HOKKAIDO UNIVERSITY

Title	The Millipedes (Diplopoda) of the Sakhalin Island
Author(s)	Mikhaljova, Elena V.
Description	Biodiversity and Biogeography of the Kuril Islands and Sakhalin vol.3
Citation	北海道大学総合博物館研究報告, 5, 63-77
Issue Date	2009-03
Doc URL	https://hdl.handle.net/2115/47860
Type	departmental bulletin paper
File Information	v. 3-4.pdf

Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP

Biodiversity and Biogeography of the Kuril Islands and Sakhalin (2009) 3, 63–77.

The Millipedes (Diplopoda) of the Sakhalin Island

Elena V. Mikhaljova

Institute of Biology and Soil Science, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok 690022, Russia.
E-mail: mikh@mail.primorye.ru

Abstract A review of the millipede fauna of the Sakhalin Island is provided, with 13 recognizable species involved. A brief historical account, a comparative analysis, and some zoogeographical comments are provided. In addition, new faunistic records and data on the distribution of the island's species are given. Illustrations are provided for all species encountered. All currently known species from the Sakhalin Island are keyed.

Key words: Diplopoda, fauna, distribution, keys, Sakhalin, islands, Far East of Russia

Introduction

The first data on the millipede fauna of the Sakhalin Island derive from the publication of Chamberlin & Wang (1953) in which the only synanthropic subcosmopolitan species was mentioned as occurring in this island. After a long period of inactivity the first ecological observations of general millipede abundance in the southern part of Sakhalin have appeared (Molodova 1973, 1974, 1976). At the same time Golovatch (1976) described the new genus and species from there. These data remained the only reliable records of the millipedes of the Sakhalin Island until the 1990's of the twentieth century when additional species were reported from this island (Mikhaljova 1990, 1993). The papers exclusively devoted to the diplopods of the Sakhalin and Kurile islands was published after a break (Mikhaljova 1995; Mikhaljova and Basarukin 1995). In addition, new taxonomical data, faunistic reviews and the information on the distribution of some species have appeared (Enghoff 1994; Ganin 1997; Mikhaljova 1998a, 1998b, 2000; Mikhaljova and Golovatch 2001; Mikhaljova and Korsós 2003; Mikhaljova and Marusik 2004, 2006; Shear 1990; Shelley 1993, 1998).

The main data on the diplopods of the Sakhalin Island are summarized in the review of the millipede fauna of the Asian part of Russia (Mikhaljova 2004).

Material and Methods

Materials treated here are deposited in the collection of the Institute of Biology and Soil Science, Far Eastern Branch of the Russian Academy of Sciences (IBSS), Vladivostok, Russia.

Species names include the literature references for Sakhalin only. The classification adopted here is basically that of Hoffman (1980).

Faunistic Part

Order Polyzoniida
Family Polyzoniidae

***Angarozonium aduncum* (Mikhaljova, 1995)** [Figs 1–2.]

Polyzonium aduncum Mikhaljova, 1995 in: Mikhaljova & Basarukin, 1995: 90–91, 90: map 1, 91: figs 1–3.

Angarozonium aduncum – Shelley, 1998: 30; Mikhaljova, 1998b: 12, 11: figs 21–22, 12: map 2; 2004: 44–45, 44: figs 20–21, 45: map 2; Mikhaljova & Marusik, 2006: 116, 122, 124–125, 116: figs 1–2.

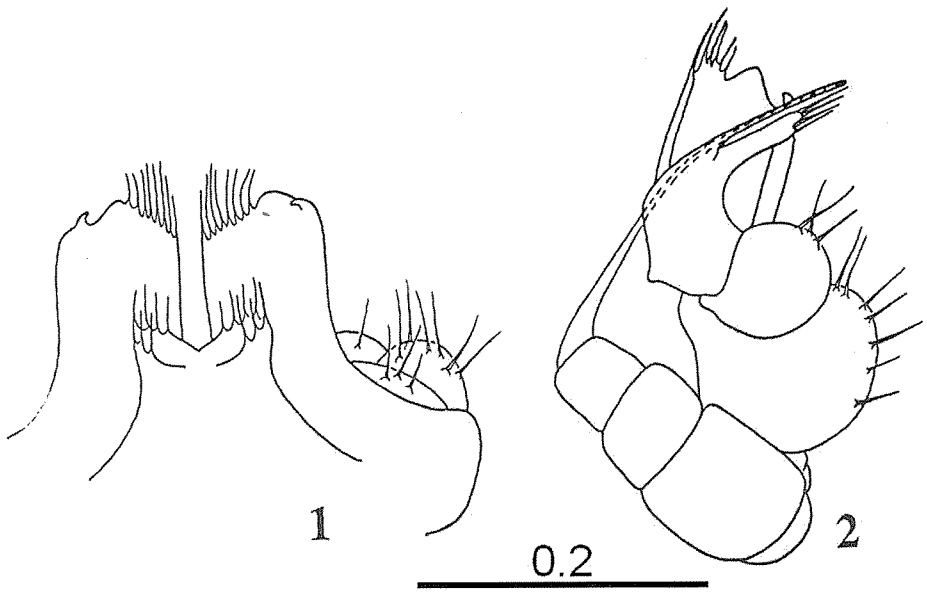
Material examined. 1 male (IBSS), Russia, Sakhalin Island, SW part, Krilyon Peninsula, W slope, ca. 5 km S of Shebunino, 36°22.536' N 141°52.562' E, 14–15.VIII.2001, leg. Yu.M. Marusik. – 1 female (IBSS), Russia, Sakhalin Island, SW part, Krilyon Peninsula, east side, Uryum River, ca. 3 km from mouth, 46°28.078' N 142°19.764' E, 17–18.VIII.2001, leg. Yu.M. Marusik.

Distribution. Russia: Far East (southern part of Sakhalin Island, Kurile Islands: Kunashir, Shikotan).

