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A review of the genus *Asellus* E.L. Geoffroy, 1762 (Crustacea: Isopoda: Asellidae) from the Asian part of Russia, with description of plesiomorphic *A. turanaicus* sp.n.

Обзор рода *Asellus* E.L. Geoffroy, 1762 (Crustacea: Isopoda: Asellidae) из азиатской части России, с описанием плезиоморфного *A. turanaicus* sp.n.

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KEY WORDS: Asellidae, *Asellus turanaicus* sp.n., *Asellus h. amuricus* syn.n., taxonomy, Far East of Russia, identification key.

КЛЮЧЕВЫЕ СЛОВА: Asellidae, *Asellus turanaicus* sp.n., *Asellus h. amuricus* syn.n., таксономия, Дальний Восток России, определительный ключ.

ABSTRACT. We describe *Asellus turanaicus* sp.n., from small pond located in the area of the Norskij State Nature Reserve (Amurskaya Area, Russian Far East). A number of plesiomorphic features allow a more detailed evaluation of its taxonomic status within the genus *Asellus*. The most remarkable plesiomorphic feature of the new species is the specific architecture of the male gonopod. We re-evaluate the taxonomy of *A. hilgendorfii amuricus* Sidorov, 2005 and provide the additional diagnostic features. *A. h. aculeiferus* Sidorov, 2005 is proposed as a junior synonym of *A. h. amuricus* Sidorov, 2005. We also provide an updated distribution map of the genus *Asellus* in the Russian Far East, as well as the revised identification key for six *Asellus* s.str. species known from Russia.

РЕЗЮМЕ. Описывается *Asellus turanaicus* sp.n. обитающий в небольшом водоеме расположенном в Норском заповеднике (Амурская область, Дальний Восток России). Ряд плезиоморфных характеристик позволяют более подробно оценить его таксономический статус внутри рода *Asellus*. Самой примечательной плезиоморфной особенностью нового вида является специфическое строение мужского гонопода. Заново пересмотрена таксономия *A. hilgendorfii amuricus* Sidorov, 2005 и найдены дополнительные диагностические признаки. *A. h. aculeiferus* Sidorov, 2005 предлагается в качестве младшего синонима *A. h. amuricus* Sidorov, 2005. Представлена обновленная карта распространения рода *Asellus* на Дальнем Востоке России, а также идентификационный ключ для шести видов *Asellus* s.str. известных из России.

Introduction

The Asellidae Rafinesque-Schmaltz, 1815 are strictly limnetic asellote family with 265 species inhabiting either lentic or slowly flowing waters of the Palearctic [Wilson, 2008]. The genus *Asellus* was established in 1762 by Etienne-Louis Geoffroy based on *Oniscus aquaticus* Linnaeus, 1758. Numerous epigean and hypogean asellid species were attributed to the genus afterwards, sometimes without adequate arguments. After several attempts to resolve inappropriate generic taxonomy by the establishment of the subgenera [for details, see Henry, Magniez, 1993], the final separation of species into two evolutionary groups was carried out [Henry, Magniez, 1995]: (1) the Palearctic "*aquaticus-hilgendorfii*" group (= the subgenus *Asellus* = *Asellus* s.str. = (*A.*) abbreviation further in the text) and (2) exclusively arctic, Siberian-Alaskan "*latifrons*" group (= the subgenus *Arctasellus* = (*Ar.*) abbreviation further in the text).

From the Far East, i.e. the Russian Far East and the Japanese archipelago, as many as 17 species and subspecies of the subgenus *Asellus* are recorded. Only one epigean and as many as eight troglobiotic taxa are present in Japan, a centre of generic speciation [Henry, Magniez, 1970]. Meanwhile, only troglobiotic *A. primoryensis* Henry et Magniez, 1993 and several epigean taxa are is known from the Russian Far East: *A. levani-*

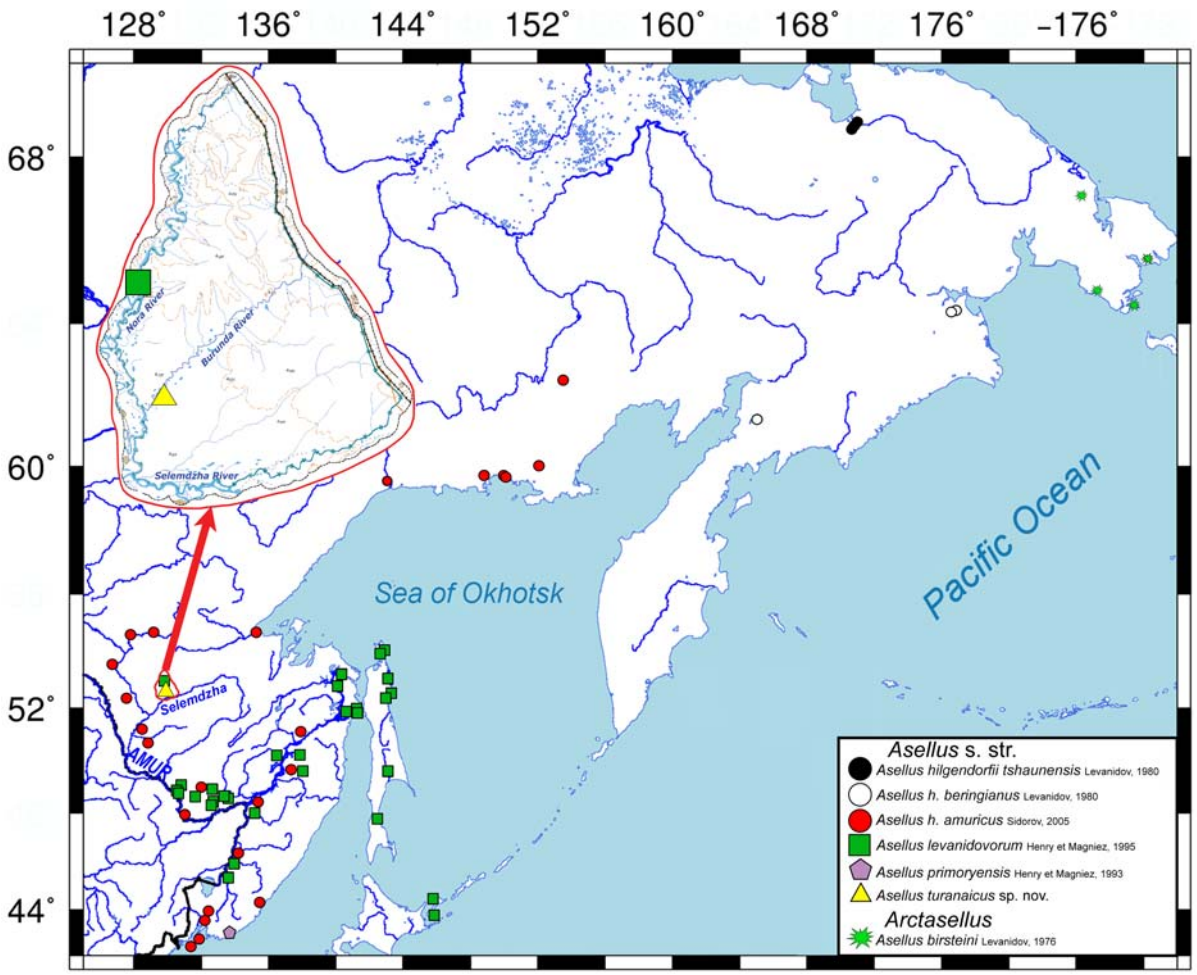
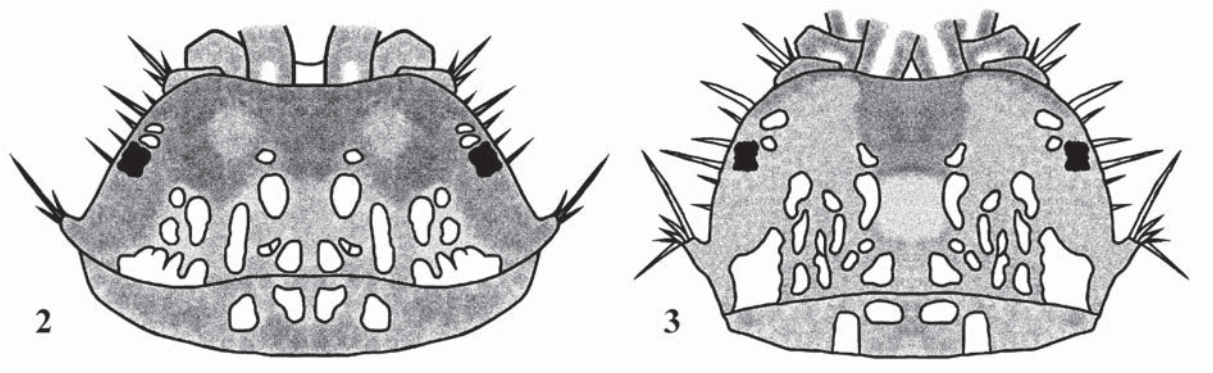


Fig. 1. Map showing the distribution of the genus *Asellus* in the Russian Far East with the position of sampling site of *Asellus* (*A.*) *turanaicus* sp.n. in the Amur River Basin. Triangle represents three sampling points within 1.5 m range.

