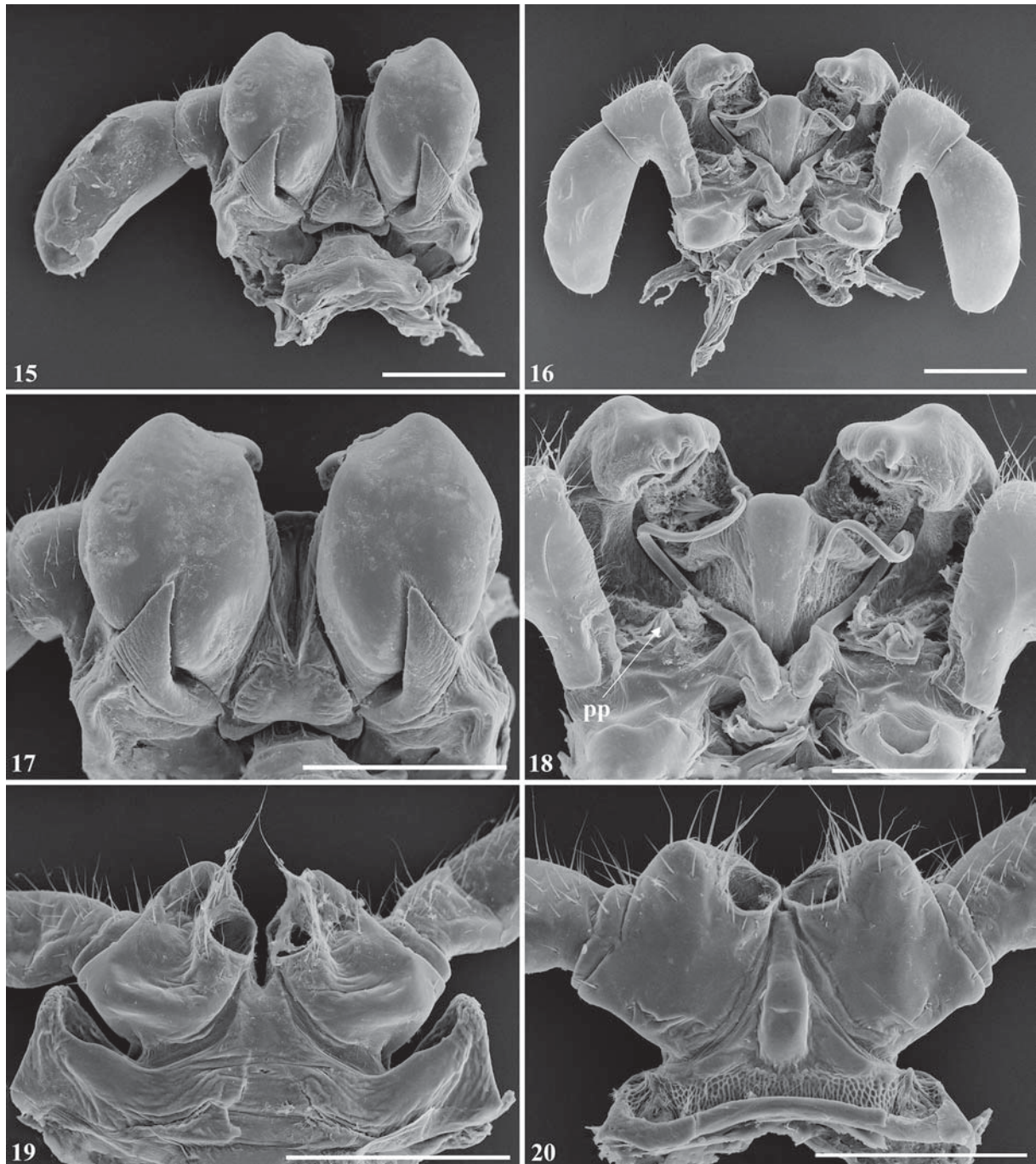
Fig. 14. Distribution of *Shearia khakassica* (circle) and *S. longa* (square). Previously known localities marked in black, new records given in white.

Рис. 14. Распространение *Shearia khakassica* (круг) и *S. longa* (квадрат). Чёрным отмечены ранее известные места находок, новые находки отмечены белым.

Conclusions

New records and restudied material allow for the distributions of five *Shearia* species to be refined. *Shearia khakassica* is recorded from the Republic of Altai for the first time, while the range limit of *S. oiskaya* is restricted to the south of the Krasnoyarsk Province.

Shearia longa is new to be reported from outside its type locality. The presence of a small, two-branched anterior angiocoxal processes (**ap**) of the posterior gonopods in *S. calycina* must supplement the description of that species, and the diagnosis of the genus in general, i.e. anterior angiocoxal processes of the posterior gonopods always have two branches. The presence of a small



Figs 15–20. *Shearia khakassica*, male (Republic of Altai, near Lak-Yyash Lakes): 15–18 — gonopods; 19 — coxae 10; 20 — coxae 11; 15, 17, 19–20 — oral view; 16, 18 — caudal view. Scale bars: 1 mm (15–18) and 0.4 mm (19–20). Designations explained in text.

Рис. 15–20. *Shearia khakassica*, самец: 15–18 — гоноподы; 19 — коксы 10-й пары ног; 20 — коксы 11-й пары ног; 15, 17, 19–20 — спереди; 16, 18 — сзади. Масштаб: 1 мм (15–18) и 0,4 мм (19–20). Объяснение обозначений дано в тексте.

posterior angiocoxal processes (**pp**) of the posterior gonopods in *S. khakassica* must supplement the description of that species, and the diagnosis of the genus in general as well, i.e. posterior angiocoxal processes of the posterior gonopods are always present.

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