Revision of the East Palaearctic genus *Isonychia* (Ephemeroptera: Isonychiidae)

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The Canadian Entomologist **136**: 1 – 41 (2004)

Abstract—The species of the genus *Isonychia* Eaton, 1871 (Isonychiidae) of East Palaearctic are revised. Two subgenera, *Isonychia* s.s. and *Prionoides* Kondratieff *et* Voshell, 1983, are represented in the Palaearctic. New species and subspecies of *Isonychia* s.s. are described: *I. sexpetala* **sp. nov.**, *I. ussurica sibirica* **subsp. nov.**, *I. concoloria* **sp. nov.**, *I. crassiuscula* **sp. nov.**, and *I. vshivkovae* **sp. nov.** with subspecies *I. vshivkovae vshivkovae* and *I. vshivkovae sinitshenkovae* **subsp. nov.** A new species group *japonica*, with three species (*I. crassiuscula*, *I. vshivkovae*, and *I. japonica*), is recognized on the basis of adult and larval characteristics. The name *Isonychia hainanensis* She *et* You, 1988 is synonymized with *Isonychia ignota* (Walker, 1853) **syn. nov.**

Tiunova TM, Kluge NJ, Ishiwata S. 2004. Révision taxonomique du genre *Isonychia* (Ephemeroptera : Isonychiidae) du Paléarctique oriental. *The Canadian Entomologist* **136** : 1–41.

Résumé—Les espèces du genre *Isonychia* Eaton, 1871 (Isonychiidae) du Paléarctique oriental sont révisées au niveau taxonomique. Elles sont séparées en deux sous-genres, *Isonychia* s.s. et *Prionoides* Kondratieff *et* Voshell, 1983. De nouvelles espèces et sous-espèces de *Isonychia* s.s. sont décrites : *I. sexpetala* **sp. nov.**, *I. ussurica sibirica* **subsp. nov.**, *I. concoloria* **sp. nov.**, *I. crassiuscula* **sp. nov.** et *I. vshivkovae* **sp. nov.** avec ses deux sous-espèces *I. vshivkovae vshivkovae* et *I. vshivkovae sinitshenkovae* **subsp. nov.** L'étude de caractères larvaux et adultes ont permis l'établissement d'un nouveau groupe d'espèces : le groupe *japonica*, comprenant trois représentants (*I. japonica, I. vshivkovae* et *I. crassiuscula*). Le nom *Isonychia hainanensis* She *et* You, 1988, est mis en synomymie avec *Isonychia ignota* (Walker, 1853) **syn. nov.**

[Traduit par la Rédaction]

Introduction

The family Isonychiidae includes a single genus, *Isonychia*. After an evaluation of the Nearctic species of the genus *Isonychia*, the genus *Isonychia* was divided to two subgenera: *Prionoides* Kondratieff *et* Voshell, 1983 and *Isonychia* Eaton, 1871 s.s.

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Nearctic representatives of the subgenus *Isonychia* were divided previously into four species groups: *sicca*, *bicolor*, *arida*, and *diversa* (Kondratieff and Voshell 1983, 1984). The group *diversa* is represented by a single, poorly known species for which a separate subgenus *Borisonychia* McCafferty, 1989 was established (McCafferty 1989).

The genus *Isonychia* is widely distributed in the Holarctic and Oriental regions. Until now, the genus *Isonychia* Eaton included 17 Nearctic species (Kondratieff and Voshell 1984), one trans-Palaearctic species (*I. ignota* Walker, 1853), one species from Iraq (*I. arabica* Al-Zubaidi *et al.*, 1987), one species from Pakistan (*I. khyberensis* Ali, 1970), six species from East Palaearctic (*I. ussurica* Bajkova, 1970; *I. japonica* (Ulmer, 1919); *I. valida* Navás, 1919; *I. shima* (Matsumura, 1931); *I. hainanensis* She *et* You, 1988, and *I. kiangsinensis* Hsu, 1936), and four species from the Oriental Region (*I. formosana* (Ulmer, 1912); *I. grandis* (Ulmer, 1913); *I. sumatrana* (Navás, 1933), and *I. winkleri* Ulmer, 1939). We add four new species (*I. sexpetala* **sp. nov.**, *I. crassiuscula* **sp. nov.**, *I. vshivkovae* **sp. nov.** (with two subspecies), *I. concoloria* **sp. nov.**) and a subspecies *(I. ussurica sibirica* **subsp. nov.**) from Siberia and the Russian Far East. The name *Isonychia mitsukonis* Morishita, reported by Morishita (1961) in her list without a description, is considered to be a *nomen nudum* (Ishiwata 2001*a*).

The Palaearctic species of *Isynychia* belong to two subgenera: *Isonychia* s.s. and *Prionoides*. The Palaearctic species of *Isonychia* s.s. do not belong to any of the Nearctic groups. Both the new Palaearctic species group *japonica* and the Nearctic group *bicolor* have dorsal flaps on the penis lobes, whereas the species group *japonica* differs by the absence of denticles on the distal margins of tergalii. The species group *japonica* includes three species: *I. japonica* in Japan, *I. crassiuscula*, and *I. vshivkovae* in Russian Far East and Siberia. The trans-Palaearctic species *I. ignota*, the East Palaearctic species *I. ussurica* and the new Far Eastern species *I. sexpetala*, each represents a species group. The new Far Eastern species *I. concoloria* is known as imagoes only, and thus its systematic position is not clear. The subgenus *Prionoides* is represented in Palaearctic by a single Japanese species, *I.* (*Prionoides*) *shima* (Matsumura, 1931).

Materials and methods

The specimens used in this study are preserved in 75%–90% ethanol, except for those collected by Matsumura (dry and on pins). Specimens examined were collected mainly by authors and obtained from the Zoological Institute of Russian Academy of Science (St. Petersburg) and the Department of Systematic Entomology, Faculty of Agriculture, Hokkaido University (Hokkaido). Fully developed eggs were obtained from preserved female mature nymphs, female subimagoes, or female imagoes. The processes used and the scanning electron micrographs were prepared by the methods of Ishiwata (1996). The names of thoracic areas and sutures are explained by Kluge (1994); additional terminology follows that of Kluge (2000).

Here the feminine term tergalia (plural tergaliae) or the neuter term tergalium (plural tergalia) is substituted by a masculine term tergalius (plural tergalii), to avoid confusion between the singular and the plural forms, which appeared in previous publications (Kluge 1989, 1996). Tergalii are paired appendages articulated to the posterior–lateral corners of an abdominal tergite (or points homologous to them, when segment structure is modified), and are moved by the lateral-most trunk muscles attached to a sternite. Abdominal tergalii are probably serial homologues of thoracic wings but are retained in Ephemeroptera larvae only. Tergalius is a morphological term reflecting homology; gill is a physiological term reflecting function. A tergalius may serve as a gill, and a gill may be a tergalius. In the genus *Isonychia*, particularly, each tergalius bears a gill (Fig. 58), and other gills are present on maxillae and legs (Fig. 90).

In the lists of material examined, following abbreviations are used.

L–S–I♂	Male imago reared from larva, with larval and subimaginal exuviae
L–S–I♀	Female imago reared from larva, with larval and subimaginal exuviae
L–S♂	Male subimago reared from larva, with larval exuviae
L–S♀	Female subimago reared from larva, with larval exuviae
S–I♂	Male imago reared from subimago, with subimaginal exuviae
S–I♀	Female imago reared from subimago, with subimaginal exuviae
I♂	Male imago
I♀	Female imago
S♂	Male subimago
S♀	Female subimago
L	Larva

The following acronyms represent the institutions from which material was either borrowed or where it is stored.

IBSS	Institute of Biology and Soil Science, Far Eastern Branch of Russian Academy of Sciences, Vladivostok, Russia
ZIN	Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia (part of this material is temporarily deposited in Department of Entomology, St. Petersburg University)
HU	Department of Systematic Entomology, Faculty of Agriculture, Hokkaido University, Hokkaido, Japan

Geographical names where possible are given according to *The Times Comprehensive Atlas of the World* (Times Books 2003).

Key to species of the genus *Isonychia* from Europe, Russia, Mongolia, and Japan

Male imagoes

1. Styliger between gonostyli pedestals only slightly shorter than gonostyli pedestals, broadly concave; penis dorsolaterally with a pair of projections, which are curved medially and bear sclerotized denticles (Figs. 96–97) (subgenus *Prionoides*) . . . . . *I.* (*P.*) *shima*
— Styliger between gonostyli pedestals strongly reduced, thus gonostyli pedestals deeply separated; penis lacks serration, with distal angles rounded (Figs. 3–5, 15, 25, 35–38, 42, 45–49, 53, 63–64, 66–69, 71, 77–83) (subgenus *Isonychia*) 2
2. 2nd segment of gonostylus in proximal part thickened, inner margin convex (Figs. 25, 37–38, 42) . . 3
— 2nd segment of gonostylus not thickened, inner margin straight or weakly concave (Figs. 3, 5, 15, 45, 53, 63, 71, 77, 81) 5
3. Processes between styliger and penis absent (Fig. 42) . . . . . *I. concoloria* **sp. nov.**
— Pair of membranous processes between penis and styliger present (Figs. 25, 35–37) (*I. ussurica*) 4
4. Forewing with transverse reddish or brownish band in apical half (Fig. 27) . . . . . *I. u. ussurica*
— Forewing without band (Fig. 39) . . . . . *I. u. sibirica* **subsp. nov.**
5. Membranous processes between styliger and penis present, penis without dorsal flaps (Figs. 3–5, 15) 6
— Membranous processes between styliger and penis absent, penis with a pair of dorsal flaps curved in proximal direction (Figs. 45–49, 53, 63–69, 71, 77–82) (group *japonica*) 7
6. Tarsal segments of foreleg nearly entirely brown (Fig. 7) . . . . . *I. ignota*
— Tarsal segments of foreleg dark brown in distal half and whitish or brownish in basal half (Fig. 14) . . . . . *I. sexpetala* **sp. nov.**

7. Penis relatively long (Figs. 63, 64, 66, 68, 69, 71) (*I. vshivkovae* **sp. nov.**) 8
— Penis relatively short (Figs. 45, 46, 48, 49, 51–53, 77–79, 82, 82) 9
8. Forewing with transverse reddish or brownish band in apical half (Fig. 65) . . . . . *I. v. vshivkovae* **subsp. nov.**
— Forewing without band . . . . . *I. v. sinitshenkovae* **subsp. nov.**
9. Pedestals of gonostyli relatively long (Figs. 77, 80, 81) . . . . . *I. japonica*
— Pedestals of gonostyli relatively short (Figs. 45–47, 53) . . . . . *I. crassiuscula* **sp. nov.**

Female imagoes and eggs

1. Subanal plate with a shallow posteromedian emargination (Fig. 98); eggs biconvex (Figs. 123–125) (subgenus *Prionoides*) . . . . . *I.* (*P.*) *shima*
— Subanal plate with deep posteromedian emargination (Figs. 8, 16, 28, 55, 70, 88); eggs spherical (Figs. 101–122) (subgenus *Isonychia*) 2
2. Knob-terminated coiled threads (KCT) densely cover entire egg (Figs. 108, 120) . . . . . *I. crassiuscula* **sp. nov.** and *I. vshivkovae* **sp. nov.**
— KCT densely cover a part of egg (Figs. 101, 102, 105, 111, 112, 115–117) 3
3. KCT densely packed on two hemispheres (Fig. 112) . . . . . *I. ussurica*
— KCT densely packed on one hemisphere (Figs. 101, 102, 105, 15–117) 4
4. Chorion without reticulation (Figs. 103, 104) . . . . . *I. ignota*
— Chorion with reticulation (Figs. 107, 118, 119) . . . . . *I. sexpetala* **sp. nov.** and *I. japonica*

Mature larvae

1. Forecoxal gill a single nonbranched filament (Fig. 99) (subgenus *Prionoides*) . . . . . *I.* (*P.*) *shima*
— Forecoxal gill a tuft of multibranched filaments (Fig. 90) (subgenus *Isonychia*) 2
2. Apical margins of tergalii of all pairs without spines (Fig. 58); abdominal tergum 10 mostly dark, with a pair of light spots close to anterior margin (Figs. 56, 72, 89) . . . . . group *japonica*
— Apical margins of tergalii (at least of posterior pairs) with spines (Fig. 34); abdominal tergum 10 light in anterior half, dark only in posterior half (Figs. 9, 22, 32) 3
3. Abdominal terga with transverse light spots (Fig. 32) . . . . . *I. ussurica*
— Abdominal terga with median longitudinal stripe, without transverse light spots (Figs. 9, 22) 4
4. Femora of middle and hind legs with longitudinal stripe; hind leg with tibia + tarsus slightly longer than femur (Fig. 11) . . . . . *I. ignota*
— Femora of middle and hind legs with two dark transverse bands; hind leg with tibia + tarsus slightly shorter than femur (Figs. 18, 19) . . . . . *I. sexpetala* **sp. nov.**

Genus *Isonychia* Eaton, 1871

Isonychia Eaton, 1871: 33 (type species: *Isonychia manca* Eaton, 1871; by original designation).
Chirotonetes Eaton, 1881: 21 (type species: *I. manca* Eaton, 1871; by direct substitution).
Jolia Eaton, 1881: 192 (type species: *Palingenia roeselli* Joly, 1870; by original designation).
Eatonia Ali, 1970: 121 (type species: *Eatonia khyberensis* Ali, 1970; by monotypy).
Oldest family-group name: Isonychiinae Burks, 1953: 108.

Description

Imago and subimago. Head: elongate. Eyes black or grey; in male always large, contiguous, or nearly contiguous on meson. **Thorax:** structure uniform in all species

(Kluge 1994, 1998). Mesonotal suture (MNs) transverse, located in anterior part of mesonotum, not terminating to medioparapsidal sutures (MPs); MPs not terminating to lateroparapsidal sutures (LPs) (Figs. 87, 91, 92); prosternum with transverse crest between basisternum (BS_1) and fuscasternum (FS_1); basisternum of mesothorax (BS_2) posteriorly narrowed and protuberant; fuscasternal protuberances of mesothorax (FS_2) contiguous over their entire length; remnants of gills present at sides of vestigial maxillae and bases of forecoxae (Figs. 86, 94, 95). In subimago, lateral pigmented area of mesonotum occupies entire sub-medioscutum up to medioparapsidal suture (Kluge 1994, Fig. 14). In cubital field of forewing branched veins go from CuA to posterior margin (Fig. 84). On hind-wing furcation of MP moved to distal part of wing and situated more distally than furcation of MA (Fig. 85) (only in selected specimens of *I. formosus* it can be more proximally). In some species, male imagoes (but never females) have the apical part of forewing shaded with brown or reddish or there is a brown or reddish transverse band occupying pterostigma andarea behind it. Such coloration is present in selected subspecies of nonrelated species (*I. u. ussurica* (Fig. 27), *I. v. vshivkovae* **subsp. nov.** (Fig. 65), and the Nearctic species *I. tusculanensis* Berner, 1948 from the group *bicolor*); the same area can be coloured in *I. grandis* Ulmer, 1913. Foreleg: in male and female imagoes and subimagoes foretibia 1.5 times longer than femur; in male imago tarsus 1.1–1.3 times longer than tibia; in subimago and female tarsus shorter than foretibia; in male and female imago and subimago first tarsal segment equal or slightly longer than second segment, segments become shorter from 1st to 4th; in male imago (but not subimago) both claws similar, blunt, and provided with a soft plate. On all legs of imago and subimago except for forelegs of male imago, two claws are similar and pointed (nonunique apomorphy in contrast to many other mayflies that have dissimilar ephemeropteroid claws). Forelegs entirely or partly dark brown (Figs. 7, 14, 26, 43, 54); middle and hind legs in most of species (including all Palaearctic species) light, usually whitish or yellowish, only tips of tarsi can be slightly shaded. **Abdomen:** lateral portions of styliger, which include muscles of gonostyli, form a pair of prominent gonostyli pedestals; ventral side of each gonostylus pedestal has an arched proximal–lateral groove, which serves as place of attachment for gonostylus muscle (Figs. 37, 38). Median part of styliger represents a thin plate (strongly reduced in subgenus *Isonychia* (Figs. 35–37) and developed in *Prionoides* (Fig. 96)), its lateral parts reach apices of gonostyli pedestals mediad of gonostyli articulations, where they sometimes form prominent ventral–apical–median angles (Fig. 38). Gonostylus with segment 1 extremely short, segment 2 longest, segments 3 and 4 well developed. Penis lobes deeply separated or connected medially by soft colourless membrane. Paracercus rudimentary (Fig. 35).

Larva. Head: frons between antennae bases forms a carina — light projection of unique form, which narrows toward clypeus and terminates by an edge flattened from sides and hanging over clypeus (Kluge 1997, Fig. 13:4). Mouthparts have uniform structure in all species. Outer surface of labrum beside slender long pointed setae bears more stout long stick-shaped setae with truncate apices (Fig. 57). Maxilla (Fig. 21) with 2 canines (plesiomorphic condition is considered to be 3 canines for Ephemeroptera); between 2 dentiseta (characteristic for Bidentiseta), proximal dentiseta well developed, spinelike, as long as setae of median rows; distal dentiseta strongly diminished or absent (Kluge 1998, Fig. 17). Maxillary palp 2-segmented (as in other Eusetisura, Kluge 1998), with segment 1 twice as short as segment 2 (Fig. 21). **Thorax:** basisternum of mesothorax posteriorly with a bifurcate projection directed posteriorly; basisternum of metathorax with a pair of projections directed posteriorly; these projections are distinctly developed in larva, being smaller or nonexpressed in imago (Fig. 86). Forelegs (specialized as filtering, as in other Eusetisura) with unique features: apex of tibia on its

inner side with a long jointed spinelike appendage; in addition to the filtering setae of femur and tibia, there are 2 longitudinal rows of smaller filtering setae on inner side of tarsus (Figs. 90, 99). Joining of forecoxa with thorax bears a gill; this has a form of either a tuft (Fig. 90) or a filament (in many *Prionoides*, Fig. 99). Each leg has following cuticular pigmentation: femur with two transverse dark bands, tibia with one transverse dark band in middle, tarsus with one transverse dark band in proximal part; in some species both bands of femur are separated by light area (Figs. 18, 19), in others are connected by dark stripe (Fig. 11); sometimes other parts of leg are also darkened, sometimes dark bands absent, and cuticle of legs is colourless. **Abdomen:** tergalii (Figs. 34, 58) of all I–VII pairs present, each with well developed ventral fibrillose gill portion (typical for Branchitergalii). Anal rib (one or two ribs initially present on tergalii of Ephemeroptera) bifurcates near base, its anterior branch goes near middle of tergalius up to apex and posterior branch goes by anal margin of tergalius; thus there are three ribs (including well-developed costal rib on costal margin). Margin of tergalius in apical part of costal rib and apical part of posterior branch of anal rib bears denticles. In some species smaller denticles are present also on apical margin of tergalius between these two areas (Fig. 34) (being absent in *Prionoides* and group *japonica*, Fig. 58). Some species have a dark spot near apex of anterior branch of anal rib (Fig. 58). Structure of caudalii (cerci and paracercus) similar in all species (Figs. 89, 100), coloration varies individually. Cercus distinctly shorter than abdomen, about a half of body length; proximal 3/4 or 2/3 of cercus has oblique segments bearing long dense primary swimming setae on inner side. Distal 1/4 or 1/3 of cercus formsa bare tail consisting of narrow cylindrical segments without swimming setae. Paracercus about 3/4 or 2/3 of cerci length, with swimming setae entire length, lacking bare tail. Usually proximal half of cerci and corresponding area of paracercus are dark; near middle of cerci and corresponding zone of paracercus this dark area terminates by a darker band; behind this band lies a light area, which on cercus reaches base of bare tail, and on paracercus reaches apex; bare tail of cercus can be dark (contrasting to light area) or light. In selected specimens of some species, cerci and paracercus entirely light or entirely dark.