Рис. 1. Карта отражающая географическое распространение рода *Asellus* на Дальнем Востоке России, с указанием места сбора *Asellus* (*A.*) *turanaicus* sp.n. в бассейне р. Амур. Треугольник представляет три точки отбора проб в диапазоне 1,5 м.

dovorum Henry et Magniez, 1995, *A. andreyi* Vekhoff, 1994, *A. hilgendorfii hilgendorfii* Bovallius, 1886, *A. h. martynovi* Birstein, 1947, *A. h. tshaunensis* Levanidov, 1980, *A. h. beringianus* Levanidov, 1980, *A. h. aculeiferus* Sidorov, 2005 and *A. h. amuricus* Sidorov, 2005. Although records of additional morphological forms from the Russian Far East and China [see Henry, Magniez, 1995] exist, which are based mainly on a comparison of "endopodite copulateur" (i.e., gonopod endopodite morphology), they are not valid taxa as they do not meet the requirements of "publication" stated in the Code [ICZN, 1999: Article 8.6]. From the Chukotka, the northernmost region of the Russian Far East, the sole representative of the subgenus *Arctasellus*, *A. birsteini* Levanidov, 1976, is recorded.

Until recently, 3 epigean *Asellus* s. str. taxa were known from the southern part of the Russian Far East. *A.* (*A.*) *levanidovorum* inhabits freshwater of islands Sakhalin and Kunashir islands and the mainland Amur Basin: besides its lower part to the confluence of the Kabarga River within the Ussuri River basin [Henry, Magniez, 1995: Fig. 18], also the middle part, i.e. Berezovoe lake within the Selemdzha River basin [Sidorov, 2005b: 258]. Except for the islands, its distribution range coincides with the ranges of 2 subspecies from a highly polymorphic *A.* (*A.*) *hilgendorfii* species complex, *A. h. amuricus* and *A. h. aculeiferus*. Although the diagnosis for the former subspecies has already been provided (Sidorov, 2005b) and minor differences in relation to the nominotypical subspecies were discussed [Henry, Magniez, 1995], we herein provide an additional diagnostic feature and present an updated distribution of the subspecies. We discuss the morphological similarity of mentioned subspecies and propose their synonymy. At the same time, we provide a detailed description of a new *Asellus* species, which was sampled in the "Norskij" State Nature Reserve within the Selemdzha River basin (Fig. 1). The locality is situated on the slopes of Turana Mountain Ridge. Turana is one of the oldest Paleozoic-age areas with the 300 km long mountain chain Jankan –



Figs 2, 3. Differences in the head pigmentation pattern: 2 — *Asellus* (*A.*) *hilgendorfii amuricus* Sidorov, 2005, male 10.2 mm, specimen 21/sd11-IBSS, Primorsky Krai, Luchegorsk; 3 — *Asellus* (*A.*) *h. hilgendorfii* Bovallius, 1886, male 9.5 mm, specimen 21/sd07-IBSS, Toyama Pref., Nyûzen-machi region, Sugisawa.

Рис. 2, 3. Различия в узорной пигментации головы: 2 — *Asellus* (*A.*) *hilgendorfii amuricus* Sidorov, 2005, самец 10,2 мм, образец 21/sd11-IBSS, Приморский край, Лучегорск; 3 — *Asellus* (*A.*) *h. hilgendorfii* Bovallius, 1886, самец 9,5 мм, образец 21/sd07-IBSS, преф. Тояма, регион Нюжен-мачи, Сугисава.

Tukuringra – Soktakhan – Jagdy. A plateau with a complex network of well-developed river valleys with boggy flat floodplains rises about 600–1800 m above sea level. The Selemdzha River is the biggest tributary of the Zeya River, which is one of the most important tributaries of the Amur River. Although the species has been mentioned previously [Sidorov, 2005b], it has not yet been described. We discuss its morphological characteristics, as well as biogeographic relationships.

In accordance with new sampling localities, as well as several changes in the generic classification, we provide an updated distribution map of the genus *Asellus* in the Russian Far East and an updated dichotomous identification key for species of *Asellus* s. str. from Russia.

Material and Methods

Samples were collected with a dip net from a small freshwater pond and preserved in 80 % ethanol. Morphometric characters, i.e. body proportions and cuticular structures, were recorded with Lomo MBS-9 stereomicroscope with a scaled micrometer eyepiece. Dissected parts were stained with methylene blue and mounted on glass microscope slides using polyvinyl lactophenol (PVL). Dissected appendages were examined and drawn using a Carl Zeiss NU-2 compound microscope equipped with a drawing device as modified by Gorodkov [1961]. Appendages for scanning electron microscopy (SEM) were dehydrated in a graded 70–96% ethanol series and dried to critical point with a Bal-Tec CPD 030. They were sputter-coated with palladium-gold and examined by Carl Zeiss EVO®40 scanning electron microscope.

The description is based on the type series, deposited in the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZINRAS), in the Zoological Museum of the Far East Federal University, Vladivostok (FEFU) and in the research collection of D.A. Sidorov in the Institute of Biology and Soil Science, Vladivostok (IBSS).

A distribution map of the genus *Asellus* in the Russian Far East was constructed with GMT 4.5.6.-1. GIS software. Locality data from Levanidov [1980], Henry and Magniez [1995] and Sidorov [2005b] were used.

Taxonomy

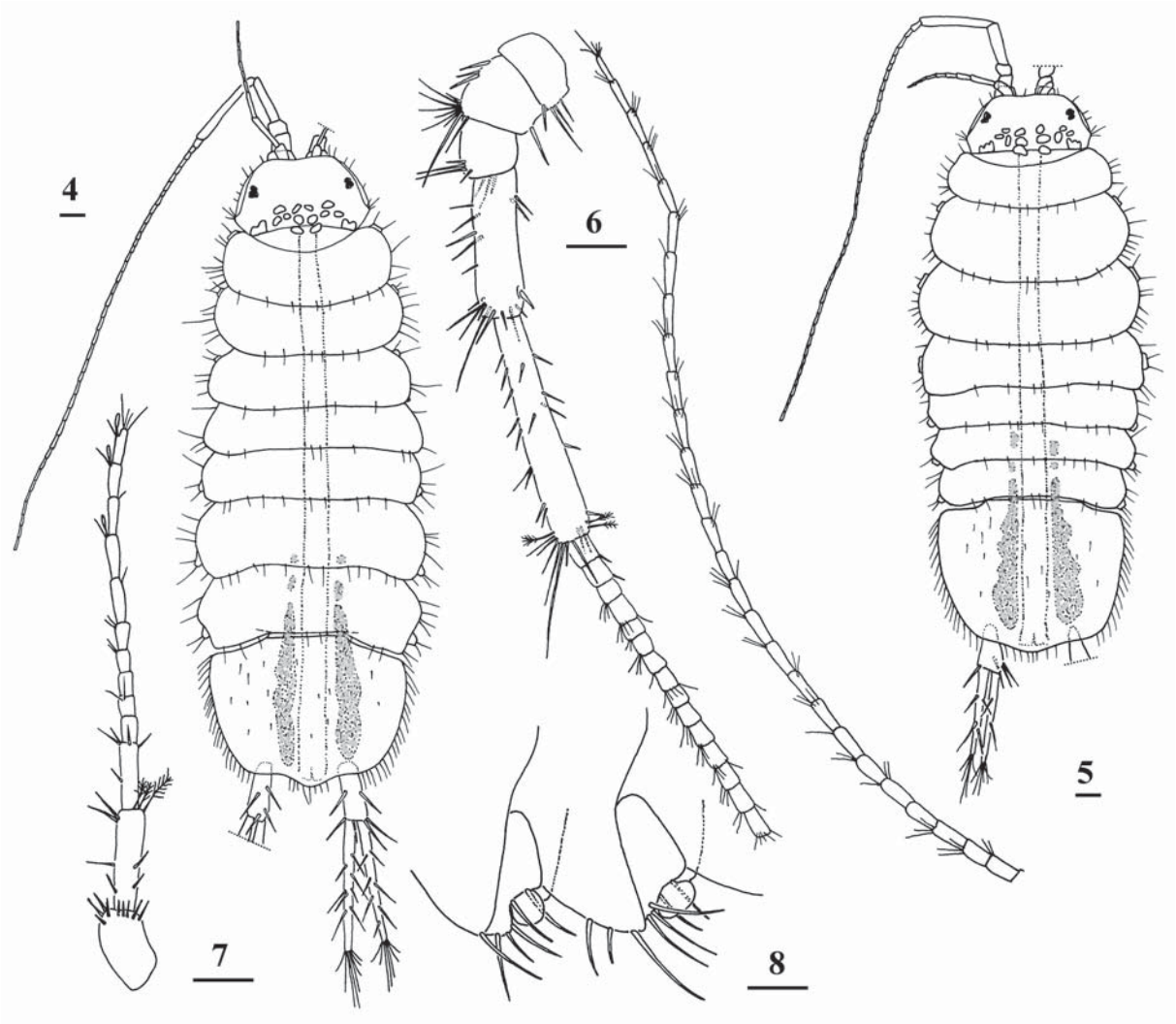
Family Asellidae Rafinesque-Schmaltz, 1815
Genus *Asellus* E.L. Geoffroy, 1762

Asellus hilgendorfii amuricus Sidorov, 2005
Fig. 2.