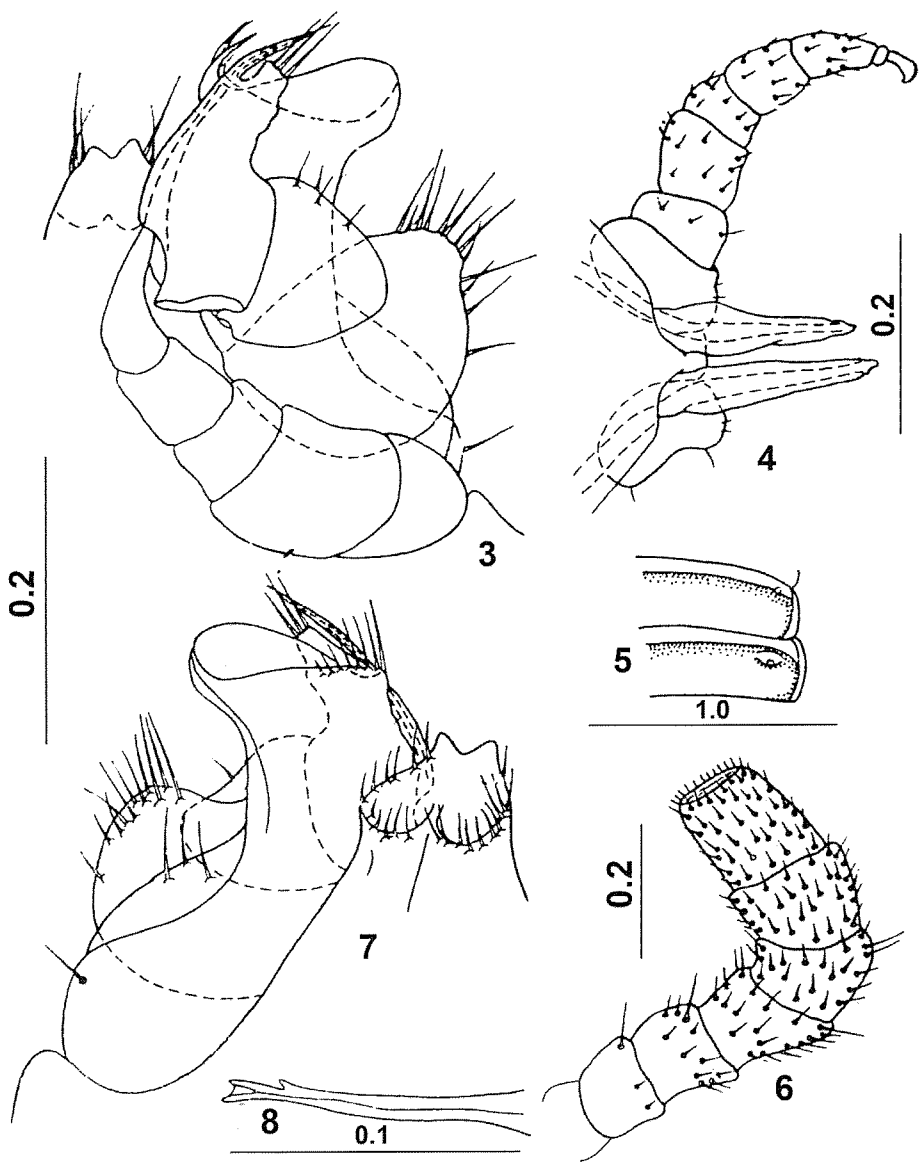
***Angarozonium amurense* (Gerstfeldt, 1859)** [Figs 3–8.]

Polyzonium cyathiferum – Mikhaljova, 1990: 137; 1993: 8–9, 8: map 1; Mikhaljova & Basarukin, 1995: 90: map 1; Ganin, 1997: 133.

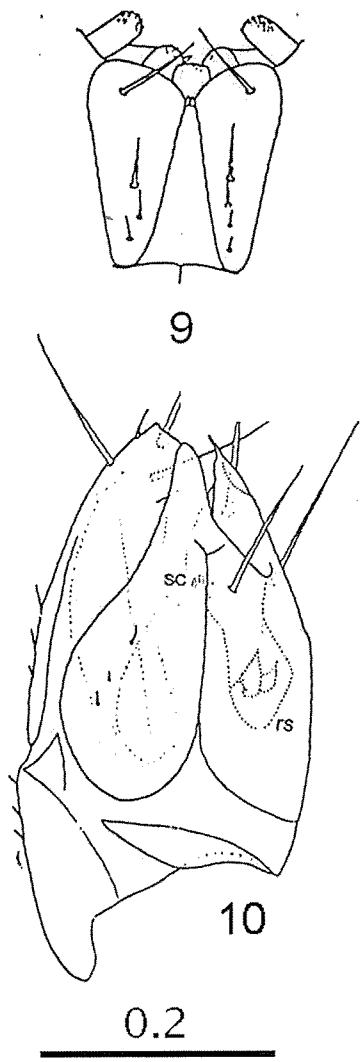
Angarozonium amurense – Mikhaljova, 1998b: 12–13, 12: map 2, 13: figs 23–28; 2002: 207; 2004: 45–48, 46: figs 22–27, 47: map 3; Mikhaljova & Marusik, 2006: 125.



Figures 1–2. *Angarozonium aduncum* (Mikhaljova, 1995). 1 – gonopods (front view); 2 – gonopods (caudal view). Scale in mm (after Mikhaljova and Basarukin 1995).



Figures 3–8. *Angarozonium amurense* (Gerstfeldt, 1859). 3 – gonopods (caudal view); 4 – male leg pair 2 and penes; 5 – sides of male body segments 5 and 6; 6 – antenna; 7 – gonopods (front view); 8 – last telopoditomere of posterior gonopod. Scales in mm (after Mikhaljova 1981, with some changes).



Figures 9–10.
Orinisobates microthylax Enghoff, 1985. 9 – lamellae linguales and promentum of female gnathochilarium; 10 – left vulva; rs – receptaculum seminis with a pair of internal flaps; sc – sclerotisations at base of receptaculum seminis. Scale in mm (after Enghoff 1985).