Subgenus *Isonychia* Eaton, 1871

Description

Male imago. Styliger between gonostyli pedestals strongly reduced, thus gonostyli pedestals deeply separated (Figs. 35–38). Penis lacks serration and projections. In all Palaearctic (but not in all Nearctic) species foreleg with trochanter, femur, and tibia dark brown, tarsus either dark brown (Fig. 7) or proximal half of each tarsal segment light (Figs. 14, 26, 43, 54).

Female imago. Subanal plate (projection of abdominal sternum IX) with moderate to deep posteromedian emargination (Figs. 8, 16, 28, 55, 70, 88).

Egg. Spherical. Knob-terminated coiled threads (KCT) with one of following arrangements: (1) packed on one hemisphere and scattered over most of chorion (Figs. 101–102, 105, 115–117), (2) packed on two hemispheres and scattered over most of chorion (Figs. 111–112), (3) densely covering entire egg (Figs. 108, 120).

Larva. Forecoxal gills always with a form of tuft of multibranched filaments (Fig. 90).

Isonychia (*Isonychia*) *ignota* (Walker, 1853)

(Figs. 1–11, 101–104)

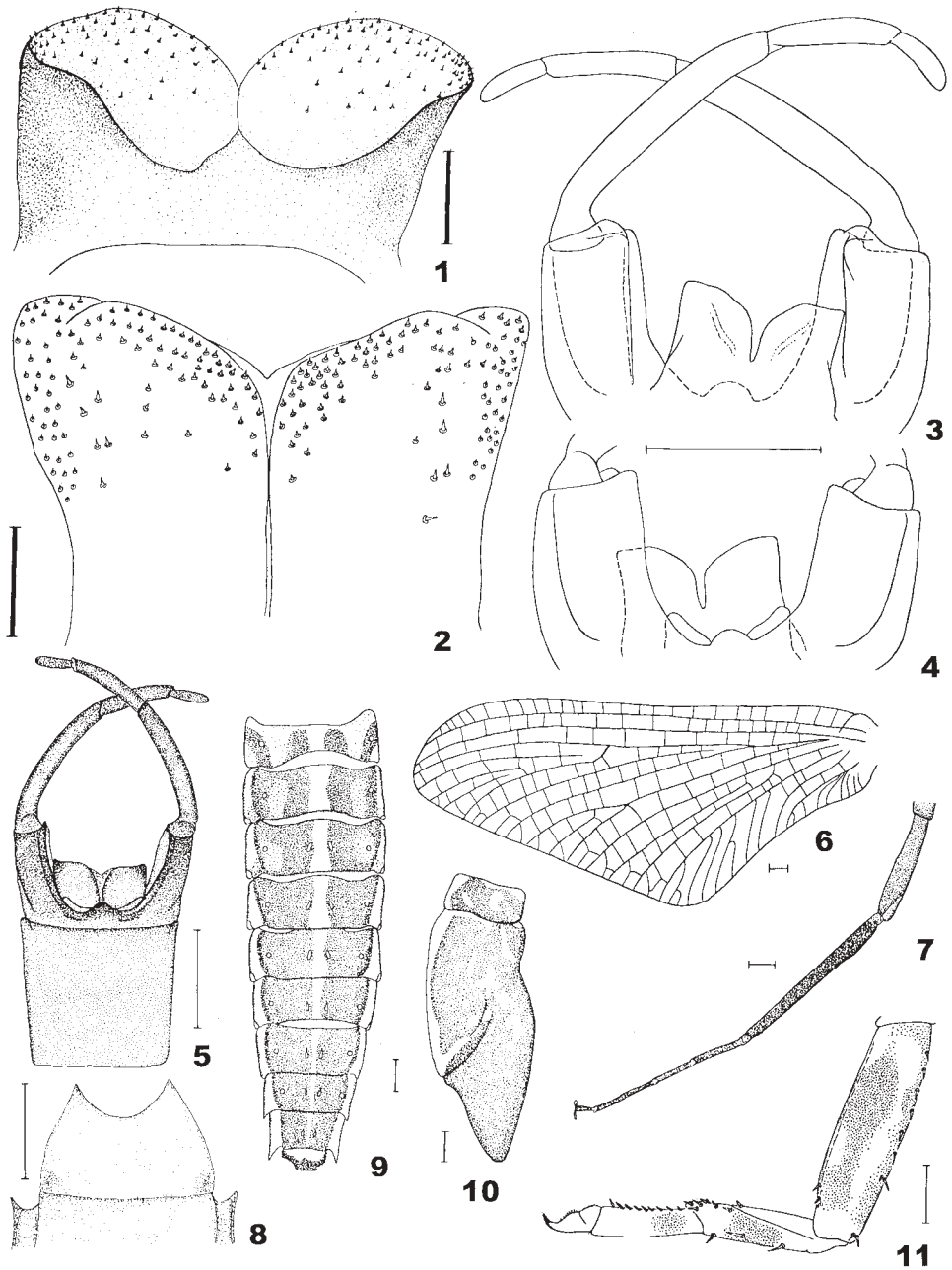
Baetis ignotus Walker, 1853: 571 (type locality: unknown, probably western Europe; holotype in Natural History Museum, London; figured by Kimmins, 1960: 275).
Isonychia ignota: Eaton, 1871: 29.
Chirotonetes ignotus: Eaton, 1885: 205.
Palingenia roeselii Joly, 1872: 67.
Jolia roeselii: Eaton, 1881: 192.
Isonychia ferruginea Albarda, 1878: 128; synonymized by Eaton, 1883–1888: 205.
Isonychia hainanensis She *et* You, 1988: 29, **syn. nov.**

Material examined

LITHUANIA. Neris River, near Nemenchine, 7.vii.1957, R Kazlauskas, 5 L (ZIN); Neris River, near Vilnius, 14–29.vi.1988, N Kluge, 6 L (ZIN). **MONGOLIA.** Haraa-Gol River, near Darhan, 12–13.viii.1997, N Kluge, 1 L–S–I♂, 1 L–S–I♀, 1 L–S♂, 1 L–S♀, 2 I♂, 5 L (ZIN); Tuul-Gol (= Tola) River, 40 km lower Lun, 10.ix.1997, N Kluge, 1 L–S♂ (ZIN). **RUSSIA. Bashkortostan:** Belaya River, near Ohlebinino, below Ufa, 18.viii.1989, N Kluge, 1 L–S–I♂ (ZIN). **Buryatia:** Uda River, lower Kurba River, 19–26.viii.1987, A Rasnitsyn, 2 I♂, 1 I♀ (ZIN); Selenga River, near Naushki, 3.viii.1997, N Kluge, 6I ♂, 1 I♀ (ZIN). **Khabarovskiy Kray:** Amur River, Slavyanka, lower Troitskoe (Field Station of Institute of Water and Ecological Problems, Khabarovsk), 9–17.vii.1984, N Kluge, 5 L–S–I♂, 5 L–S–I♀, 4 L–S♂, 3 L–S♀, 44 L (ZIN); Amur Channel (mouth of Ussuri River), near Bychiha, 21.viii.1984, N Kluge, at light, ♂♂ and ♀♀ (ZIN); Sarapul'skoe, 27.vii.1996, T Tiunova, at light, 1 I♂ (IBSS); same place, 11.vii.2000, T Tiunova, 75 I♂, 35 I♀ (IBSS).

Description

Male imago. Dimensions: forewing and body 10–13 mm, cerci 19–30 mm. **Head:** eyes black or grey, sometimes with reddish tinge. **Thorax:** thorax brown, with yellowish. Femur, trochanter, tibia and tarsal segments of foreleg dark brown, joinings lighter (Fig. 7); sometimes femur and tarsal segments lighter than tibia. Trochanter, femur, tibia, and tarsus of middle and hind legs yellow. Reared specimen from Bashkortostan with forewing length 13 mm with following length (mm) of leg segments. Foreleg: femur 2.2; tibia 3.5; tarsal segments 0.9, 0.9, 0.7, 0.6, 0.4. Middle leg: femur 2.2, tibia 2.5, tarsus 1.7. Hind leg: femur 2.2, tibia 1.9, tarsus 1.3. Wings hyaline, all veins yellowish brown; pterostigma whitish (Fig. 6). **Abdomen:** terga brownish, with dark lateral parts; terga 1–9 with dark brown band on posterior margins; terga 2–9 with a pair of dark submedian longitudinal oblique strips, which can be indistinct. Sterna brownish or yellowish; sterna 2–9 with a pair of small dark brown elongate anterolateral dots and with a pair of dark submedian longitudinal oblique strips; sterna 2–5 with four or two dots situated in transverse line behind these strips. Gonostyli pedestals, gonostyli, and penis brown or yellowish. Ventral posterior margin of styliger on apex of each gonostylus pedestal forms a ventral–inner–apical projection stretched distad of gonostylus articulation. Gonostylus without thickening (in contrast to *I. ussurica* and *I. concoloria*). Between penis and styliger a pair of membranous processes are narrowed and divergent distally (Figs. 4, 5) (these processes were not shown or mentioned in former descriptions). Penis short, reaches middle of gonostyli pedestals; median and distal margins of penis of subequal length; lateral margins in distal half smoothly concave (Figs. 3–5). Ventrally penis bears a broad row of short stout spines



FIGURES 1–11. ***Isonychia ignota*****. 1–7, male imago: 1, dorsal surface of penis; 2, ventral surface of penis; 3, genitals (dorsal view); 4, the same (ventral view); 5, the same (ventral view, in natural position); 6, forewing; 7, foreleg. 8, female imago: subanal plate (ventral view). 9–11, larva: 9, abdominal terga; 10, right half of pro- and meso-notum; 11, left hind leg. Scale bars: thin, 0.5 mm; thick, 0.1 mm.**

along distal margin, thin spines on anterolateral corners and margins, and a group of sublateral long stout spines in distal half (Fig. 2). Cerci white, with dark brown base.

Female imago. Dimensions: forewing and body 12–14 mm, cerci 17–20 mm. **Head:** head between eyes light, sometimes with brownish longitudinal median stripe or a pair of stripes; anterolaterally between lateral ocelli and eyes a pair of more or less expressed brown spots; posterolateral angles with or without dark spots. **Thorax:** thorax from yellowish to brown, sterna darker. Foreleg with femur and tibia brown, tarsus light, apex of each segment brown. Middle and hind legs white, last tarsal segment brownish. Wings hyaline, all veins yellow to yellowish brown; pterostigma whitish. **Abdomen:** terga light brown; terga 1–9 with a dark brown band on posterior margin and with a pair of more or less expressed dark brown spots on posterolateral angles. Sterna lighter, with dark markings as in male. Cerci as in male.

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brownish. **Thorax:** colour of mesonotum typical for the genus *Isonychia* (see above). Foreleg with femur light brown, tibia and tarsus entirely brown. Middle and hind legs brownish or light, with last tarsal segment brown. Wings light grey, with crossveins bordered by brown. **Abdomen:** terga light brownish; sterna light brownish or colourless. Cerci brownish.

Mature larva. Head: cuticular pigmentation: clypeus light medially, dark laterally and sometimes anteriorly; frontal carina light; most part of frons behind median ocellus dark; epicranium usually with light median stripe, which can be bordered by brown stripes; antennae brownish to whitish. **Thorax:** cuticular pigmentation: pronotum and mesonotum usually dark brown, with median longitudinal light stripe (Fig. 10); on each femur two dark bands connected, thus femur dark, with light base and apex and with longitudinal light stripe expanded at middle part; patella usually light; tibia andtarsus light, each can have wide dark band in middle (Fig. 11). Reared specimen from Bashkortostan with forewing length 13 mm with following lengths (mm) of larval leg segments: foreleg 1.7, 2.0, 1.0; middle leg 1.8, 1.5, 0.9: hind leg 2.0, 1.2, 0.9. In hind leg of various specimens femur/tibia ratio 1.6–2.0, femur/(tibia + tarsus) ratio 0.9–1.0, *i.e.*, tibia + tarsus not shorter than femur (in contrast to other Palaearctic species). Ventral cleft of hind femur usually with 4 (from 2 to 6) spines. **Abdomen:** cuticular pigmentation: terga dark brown or brown with light median longitudinal stripe (Fig. 9), which can be parallel sided or widened at posterior margin of each segment, widened in middle of each segment, narrowed toward posterior part of abdomen, interrupted, or represented by a light spot on anterior margin of each segment or nearly completely absent; sometimes a pair of submedian light stripes or spots lateral to this stripe; terga 1–9 usually with a pair of small light lateral spots; tergum 10 dark posteriorly and light anteriorly; sternum 1 light; sterna 2–9 with light lateral margins and narrow blackish strip in each side; sterna 2–5 with a pair of subapical oblique dark stripes and four or two dots; sterna 6–9 with a pair of oblique dark stripes only. Each tergalius with small denticles on apical margin (besides larger denticles on apical parts of costal and anal ribs) (as in Fig. 34); tufts of filaments black in middle part and white in basal and distal part, thick, reaching middle part of tergalius. Bare tail of cercus light or slightly darkened.

Egg. Spherical; chorion covered with tubercles, without reticulation; knob-terminated coiled threads (KCT) dense in one hemisphere and absent in other hemisphere (Figs. 101–104).

Distribution and biology

This is the only trans-Palaearctic species of the genus *Isonychia*, distributed from Western Europe to Far East, and the only European species. Comparison of reared specimens from southern Urals (Bashkortostan), Transbaikalia (Buryatia and Mongolia), and the Far East (Khabarovskiy Kray) shows that they are conspecific. Larvae inhabit plain rivers; in Siberia and Russian Far East these larvae occupy lower parts of rivers of which upper parts are occupied by *I. u. sibirica* (in Siberia and Mongolia) or other species (in the Far East).

Discussion

Male imago of *I. ignota* can be distinguished from all other East Palaearctic species by nearly completely dark foretarsi (whereas in other species proximal halves of segments are contrastly light) and by distinct dark submedian maculae on abdominal sterna. Larvae of *I. ignota* differ from all other species by less shortened tibia and tarsus on hind leg.

Isonychia hainanensis was described from southern China as imagoes only (She and You 1988). As in *I. ignota*, gonostyli pedestals are long, with pointed ventral–inner–apical corner; ventral basal processes of penis are present; foretarsi are dark. No difference was found between specimens of *I. hainanensis* and *I. ignota*, therefore, we regard these names as synonyms.

Isonychia (*Isonychia*) *sexpetala* sp. nov.

(Figs. 12–22, 105–107)

Material examined

Holotype. RUSSIA. Primorskiy Kray: Ussuri River, near Vladykin Island, 2.viii.1992, T Tiunova, L–S–I♂ (IBSS).

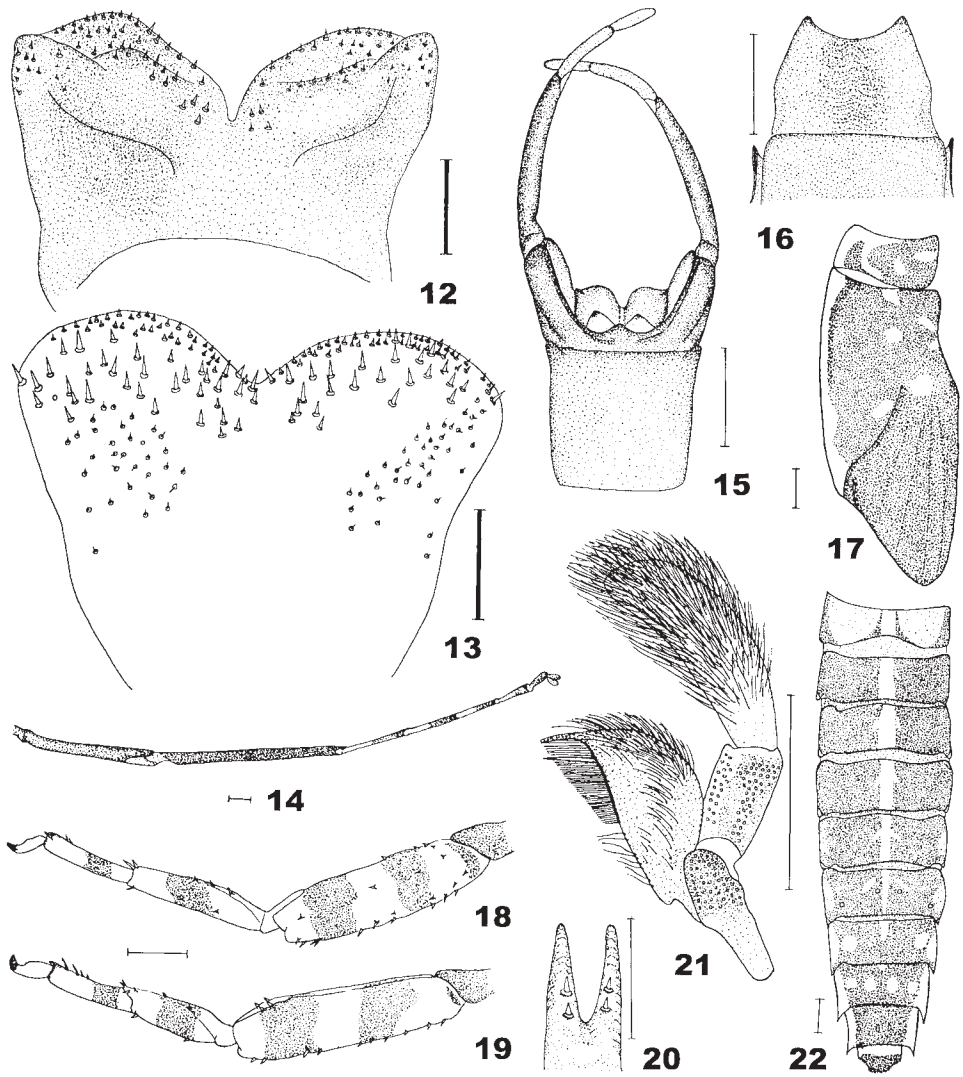
Paratypes. RUSSIA. Primorskiy Kray: Ussuri River, near Vladykin Island, 5.viii.1994, T Tiunova, 1 L–S–I♂ (IBSS); same place, at light, 2 I♂ (IBSS); near Utyos Mountain, 19.vii.1991, T Tiunova, 1 L (IBSS); 1 km lower Utyos Mountain, 4.viii.1994, T Tiunova, 2 I♂, 2 I♀, 2 L (IBSS); 2 km below Stepanovka, 21.ix.1991, T Tiunova, 1 L (IBSS); near Stepanovka, 20.vii.1991, T Tiunova, 3 L (IBSS); Gorniye Klyuchi, 18.vii.1996, T Tiunova, 9 I♂, 2 I♀, 1 L–S♂, 15 L (IBSS). Ussuri River Basin, Kabarga River, 6 km below mouth, 28–30.vii.1998, T Tiunova, 1 I♂ (at light), 1 L–S–I♂, 1 L–S♀, 4 L (IBSS); same place, 14.vii.2000, T Tiunova, at light, 2 I♂ (IBSS); Rasdol'naya River, Pokrovka, 6.ix.1991, T Vshivkova, at light, 4 I♂, 5 I♀, 1 L (IBSS). **CHINA.** Songhua Jiang (= Sungari) River, N Meshkova, 1 L (ZIN).