Asellus aquaticus (Linnaeus): Derzhavin, 1930: 3.
Asellus hilgendorfii Bovallius: Birstein, 1939: 57, 1951: 62; Vekhoff, 1994: 26; Henry, Magniez, 1995: 110, Fig. 19 (forme du Primorye et du bassin inferieur de l'Amour).
Asellus martynovi Birstein: Sidorov, 2005: 108.
Asellus hilgendorfii amuricus Sidorov, 2005b: 261, Fig. 3.
Asellus hilgendorfii aculeiferus Sidorov, 2005b: 261, Fig. 2, syn.n.

ADDITIONAL DIAGNOSTIC FEATURE. *Asellus* (*A.*) *h. amuricus* (Fig. 2, specimen from Luchegorsk) head pigmentation pattern with fewer fused muscular prints (visible as bright coloured patches) in contrast to several small and distinct muscular prints (visible as bright spots) in *A.* (*A.*) *h. hilgendorfii* from Nyûzen-machi (Fig. 3). Head of the former subspecies darker at the anterior than the posterior half, while the colour more homogenous in the latter.

REMARKS. Henry and Magniez [1995] established the differences among *A.* (*A.*) *hilgendorfii* forms solely on the architecture of the male copulatory organ; they indicated minute differences in the shape of 'basal spur' between the Japanese and Amur forms. Afterwards, Sidorov [2005b] listed additional distinguishing features between the mainland *A. h. amuricus* and islandic *A. h. hilgendorfii* from Nyûzen-machi of Toyama (its characteristics are given in parentheses), based



Figs 4–8. *Asellus* (*A.*) *turanaicus* sp.n., male 5.8 mm, holotype 1/88502-ZINRAS: 6 — antenna; 7 — antennula; 8 — coxopodites V and VI, ventral view. Male 5.0 mm, paratype X44973/Cr-1814-FEFU: 4 — habitus, dorsal view. Female 4.2 mm, paratype X44973/Cr-1812-FEFU: 5 — habitus, dorsal view. Scale bars 0.2 mm.

Рис. 4–8. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,8 мм, голотип 1/88502-ZINRAS: 6 — антена; 7 — антеннула; 8 — коксоподиты V и VI, вид снизу. Самец 5,0 мм, паратип X44973/Cr-1814-FEFU: 4 — габитус, вид сверху. Самка 4,2 мм, паратип X44973/Cr-1812-FEFU: 5 — габитус, вид сверху. Линейки 0,2 мм.

on a small latter sample: male pereopod I propodus with proximal apophysa unarticulated (proximal apophysa articulated), male pleopod II protopodite with group of 2–3 small distomedial setae and/or 1 spine (3–6 long stiff setae) [cf., Matsumoto, 1963; Nunomura, 2002], male pleopod II endopodite with crypte reposed proximally, reaching to the tip of endopodite (crypte reposed distally) [cf., Henry, Magniez, 1995: 111, Figs 19, 20].

While re-examining specimens of *A.* (*A.*) *h. aculeiferus* Sidorov, 2005, we came to the conclusion that its only specificity is the presence of distomedial spine on male pleopod II protopodite. That, however, could be aberrance due to dwelling of the specimens in the artificial water reservoir-cooler at the thermal power station Primorskaja. We therefore propose designation of *A. h. aculeiferus* as the junior synonym of *A. h. amuricus*.

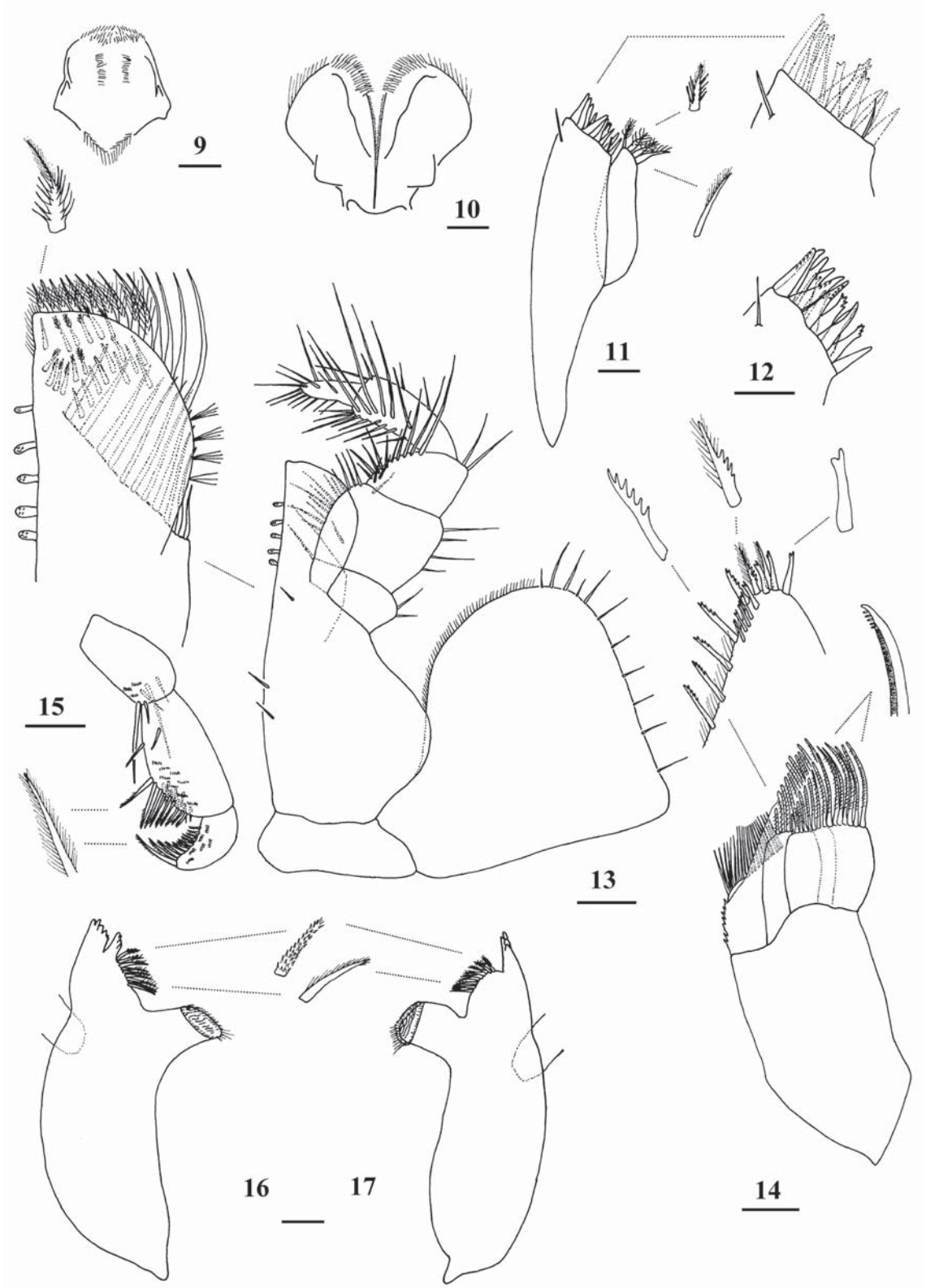
An updated distribution of *A.* (*A.*) *h. amuricus* in the Russian Far East is presented (Fig. 1).

Asellus turanaicus **sp.n.**
Figs 4–39.

Asellus sp.: Sidorov 2005b: 267, Figs 5A, B.