Material examined. 2 males, 5 females (IBSS), Russia, Sakhalin Island, Poronaisk District, near Poronaisk, *Salix* forest, 24.VIII.1993, leg. A.M. Basarukin. – 1 male (IBSS), Russia, Sakhalin Island, CN part, Tim River (upper flow), E of Palevo village, 50°37' N 142°55' E, 7–8.VIII.2001, leg. Yu.M. Marusik.

Distribution. Russia: Siberia (central part of Krasnoyarsk Province, Irkutsk Area, Chita Area, Buryatia, Republic of Sakha [Yakutia]), Far East (southern part of Khabarovsk Province, Jewish Autonomous Region, northern and central parts of Sakhalin Island, Kamchatka Peninsula). Northeast China. North Mongolia.

Order Julida
Family Nemasomatidae

***Orinisobates microthylax* Enghoff, 1985** [Figs 9–10.]

Orinisobates microthylax – Mikhaljova, 1993: 16, 12: map 2; 1998a: 7; 1998b: 73, 73: map 19, 72: figs 316–317; 2004: 94–96, 94: map 12, 95: figs 211–212; Mikhaljova & Basarukin, 1995: 91–92, 90: map 1; Mikhaljova & Golovatch, 2001: 107; Mikhaljova & Korsós, 2003: 219–220; Mikhaljova & Marusik, 2004: 5; 2006: 116–117, 123–125, 117: figs 3–4; Enghoff, 1994: 29.

Remarks. This species is characterized by parthenogenesis.

Distribution. Russia: Siberia (Buryatia), Far East (central and southern parts of Kamchatka Peninsula, southern part of Kuriles, Sakhalin Island, southern part of Khabarovsk Province, Primorsky Province, Amurskaya Area, Jewish Autonomous Region).

***Orinisobates soror* Enghoff, 1985** [Figs 11–16.]

Orinisobates soror – Mikhaljova, 1990: 137; 1993: 16, 12: map 2; 1998a: 7; 1998b: 72–73, 72: figs 312–315, 73: map 19; 2004: 92–94, 93: figs 205–210, 94: map 12; 2006: 202; Mikhaljova & Basarukin, 1995: 91, 90: map 1; Mikhaljova & Marusik, 2006: 117, 123–125, 117: figs 5–10; Ganin, 1997: 133.

Material examined. 19 males, 23 females, 4 juveniles (IBSS), Russia, Sakhalin Island, Korsakov District, near Utiosnoe, 15.IX.1993, leg. A.M. Basarukin.

Distribution. Russia: Far East (southern part of Sakhalin Island, Moneron Island, southern and middle parts of Kuriles).

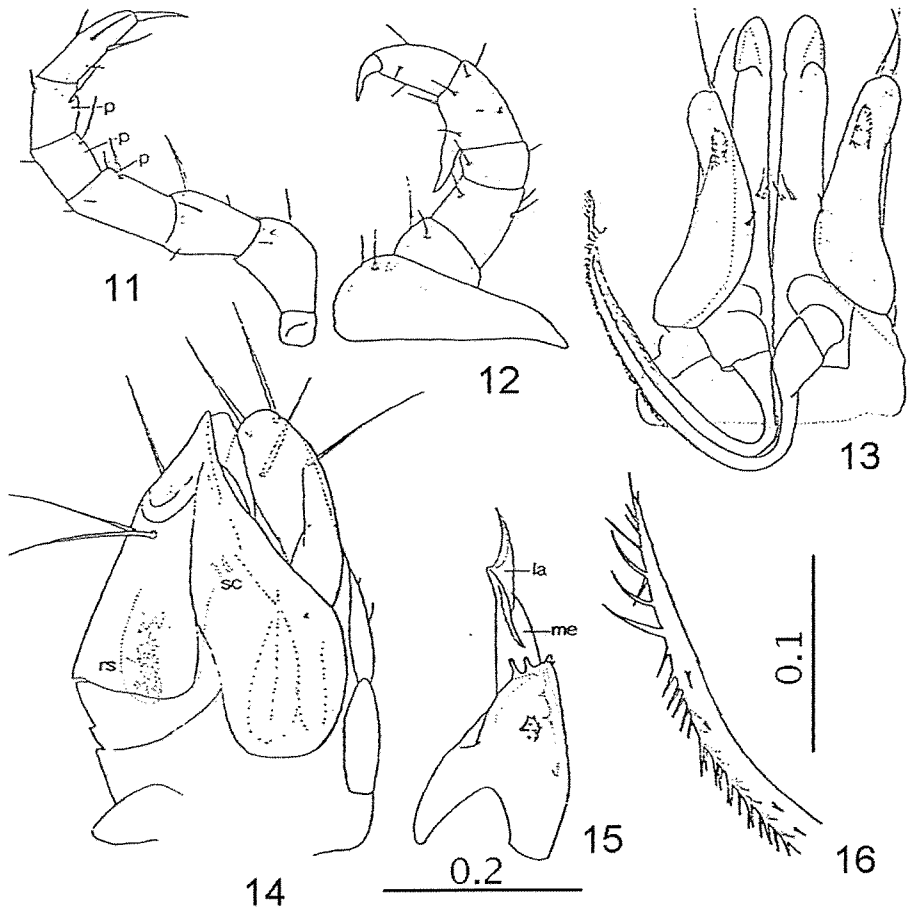
Order Chordeumatida
Family Diplomaragnidae

***Sakhalineuma basarukini* (Mikhaljova, 1995)** [Figs 17–23.]

Diplomaragna basarukini Mikhaljova, 1995: 82, 81: figs 5–12; 1998b: 21–22, 20: figs 57–62, 19: map 5; Mikhaljova & Basarukin, 1995: 94, 93: map 3.

Sakhalineuma basarukini – Mikhaljova, 2000: 172; 2004: 124–126, 125: figs 284–290, 126: map 17; Mikhaljova & Marusik, 2006: 125.