Etymology

The epithet *sexpetala* (meaning six petalled) is connected with egg chorion sculpture (Fig. 107).

Description

Male imago. Dimensions: forewing and body 10–12 mm, cerci 19–27 mm. **Head:** eyes black tinged with grey. **Thorax:** thorax dark brown. Femur of foreleg dark brown, lighter basally; tibiae dark brown to dark; basal half of tarsal segments white, distal half brown; last tarsal segment brown (Fig. 14). General colour of middle and hind legs white; femur and tibia tinged with yellowish; tarsi tinged with brownish.



FIGURES 12–22. ***Isonychia sexpetala.*** **12–15, male imago: 12, dorsal surface of penis; 13, ventral surface of penis; 14, foreleg; 15, genitals (ventral view). 16, female imago: subanal plate (ventral view). 17–22, larva: 17, right half of pro- and meso-notum; 18, left middle leg; 19, left hind legs; 20, ventral cleft of hind femur (ventral view); 21, right maxilla; 22, abdominal terga. Scale bars: thin, 0.5 mm; thick, 0.1 mm.**

Length (mm) of segments in forelegs: femora 2.0–2.2; tibia 2.9–3.2; tarsal segments 0.9–1.1, 0.8–0.9, 0.7–0.8, 0.5–0.6, 0.2–0.3. Wings hyaline, with all veins yellowish brown; pterostigma whitish tinged with brownish. **Abdomen:** terga dark reddish brown; terga 1–9 with dark band on posterior margins; terga 2–7 or 2–8 with a pair of submedian oval black spots in middle part. Sterna 1–9 light brown tinged with reddish; sterna 3–5 with a pair of long light spots in middle part. Gonostyli pedestals and penis light brown; first and second gonostylus segments dark brown and well contrasted with light penis; third segment light brown; last segment white or light brownish. Gonostylus without thickening (in contrast to *I. ussurica* and *I. concoloria*). Between penis and styliger a pair of triangular membranous processes; with apices reddish brown to purplish (Fig. 15). Penis short, reaching to middle part of gonostyli pedestals; distal margin of penis wider than median one; anterolateral corners of penis lobes rounded. A narrow row of short stout spines is present along distal margin of each penis lobe; proximally to it, a broad row of long stout spines; lateral margins in distal part with groups of thin spines (Fig. 13). Cerci light yellow to whitish, base brown.

Female imago. Dimensions: forewing and body 10–13 mm, cerci 18–23 mm. **Head:** yellowish to brownish. **Thorax:** pronotum light brown, anterior and lateral margins brown; meso- and meta-notum yellowish brown; prosternum brown; meso- and meta-sternum light brown. Femur and tibia of foreleg brown with reddish tinge, joint yellowish; tarsi yellowish, joints of tarsal segments tinged with brown. Middle and hind legs white. Wings hyaline, all veins yellow to yellowish brown; pterostigma whitish. **Abdomen:** terga light brown with reddish tinge; terga 1–9 with black bands on posterior margins; terga 2–5 with a pair of small dark spots in middle part. Sterna light brown. Cerci white with reddish-brown base.

Mature larva. Dimensions: body 11–13 mm, cerci 6–8 mm. **Head:** cuticular pigmentation: clypeus entirely dark brown; frontal carina light, frons behind median ocellus dark; epicranium with light median longitudinal stripe; labrum with whitish lateral margins; mandibles dark brown with light brown or whitish area near incisors; segment 1 of maxillary palp and base of segment 2 light, segment 2 brown. **Thorax:** cuticular pigmentation: nota dark brown, with light median longitudinal stripe; pronotum with two pairs of submedian semilunar marks and small long light spots or streaks near lateral margins; mesonotum with a big light spot in base of wings pads, two round light spots in medioanterior area and a pair of light streaks near lateral margin (Fig. 17); on each leg femur light, with two wide transverse brown bands; tibia and tarsus each with transverse brown band in middle (Figs. 18, 19). Most often length (mm) of segments: foreleg 1.6, 1.7, 0.8; middle leg 1.8, 1.2, 0.8; hind leg 2.0, 1.0, 0.8. Ventral cleft of hind femur usually with 5 (from 4 to 6) spines (Fig. 20). **Abdomen:** cuticular pigmentation: terga brown; terga 1–7 with light median longitudinal stripe sharply narrowing posteriorly and reaching middle part of tergum 7; tergum 1 light with brown lateral margins; terga 2–9 with a pair of submedian droplike light spots and a pair of round light spots in middle part of lateral margins; lateral margins of terga 5–9 light; tergum 10 light anteriorly, dark brown posteriorly (Fig. 22); sterna brown; sterna 2–9 with a pair of round darker spots near anterolateral corners; sterna 4–9 with a pair of small light streaks and two or four spots in the middle part. Each tergalius with small denticles on apical parts of costal and anal ribs (as in Fig. 34); tufts of filaments not thick, reaching middle part of tergalius. Bare tail of cercus dark brown or dark with light tip.

Egg. Spherical; chorion covered with reticulation; knob-terminated coiled threads (KCT) dense in one hemisphere and scattered over most of egg (Figs. 105–107).

Distribution and biology

South of Russian Far East and northeast of China. Larvae of this species are found in gravel and pebble in the middle part of the Ussuri River, which can be characterized as a metarhithral.

Discussion

Isonychia sexpetala is similar to *I. ignota*; however, male imago can be distinguished from that of *I. ignota* by the structure of penis (Figs. 12–15) and the lighter tarsal segments (Fig. 14). Larva of *I. sexpetala* differs from that of *I. ignota* by presence of two separated dark transverse bands on middle and hind legs (Figs. 18, 19); in contrast to *I. ignota* on hind leg tibia + tarsus is slightly shorter than femur.

Isonychia (*Isonychia*) *ussurica* Bajkova, 1970

(Figs. 23–39, 111–114)

Material examined

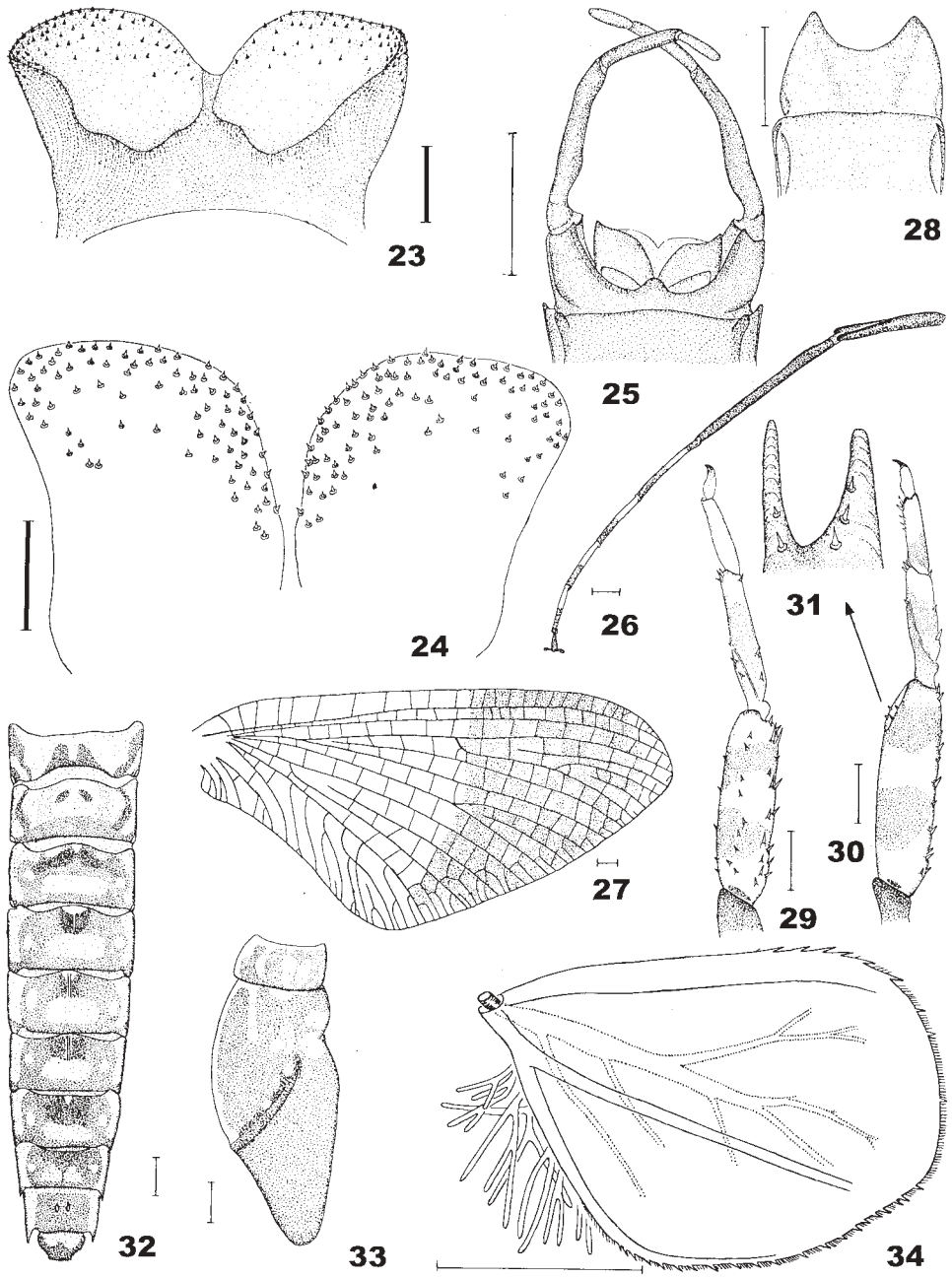
See below, separately for *I. u. ussurica* and *I. u. sibirica* **subsp. nov.**

Description

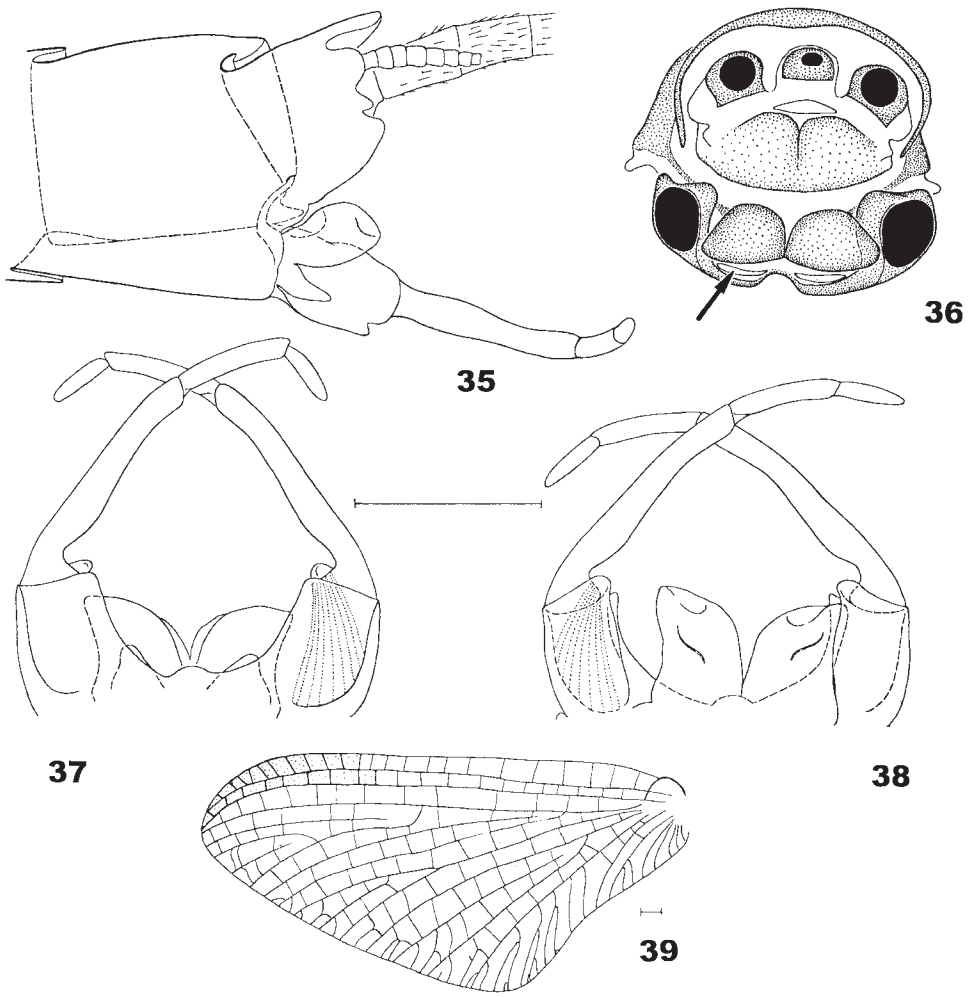
Male imago. Dimensions: forewing and body 10–14 mm, cerci 22–27 mm. **Head:** eyes black or grey, sometimes with reddish. **Thorax:** thorax brown with yellowish. Forefemur dark brown tinged with reddish; foretibiae dark brown to black; each of tarsal segments 1–4 white in basal half and brown in distal part; last tarsal segment entirely brown (Fig. 26). Middle and hind legs colourless; last tarsal segment sometimes brownish. Wing colour different in *I. u. ussurica* (Fig. 27) and *I. u. sibirica* (Fig. 39). **Abdomen:** terga 1–9 reddish brown, lateral parts darker, with lighter maculae; each tergum with dark brown band on posterior margin; no median or submedian light or dark stripes or spots. Sterna light brown. Gonostyli pedestals and gonostyli dark brown; penis lighter. Gonostyli pedestals relatively short, divergent, with ventral–inner–apical angle prominent (Fig. 38) or obtuse. Gonostylus segment 2 in proximal part with distinct widening, thus its inner margin distinctly convex (Figs. 25, 37, 38). Between styliger and penis a pair of rounded conic soft colourless processes (Figs. 35–37). Penis relatively wide and short, reaching to more than 1/2 of gonostyli pedestals; median margins of penes divergent; oblique dorsal ridges distinct, but not curved anteriorly (Figs. 25, 35–38). All spines on penis short (Fig. 24). Cerci white, with brown base.

Female imago. Dimensions: forewing and body 10–14 mm, cerci 19–24 mm. **Head:** head between eyes light, always without median dark stripe; anterolaterally between lateral ocelli and eyes sometimes tinged with brown; posteralateral angles always with dark brown spots. **Thorax:** thorax from yellowish to brown, sterna darker. Foreleg with femur and tibia brown; tarsal segments brownish or white, with brown apices. Middle and hind legs white; last tarsal segment brownish. Wings hyaline (in contrast to male, always without brown band); veins brownish to yellowish. **Abdomen:** terga brown, lateral sides reddish; terga 1–9 with a dark brown band on posterior margin. Sterna lighter. Cerci as in male.

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brownish. **Thorax:** colour of mesonotum typical for the genus *Isonychia* (see above). Foreleg with femur light brown, tibia brown; tarsal segments can be entirely brown (in some males), or segments 1–4 light in proximal half and brown in distal half and segment 5 brown; in female tarsi lighter than in male, sometimes entirely



FIGURES 23–34. ***Isonychia ussurica ussurica.*** **23–27, male imago: 23, dorsal surface of penis; 24, ventral surface of penis; 25, genitals (ventral view); 26, foreleg (lateral view); 27, forewing. 28, female imago: subanal plate (ventral view). 30–34, larva: 29, right middle leg; 30, right hind leg; 31, ventral cleft of hind femur (ventral view); 32, abdominal terga; 33, right half of pro- and meso-notum; 34, right tergalius V (dorsal view). Scale bars: thin, 0.5 mm; thick, 0.1 mm.**



FIGURES 35–39. ***Isonychia ussurica sibirica*** **male imago. 35, abdominal segments IX and X (median section); 36, the same (apical view, arrow shows soft process between styliger and penis); 37, genitals (ventral view, paratype, muscle of right gonostylus shown by dotted lines); 38, the same, holotype (dorsal view); 39, forewing. Scale bars: 0.5 mm.**

light. Middle and hind legs light, with last tarsal segment brownish. Wings light grey, with crossveins bordered by brown. **Abdomen:** terga light brownish; sterna light brownish or colourless. Cerci brownish.