MATERIAL EXAMINED. Holotype specimen (1/88502-ZINRAS): male, 5.8 mm, collected in small pond on the bank of the Burunda River, the Nora River (tributary of the Selemdzha River) basin, Ekimchansky District, Amurskaya Area, Russia; coordinates, WGS 84: 52.57111 °N 130.09083 °E; 16th June 2004, coll. D.A. Sidorov, L.A. Medvedeva. Deposited in the Zoological Institute of the Russian Academy of Sciences (ZINRAS), St. Petersburg, Russia.

PARATYPE SPECIMENS (X44972/Cr-1811-1819-FEFU): 3 females (4.0 mm, 4.2 mm, 4.5 mm), 4 males (5.0 mm, 5.5 mm, 6.0 mm, 6.2 mm), 2 intersex specimens (2 x 5.0 mm), same data as for holotype.



Figs 9–17. *Asellus* (*A.*) *turanaicus* sp.n., male 5.8 mm, holotype 1/88502-ZINRAS: 9 — labrum; 10 — labium; 11 — maxillula, left; 12 — outer plate of maxillula, right; 13 — maxilliped; 14 — maxilla; 15 — mandible, palp; 16 — mandible, left; 17 — mandible, right. Scale bars 0.1 mm.

Рис. 9–17. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,8 мм, голотип 1/88502-ZINRAS: 9 — верхняя губа; 10 — нижняя губа; 11 — максиллула, левая; 12 — внешняя пластинка максиллулы, правая; 13 — ногочелюсть; 14 — максилла; 15 — мандибула, щупик; 16 — мандибула, левая; 17 — мандибула, правая. Линейки 0,1 мм.

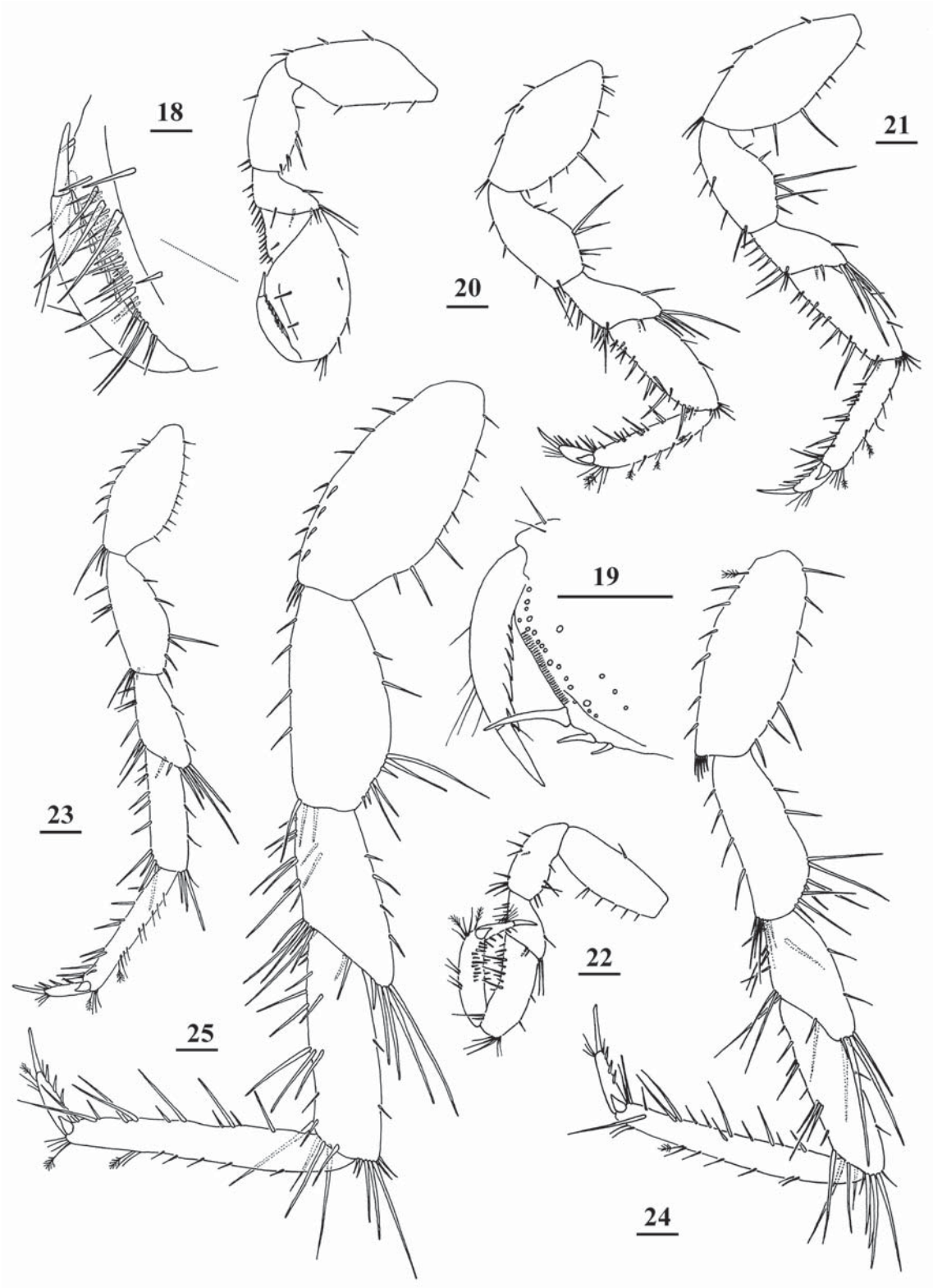
OTHER SPECIMENS EXAMINED FROM THE TYPE LOCALITY: 7 females (3 × 3.5 mm, 3.75 mm, 2 × 4.0 mm, 4.25 mm), 5 males (2 × 5.0 mm, 5.25 mm, 5.5 mm, 6.0 mm). Deposited in the Zoological Museum of the Far East Federal University, Vladivostok (X43579/Cr-1618-FEFU).

MATERIAL FOR SEM: male, 5.0 mm, same data as holotype. Deposited in the research collection of D.A. Sidorov in the Institute of Biology and Soil Science, Vladivostok (21/sd02-IBSS), Russia.

DIAGNOSIS OF MALE. With common characteristics of the subgenus *Asellus* sensu Henry and Magniez, i.e., lateral head incisions absent, maxillula inner plate with 4 setae distally and cannula inserted in crypt. Body slightly reddish, marbled with light-coloured spots. Antennula and antenna lengths about 25% and 100–110% of body length. Exopod of pleopod I without concavity on lateral margin, ventromedial surface with two rows of simple setae. Male pleopod II endopodite with short and stout basal spur, capitulum well-developed but not helical, squamiferous membrane absent, crypte straight, anterior lobe completely reduced, cannula prominent and clearly visible yet not surpassing capitulum outline. Pleopods IV and V with intermediate sized *respiratory areae*, comprising 50% and 42% of exopodite surface, respectively. Largest female 4.5 mm, largest male 6.2 mm.

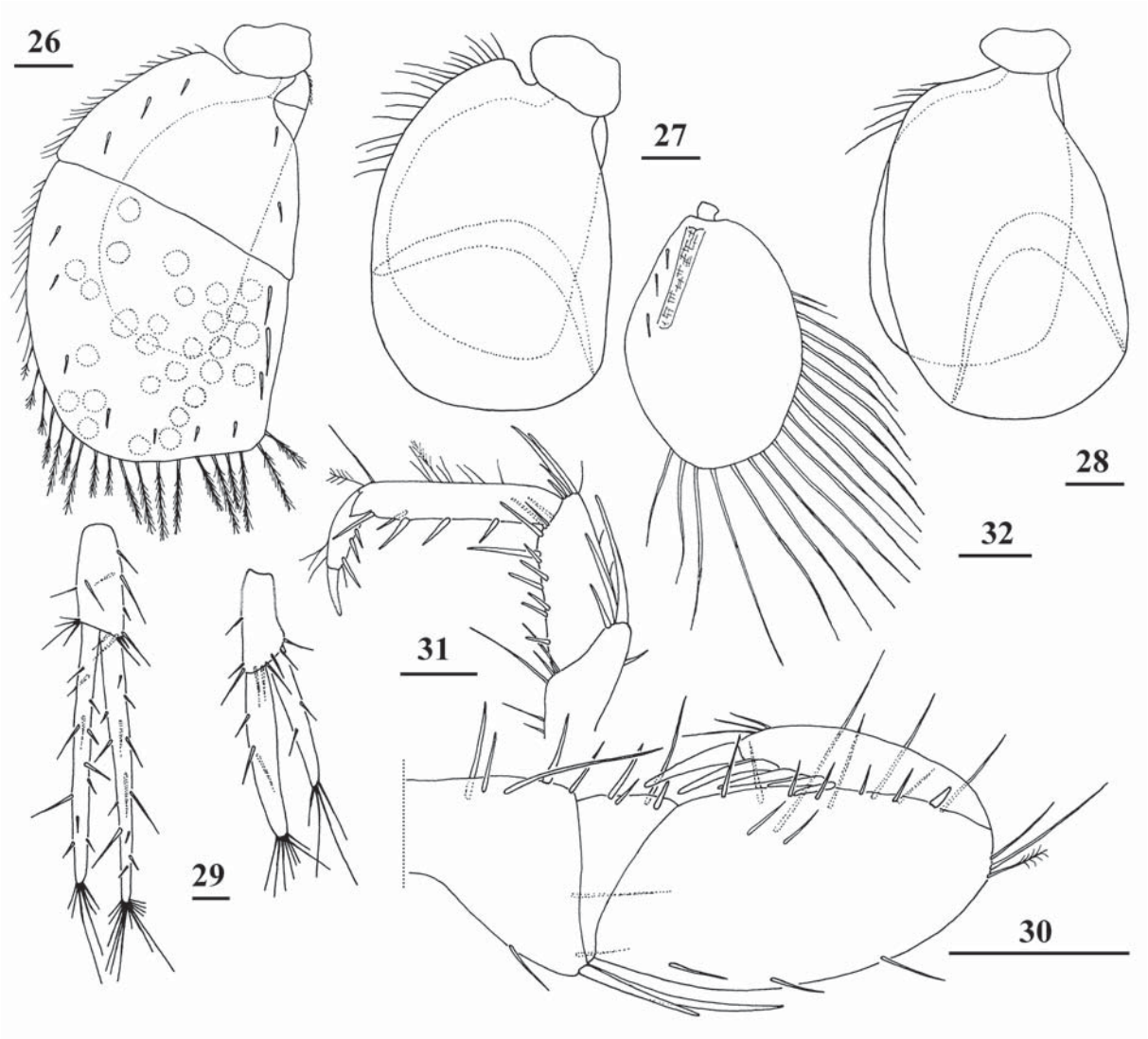
ETYMOLOGY. The specific epithet turanaicus (Latin) an adjective that refers to the name of Turana Mountain Ridge, where it was collected.