Material examined. 3 males, 9 juveniles (IBSS), Russia, Sakhalin Island, central part, Leonidovka River (right tributary of Poronai River), 30 m downstream from Ulyanovka River mouth, 49°15.092' N 142°43.889' E, 4–5.VIII.2001, leg. Yu.M. Marusik. – 1 male, 1 female, 1 juvenile (IBSS), Russia, Sakhalin Island, CN part, Tim River (upper flow), east of Palevo, 50°37' N 142°55' E, 220 m, 7–8.VIII.2001, leg.



Figures 11–16. *Orinisobates soror* Enghoff, 1985. 11 – male midbody leg; 12 – male leg of pair 1 (front view); 13 – anterior gonopods (caudal view); 14 – right vulva; 15 – right posterior gonopod (lateral view); 16 – distal part of flagellum; la – lateral lamella; me – mesal lamella; p – soft pads; rs – receptaculum seminis with sperm; sc – sclerotisations at base of receptaculum seminis. Scales in mm (after Enghoff 1985).

Yu.M. Marusik. – 2 males, 1 juvenile (IBSS), Russia, Sakhalin Island, NE part, East Sakhalin Range, below Chamginski Pass, 50°39.830' N 143°10.001' E, 400 m, *Abies-Larix-Picea* forest with *Ledum*, thick layer of *Sphagnum*, litter of sparse *Pinus pumila* bushes among forest, 8.VIII.2001, leg. Yu.M. Marusik.

Distribution. Russia: Far East (northern and central parts of Sakhalin Island).

***Sakhalineuma curvatum* (Mikhaljova, 1995)** [Figs 24–28.]

Diplomaragna curvata Mikhaljova, 1995: 83–86, 84: figs 19–23; 1998b: 23, 23: figs 72–74, 19: map 5; Mikhaljova & Basarukin, 1995: 94, 93: map 3.

Sakhalineuma curvatum – Mikhaljova, 2000: 172; 2004: 129–130, 130: figs 299–303, 126: map 17; 2006: 202–203; Mikhaljova & Marusik, 2006: 118, 123–125, 118: figs 12–16.

Material examined. 2 males, 2 females (IBSS), Russia, Sakhalin Island, SW part, Krilyon Peninsula, W shore, ca. 5 km S of Shebunino, Kitosia River mouth, 36°22.536' N 141°52.562' E, 14–15.VIII.2001, leg. Yu.M. Marusik. – 3 males, 3 females, 5 juveniles (IBSS), Russia, Sakhalin Island, SW part, Krilyon Peninsula, eastern side, Uryum River, ca. 3 km from mouth, 46°28.078' N 142°19.746' E, 17–18.VIII.2001, leg. Yu.M. Marusik.

Remarks. The diplopod materials from the Moneron Island contain juveniles and a single female belonging to the genus *Sakhalineuma* (Mikhaljova 2006). In the absence of males it appears impossible to provide a closer identification. However, it seems quite plausible that these individuals actually belong to *S. curvatum* or *S. tuberculatum* known from the Krilyon Peninsula, Sakhalin Island.

Distribution. Russia: Far East (southern part of Sakhalin, ?Moneron Island, Kurile Islands: Kunashir, Iturup).

***Sakhalineuma globuliferum* (Mikhaljova, 1995)** [Figs 29–31.]

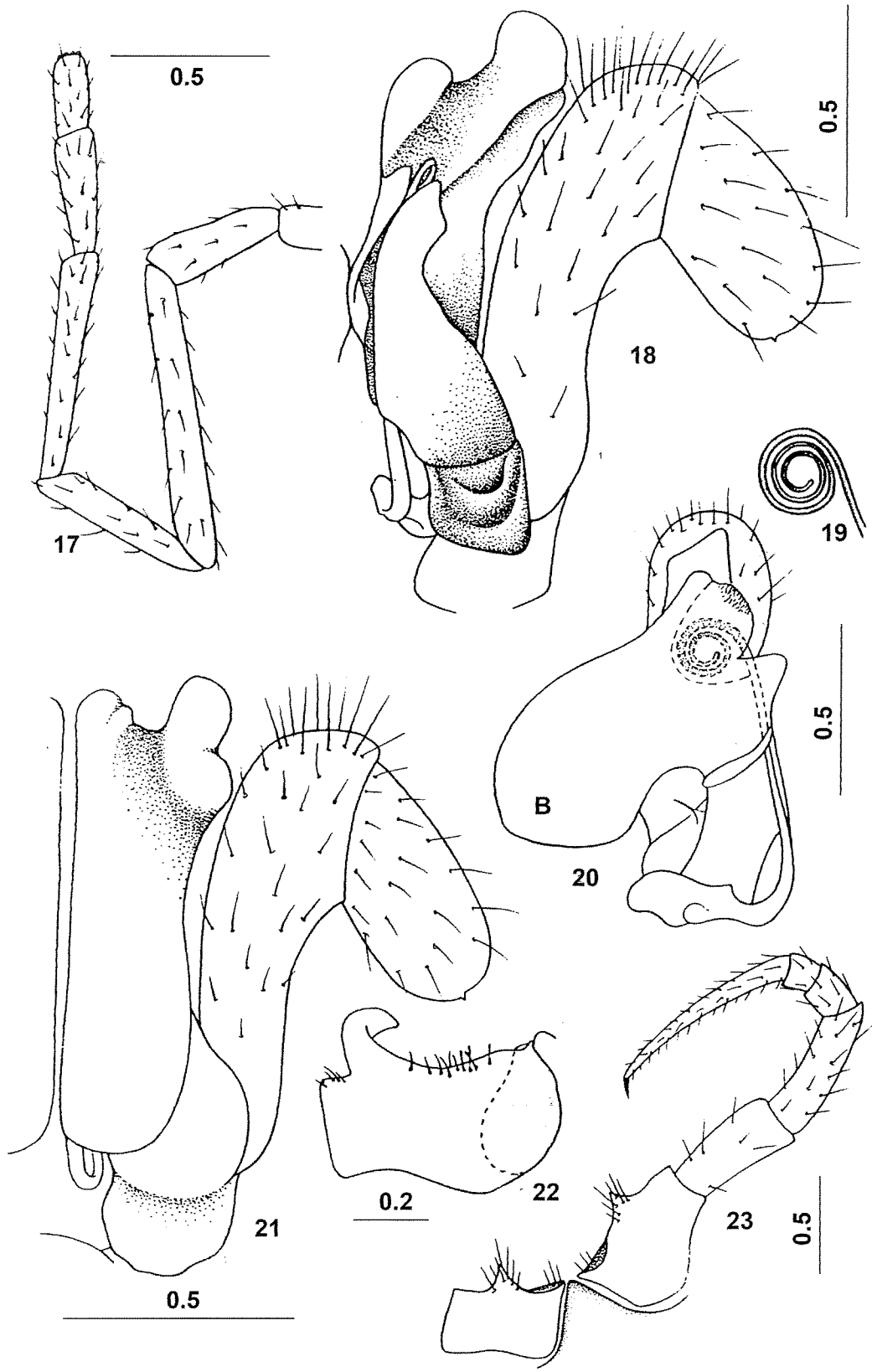
Diplomaragna globulifera Mikhaljova, 1995: 87, 86: figs 27–29; 1998b: 22–23, 22: figs 69–71, 19: map 5; Mikhaljova & Basarukin, 1995: 94, 93: map 3.