Mature larva. Dimensions: body 11–14 mm, cerci 5–7 mm. **Head:** cuticular pigmentation: clypeus can be entirely light or light medially–posteriorly and dark anteriorly and laterally; frontal carina light; most part of frons behind median ocellus dark; epicranium with light median stripe narrowed anteriorly and bordered by a pair of wide dark stripes; antennae usually with darkened pedicellus and lighter flagellum. **Thorax:** cuticular pigmentation: pronotum and mesonotum can be dark with median longitudinal light stripe (Fig. 33); all femora with two separate dark bands; bands on foreleg usually distinct, rarely absent; bands on middle and hind legs may be as on foreleg (Figs. 29, 30), or lighter, smaller, or absent; patella usually light, sometimes on hind leg with dark

outer side; dark bands on tibia and tarsus on foreleg usually distinct and wide, on middle and hind legs smaller, lighter, or absent. Hind leg of various specimens with femur/tibia ratio 1.8–2.1, femur/(tibia + tarsus) ratio 1.05–1.15, *i.e.*, femur slightly longer than tibia + tarsus. Ventral cleft on hind femur usually with 4 (range 2–6) spines (Fig. 31). **Abdomen:** cuticular pigmentation: terga (Fig. 32) without median longitudinal light stripe, typical for majority of *Isonychia*; each tergum with more or less developed transverse light area. Tergum 1 light with a pair dark brown submedian triangular maculae close to posterior margin. Each of terga 2–9 have following patterns. Lateral parts of tergum (laterad of tergalii bases) can be light (in lighter specimens); anteromedian part dark or with a pair of dark maculae separated by light line; posterior part usually with large transverse light area, posterior margin dark. On foreterga dominate light areas, on hind terga dominate dark ones. Hind-most of these segments can have a pair of light submedian longitudinal stripes and a pair of light sublateral round spots. In lighter specimens tergum 2 light, with dark posterior margin and a pair of dark submedian spots anteromedially; next terga have dark anterior part with light median line on it, light area behind it and dark posterior margin; hind terga have dark anterior part without light line, light area behind it, and dark posterior margin. In darker specimens tergum 2 dark, with small light area in median part of anterior margin and with light median line; hind terga can be entirely dark; tergum 10 always light in anterior half and dark in posterior half. Tergalius colourless, with colourless costae and colourless fibrillose portions. Each tergalius has small denticles on apical margin (Fig. 34); fibrillose portion not thick and reaches middle part of tergalius. Bare tail of cercus usually dark brown, rarely light.

Egg. Spherical; chorion partly covered with reticulation; KCT densely packed on two hemispheres and scattered over most of egg (Figs. 111–113).

Distribution

Siberia, Mongolia, Russian Far East (from Kuznetsk Alatau in the west to Primorskiy Kray in the east). Two subspecies are distributed in different parts of this area: *I. u. sibirica* **subsp. nov.** in the western part of the species area and *I. u. ussurica* in the eastern part.

Isonychia (*Isonychia*) *ussurica ussurica* Bajkova, 1970

(Figs. 23–34, 111–114)

Isonychia ussurica Bajkova, 1970: 148 (imaginal description; type locality: Khor River; holotype in Zoological Institute, St. Petersburg (Kluge 1995)).
Isonychia sp. 1: Bajkova 1970: 153 (larval description).

Material examined

RUSSIA. Khabarovskiy Kray: Khor River, Bol'shaya Channel, 20.viii.1956, O Bajkova, I ♂ (holotype of *I. ussurica*, ZIN); same place, 14.ix.1951, I♀ (paratype of *I. ussurica*, ZIN); same place, 15.viii.1950, 4 I♂, 2 I♀ (ZIN); Khor River near Bichevaya, 27.viii–6.ix.1984, N Kluge, 2 L–S–I ♂, 2 L–S–I♀, 30 L (ZIN); Amur River, near Sarapul'skoe, 11.vii.2000, T Tiunova, at light, 1 I ♂ (IBSS); Kondrat'evka, 24.vii.1996, T Tiunova, 9 L (IBSS). **Primorskiy Kray:** Ussuri River, Novo-Chuguyevka, 24.viii.1980, N Kluge, 1 L–S ♂, 3 L (ZIN); Utyos Mountain (about 1 km lower mouth of Arsen'evka River), 19.vii.1991, T Tiunova, 1 I ♂, 2 L (IBSS); 1.5 km lower Utyos Mountain, 2.viii.1992, T Tiunova, 8 L (IBSS); 1 km lower Utyos Mountain, 4.viii.1994, T Tiunova, 3 L (IBSS); 0.5 km lower Arkhipov Stream's mouth, 29.vii.1994, T Tiunova, 5 I♂, 7 I♀ (IBSS); between Kamenka and Vartakhovka, 30–31.vii.1994, T Tiunova, 4 I♂, 3 I♀

(IBSS); Stepnoe, 1.viii.1994, T Tiunova, 1 L–S–I♂, 2 L–S♂ (IBSS); near Vladykin Island, 1 km lower Stepanovka, 2.viii.1992, T Tiunova, 2 L–S–I♂ (IBSS); same place, 5.viii.1994, T Tiunova, 1 I♂ (at light), 1 L (IBSS); Stepanovka, 20.vii.1991, T Tiunova, 1 L (IBSS); 3 km lower Podgornoe, 21.vii.1991, T Tiunova, 2 L (IBSS). Ussuri River Basin, Kabarga River, about 6 km lower mouth, 14.vii.2000, T Tiunova, at light, 4 I♂ (IBSS); Arsen'evka River, Yakovlevka, 18.vii.1989, T Tiunova, 6 L (IBSS); Bikin River, 4 km lower mouth of Omorochka River, 30.vii.1995, T Tiunova, 1 I♂ (IBSS); near Degdiyuoni Mountain, 1.viii.1995, T Tiunova, 1 L (IBSS); 1 km lower Yaseneviy, 2.viii.1995, T Tiunova, 1 L (IBSS).

Description

Male imago. Dimensions: forewing and body 10–14 mm (holotype 11 mm), cerci 22–27 mm. **Thorax:** forewing with a dark brown or reddish transverse band arising from pterostigma posteriorly (Fig. 27) (like in *I. v. vshivkovae*, but in contrast to other East Palaearctic species). Length (mm) of leg segments of holotype are the following. Foreleg: femur 2.1, tibia 3.3, tarsal segments 1.0, 0.9, 0.8, 0.7, 0.4. Middle leg: femur 2.1, tibia 2.7, tarsus 1.8. Hind leg: femur 2.3, tibia 2.0, tarsus 1.3. For other characters see species description and original description by Bajkova (1970).

Female imago. Dimensions: forewing and body 10–14 mm, cerci 19–24 mm. **Thorax:** in contrast to male, forewing without coloration behind pterostigma. For other characters see species description.

Mature larva. See species description.

Distribution

Russian Far East: Khabarovskiy Kray and Primorskiy Kray.

Isonychia (*Isonychia*) *ussurica sibirica* subsp. nov.

(Figs. 35–39)

Material examined

Holotype. RUSSIA. Chitinskaya Oblast': Khilok River near Bada, 4.viii.1994, N Kluge, L–S–I♂ (ZIN).

Paratypes. RUSSIA. Kemerovskaya Oblast': Tom' River, 25.viii.1963, A Rasnitsyn, 8 I♂, 1 I♀ (ZIN). **Krasnoyarskiy Kray:** Yenisey River, 29.vii.1948, 5 L (ZIN); Yenisey River near Ust'-Pitskaya, 27.vii, P Pir, 3 L (juv.) (ZIN); Bazuriha near Krasnoyarsk, 10.viii.1900, G Jacobson, 1 I ♂ (ZIN); District of Minusinsk, Novoselovo, 9–11.viii.1924, B Vinogradov, 8 I ♂, 5 I♀, 7 S♂, 3 S♀ (ZIN). **Irkutskaya Oblast':** Oka River, 29.vii.1942, 1 L (ZIN). **Buryatiya:** Vitim River near Romanovka, 6.viii.1963, A Rasnitsyn, 1 I ♂, 7 S (ZIN); same place, 8.viii.1969, V Zherichin *et al.*, I♂♂, I♀♀, S♂♂, S♀♀ (ZIN); District of Zaigraevo, Uda River lower Kurba River, 19.viii.1987, A Rasnitsyn, I♂♂, I♀♀ (ZIN); **Chitinskaya Oblast':** Narymka River (tributary of Olenguy River), 5 km from Elizavetino, 11.viii.1981, N Sinitshenkova, 1 I♂ (ZIN); Ingoda River, near Alexandrovka, 30.vii.1994, N Kluge, 1 I♂ (ZIN); Khilok River near railway station Bada, 12–17.viii.1987, A Rasnitsyn, 33 I♂, 3 I♀, 1 S♂, 1 S♀, 5 L (ZIN); same place (together with holotype), 1–6.viii.1994, N Kluge, 5 L–S–I♂, 5 L–S–I♀, 2 L–S♂, 2L–S♀, 75 L (ZIN). **MONGOLIA.** Selenge Moron (= Selenga) River near mouth of Egiyn-Gol River, 16–21.viii.1997, N Kluge, 2 L–S–I♂, 1 L–S–I♀, 3 L–S♂, 2 I♂, 2 I♀, 15 L (ZIN); Orhon-Gol River SE Bulgan, N Kluge, 16–18.viii.1997, 2 I♂, 2 I♀, 1 L (ZIN); Khara-Gol River near Darhan, 16.viii.1997, N Kluge, 1 L–S–I♂, 1 L (ZIN).

Etymology

The epithet *sibirica* is connected with distribution of this subspecies in West and East Siberia, in contrast to more eastern distribution of the nominative subspecies.

Description

Male imago. Dimensions: forewing and body 10–12 mm (holotype 11 mm). **Thorax:** wing membrane colourless, veins yellowish or light brownish, in pterostigma longitudinal and crossveins darker, brownish, membrane of pterostigma whitish or light brownish (Fig. 39) (no band behind pterostigma, in contrast to *I. u. ussurica*). For other characters see species description. Length (mm) of leg segments of holotype are the following. Foreleg: femur 1.8, tibia 2.8, tarsal segments 0.9, 0.8, 0.7, 0.5, 0.3. Middle leg: femur 1.8, tibia 2.7, tarsus 1.5. Hind leg: femur 2.1, tibia 1.8, tarsus 1.1.

Female imago. See species description. Length: forewing and body about 13 mm. Wings similar to that of male, pterostigma whitish.

Mature larva. See species description. Length (mm) of leg segments of holotype are the following. Foreleg: femur 1.4, tibia 1.6, tarsus 0.9. Middle leg: femur 1.5, tibia 1.2, tarsus 0.7. Hind leg: femur 1.9, tibia 1.0, tarsus 1.7.

Distribution

Siberia (from Kuznetsk Alatau to Transbaikalia) and Mongolia.

Isonychia (*Isonychia*) *concoloria* sp. nov.

(Figs. 40–44)

Material examined

Holotype. RUSSIA. Khabarovskiy Kray: Amur River lower Troitskoe, 2.viii.1996, T Tiunova, I♂ (IBSS).

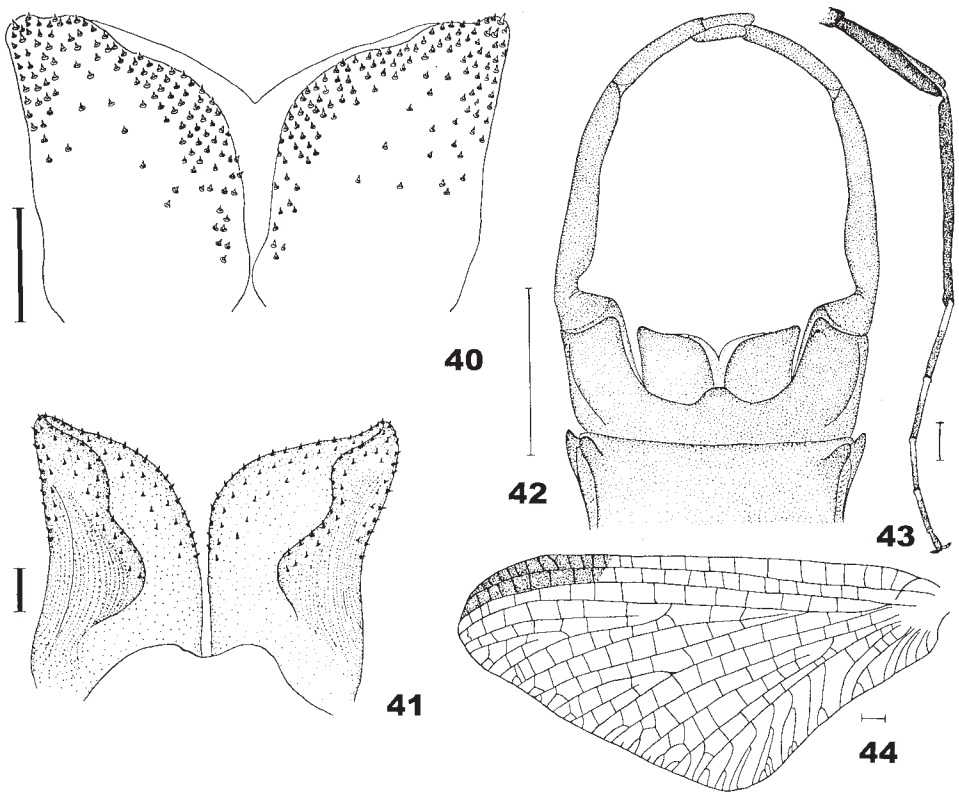
Paratypes. Together with holotype, 13 I♂ (swarming), 1 S♂ (at light) (IBSS).

Etymology

The species name *concoloria* means monotonous.

Description

Male imago. Dimensions: forewing and body 10–11 mm, cerci 22–26 mm. **Head:** eyes black. **Thorax:** thorax dark brown. Femur of foreleg dark brown; tibiae dark brown to black with light brown joint; tarsal segments 1–3 with proximal 1/3 white, distal part dark brown, often segment 3 brown completely; tarsal segment 4 brown or brownish, sometimes with whitish base; last segment brown (Fig. 43). Middle and hind legs yellowish with tarsal segment joints brown; last tarsal segment entirely brown. Length (mm) of segments in foreleg femur 1.8–1.9, tibia 2.7–2.9, tarsal segments 1.0–1.1, 0.9–1.0, 0.7–0.8, 0.6, 0.3. Wings hyaline, all veins brown; pterostigma brown or light brown (Fig. 44). **Abdomen:** tergum 1 dark brown, posterior margin black; other terga brown, lateral sides with reddish tinge; terga 2–9 with dark brown bands in posterior margin; tergum 9 darker than 2–8; terga 2–9 with a pair of whitish strokes, often unclear. Sterna brown; sternum 1 dark brown; sterna 9 darker than 2–8. Cerci light yellow to whitish with brown base. Gonostyli pedestals and gonostyli dark brown; penis light brown. Penis reaching apices of gonostyli pedestals; apices slightly



FIGURES 40–44. ***Isonychia concoloria*** **male imago. 40, dorsal surface of penis; 41, ventral surface of penis; 42, genitals (ventral view); 43, foreleg; 44, forewing. Scale bars: thin, 0.5 mm; thick, 0.1 mm.**

long and rounded (Fig. 43). Penis with a broad row of short stout spines along distal margin; anterolateral sides densely covered by short stout spines; apices with longer spines (Fig. 40).

Male subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brown, basal segment dark brown. **Thorax:** pronotum dark brown; mesonotum light brown; colour of mesonotum typical for the genus *Isonychia* (see above). Foreleg dark brown to black; tibia darker than femur and tarsus. Middle and hind legs yellowish with brown joints; tarsal segments brownish; last segment darker distally. Wings brown, turbid; crossveins bordered by dark brown. Terga dark brown; sterna 2–9 with a pair of dark strokes and four dots. Cerci brown, base dark brown.

Larva. Unknown.

Distribution and biology

Known from a single place in Russian Far East. The imagoes were collected when swarming high over the water.

Discussion

The male genitals of *I. concoloria* are similar to those of *I. ussurica* but differ in absence of processes between penis and styliger (Fig. 43).

Japonica species group

(Figs. 45–90)

Diagnosis

The new Palaearctic species group *japonica* has dorsal flaps on penis lobes as in Nearctic group *bicolor* but differ from the group *bicolor* in absence of denticles on distal margins of tergalii.