DESCRIPTION (holotype and specimen used for SEM). *Body* (Fig. 4) length 5.8 mm and 5.0 mm respectively, 2.7 times of pereonite 7 width; head sub-trapezoidal with slightly concave frontal margin, about 1.6 times as wide as long, head pigmentation homogenous with some light-coloured spots. Pereonite 1 width 120% of head width; pereonite 4 shortest, its length about half of pereonite 7 length; pereonites 6 and 7 sub-equal, longest and widest, about as long as head; lateral margins of pereonites 1–6 rounded, lateral margins of pereonite 7 angular with slightly concave distolateral margin, lateral and terminal margins of all pereonites with scarce fine simple setae; coxopodites (Fig. 8) well developed margins slightly visible from above. Pleotelson rounded sub-trapezoidal, its length 80% of its width and 30 % of its body length, as broad as pereonite 2, lateral margins fringed with dense short stiff simple setae. *Antenna* (Fig. 6) longer than body; articles 2–6 length relations 0.2 : 0.3 : 0.3 : 0.6 : 1, article 5 with short robust seta at inferodistal angle, article 6 with 3 broom setae and cluster of simple setae on distal margin; flagellum length 70% of antenna length, of 42 articles. *Antennula* (Fig. 7) length about 25% of body length and 43% of antenna length; articles 1–3 length relations: 0.8 : 1 : 0.6, article 2 with 3 broom setae at inferodistal angle; flagellum length about 1.3 times of podomeres length, of 8–10 articles, successive articles longer, article 1 smooth, its length about 40% of article 3 length, distal 3 articles with one minute aesthetasc with setae each. *Mouthparts. Labrum* (Fig. 11) rhomboidal, with fine simple setae at rounded apex, epistome tapering, with fine setae along margin. *Labium* (Fig. 10) sub-triangular, divided almost to the base, mandibular lobes tapering proximally. *Mandibles* (Figs 16, 17) sub-equal, with 4-cuspate *pars incisiva* (incisor) and 4-cuspate left *lacinia mobilis*, setal row of 3 serrate and 6 plumose stiff setae; palp (Fig. 15) shorter than mandibular corpus, article 1 with 2 long and 3 short distal setae, article 2 1.3 times as long as article 1, with row of 9 plumose and 2 simple medial setae, article 3 with row of 11 plumose setae. *Maxillula* (Figs 11, 12) inner plate with 4 apical pappose setae; outer plate with 13 dentate robust setae or with 12 dentate robust and 1 simple thin setae, 1 simple seta sub-apically on lateral margin. *Maxilla* (Fig. 14) inner plate longer than outer plate, rounded sub-triangular, with longer row of 7 setae (5 serrate and 2 serrate-setulate), shorter row of 8 bifid setae laterally and apically, and with oblique row of 21 simple setae; lateral and middle plates with 15 and 11 striated setae, respectively. *Maxilliped* (Fig. 13) endite width about 80 % of palp article 2 width, about twice as long as wide, with 5 coupling hooks at distomesial margin, 4 long simple and 10 pappose stiff setae distally, 11 simple slender setae of oblique row and with numerous short plumose setae sub-apically on ventral surface; palp article 1 shortest, 3 times as wide as long; article 2 sub-rectangular, little shorter than article 4; articles 3–5 length relations: 0.5 : 1 : 0.5; epipodite sub-triangular, with sparse longer setae along lateral margin and dense shorter setae along distal margin. *Pereopods I–VII* (Figs 18–25) sub-similar in construction, increasing in length towards posterior pairs (except pereopod IV); pereopods II–VI with 3 denticles and 1 seta along dactylus inner margin. *Pereopod I* (Figs 18, 19) length about 40% of body length; basis stout, as long as propodus, with 3 and 4 short setae on superior and inferior margins, respectively; ischium length 90% of basis length; carpus triangular, superior margin length equal to merus inferior margin length, carpus inferior margin with a row of short setae; merus poorly developed, with 2 long and 3 short setae at distosuperior angle; propodus sub-rhomboidal, 1.5 times as long as wide, superior margin twice as long as palm, palmar margin oblique, straight or slightly concave, proximal apophysa developed, armed with 3 strong acute, knife-like setae, palmar edge and mesial surface with fingerprint pattern, with rows of short simple setae and proximal set of 4 long stiff simple setae; dactylus little longer than palm, with 6 denticles along inferior margin and with 5–6 simple setae along superior margin, claw length 25% of dactylus length, with 1 basal seta. *Pereopod II* (Fig. 20) length 116% of pereopod I length; basis–dactylus length relations: 1 : 0.7 : 0.4 : 0.8 : 0.8 : 0.4; propodus as long as carpus; claw half as long as dactylus length. *Pereopod III* (Fig. 21) length 120% of pereopod I length; basis–dactylus to basis length relations: 1 : 0.6 : 0.4 : 0.7 : 0.7 : 0.4; propodus as long as carpus; claw half as long as dactylus. *Pereopod IV* (Fig. 22) prehensile; its length 90% of pereopod I length; basis–dactylus length relations: 1 : 0.6 : 0.4 : 0.7 : 0.7 : 0.5; carpus sickle-shaped, with 4 strong and long simple setae and numerous short stiff simple setae on superior margin; propo-



Figs 18–25. *Asellus* (*A.*) *turanaicus* sp.n., male 5.8 mm, holotype 1/88502-ZINRAS: 18 — pereopod I; 20 — pereopod II; 21 — pereopod III; 22 — pereopod IV; 23 — pereopod V; 24 — pereopod VI; 25 — pereopod VII. Male 5.0 mm, paratype X44973/Cr-1814-FEFU: 20 — pereopod I, palm (setation omitted). Scale bars 0.2 mm.