Sakhalineuma globuliferum – Mikhaljova, 2000: 172; 2004: 128–129, 129: figs 296–298, 126: map 17; Mikhaljova & Marusik, 2006: 125.

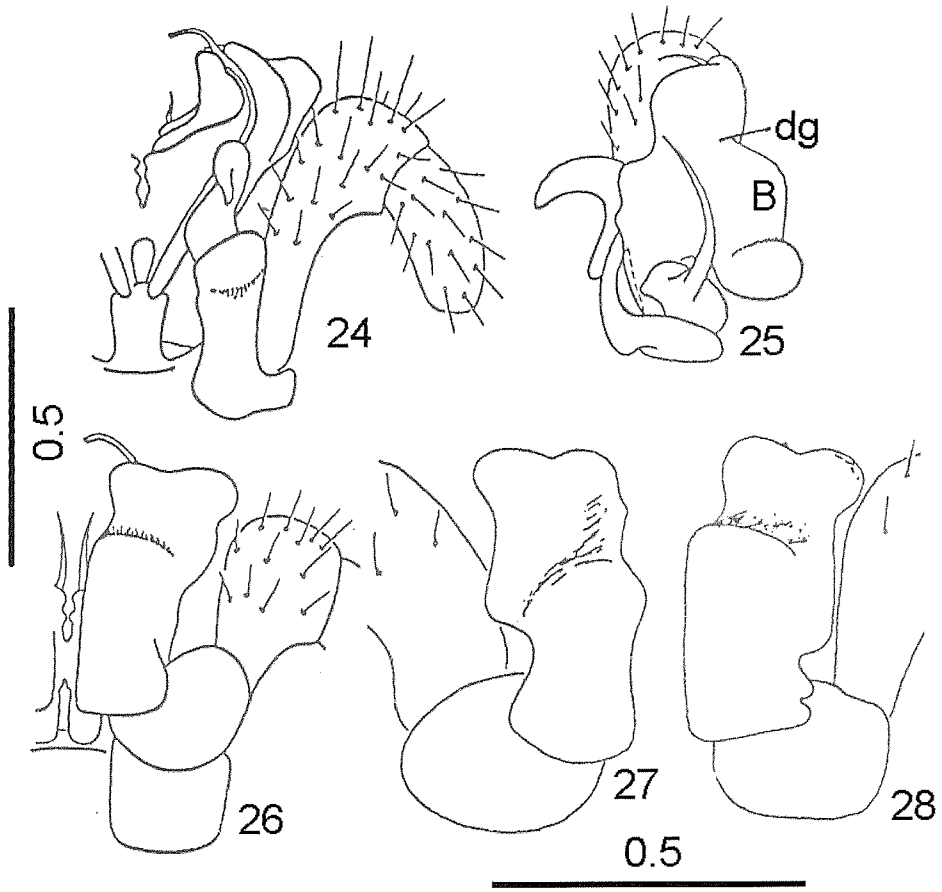
Distribution. Russia: Far East (northern and central parts of Sakhalin Island).

***Sakhalineuma molodovae* Golovatch, 1976** [Figs 32–34.]

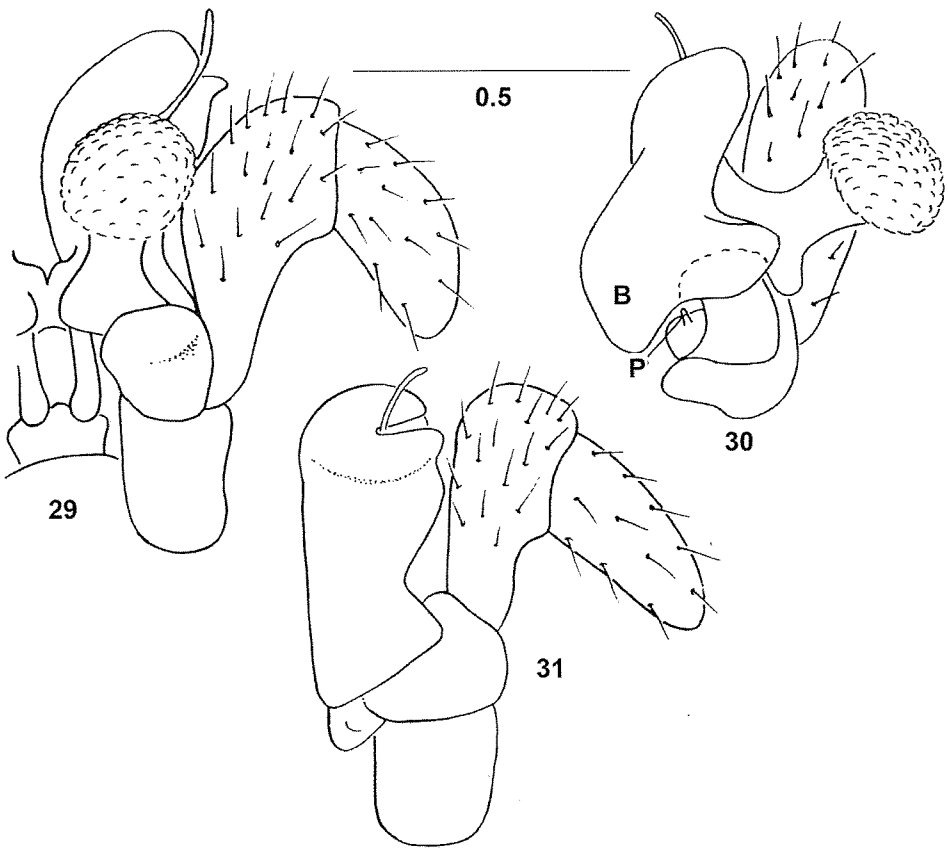
Sakhalineuma molodovae Golovatch, 1976: 1491–1492, 1490: fig 1; Mikhaljova, 2000: 172: figs 53–55; 2004: 131–132, 131: figs 304–306, 126: map 17; Mikhaljova & Marusik, 2006: 125; Shelley et al.,