Description

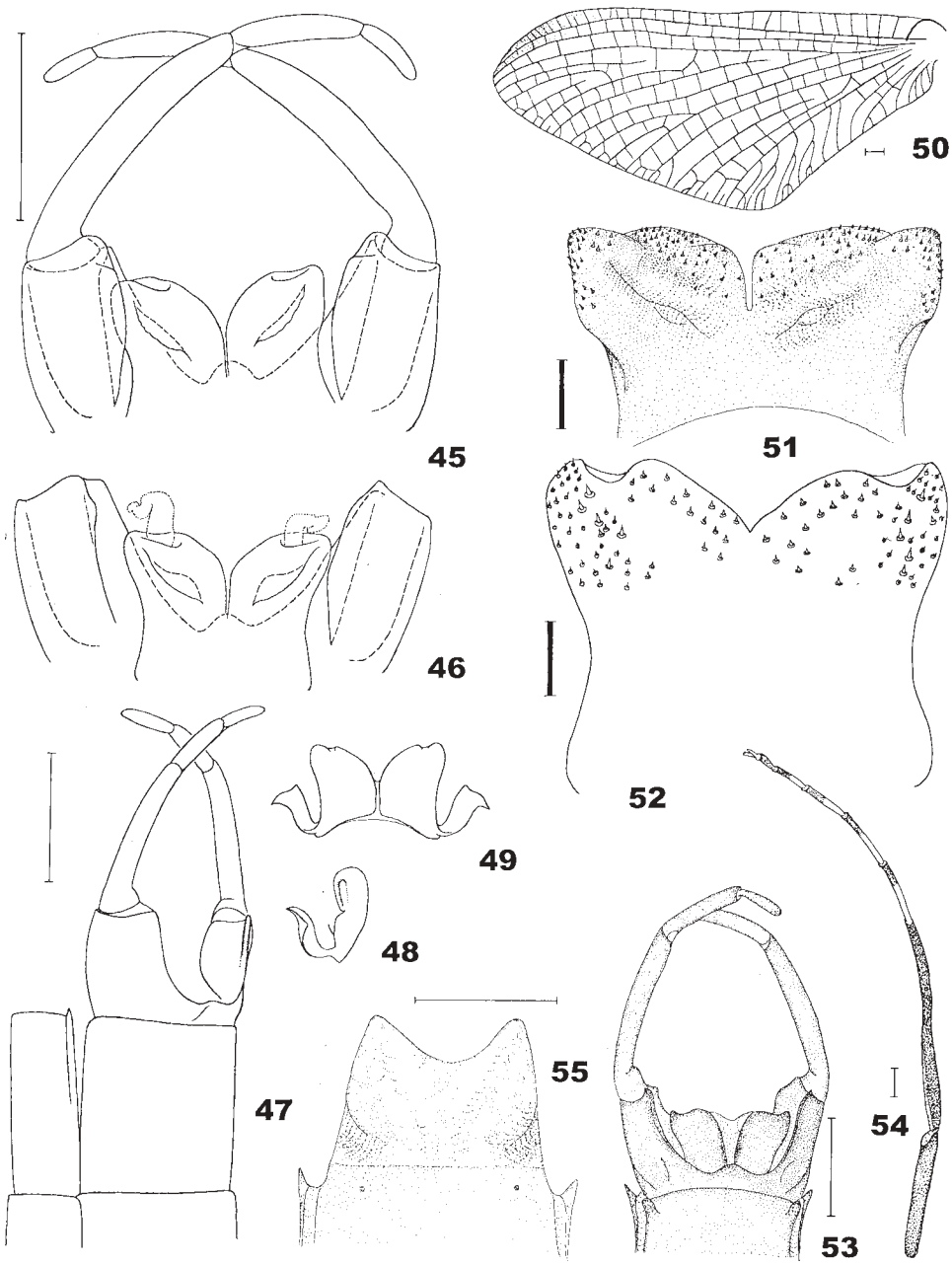
Male imago. Abdomen: terga and sterna brownish or reddish brown. Each of terga 2–9 darkened in lateral parts (the same in *I. ignota* and *I. ussurica*), with a pair of distinct submedian dark stripes that reach hind margin in this area (in contrast to *I. ignota*, which have submedian dark stripes not reaching hind margin of segment); medial area between these dark stripes light, thus abdomen has more or less distinct median longitudinal light stripe (similar to that in cuticular pigmentation of larva; see below). Posterior margin of each tergum with greyish-brown band (as in other *Isonychia*). Submedian oblique stripes (places of anterior attachment of sternal muscles, and four or two dots forming a transverse line behind them on each sternum), distinct, being lighter than background (in contrast, darker than background than in *I. ignota*, and invisible in *I. ussurica*). Gonostylus without thickening (in contrast to *I. ussurica* and *I. concoloria*). Processes between styliger and penes absent (in contrast to *I. ignota*, *I. sexpetala*, and *I. ussurica*). Penis on dorsal side with a pair of distinct oblique flaps curved anteriorly (Figs. 45, 46, 48, 51, 63, 64, 68, 71, 77, 78, 82) (more prominent than in *I. ignota* and *I. ussurica*, like that in North American group *bicolor*).

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Thorax:** colour of mesonotum typical for the genus *Isonychia* (see above). Wings brownish grey; forewing with indistinct large transverse darker and lighter areas, the largest darker area occupying distal part of wing including pterostigma. In contrast to subimagoes of other Palaearctic species (including Nearctic *I. bicolor*) crossveins area not bordered by brown.

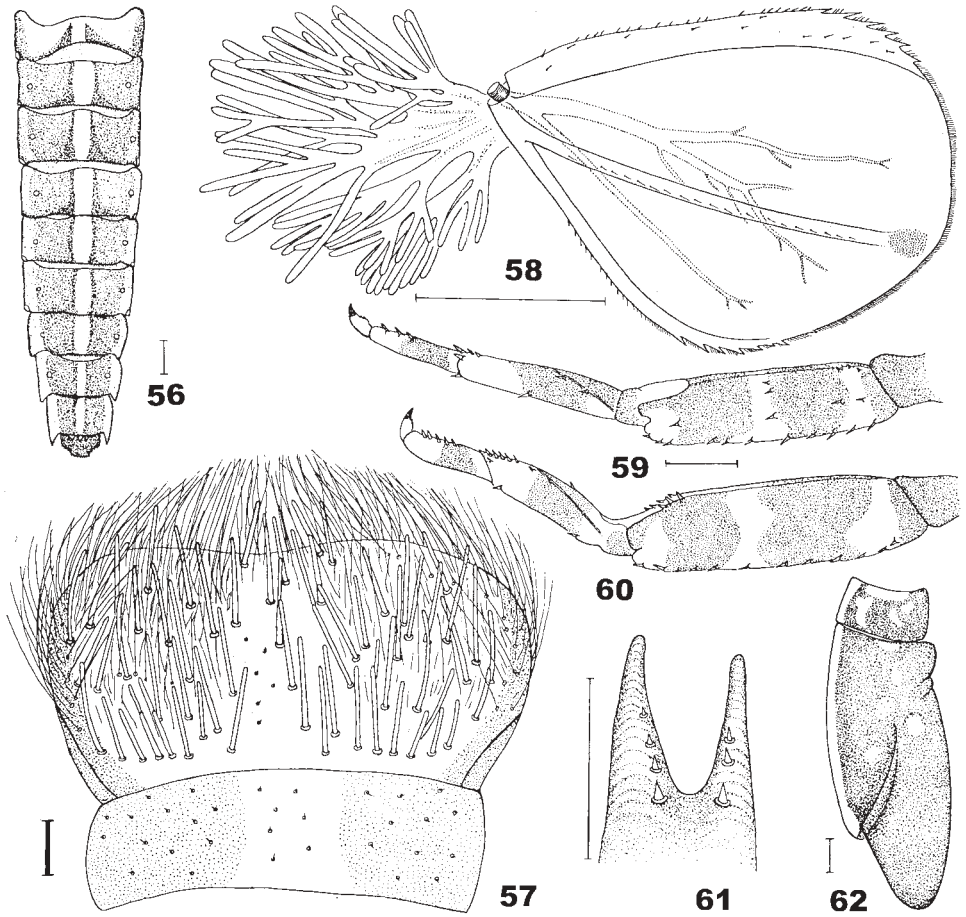
Mature larva. Abdomen: on margins of tergalius short denticles present only on distal part of costal rib and distal part of anal rib but not on apical margin; apical margin bears fine short setae only (Fig. 58) (the same in subgenus *Prionoides* but not in any other group of subgenus *Isonychia*; formerly this character was regarded to be a subgeneric character of *Prionoides* (Kondratieff and Voshell 1983, 1984)). Cuticular pigmentation (in addition to hypodermal pigmentation similar to that of imago): terga 1–9 always with distinct longitudinal median light stripe on dark background (in contrast to *I. ussurica*); this light stripe is contrast, being often bordered by a pair of narrower longitudinal dark stripes (Figs. 56, 72, 89); lateral margins of terga can be lighter; each of terga 2–9 often with a pair of small round light spots in middle part of lateral side; tergum 10 dark, with a pair of light spots close to anterior margin (in contrast to *I. ignota*, *I. sexpetala*, and *I. ussurica*).

Distribution and composition

The group *japonica* is distributed in East Palaearctic only and includes *I. japonica*, *I. crassiuscula* **sp. nov.**, and *I. vshivkovae* **sp. nov.** (with 2 subspecies).



FIGURES 45–55. ***Isonychia crassiuscula*** **imago. 45–54: male imago; 45, genitals (dorsal view); 46, styliger and penis of another specimen (dorsal view); 47, abdominal segment IX with styliger and gonostyli (lateral–ventral view, penis and segment X removed) 48, penis with penial arms (lateral view); 49, the same (ventral view); 50, forewing; 51, dorsal surface of penis; 52, ventral surface of penis; 53, genitals (ventral view, in natural position); 54, foreleg. 55, female imago: subanal plate (ventral view). Scale bars: thin, 0.5 mm; thick, 0.1 mm.**



FIGURES 56–62. ***Isonychia crassiuscula*** **larva. 56, abdominal terga; 57, labrum and clypeus; 58, right tergalius V (dorsal view, ventral lobe turned apart) 59, left middle leg; 60, right middle leg; 61, ventral cleft of hind femur (ventral view); 62, right half of pro- and meso-notum. Scale bars: thin, 0.5 mm; thick, 0.1 mm.**

Isonychia (*Isonychia*) *crassiuscula* sp. nov.

(Figs. 45–62, 108–110)

Material examined

Holotype. RUSSIA. Primorskiy Kray: Ussuri River, 8–9 km lower Koksharovka, 1.viii.1994, T Tiunova, L–S–I♂ (IBSS).

Paratypes. RUSSIA. Primorskiy Kray: Ussuri River, together with holotype, 5 L–S–I♂, 10 L–S–I♀, 4 L–S♂, 1 L–S♀, 1 L (IBSS); near Novo-Chuguyevka, 27.vii.1992, T Tiunova, 1 L (IBSS); 4–5 km lower Kamenka, 3.vii.1993, T Tiunova, 2 L (IBSS); 0.5 km lower mouth of Archipov Stream, 29.vii.1994, T Tiunova, 9 L (IBSS); between Kamenka and Vartahovka, 31.vii.1994, T Tiunova, 1 L–S♂ (IBSS); Bulygo-Fadeevo, 1–9.viii.1980, N Kluge, 3 L–S–I♂, 3 L–S ♂, 3 L–S♀ (ZIN).

Etymology

Latin word *crassiuscula* is connected with thick and fatty larval abdomen.

Description

Male imago. Dimensions: forewing and body 12–16 mm, cerci 15–29 mm. **Head:** eyes grey. **Thorax:** pronotum dark brown; mesonotum in general brown with two distinct thin dark longitudinal lines. Femur and tibia of foreleg dark brown tinged with black; basal part of tarsal segments 1–4 white, distal part blackish; last tarsal segment brownish (Fig. 54). General colour of middle and hind legs white; joints of tarsal segments brownish. Length (mm) of segments of holotype are the following. Foreleg: femur 2.1, tibia 3.2, tarsal segments 1.1, 1.0, 0.8, 0.7, 0.4. Middle leg: femur 2.1, tibia 3.0, tarsus 1.7; hind leg: femur 2.6, tibia 2.5, tarsus 1.7. Wing hyaline, all veins light brown; pterostigma whitish or light brownish. **Abdomen:** terga typical for the group; tergum 1 dark brown to blackish and well contrasted with other terga; terga 2–5 or 2–6 light brown to yellowish anteriorly, brown to dark brown posteriorly; terga 8–9 brown; terga 1–9 with lateral sides dark brown, with dark brown band on posterior margins and with a wide white median longitudinal stripe. Sternum 1 dark brown; sternum 2 dark brown, lighter than sternum 1; sterna 3–9 light brown with blackish tinge; sterna 8–9 darker than 3–7 ones; sterna 1–9 with a pair of oblique white stripes and some dots. Styliger, gonostyli, and penis from whitish to brown; first and second gonostyli segments can be entirely dark or first segment and base of second segment whitish, lighter than gonostyli pedestals and distal part of second segment, which are dark brown. Gonostyli pedestals relatively short; penis relatively short but extending beyond middle of gonostyli pedestals; dorsal flap (typical for the group *japonica*; see above) oblique, without sharp curvation (in contrast to *I. japonica*) (Figs. 45–49). Ventrally penis with small subapical stout spines; distal–lateral corners with thin spines; each side with a narrow long row of big stout spines (Fig. 52). Cerci white, tinged with yellowish, base dark brown.

Female imago. Dimensions: body 15–16 mm, forewing 12–14 mm, cerci 22 mm. **Head:** eyes dark grey. Head between eyes light, with a pair of distinct brownish longitudinal median stripes in hind part curved laterally and connected with dark brown posterolateral angles; anterolaterally between lateral ocelli and eyes a pair of more or less expressed brown spots. **Thorax:** pronotum dark brown, with light marks and trapeziform spot in middle part. Meso- and meta-notum yellowish brown; meso- and meta-sternum dark brown. Femur and tibia of foreleg dark brown tinged with black reddish; tarsal segments in general white, apex of each segment dark brown; last segment brown. Middle and hind legs white, joints of tarsal segments brownish. Wing hyaline, veins brown; pterostigma whitish. **Abdomen:** terga coloured as in male, but tinged with reddish. Terga 2–8 with a pair of small white spots in middle part of lateral sides. Sternum 1 dark brown tinged with black; sterna 2–8 light brown anteriorly, dark brown reddish posteriorly; sternum 9 dark brown, lighter than sternum 1; sterna 2–9 with a pair of oblique white stripes and four dots. Subanal plate dark brown. Cerci white, with dark brown-reddish base.

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brown. **Thorax:** colour of mesonotum typical for the genus *Isonychia* (see above). Foreleg with femur light brown, margins darker; tibiae brown; tarsal segments can be entirely brown or segments 1–4 light in proximal half and brown in distal half and segment 5 brown. Wings brownish grey; forewing sometimes with indistinct lighter and darker transverse maculation; crossveins not bordered by brown. **Abdomen:** light brownish. Cerci brownish.

Mature larva. Dimensions: body 13–15 mm, cerci 6–7 mm. **Head:** cuticular pigmentation: clypeus light medially, dark laterally; frontal carina light; most part of frons behind median ocellus dark; epicranium with light median stripe bordered by dark stripes; antennae dark, pedicellus lighter than proximal part of flagellum. **Thorax:** cuticular pigmentation: nota dark with light median longitudinal stripe; pronotum with white anterior margin and a pair of submedian semilunar marks; mesonotum with a pair of diffuse white spots in middle area and a pair of subapical diffuse spots (Fig. 62); femur of each leg with two wide transverse dark brown bands; tibia witha median dark brown transverse band; tarsus in basal part dark brown, in distal part light (Figs. 59, 60). Length (mm) of leg segments of holotype are the following. Foreleg: femur 1.6, tibia 2.0, tarsus 1.0. Middle leg: femur 2.1, tibia 1.5, tarsus 0.8. Hind leg: femur 2.5, tibiae 1.1, tarsus 0.8. In hind leg of various specimens ratio femur/tibia ratio 1.6–2.2, femur/(tibia + tarsus) ratio 1.1–1.3, *i.e.*, femur distinctly longer than tibia + tarsus. Ventral cleft of hind femur usually with 6 (from 5 to 8) spines (Fig. 61). **Abdomen:** typical for *japonica* group (Fig. 56). Each tergalius with small brown or purplish spot near apex of anterior branch of anal rib (Fig. 58); tufts of filaments black, with white apices, thick, reaching 2/3 of tergalius length. Bare tail of cercus dark, with light tip.

Egg. Spherical; knob-terminated coiled threads (KCT) densely covering entire egg (Figs. 108–110).

Distribution and biology

South of Russian Far East. Larvae are found in pebble in the upper part of Ussuri River which can be characterized as a rhithral. Our studies how that larvae of *I. crassiuscula* are distributed in the upper courses of the rivers in an overlapping zone with *I. ussurica*, but never with *I. sexpetala*.

Discussion

Male imago of the new species differs from *I. japonica* and *I. vshivkovae* **sp. nov.** by shorter gonostyli pedestals and from *I. vshivkovae* by shorter penis (Figs. 47–49). Egg well differs from *I. japonica* by KCT covering entire surface (Fig. 108).

Isonychia (*Isonychia*) *vshivkovae* sp. nov.

(Figs. 63–76, 120–122)

Material examined

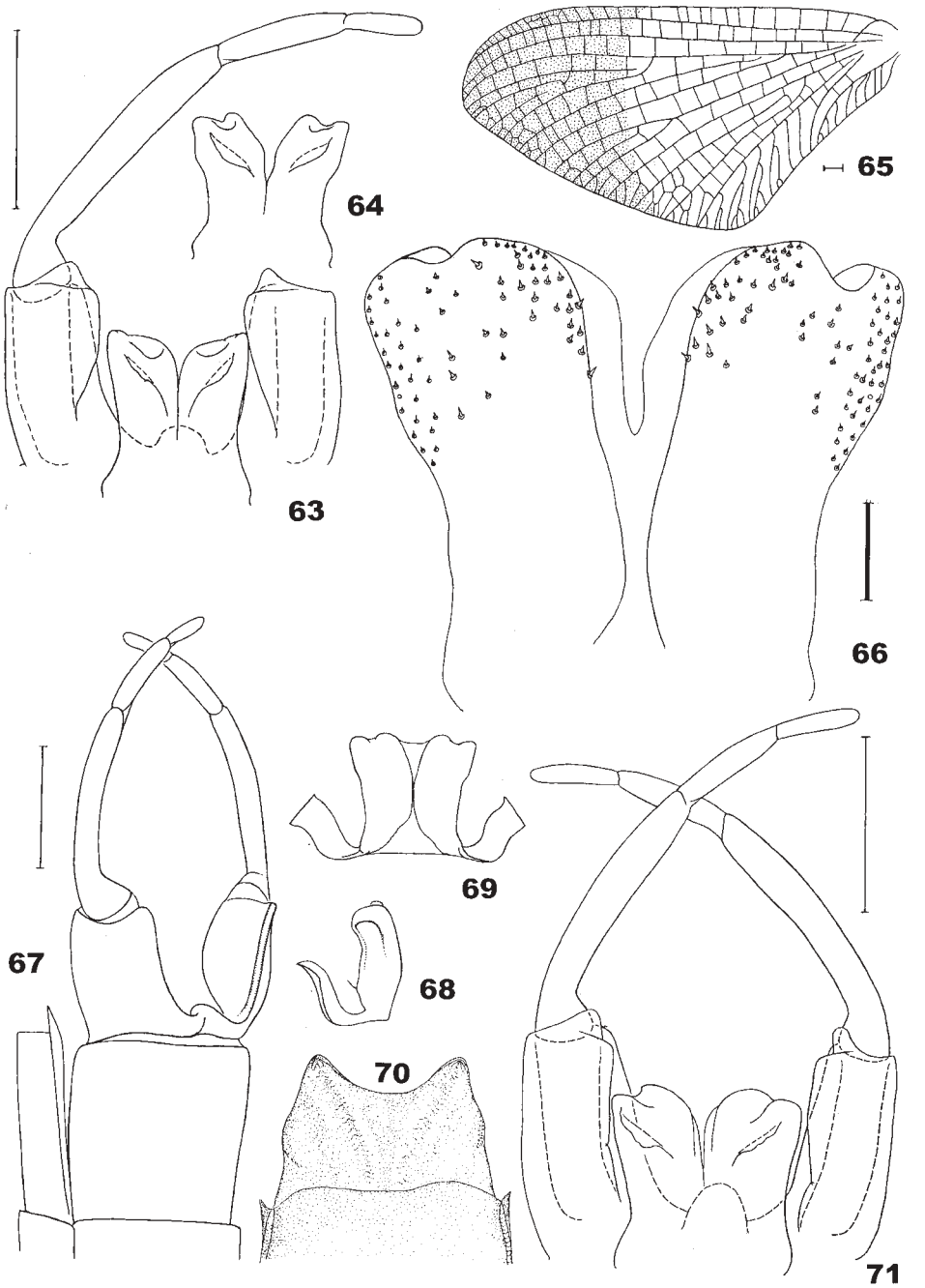
See below, separately for *I. v. vshivkovae* and *I. v. sinitshenkovae* **subsp. nov.**

Etymology

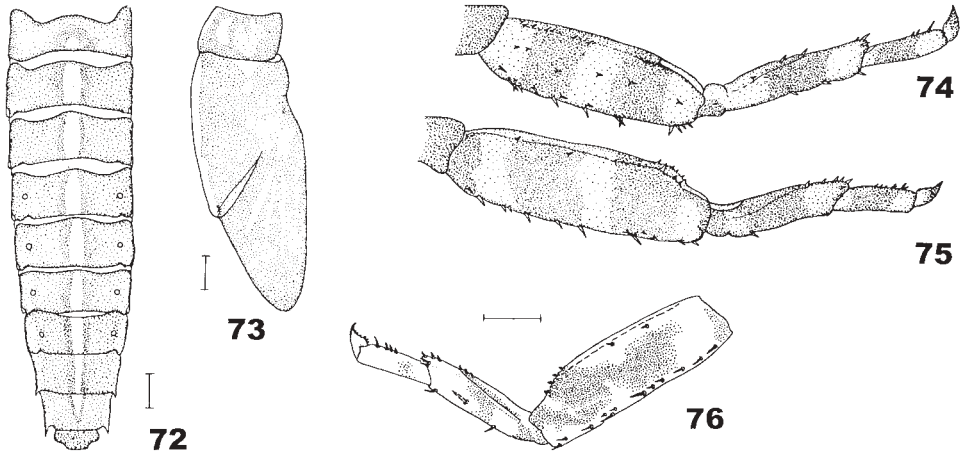
The new species is named in honour of hydrobiologist Tatiana Vshivkova, who collected and studied this species.