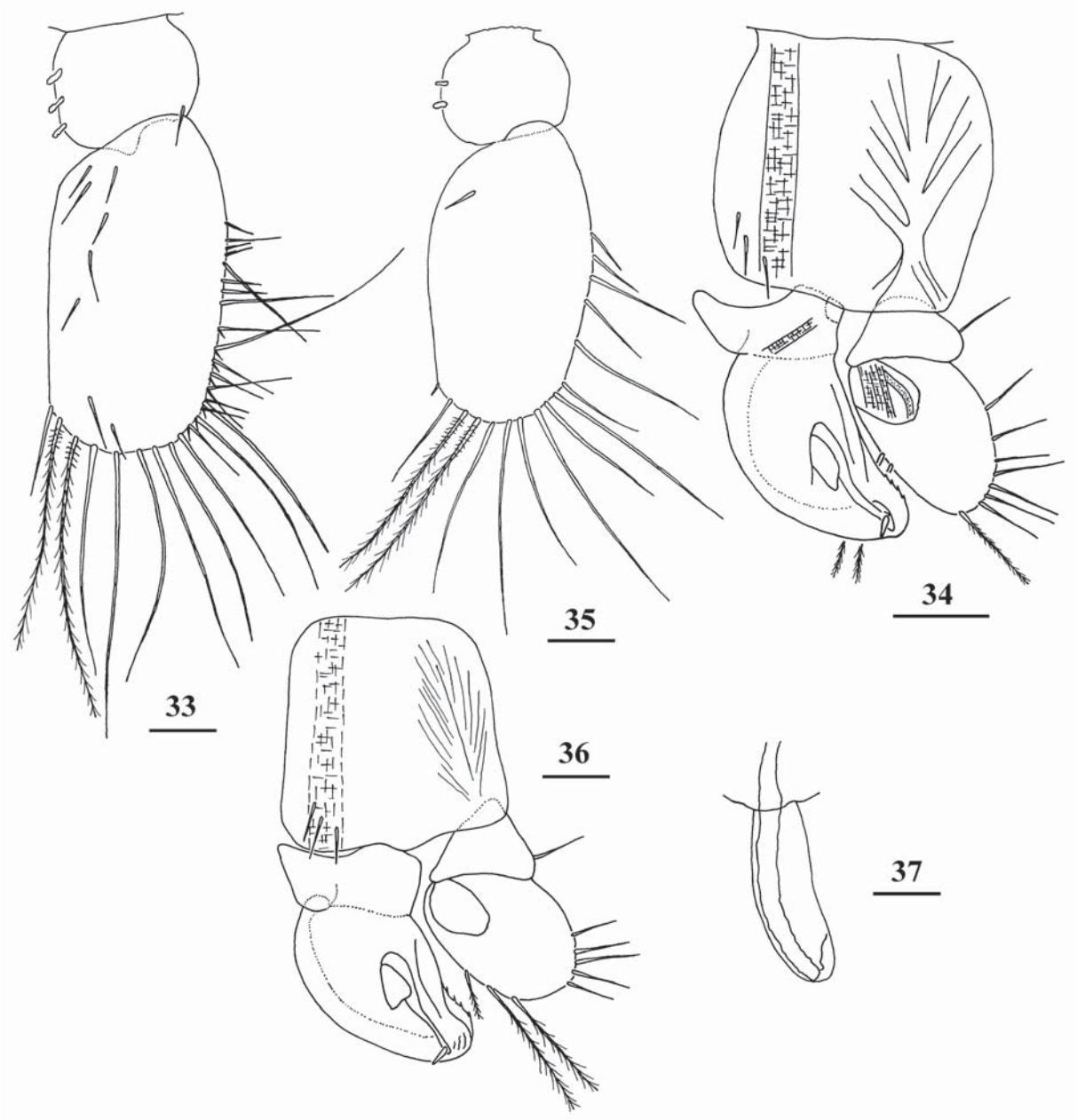
Рис. 18–25. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,8 мм, голотип 1/88502-ZINRAS: 18 — переопод I; 20 — переопод II; 21 — переопод III; 22 — переопод IV; 23 — переопод V; 24 — переопод VI; 25 — переопод VII. Самец 5,0 мм, паратип X44973/Cr-1814-FEFU: 20 — переопод I, ладонь (щетинки пропущены). Линейки 0,2 мм.



Figs 26–32. *Asellus* (*A.*) *turanaicus* sp.n., male 5.8 mm, holotype 1/88502-ZINRAS: 26 — pleopod III, dotted circles are ciliate epibionts; 27 — pleopod IV; 28 — pleopod V; 29 — uropods. Female 4.2 mm, paratype X44973/Cr-1812-FEFU: 30 — pereopod I, part; 31 — pereopod IV, part; 32 — pleopod II. Scale bars 0.2 mm.

Рис. 26–32. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,8 мм, голотип 1/88502-ZINRAS: 26 — плеопод III, пунктирными кружками показаны ресничные эпибионты; 27 — плеопод IV; 28 — плеопод V; 29 — уропод. Самка 4,2 мм, паратип X44973/Cr-1812-FEFU: 30 — переопод I, часть; 31 — переопод IV, часть; 32 — плеопод II. Линейки 0,2 мм.

dus as long as carpus, with row of short setae along inferior margin and row of sub-marginal setae on mesial surface; claw length 40% of dactylus length. *Pereopod V* (Fig. 23) as long as pereopod III; basis–dactylus length relations: 1 : 0.9 : 0.6 : 0.9 : 1 : 0.5; merus distosuperior angle armed with 4 long stiff setae; propodus length 115% of carpus length; claw length 40% of dactylus length. *Pereopod VI* (Fig. 24) length 170% of pereopod I length; basis–dactylus length relations: 1 : 0.8 : 0.4 : 0.7 : 1 : 0.5; merus distosuperior angle armed with 4 long stiff setae; propodus length 150% of carpus length; claw length 40% of dactylus length. *Pereopod VII* (Fig. 25) length 210% of pereopod I length; basis–dactylus length relations: 1 : 0.8 : 0.5 : 0.8 : 1 : 0.4; merus distosuperior angle armed with 4 long and 1 short stiff setae; propodus length 130% of carpus length; claw length 40% of dactylus length. *Pleopod I* (Fig. 33) protopodite rounded sub-rectangular, 1.2 times as wide as long, about 30% of exopodite length, with 2–3 coupling hooks on medial margin and 1 seta at disto-lateral angle; exopodite elongated, rounded sub-rectangular, about 1.9 times as long as wide, without concavity on lateral margin, with 11 long plumose setae on terminal margin, numerous simple short setae on lateral margin and two rows of simple setae on ventromedial surface. *Pleopod II* (Figs 34, 36) protopodite sub-quadratic, as long as wide, with group of distomedial simple setae; exopodite shorter than protopodite, article 1 rounded sub-triangular, with 1 simple seta on lateral margin, terminal article ovoid, longer



Figs 26–32. *Asellus* (*A.*) *turanaicus* sp.n., male 5.8 mm, holotype 1/88502-ZINRAS: 26 — pleopod III, dotted circles are ciliate epibionts; 27 — pleopod IV; 28 — pleopod V; 29 — uropods. Female 4.2 mm, paratype X44973/Cr-1812-FEFU: 30 — pereopod I, part; 31 — pereopod IV, part; 32 — pleopod II. Scale bars 0.2 mm.

Рис. 26–32. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,8 мм, голотип 1/88502-ZINRAS: 26 — плеопод III, пунктирными кружками показаны ресничные эпибионты; 27 — плеопод IV; 28 — плеопод V; 29 — уропод. Самка 4,2 мм, паратип X44973/Cr-1812-FEFU: 30 — переопод I, часть; 31 — переопод IV, часть; 32 — плеопод II. Линейки 0,2 мм.

than wide, catch lobe well developed, with 3 plumose and 7 simple setae on medial and lateral margins, respectively; endopodite bottle-shaped, slightly longer than protopodite, 2.2 times as long as wide, distally with sparse finger-like (or ctenoid) cuticular scales, *basal spur* stout, elongated sub-triangular, biarticulated, its length about 27 % of endopodite length, *labial spur* short and coniform, lanose (or pubescent), *anterior lobe* completely reduced, *capitulum* well-developed but not helical, *squamiferous membrane* absent, *crypte* relatively long and opened, straight, lower edge lined with "soft limbus" with ctenoid (i.e., comb-like margined) cuticular scales, rigid *cannula* well-developed, distinct, projecting from well-developed roundish "collar" almost devoid of cuticular scales, not surpassing capitulum outline. *Pleopod III* (Fig. 26) exopodite subovoid, with almost rectilinear medial and rounded lateral margins, 1.5 times as long as wide, divided by

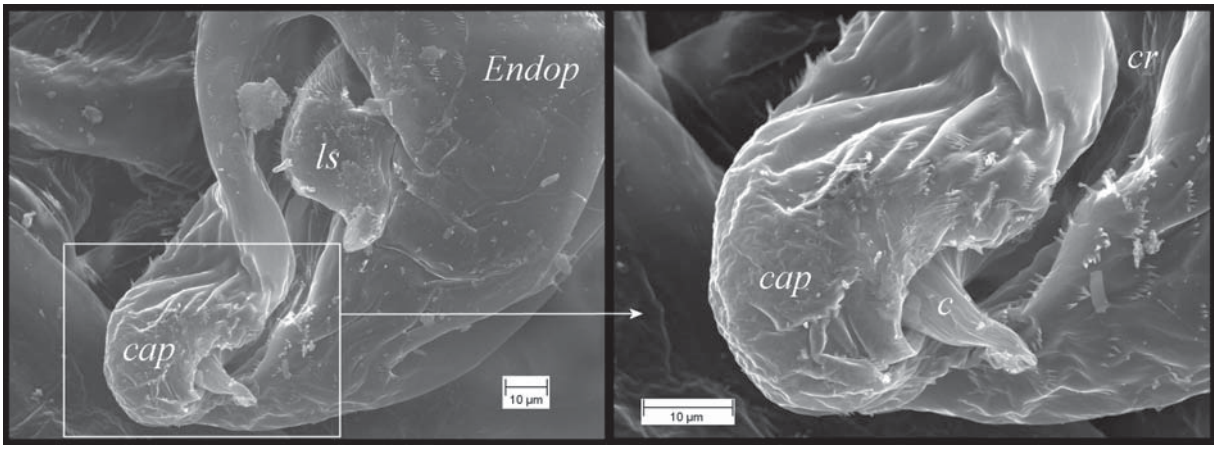


Fig. 38. *Asellus* (*A.*) *turanaicus* sp.n., male 5.0 mm: SEM photo of pleopod II endopod, ventral view. Abbreviations: *c* — cannula, *cap* — capitulum, *cr* — crypte, *Endop* — endopodite, *ls* — labial spur.