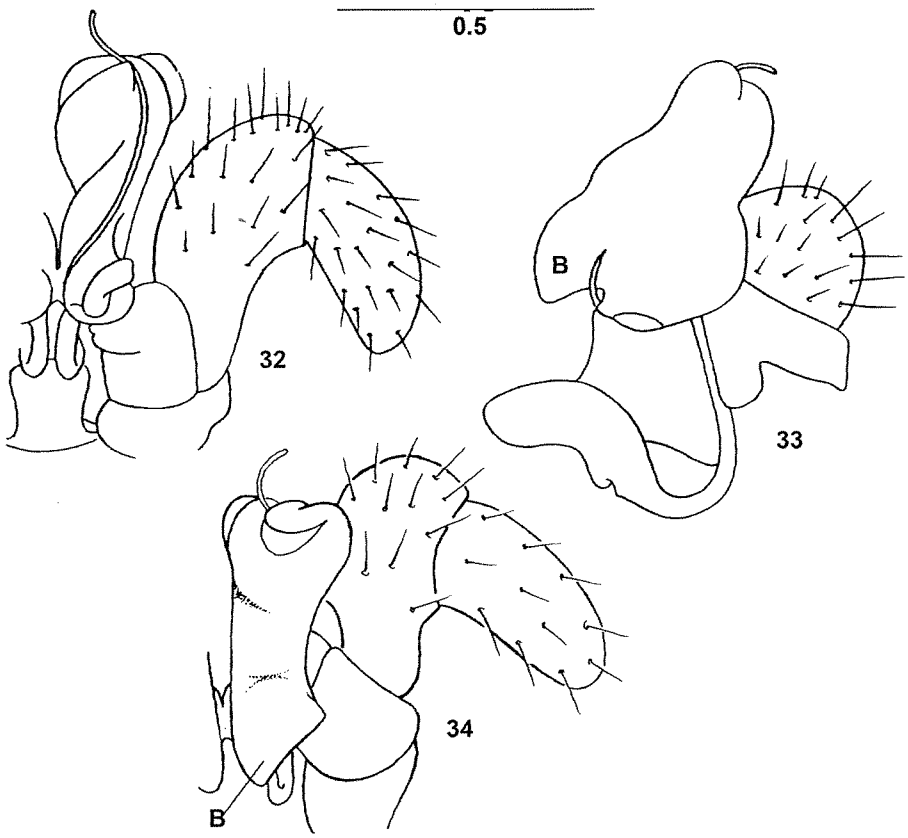
Figures 17– 23.
Sakhalineuma basarukini (Mikhaljova, 1995). 17 – antenna; 18 – gonopods (caudal view); 19 – distal part of anterior gonopod telopodite (mesal view, enlarged not to scale); 20 – gonopods (mesal view); 21 – gonopods (front view); 22 – male coxa 11; 23 – male leg pair 10; B – prominence of colpocoxite. Scales in mm (17–21, 23 – after Mikhaljova 1998b; 22 – after Mikhaljova 1995).



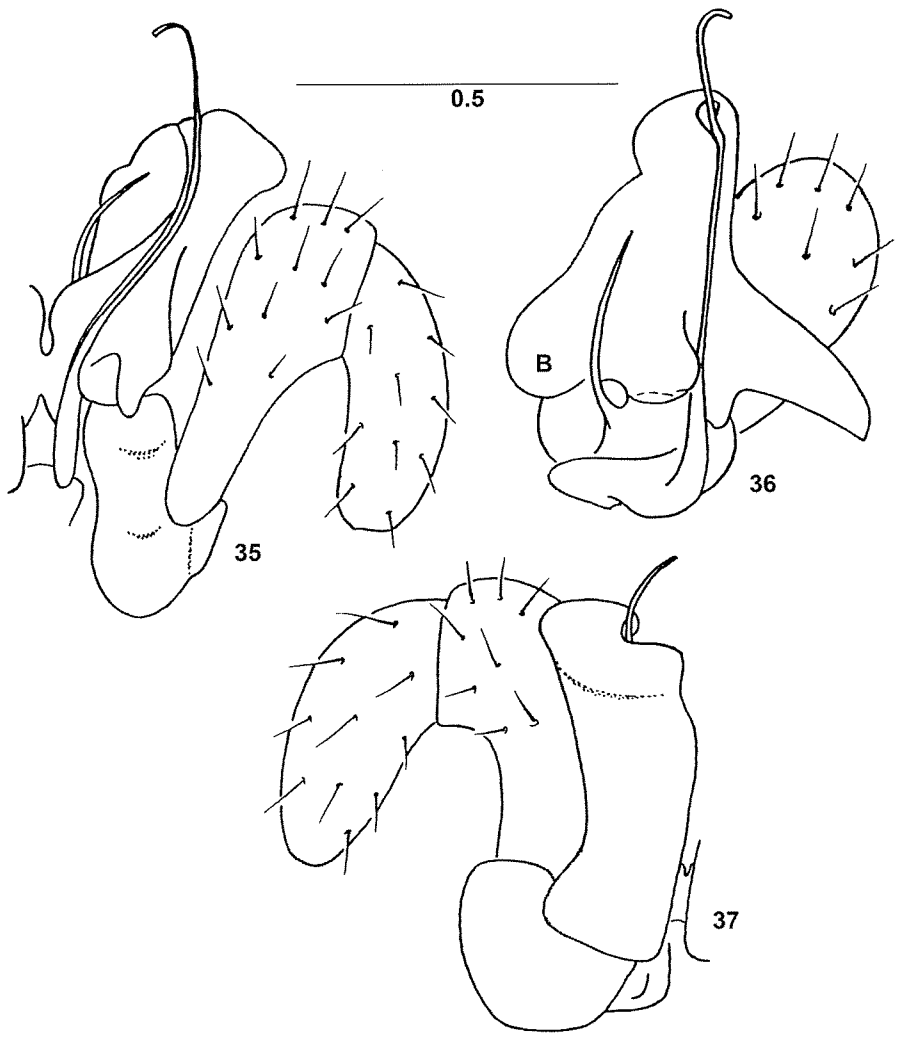
Figurers 24–28. *Sakhalineuma curvatum* (Mikhaljova, 1995). 24 – gonopods (caudal view); 25 – gonopods (mesal view); 26–28 – gonopods (front view); B – prominence of colpocoxite; dg – distal groove of colpocoxite. Scales in mm (24–26 – after Mikhaljova 1998b; 27–28 – after Mikhaljova 1995).