Description

Male imago. Dimensions: forewing and body 11–13 mm (holotype 13 mm), cerci 27–28 mm. **Head:** eyes black or grey, sometimes with reddish. **Thorax:** terga and sterna from yellowish brown to brown, pleura lighter. Foreleg with coxa, trochanter, femur and tibia dark brown; tarsal segments 1–4 whitish in proximal half and brownish in distal half, segment 5 brownish. Middle and hind legs with coxa brown; trochanter, femur, tibia, and tarsus light yellowish or whitish, tarsal segment 5 darkened. Length (mm) of leg segments of holotype are the following. Foreleg: femur 2.0, tibia 3.5, tarsal



FIGURES 63–71. ***Isonychia vshivkovae*** **imago. 63–70,** ***Isonychia vshivkovae vshivkovae*****. 63–69, male imago: 63, genitals of holotype (dorsal view); 64, penis of paratype (dorsal view); 65, forewing; 66, ventral surface of penis; 67, abdominal segment IX with styliger and gonostyli (lateral–ventral view, penis and segment X removed) 68, penis with penial arms (lateral view); 69, the same (ventral view). 70, female imago: subanal plate (ventral view). 71,** ***Isonychia vshivkovae sinitshenkovae*****, genitals (dorsal view). Scale bars: thin, 0.5 mm; thick, 0.1 mm.**



FIGURES 72–76. ***Isonychia vshivkovae vshivkovae*** **larva. 72, abdominal terga; 73, right half of pro- and meso-notum; 74, right middle leg; 75, right hind leg; 76, left hind leg of another specimen. Scale bars: 0.5 mm.**

segments 1.1, 1.1, 0.8, 0.7, 3.5. Middle leg: femur 2.2, tibia 3.0, tarsus 1.3. Hind leg: femur 2.3, tibia 2.4, tarsus 1.3. Forewing with (Fig. 56) or without brown band, differently in subspecies *I. v. vshivkovae and I. v. sinitshenkovae*; pterostigma reddish; longitudinal veins light brown or yellowish, crossveins light brown. **Abdomen:** reddish brown, colour pattern typical for the group. Penis, gonostyli pedestals, and first two segments of gonostyli brown, distal segments of gonostyli pale (in one specimen gonostyli pale proximally and dark medially). Gonostyli pedestals long; penis long (much longer than in other species described here), exceeding middle of gonostyli pedestals; lateral margins in proximal part concave, distally parallel (Figs. 63, 64, 67–69, 71). Ventral surface of penis in distal part covered by smaller and longer spines; larger spines sometimes on median part only (Fig. 66) or median and lateral parts of each penis lobe.

Female imago. Dimensions: forewing and body 14–16 mm. **Head:** head between eyes light, with brownish longitudinal median stripe or a pair of stripes; anterolaterally between lateral ocelli and eyes a pair of more or less expressed brown spots; posterolateral angles with dark spots. **Thorax:** yellowish brown with brown, sterna brown. Colour of legs as in male. Wings as in male, with pterostigma more or less reddish, but in the both subspecies without coloration of membrane behind pterostigma. **Abdomen:** yellowish brown or reddish, colour patterns typical for the group. Cerci as in male.

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brownish. **Thorax:** colour of mesonotum typical for the genus *Isonychia* (see above). Foreleg with femur light brown, margins darker; tibia brown; tarsal segments can be entirely brown or segments 1–4 light in proximal half and brown in distal half and segment 5 brown. Wings brownish grey; forewing with indistinct lighter and darker transverse maculation, apical area dark; crossveins not bordered by brown. **Abdomen:** light brownish. Cerci brownish.

Mature larva. Head: cuticular pigmentation: clypeus light medially, dark laterally; frontal carina light; most part of frons behind median ocellus dark; epicranium with light median stripe bordered by dark stripes; antennae usually dark proximally. **Thorax:** cuticular pigmentation: pro- and meso-notum usually dark, with median longitudinal light stripe (Fig. 73); legs light with brown bands; femur of each leg with two transverse brown bands, often completely separated one from another (Figs. 74–75) or

fused (Fig. 76); patella on outer side dark; tibia with transverse dark band in middle; tarsus of foreleg dark proximally; tibia of middle and hind legs with or without dark bands in middle; tarsi of middle and hind legs proximally darkened or not. Length (mm) of leg segments of holotype are the following. Foreleg: femur 1.4, tibia 1.8, tarsus 0.8. Middle leg: femur 1.8, tibia 1.3, tarsus 0.7. Hind leg: femur 2.0, tibia 1.1, tarsus 0.7. In hind leg of various specimens femur/tibia ratio 1.7–2.0, femur/(tibia + tarsus) ratio 1.1–1.4, *i.e.*, femur distinctly longer than tibia + tarsus. Ventral cleft of hind femur usually with 6–9 (from 3 to 10) spines. **Abdomen:** typical for *japonica* group (Fig. 72). Bare tail of cercus dark with light tip.

Egg. Spherical; knob-terminated coiled threads (KCTs) densely cover entire egg (Figs. 120–122).

Distribution

East Siberia and Russian Far East from Transbaikalia in the west to Primorskiy Kray in the east. Two subspecies are distributed in different parts of this area: *I. v. sinitshenkovae* in the west and *I. v. vshivkovae* in the east.

Discussion

New species differs from *I. japonica* and *I. crassiuscula* **sp. nov.** by more intensively coloured pterostigma and longer penis, from *I. crassiuscula*, also by longer gonostyli pedestals (Figs. 67–69). Eggs distinct from those of *I. japonica* by KCTs covering entire surface (Fig. 120). Male imago of Far Eastern subspecies *I. v. vshivkovae* differs from *I. japonica* and *I. crassiuscula* by coloured apical half of forewing (Fig. 65).

Isonychia (*Isonychia*) *vshivkovae vshivkovae* subsp. nov.

(Figs. 63–70, 72–76, 120–122)

Isonychia sp.: Tshernova *et al.* 1986: 124, Fig. 55:1,2 (wings).

Material examined

Holotype. RUSSIA. Primorskiy Kray: Ussuriyskiy Natural Reserve, Komarovka River, 27.viii.1990, N Kluge, L–S–I♂ (ZIN).

Paratypes. RUSSIA. Primorskiy Kray: Together with holotype, 25–29.viii. 1990, 3 L–S–I♀, 3 L–S♂, 4 L–S♀, 10 L; same locality, 22–28.viii.1983, T Vshivkova, 1 L–S–I♂, 7 I♂, 3 I♀, L (exuviae), 1 L (ZIN); Partizanskaya River, Partizansk (= Suchan), source of Tigrovaya River, 30.viii.1928, A Kurenzov, 1 I♂ (dry collection, ZIN).

Description

Male imago. Thorax: forewing with a dark brown or reddish transverse band arising from pterostigma posteriorly (Fig. 65) (like in *I. u. ussurica*, but in contrast to other species of the group *japonica*). For other characters see species description.

Female imago. See species description. In contrast to male, forewing without coloration behind pterostigma.

Mature larva. Abdomen: each tergalius without spot near apex of anterior branch of anal rib. For other characters see species description.

Distribution

Russian Far East: south of Primorskiy Kray only.

Isonychia (*Isonychia*) *vshivkovae sinitshenkovae* subsp. nov.

(Fig. 71)

Material examined

Holotype. RUSSIA. Chitinskaya Oblast': Olenguy River near Elizavetino (70 km SE Chita), 4.viii.1981, N Sinitshenkova, 1 I♂.

Paratypes. Together with holotype, 9.viii.1981, 2 I♀; same place, 13.viii.1981, A Rautian, 37 L (mature); same place, 17.vii.1981, N Sinitshenkova, 14 L (juvenile).

Etymology

The new subspecies is named in honour of ephemeropterologist and paleontologist Nina Sinitshenkova, who collected this species.

Description

Male imago. Thorax: forewing as in female, without coloration behind pterostigma (in contrast to *I. v. vshivkovae*), pterostigma reddish. For other characters see species description.

Female imago. See species description.

Mature larva. Abdomen: each tergalius usually with more or less distinct spot near apex of anterior branch of anal rib (as in Fig. 58). For other characters see species description.

Distribution

Siberia: Transbaikalia.

Isonychia (*Isonychia*) *japonica* (Ulmer, 1919)

(Figs. 77–90, 115–119)

Chirotonetes japonicus Ulmer, 1919: 12 (imaginal description; syntypes (according to original description): adult male and female from Gifu-ken, Honshu, Japan in Ulmer's collection; adult male and female from Gifu in Brussels Museum; adult male from Korea in Berlin Museum).

Isonychia japonica: Ulmer, 1932: 4; Uéno and Okamoto, 1932: 1956; Matsumura, 1933: 66; Imanishi, 1933: 67; Ulmer, 1936: 4; Imanishi, 1940: 234.

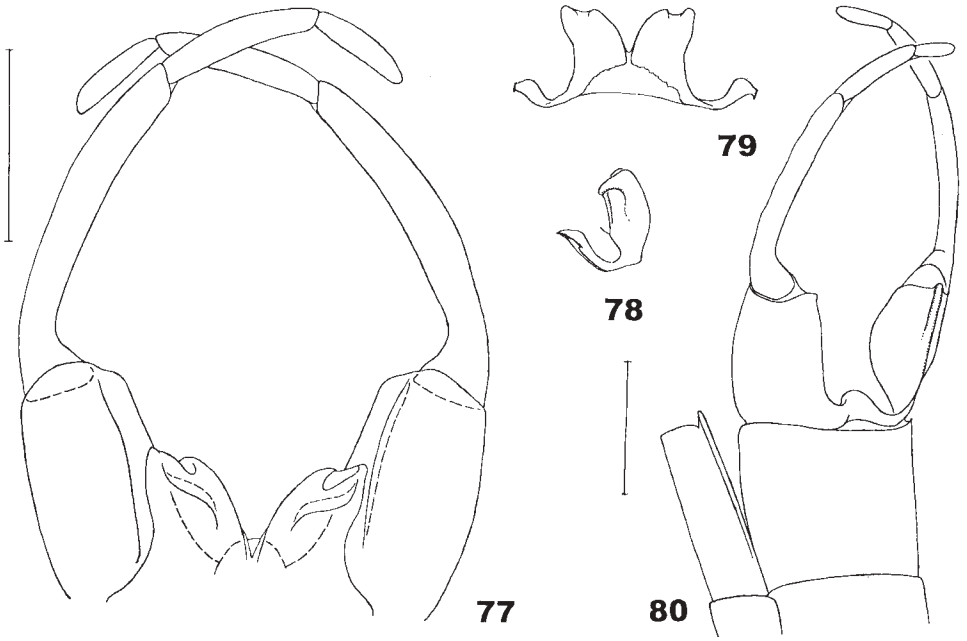
Sparrea violacea Matsumura, 1931: 1475 (imaginal description; type locality: Hokkaido; syntypes in Hokkaido University); Matsumura, 1931: 200; Uéno, 1931: 111. Synonymized by Imanishi 1933.

Chirotenetes (?) *japonicus*: Uéno, 1928: 52 (larval description).

Isonychia (*Isonychia*) *japonica*: Ishiwata 2001*a*: 69; 2001*b*: 183; 2002: 17.

Material examined

JAPAN. Hokkaido: Sapporo, 6.ix.1919, 6 I♂ (syntypes of *Sparrea violacea*, HU); Sapporo, 6.ix.1919, S Matsumura, 7 I♂ (HU); Kushirogawa River, Sakae-machi, Kushiro-shi, 18.ix.1989, N Kuhara, 3 L; Daiichiusakumabashi Bridge, Chitosegawa River, Rankoshi, Chitose-shi, 25.ix.1999, T Ito, 1 I♂, 1 I♀ (ZIN). **Honshu:** Chiba Prefecture, Obitsugawa River, Kimitsu-shi, 15.ix.1993, S Ishiwata, 1 I♂, 1 I♀; Shiga Prefecture, Suigensi-cho, 28.vi.1995, S Uchida, 1 I♂, 1 I♀; Kanagawa Prefecture, Aoyamachindenchi, Aoyama, Tsukui-machi, 29.viii.1992, S Ishiwata, I♂ (ZIN); Saitama Prefecture, Kaiheibashi Bridge, Arakawa River, 6.iv.1993, S Ishiwata, 1 I♂ (ZIN);



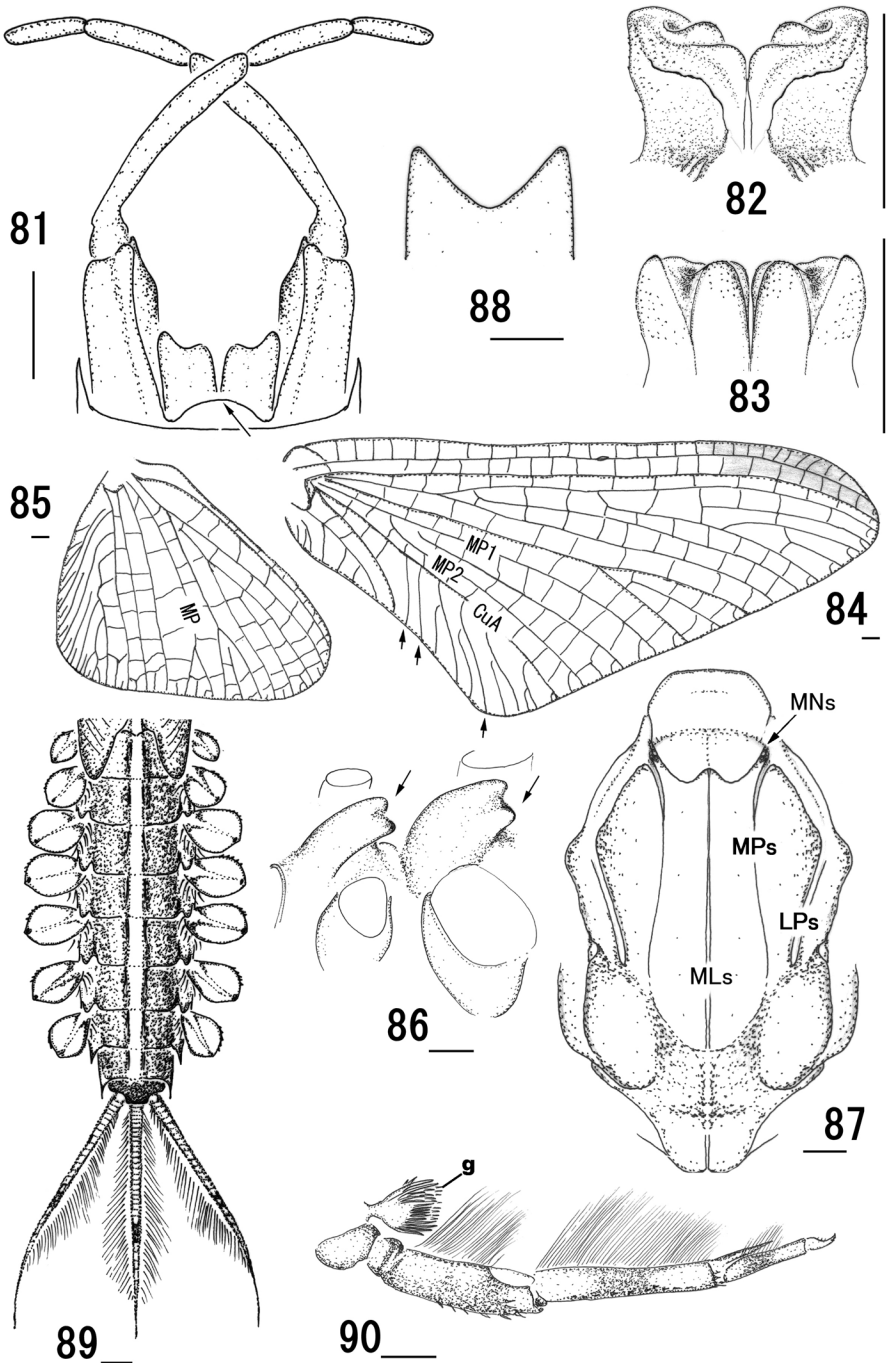
FIGURES 77–80. *Isonychia japonica*, genitals of male imago. 77, genitals (dorsal view); 78, penis with penial arms (lateral view); 79, the same (ventral view); 80, abdominal segment IX with styliger and gonostyli (lateral–ventral view, penis and segment X removed). Scale bars: 0.5 mm.