Рис. 38. *Asellus* (*A.*) *turanaicus* sp.n., самец 5,0 мм: СЭМ изображение эндоподита плеопода II, вид снизу. Обозначения: *c* — канюля, *cap* — головка, *cr* — крипта, *Endop* — эндоподит, *ls* — подвижный (цилиндрический) отросток.

oblique line into two parts, terminal and lateral margins fringed with numerous simple setae, 19 terminal setae plumose; endopodite length 70% of exopodite length. *Pleopod IV* (Fig. 27) exopodite sub-ovoid, 1.4 times as long as wide, lateral margin proximally with group of simple setae, *respiratory area* surface 50% of exopodite surface; endopodite length 80% of exopodite length. *Pleopod V* (Fig. 28) sub-similar to pleopod IV, exopodite *respiratory area* "intermediate" [*sensu* Prevorčnik et al., 2009], its surface 42% of exopodite surface, *linea area* beginning and ending at the transitions from internal/external to distal margin. *Uropod* (Figs 4, 29) vary in length, as long as pleotelson or little longer; protopodite length about 30–40% of uropod length; exopodite little shorter than endopodite.

SEXUAL DIMORPHISM. Females similar to male except: adult females somewhat smaller than adult males, *body* (Fig. 5) length 3 times of pereonite 7 width; head 1.7 times as wide as long. Pereonite 1 width 130% of head width; pereonites 3 and 4 widest; pereonites 5-7 sub-equal, shortest, their length about half of pereonite 3 length; pereonite 7 narrowest. Pleotelson sub-trapezoidal, its length 80% of its width and 27% of body length, as wide as pereonite 7. *Antennula* with 6–7 flagellar articles. *Antenna* with 31–34 flagellar articles. *Pereopod I* (Fig. 30) propodus oblong, 1.9 times as long as wide, palm convex, with 1 short stout seta and 5 short slender setae on superior margin and with row of slender longer setae on inferior margin, palmar apophysis absent; dactylus longer than palm with 4 strong denticles along inferior margin and 3–5 setae on superior margin, claw length 30% of dactylus length, with 1 basal simple seta. *Pereopod IV* (Fig. 31) non-prehensile; carpus length 70% of propodus length, propodus with 5–6 strong setae along superior margin; dactylus with 3 denticles and 1 setae along inferior margin, claw length 40% of dactylus length. *Pleopod II* (Fig. 32) ovoid, its length 140% of its width, with 3 short setae at proxomedial angle and 17 long plumose setae on terminal and lateral margins.

VARIABILITY. In male and female adults, insignificant variability in number of the antennular flagellar articles is observed, as well as in the shape and setation pattern of pleopod I exopodite and length of uropods. In males, basal spur of pleopod II endopodite varies from the elongated with a blunt apex to a rather truncate with a pointed apex.

In 5.0 mm long *intersex specimen* with minute female brood plates on pereonites 1-4, two pairs of anterior pleopods (Figs 35, 36) and genital papillae (Fig. 37) were found. Such intersexes were recorded before and Maercks [1931] and Needham [1941] both pointed out, that they are always females in *Asellus aquaticus*. However, their anterior pleopods, which are never completely male in form, corresponded to various stages in the normal development of the male organs. Pleopod I (Fig. 35) protopodite in our specimen has 2 coupling hooks on medial margin and no setae at distolateral angle. Its exopodite is slender, more ovoid, about 1.6 times as long as wide, with 9 long plumose setae on distal margin and 1 simple seta at proxomedial angle. Pleopod II (Fig. 36) protopodite is sub-trapezoidal, terminal article of exopodite has few setae, endopodite is stout, as long as protopodite, its length is 1.7 times its width, it has less cuticular scales on capitulum and short subtriangular basal spur. Labial spur is truncated.

TAXONOMIC AFFINITIES. Although the extremely short and coniform basal and labial spurs of male pleopod II endopodite, reduced anterior lobe and easily visible cannula might readily classify *A. turanaicus* sp.n. in the subgenus *Arctasellus* (with *A. latifrons*, *A. birsteini* and *A. alaskensis*), its cannula that is still inserted in the crypte, the lack of lateral head incisions and rather well developed and free coxopodites (Fig. 8) visible in dorsal view, place it within the subgenus *Asellus*.

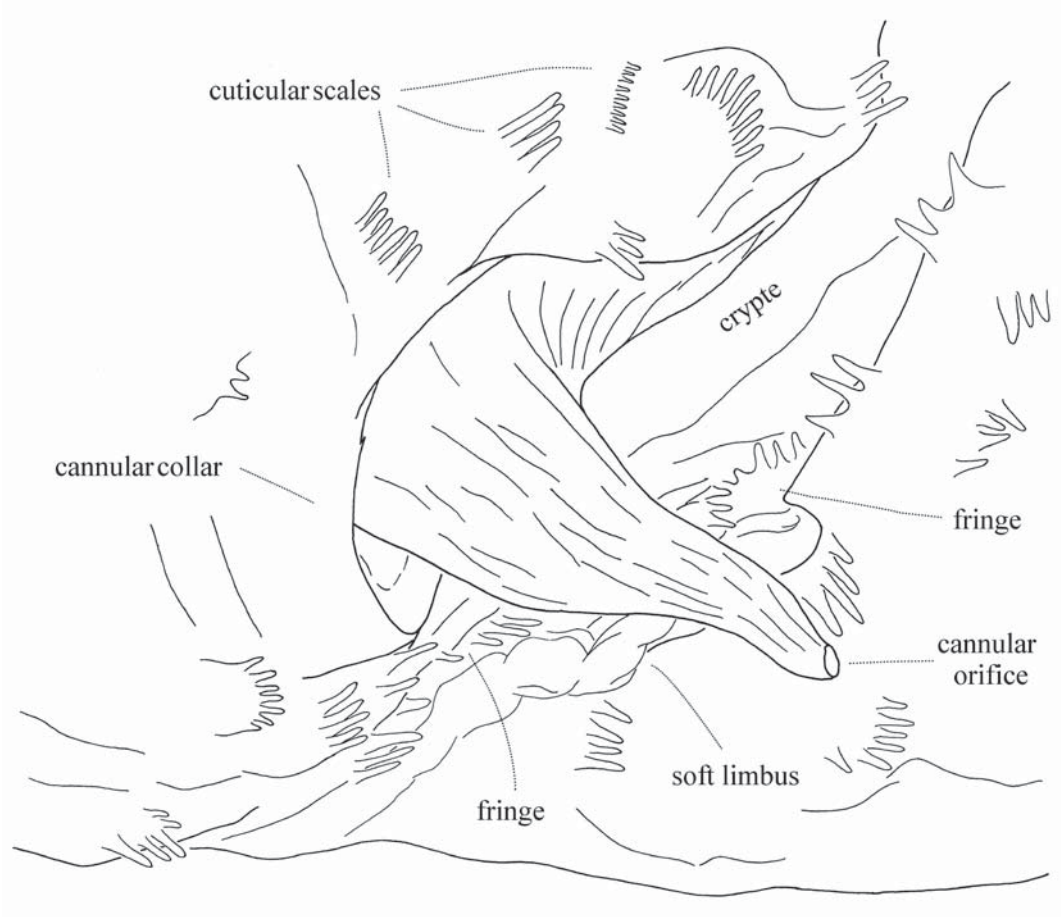


Fig. 39. A detailed morphological outline of male pleopod II endopod (capitular part) with designation of structures. *Asellus* (*A.*) *turanaicus* sp.n., male 5.0 mm, paratype X44973/Cr-1814-FEFU.

Рис. 39. Подробный морфологический эскиз эндоподита мужского плеопода II (головная часть) с обозначением структур. *Asellus* (*A.*) *turanaicus* sp.n., самец 5.0 мм, паратип X44973/Cr-1814-FEFU.