Figures 29–31. *Sakhalineuma globuliferum* (Mikhaljova, 1995). 29 – gonopods (caudal view); 30 – gonopods (mesal view); 31 – gonopods (front view); B – prominence of colpocoxite; p – mesal process of angiocoxite. Scale in mm (after Mikhaljova 1998b).



Figures 32–34. *Sakhalineuma molodovae* Golovatch, 1976. 32 – gonopods (caudal view); 33 – gonopods (mesal view); 34 – gonopods (front view); B – prominence of colpocoxite. Scale in mm (after Mikhaljova 1998b).



Figures 35–37. *Sakhalineuma sakhalinicum* (Mikhaljova, 1995). 35 – gonopods (caudal view); 36 – gonopods (mesal view); 37 – gonopods (front view); B – prominence of colpocoxite. Scale in mm (after Mikhaljova 1998b).

2000: 78.

Diplomaragna molodovae – Shear, 1990: 27, 25: figs 62–64; Mikhaljova, 1993: 25; 1995: 79–82, 80: figs 1–4; 1998b: 23–25, 24: figs 75–77, 19: map 5; Mikhaljova and Basarukin, 1995: 94, 93: map 3; Ganin, 1997: 133.

Distribution. Russia: Far East (southern part of Sakhalin Island).

***Sakhalineuma sakhalinicum* (Mikhaljova, 1995)** [Figs 35–37.]

Diplomaragna sakhalinica Mikhaljova, 1995: 86–87, 85: figs 24–26; 1998b: 25, 24: figs 78–80, 19: map 5; Mikhaljova and Basarukin, 1995: 94, 93: map 3.

Sakhalineuma sakhalinicum – Mikhaljova, 2000: 173; 2004: 132–133, 132: figs 307–309, 126: map 17; Mikhaljova & Marusik, 2006: 125.

Distribution. Russia: Far East (southern part of Sakhalin Island).

***Sakhalineuma tuberculatum* (Mikhaljova, 1995)** [Figs 38–42.]

Diplomaragna tuberculata Mikhaljova, 1995: 82–83, 83: figs 13–18; 1998b: 22, 21: figs 63–68, 19: map 5; Mikhaljova & Basarukin, 1995: 94, 93: map 3.

Sakhalineuma tuberculatum – Mikhaljova, 2000: 173; 2004: 126–128, 126: map 17, 127: figs 291–295; 2006: 202–203; Mikhaljova & Marusik, 2006: 118–119, 123–125, 119: figs 17–21.

Remarks. The diplopod materials from the Moneron Island contain juveniles and a single female belonging to the genus *Sakhalineuma* (Mikhaljova 2006). In the absence of males it appears impossible to provide a closer identification. However, it seems quite plausible that these individuals actually belong to *S. curvatum* or *S. tuberculatum* known from the Krilyon Peninsula, Sakhalin Island.

Distribution. Russia: Far East (southern part of Sakhalin, ?Moneron Island, Kurile Islands: Kunashir, Paramushir).

Family Caseyidae

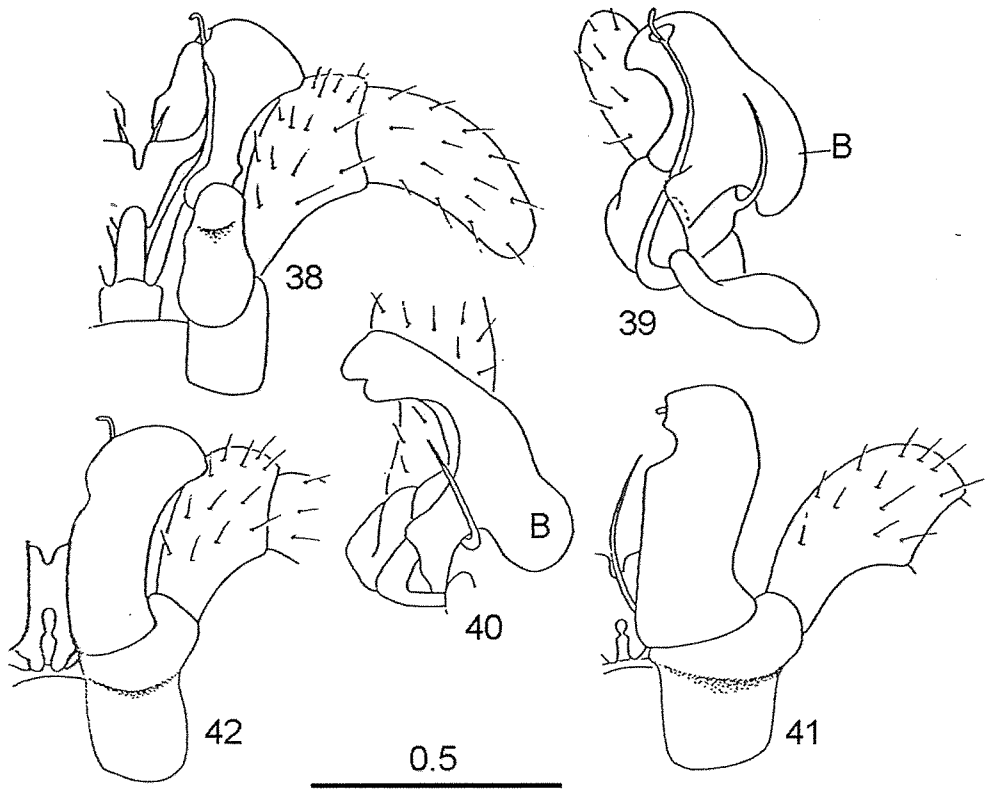
***Underwoodia kurtschevae* Golovatch, 1980** [Figs 43–55.]