Gunma Prefecture, Tonegawa River, Tamamura-cho, 19.ix.1999, S Ishiwata, 1 I♂ (ZIN); Nara Prefecture, Takamigawa River, Higashiyoshino-mura, vii.1996, S Ishiwata, 1 I♂, 1 S♂ (ZIN); Mie Prefecture, Nishimura-machi, Yokkaichi-shi, 11.vi.1988, Morita, 1 I♂ (ZIN); Tottori Prefecture, Sasafuki Bridge, Hinokawa River, Mizokuchi-cho, 5.ix.2000, S Ishiwata, 1 I♂, 2 I♀ (ZIN). **Shikoku:** Kochi Prefecture, Miyamukaibashi Bridge, Kubokawa River, Shimantogawa River, Towa-mura, 11.x.1988, S Ishiwata, 1 I♂, 1 I♀. **Kyushu:** Miyazaki Prefecture, Nanatsuyamagawa River, Morotsuka-son, 22.iii.1988, S Ishiwata, 1 L.

Description

Male imago. Dimensions: forewing and body 10–18 mm. **Head:** eyes grey with reddish tinge. **Thorax:** terga and sterna brown, pleura lighter. Foreleg with trochanter, femur, and tibia dark brown; tarsal segments 1–4 whitish in proximal half and dark brown in distal half, segment 5 dark brown. Middle and hind legs with coxa brown; trochanter,femur, tibia, and tarsus light yellowish or whitish, distal part of tarsal segment 5 darkened. Wings without coloration, all veins colourless or light yellowish, pterostigma from white to very light brownish (Figs. 84–85). **Abdomen:** brown, colour typical for group *japonica* (see above). Gonostyli pedestals long; penis short, not exceeding middle of gonostyli pedestals; dorsal flap (typical for group *japonica*; see above) sharply curved, being nearly transverse in distal part and nearly longitudinal in proximal–median part (Figs. 77–83). Cerci whitish with brown base.

Female imago. Dimensions: forewing and body 12–20 mm. **Head:** eyes dark grey. Head between eyes light, with a pair of distinct brownish longitudinal median stripes whose hind parts are curved laterally and connected with dark brown lateral angles; anterolaterally between lateral ocelli and eyes a pair of brownish spots. **Thorax:**



FIGURES 81–90. ***Isonychia japonica*****. 81–87, male imago: 81, genitals (ventral view); 82, penis (dorsal view); 83, penis (ventral view); 84, forewing; 85, hind wing; 86, meso- and meta-sternum (ventral–lateral view); 87, mesonotum. 88, female imago: subanal plate (ventral view). 89–90, larva: 89, abdomen (dorsal view); 90, right foreleg. g, gill; LPs, lateroparapsidal suture; MLs, median longitudinal suture; MNs, mesonotal suture; MPs, medioparapsidal suture. Scale bars: 0.5 mm.**

yellowish brown with brown, sterna brown. Colour of legs and wings as in male. **Abdomen:** yellowish-reddish-brown colour pattern typical for group *japonica*. Cerci as in male.

Subimago (cuticular pigmentation, in addition to hypodermal pigmentation as in imago). **Head:** antennae brown. **Thorax:** colour of mesonotum typical for genus *Isonychia* (see above). Wings brownish grey; forewing can have indistinct lighter and darker maculation; crossveins not bordered by brown. **Abdomen:** light brown. Cerci brownish.

Mature larva. Head: brown to dark brown with whitish stripe on epicranium. **Thorax:** nota brown to reddish brown with whitish or yellowish middorsal stripe, stripe rarely faint. **Abdomen:** typical for group *japonica* (Fig. 89). Bare tail of cercus dark with light tip.

Egg. Spherical; chorion partly covered with reticulation; KCTs densely packed on one hemisphere, scattered on other hemisphere (Figs. 115–119).

Distribution

Japan, from Hokkaido to Kyushu. Formerly this species was reported from China, Mongolia, Korea, and Russian Far East (Ulmer 1936; Imanishi 1940; Tshernova 1952; Braasch 1982; Tshernova *et al.* 1986; Vshivkova 1988; Bae *et al.* 1994); in these cases it was confused with other species described above. Gose (1979) stated that *I. japonica* was distributed from Hokkaido to Okinawa; however, its presence on Okinawa is not confirmed.

Discussion

Isonychia japonica differs from *I. vshivkovae* **sp. nov.** by shorter penis, from *I. crassiuscula* **sp. nov.** by longer gonostyli pedestals and more transverse dorsal flap of penis.

Until recently, *I. japonica* was the only species of the subgenus *Isonychia* known from Japan. Navás (1919) reported *Chorotonetes aridus* (Say) from Shinamo (= Shinano, now Nagano Prefecture, Honshu, Japan) without description. The North American species *Isonychia arida* (Say, 1839) has unique bicoloured foretibia of male and female imago (Kondratieff and Voshell 1984); this species was never found in Japan, therefore, we suspect that *I. arida* was reported in Japan erroneously. A single dry female imago labelled Japan (deposited in ZIN), probably belongs to a species different from *I. japonica*; however, it is unclear if this specimen was really collected in Japan. Examined specimens of *I. japonica* from Japan are morphologically indistinguishable except for the eggs; eggs are somewhat variable in size of area occupied by densely packed KCTs.

Subgenus *Prionoides* Kondratieff *et* Voshell, 1983

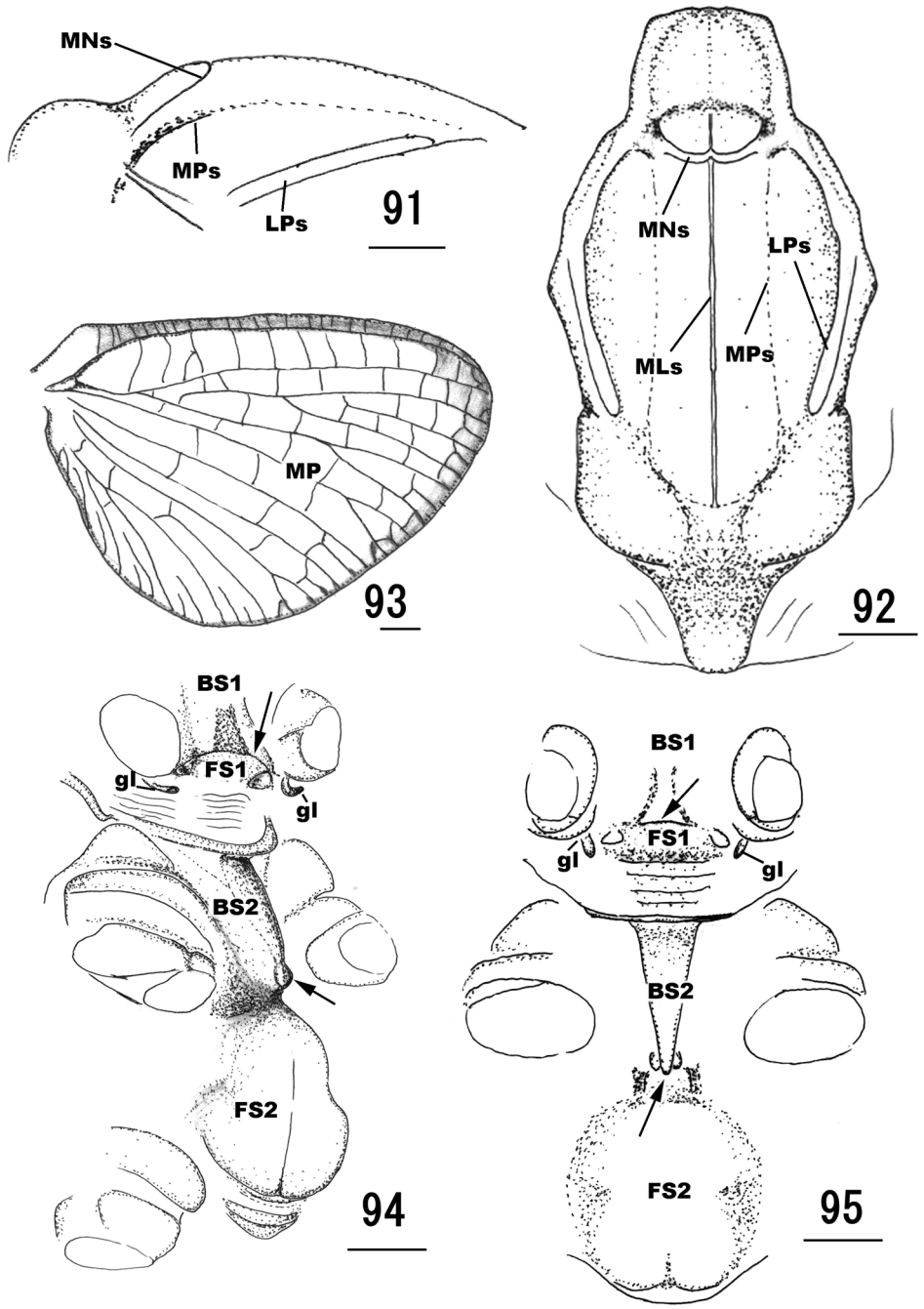
(Figs. 91–100, 123–125)

Isonychia subgenus *Prionoides* Kondratieff *et* Voshell, 1983: 129 (type species: *Isonychia georgiae* McDunnough, 1931; by original designation).

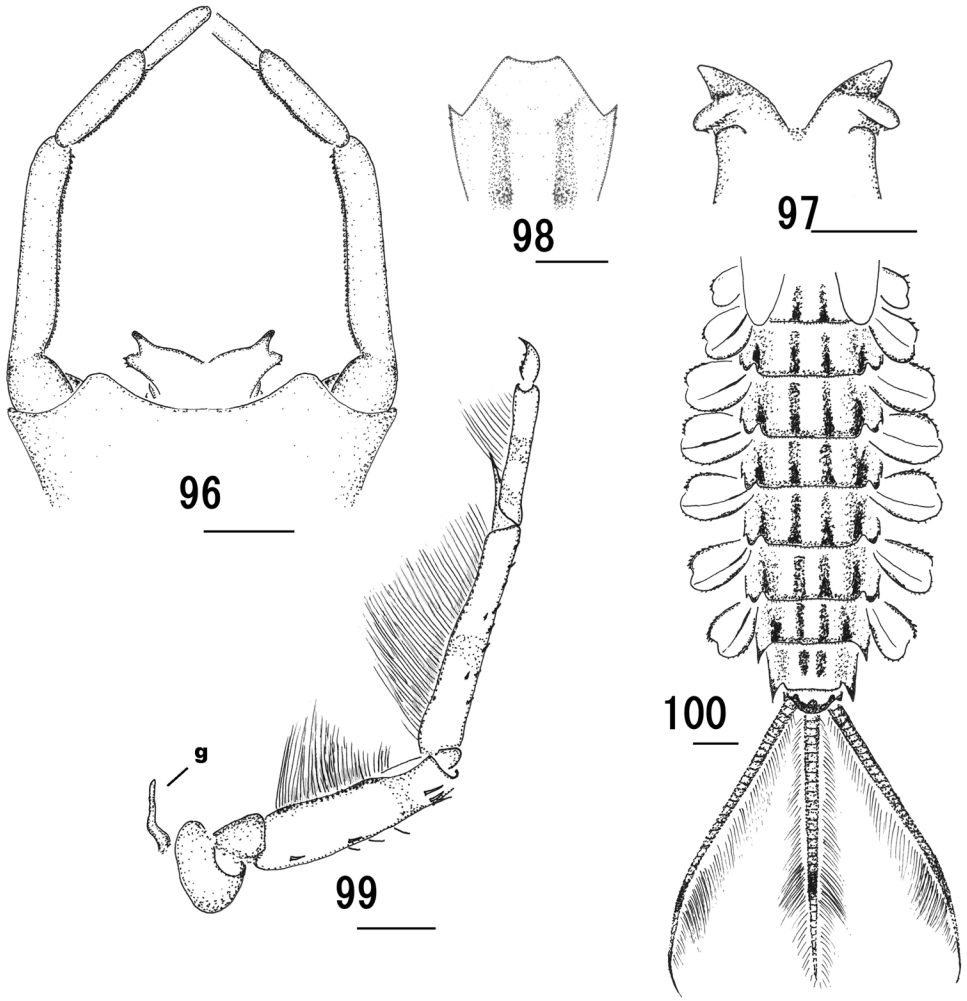
Description

Male imago. Styliger between gonostyli pedestals only slightly shorter than gonostyli pedestals, broadly concave (Fig. 96). Penis dorsolaterally with a pair of projections, curved medially and bearing sclerotized denticles (Fig. 97).

Female imago. Subanal plate with shallow posteromedian emargination (Fig. 98).



FIGURES 91–95. ***Isonychia*** **(*Prionoides*)** ***shima*** **male imago. 91, anterior part of mesonotum (lateral view); 92, hind wing; 93, mesonotum; 94, pro- and meso-sternum (ventral–lateral view, arrow showing transverse crest); 95, the same (ventral view). gl, gill remnant; BS1, prothoracic basisternum; BS2, mesothoracic basisternum; FS1, prothoracic furcasternum; FS2, mesothoracic furcasternum; LPs, lateroparapsidal suture; MLs, median longitudinal suture; MNs, mesonotal suture; MPs, medioparapsidal suture. Scale bars: 0.5 mm.**



FIGURES 96–100. ***Isonychia* (*Prionoides*) *shima*. 96–97, male imago: 96, genitals (ventral view); 97, penis (dorsal view). 98, female imago: subanal plate (ventral view). 99–100, larva: 99, right foreleg (dorsal view); 100, abdomen (dorsal view). g, gill. Scale bars: 0.5 mm.**

Larva. Forecoxal gills usually have a form of single thick filament (Fig. 99) (a tuft of multibranched filaments in North American *I.* (*P.*) *sayi* Burks, 1953).

Egg. Biconvex; KCTs closely spaced at centre on one side; micropyle present on the side lacking KCTs (Figs. 123–125).

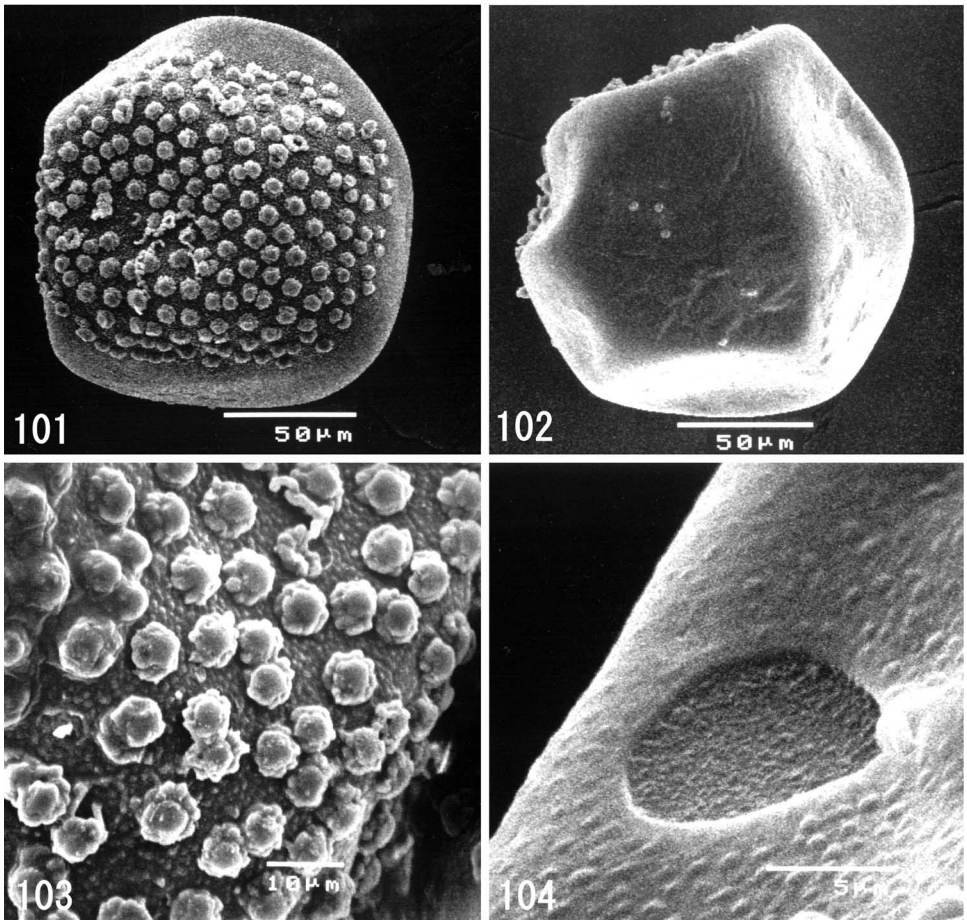
Isonychia (*Prionoides*) *shima* (Matsumura, 1931)

(Figs. 91–100, 123–125)

Rhoenanthus shima Matsumura, 1931*a*: 1470 (imaginal description; type locality: Hokkaido; syntype in Hokkaido University); Matsumura, 1931*b*: 200; Uéno, 1931: 105.

Isonychia (*Prionoides*) *shima*: Ishiwata, 2001*a*.