By the exposure of its cannula as well as the shape of the capitulum, *A. turanaicus* sp.n. fits best to epigean *A.* (*A.*) *levanidovorum* (southern part of the Russian Far East) and hypogean *A.* (*A.*) *primoryensis* (Primorye region). Yet, cannula of *A. levanidovorum* is so long that it is surpassing the outline of the short and obtuse capitulum (not surpassing the capitulum in *A. turanaicus* sp.n.), the species' head is prominently pigmented anteriorly and lighter posteriorly (more homogenous in *A. turanaicus* sp.n.) and body is more elongated (wider in *A. turanaicus* sp.n.). Subterranean *A.* (*A.*) *primoryensis* differs from the new species by its much shorter cannula, but primarily by the lack of body pigmentation and eyes.

In addition to the above mentioned *Arctasellus*-specific characters, *A. turanaicus* sp. nov. differs from all other members of the subgenus *Asellus* by the absence of the internal squamiferous membrane on the pleopod II endopodite, replaced by a seemingly smooth collar surrounding the cannula (see Figs 38, 39). The incongruence with the common "*Asellus* pattern" itemized by Henry and Magniez [1993, 1995] [see also Henry et al., 1994], suggests primitiveness of male pleopod II endopodite. Its plesiomorphic features are: (i) short and obtuse (not complexly helical) capitulum, (ii) distinct and projected cannula, (iii) parallel to longitudinal endopodite axis and (iv) "limiter" apparently homologous to the anterior lobe, limiting lower edge of the crypte by forming a small prominence. The unique lack of the squamiferous membrane, which is characteristic of both subgenera is hard to explain. In *A. turanaicus* sp. nov. only sparse cuticular scales on the distal part of endopodite and the similar ones on the "soft limbus" resemble the scales otherwise present on the membrane in the subgenus *Arctasellus*, as they are ctenoid. They apparently originate from bunches of cuticular microtrichs of different lengths, fused at their bases [see Mekhanikova, Takhteev, 2008]. An additional plesiomorphy of the new species is the absence of concavity on the lateral margin of male pleopod I exopodite [Birstein, 1951], characteristic for *Arctasellus* species, as well as all *Asellus* s.str. species from the Far East (i.e., *A. hilgendorfii* species complex, *A. epimeralis*, *A. levanidovorum*, *A. primoryensis* and all troglobiotic Japanese species).

DISTRIBUTION AND ECOLOGY. *Asellus* (*A.*) *turanaicus* sp.n. is an inhabitant of the swampy floodplains (Fig. 1) in the Amur Basin. Specimens were sampled from several small (approx. 5–20 m in diameter), 15–50 cm deep and richly vegetated ponds on the left terraced bank of the Burunda River, not far from its confluence with the Nora River. Ponds coalesced in a large waterlogged lands in some places, possibly representing permafrost lakes i.e. "taliki" or supra-permafrost taliks, as the water was cold (T = 3–5 °C). The species was rather frequent and numerous, found on decaying vegetation. Collected females had well developed brood plates; some were brooding 5–17 eggs in the marsupium, the others were carrying 3–8 mancas. All examined specimens were infested with ciliate epibionts (Fig. 26) [see Mayén-Estrada, Aladro-Lubel, 2007].

REMARKS. *Asellus* (*A.*) *levanidovorum* was found only about 5 km from *A.* (*A.*) *turanaicus* sp.n., but in quite different habitat, i.e. peat moss lake Berezovoe with summer thermal stratification. Water was warm (T = 17 °C) in its upper layer. Both sites are located in the region of discontinuous permafrost with maximum thickness of 100 m. To verify the possible relationship between the occurrence of other *Asellus* taxa and presence and thickness of permafrost in the Russian Far East, we compared the *Asellus* distribution map (Fig. 1) with an album of small-scaled maps of permafrost in Russia created by Pavlov and Malkova [2005] [see also Malkova et al., 2011]. Only the northeasternmost *Asellus* taxa: *A.* (*A.*) *h. tshaunensis*, *A.* (*Ar.*) *birsteini* and *A.* (*A.*) *h. beringianus*, were bound each to their particular permafrost region: a continuous permafrost with prevailing thickness of 300–500 m, 300–100 m and discontinuous permafrost with maximum thickness of 100 m, respectively. *Asellus* (*A.*) *levanidovorum* and *A.* (*A.*) *h. amuricus* were each inhabiting several (3–4) regions, from permafrost-free to discontinuous permafrost and from permafrost-free to continuous permafrost with prevailing thickness up to 300 m, respectively. Nevertheless, the range of the former species is much smaller, covering the geographic latitudes between 43–54 °N and latitudes between 130–146 °E, while the latter subspecies can be found in the waste area from 42–63 °N to 127–153 °E. *Asellus* (*A.*) *primoryensis* was found only in the permafrost-free area.

KEY TO THE SPECIES OF THE SUBGENUS *ASELLUS* FROM RUSSIA (MATURE MALES)

1. Coxopodites reduced and coalescent with sternites, not visible dorsally. Postmandibular lobes prominent, i.e. head with lateral incisions. ..... Subgenus *Arctasellus*
— Coxopodites free and mobile, visible dorsally. Postmandibular lobes subtle ..... Subgenus *Asellus* 2
2. Eyes and body pigmentation absent. .... *A. primoryensis* Henry et Magniez, 1993
— Eyes and body pigmentation present. 3
3. Pleopod I exopodite with distinct concavity on lateral margin. Head with two bright patches posteriorly, separated by darker median line. .... *A. aquaticus* Linnaeus, 1758
— Pleopod I exopodite without concavity on lateral margin. Head pigmentation another. 4
4. Pleotelson longer than wide. Coxopodites of all pereopods large and prominent dorsally. .... *A. epimeralis* Birstein, 1947
— Pleotelson no longer then wide. At least anterior four coxopodites small and inconspicuous dorsally. 5
5. All coxopodites inconspicuous. Pleopod II endopodite with short basal and labial spurs, prominent cannula not surpassing capitulum outline and without internal squamiferous membrane. Antennae longer than body. .... *A. turanaicus* sp.n.
— Coxopodites I-IV inconspicuous. Pleopod II endopodite with long basal and labial spurs, diverse cannula and with internal squamiferous membrane. Antennae shorter than body. 6
6. Pleopod II endopodite with prominent cannula surpassing capitulum outline. Anterior half of head distinctly darker than posterior, area around eyes light. .... *A. levanidovorum* Henry et Magniez, 1995
— Pleopod II endopodite with concealed short cannula. Head pigmentation less intense and more uniform. .... *A. hilgendorfii* Bovallius, 1886

ОПРЕДЕЛИТЕЛЬНАЯ ТАБЛИЦА ВИДОВ ПОДРОДА *ASELLUS* ИЗ РОССИИ (ДЛЯ ПОЛОВОЗРЕЛЫХ САМЦОВ)

1. Коксоподиты редуцированы и слиты со стернитами, не видны сверху. Постмандибулярные доли отчетливые, т.е. голова с боковыми выемками. .... Subgenus *Arctasellus*
— Коксоподиты свободные и подвижные, видны сверху. Постмандибулярные доли едва различимы. .... Subgenus *Asellus* 2
2. Пигментация глаз и тела отсутствует. ....*A. primoryensis* Henry et Magniez, 1993
— Пигментация глаз и тела присутствует. 3
3. Экзоподит плеопода I с отчетливой выемкой на наружном крае. Голова с двумя яркими пятнами сзади, разделенных темной линией по середине. .... *A. aquaticus* Linnaeus, 1758
— Экзоподит плеопода I без выемки на наружном крае. Пигментация головы другая. 4
4. Плеотельсон больше в длину, чем в ширину. Коксоподиты всех переоподов большие и заметны сверху. ..... *A. epimeralis* Birstein, 1947
— Плеотельсон не больше в длину. Первые четыре коксоподита маленькие и незаметны сверху. 5
5. Все коксоподиты не видны сверху. Эндоподит плеопода II с коротким базальным и подвижным отростками, выступающая канюля не пересекает край головки и внутренняя чешуйчатая мембрана отсутствует. Антена длиннее тела. ..... *A. turanaicus* sp. n.
— Коксоподиты I-IV не видны. Эндоподит плеопода II с длинным базальным и подвижным отростками, канюля различается по длине и внутренняя чешуйчатая мембрана развита. Антена короче тела. 6
6. Эндоподит плеопода II с выступающей канюлей пересекающей край головки. Передняя половина головы отчетливо темнее задней, область вокруг глаз светлее. ..... *A. levanidovorum* Henry et Magniez, 1995
— Эндоподит плеопода II со скрытой, короткой канюлей. Пигментация головы слабо интенсивная и более равномерная. ..... *A. hilgendorfii* Bovallius, 1886

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