Siphlonisca jazana Matsumura, 1931*a*: 1475 (imaginal description; type locality: Hokkaido; syntypes in Hokkaido University); Matsumura, 1931*b*: 200; Uéno, 1931:



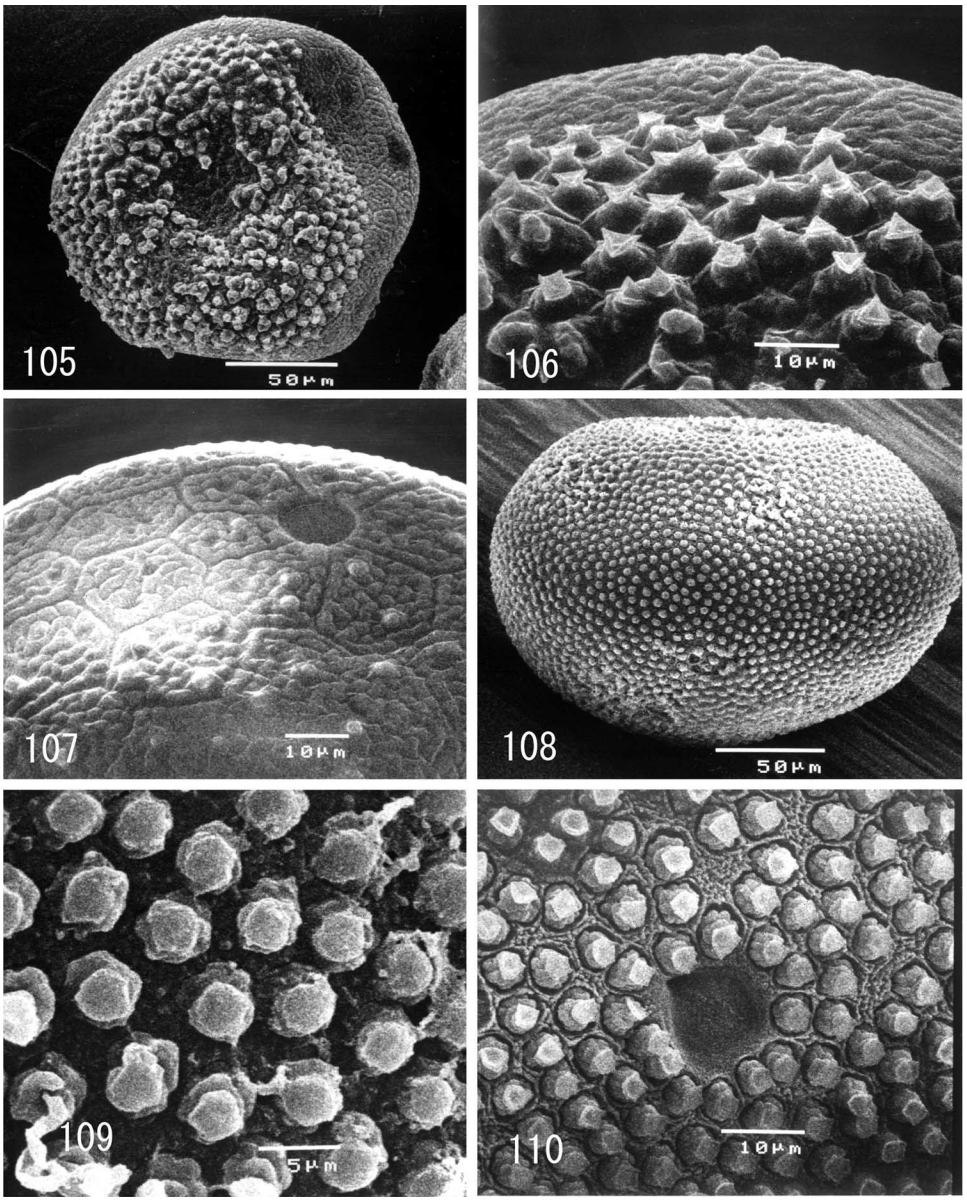
FIGURES 101–104. ***Isonychia ignota*** **eggs. 101, view to KCT-packed pole; 102, view to KCT-scattered pole; 103, KCT-concentrating pole; 104, micropyle. KCT, knob-terminated coiled thread.**

106; Matsumura, 1933: 64 (imaginal description); Imanishi, 1933: 68 (imaginal description). Synonymized by Ishiwata 2001*a*.

Siphlonisca sukashii Matsumura, 1931: 1475 (imaginal description; type locality: Hokkaido; syntype in Hokkaido University); Matsumura, 1931: 200; Uéno, 1931: 106; Matsumura, 1933: 66 (imaginal description); Imanishi, 1933: 69. Synonymized by Ishiwata, 2001*a*.

Material examined

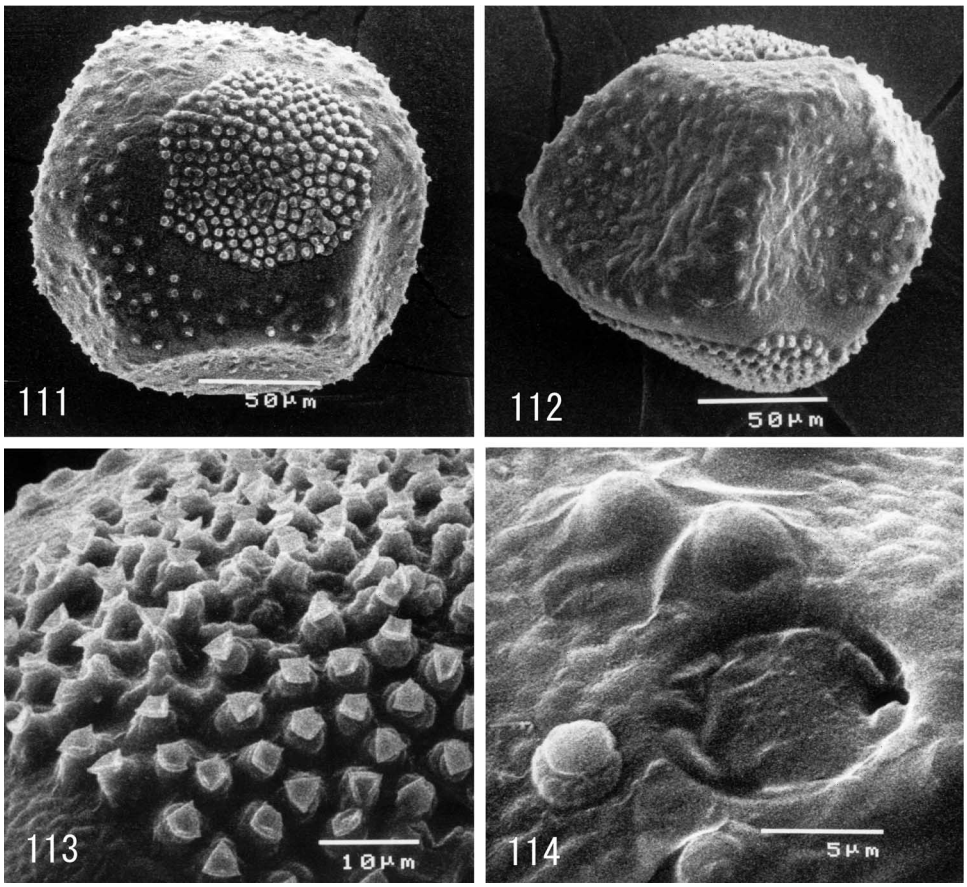
JAPAN. Hokkaido: Sapporo, 13.viii.1918, 1 I♀ (syntype of *Rhoenanthus shima*, HU); Jozankei, Sapporo, 28.viii.1913, 5 I♂ (syntypes of *Siphlonisca jazana*, HU); 18.vi.1916, 1 I♀ (syntype of *Siphlonisca sukashii*, HU); Jozankei, Sapporo, 28.viii.1913, S Matsumura, 5 I♀ (HU); Chitosegawa River, Chitose-shi, Ishikari-shicho, 23.ix.1997, S Ishiwata, 1 I♂, 1 I♀; Shimizu-cho, Tokachigawa River, Kamikawa-gun, Tokachi-shicho, 11.vii.1985, S Ishiwata, 3 L; **Honshu:** Niigata Prefecture, Miomotegawa River, Asahi-mura, Iwafune-gun, 31.vii.1994, S Ishiwata, 1 S ♂ (ZIN), 1 S♀.



FIGURES 105–110. Eggs. 105–107, *Isonychia sexpetala*: 105, view to KCT-packed pole; 106, KCT-packed pole; 107, micropyle. 108–110, *Isonychia crassiuscula*: 108, general view; 109, knob-terminated coiled threads (KCT); 110, micropyle.

Description

Male imago. Dimensions: body 12–14 mm, forewings 10–14. **Thorax:** wings hyaline; forewing slightly margined with brown, hind wing distinctly margined with brown. On foreleg, trochanter and femur yellow, tibia and tarsus dark brown. Middle and hind legs yellow. **Abdomen:** pale, tergum 1 entirely dark, each tergum 2–9 with following contrast dark brown markings: pair of longitudinal submedian stripes, pair of



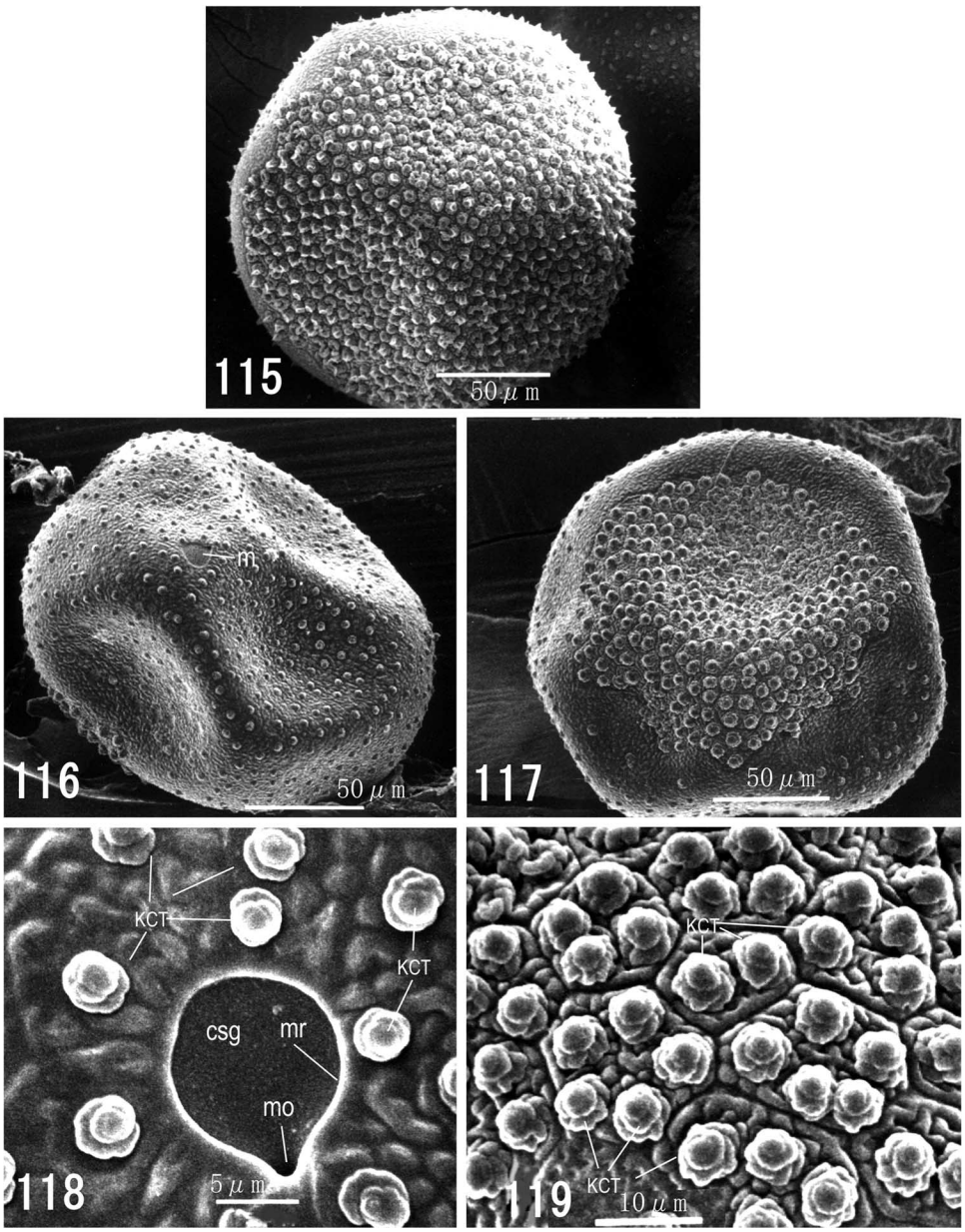
FIGURES 111–114. ***Isonychia ussurica*** **eggs. 111, view to pole; 112, view to equator; 113, pole; 114, micropyle.**

oblique lateral stripes divergent anteriorly, and transverse band on posterior margin (similar to larva, Fig. 100); each sternum 2–9 with a pair of contrast dark brown submedian longitudinal stripes. Genitals typical for the subgenus *Prionoides* (Figs. 96–97).

Female imago. Dimensions: body 13–16 mm, forewings 12–15 mm. Prosternum and mesosternum wider than those of male.

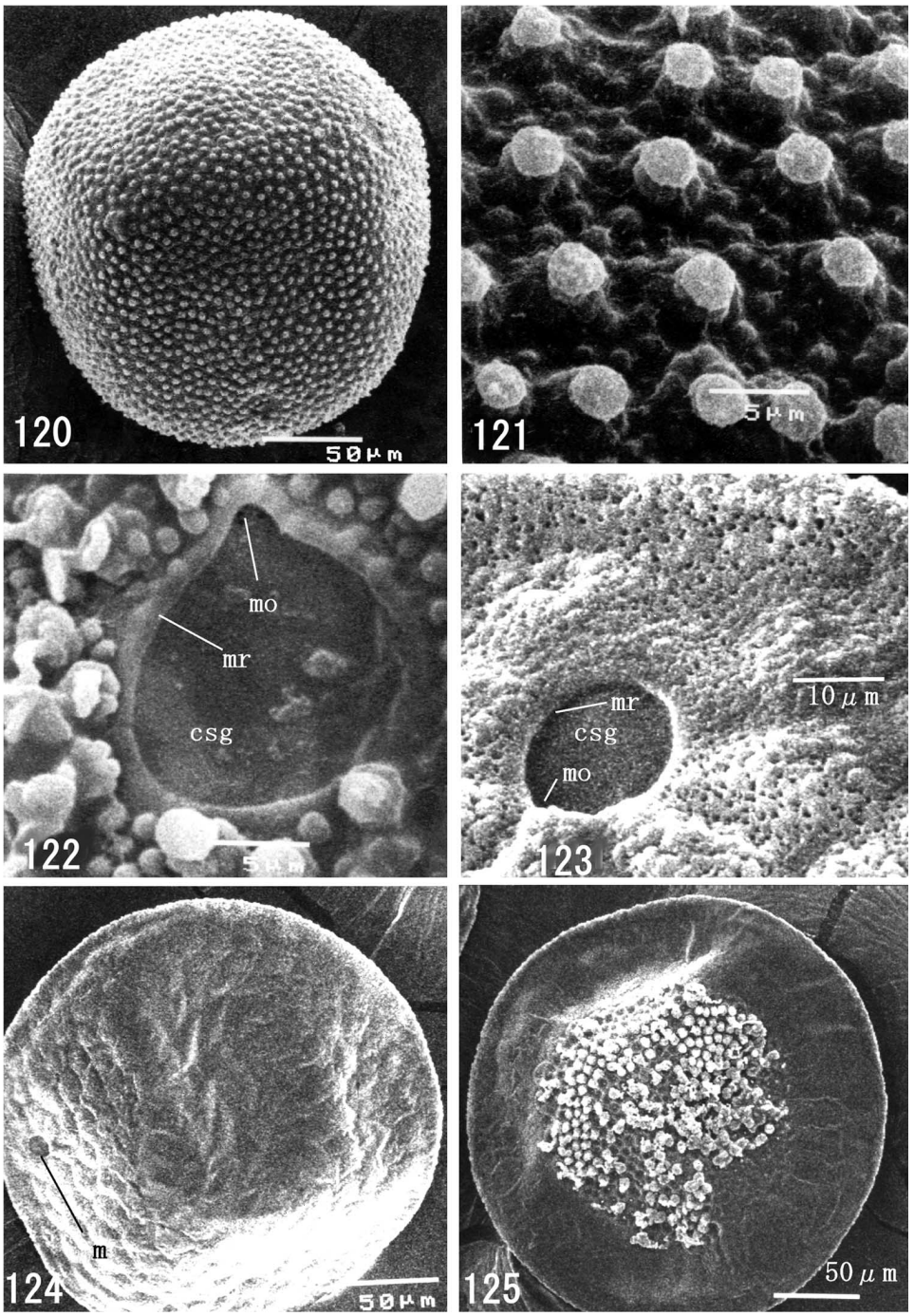
Subimago. Body colour and marking as in imago. **Thorax:** Colour of mesonotum typical for genus *Isonychia* (see above). Wings light grey.

Mature larva. Dimensions: body 10–15 mm. **Head:** cuticular pigmentation: brown to yellowish brown with whitish coronal stripe. **Thorax:** nota brown to yellowish brown with whitish middorsal stripe (cuticular pigmentation); pronotum, besides cuticular markings, with two pairs of hypodermal brown spots. Femur of each leg with two wide transverse dark brown bands; tibia with a median dark brown transverse band; tarsus in basal part dark brown, in distal part light (cuticular pigmentation). Forecoxal gills in form of a single thick filament (Fig. 99). **Abdomen:** terga 1–9 yellowish brown to brown, with a wide contrast light middorsal stripe (cuticular pigmentation) and distinct hypodermal pigmentation as in imago: a pair of submedian dark brown stripes bordering light middorsal stripe, and a pair of more lateral oblique stripes or series of dots (Fig. 100). Tergum X light in anterior half, dark in posterior half (hypodermal



FIGURES 115–119. ***Isonychia japonica*** **eggs. 115, view to KCT-packed pole (specimen from Gifu-ken, Suigenji-cho); 116–117, specimen from Chiba-ken, Kimitsu-shi: 116, view to KCT-scattered pole; 117, view to KCT-packed pole; 118, micropyle; 119, KCT-packed pole. csg, chorionic sperm guide; KCTs, knob-terminated coiled threads; m, micropyle; mo, micropylar opening; mr, micropylar rim.**

pigmentation). Sterna lighter; sterna 2–9 with a pair of submedian oblique dark brown hypodermal and cuticular streaks and a pair of cuticular brown spots near anterolateral angles.



FIGURES 120–125. Eggs. 120–122, *Isonychia vshivkovae*: 120, general view; 121, KCTs; 122, micropyle. 123–125, *Isonychia* (*Prionoides*) *shima*: 123, micropyle; 124, view to KCT-lacking side; 113, view to KCT-packed side. KCTs, knob-terminated coiled threads; csg, chorionic sperm guide; m, micropyle; mo, micropylar opening; mr, micropylar rim.

Egg. Biconvex; KCTs packed on one side; micropyle on opposite side (Figs. 123–125).

Distribution

Japan: Hokkaido and Honshu.

Discussion

Rhoenanthus shima Matsumura, 1931 was declared to be a *nomen dubium* by Bae and McCafferty (1991); however, status of this species was clarified when the syntype, located in the Matsumura Collection in Hokkaido University, was examined (Ishiwata 2001*a*).

Acknowledgments

This study was financed by the Grant-in-Aid for Overseas Scientific Survey, No. 04041035, from the Ministry of Education, Science, Culture, and Sports (Japan), and by the Federal Program for Support of Leading Scientific Schools, No. 00-15-97934 (Russian Federation); and partially supported by the fund for International Cooperative Study from the Japan Society for the Promotion of Science (1991) to S Tanaka, Toyama University, and Grant-in-Aid for International Scientific Research, No. 07041130, from the Ministry of Education, Culture, and Science of Japan.

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(Received: 3 February 2003; accepted: 26 June 2003)