Underwoodia kurtschevae – Mikhaljova, 1990: 137; 1993: 17–18; 1998b: 40–42, 39: figs 138–141, 40: map 9; 2004: 202–205, 203: figs 505–517, 204: map 26; 2006: 202; Mikhaljova & Basarukin, 1995: 92–94, 92: figs 4–7, 93: map 2; Mikhaljova & Marusik, 2004: 6; 2006: 119–120, 122–125, 120: figs 22–34; Shelley, 1993: 175, 172: fig. 10, 175: map (= fig. 12); Ganin, 1997: 133.

Material examined. 2 juveniles (IBSS), Russia, Sakhalin Island, Aniva District, ca. 5–7 km E of Novoaleksandrovsk, 5.VI.1992, leg. A.M. Basarukin. – 5 females (IBSS), Russia, Sakhalin Island, Aniva District, ca. 5 km E of Novoaleksandrovsk, coniferous litter, 27.VI.1992, leg. A.M. Basarukin. – 2 females, 1 juvenile (IBSS), Russia, Sakhalin Island, Aniva District, ca. 5–9 km E of Novoaleksandrovsk, 17.VII.1992, leg. A.M. Basarukin. – 1 juvenile (IBSS), Russia, Sakhalin Island, Aniva District, near Novoaleksandrovsk, Krasnoselskaya River, humid alder forest, 17–30.V.1993, leg. A.M. Basarukin. – 1 female (IBSS), Russia, Sakhalin Island, Aniva District, ca. 5–7 km E of Novoaleksandrovsk, bilberry-bush, 17.VI.1994, leg. A.M. Basarukin. – 10 females, 3 juveniles (IBSS), Russia, Sakhalin Island, Aniva District, Mt. Chekhova, N-W slope, coniferous forest, 8.IX.1994, leg. A.M. Basarukin. – 2 juveniles (IBSS), Russia, Sakhalin Island, Aniva District, Mt. Chekhova, N-W slope, *Betula* forest with coniferous tree, 8.IX.1994, leg. A.M. Basarukin. – 1 female, 2 juveniles (IBSS), Russia, Sakhalin Island, Aniva District, Mt. Chekhova, N-W slope, *Pinus pumila*, 8.IX.1994, leg. A.M. Basarukin. – 4 females (IBSS) Russia, Sakhalin Island, Korsakov District, near Lesnoe, 28.VI.1994, leg. A.M. Basarukin. – 2 females, 1 juvenile (IBSS), Russia, Sakhalin Island, Korsakov District, near Utiosnoe, coniferous forest, 21.VIII.1994, leg. A.M. Basarukin. – 2 females, 1 juvenile (IBSS), Russia, Sakhalin Island, near Yuzhno-Sakhalinsk, mixed forest, 1–3.VI.1993, leg. A.M. Basarukin. – 3 females (IBSS), Russia, Sakhalin Island, Timovskoe District, ca. 10 km W of Yasnoe, 3–5. VII.1993, leg. A.M. Basarukin. – 2 females, 3 juveniles (IBSS), Russia, Sakhalin Island, Tomari District, near Baklan'e Lake, coniferous forest, 3.VIII.1994, leg. A.M. Basarukin. – 8 juveniles (IBSS), Russia, Sakhalin Island, SE part, near Sokol Field Station, Belaya River (middle flow), 47°14.560' N 142°46.550' E, 16.VII–21. VIII.2001, leg. Yu.M. Marusik. – 1 female (IBSS), Russia, Sakhalin Island, SE part, ca. 27 km E of Sokol Field Station, Belaya River, 47°15.347' N 142°48.397' E, 17.VII.2001, leg. Yu.M. Marusik. – 15 females, 10 juveniles (IBSS), Russia, Sakhalin Island, SE part, near Staroaubskoye, Naiba River, mouth part, 47°24' N 142°45' E, 23.VII–12.VIII.2001, leg. Yu.M. Marusik. – 4 juveniles (IBSS), Russia, Sakhalin Island, Leonidovka River (right tributary of Poronai River), 30 m downstream from Ulyanovka River mouth, 49°15.092' N 142°43.889' E, 4–5.VIII.2001, leg. Yu.M. Marusik. – 2 females (IBSS), Russia, Sakhalin Island, upper Evay River, Mt. Evay, *Picea* forest, 8.IX.2001, leg. V.A. Kostenko.

Remarks. This species is characterized by parthenogenesis.

Distribution. Russia: Far East (Primorsky and Khabarovsk provinces, Amurskaya Area, Jewish Autonomous Region, Kamchatka Peninsula, Sakhalin Island, Moneron Island, Kurile Islands: Zelyonyi, Shikotan, Kunashir, Iturup, Urup, Chirpoi, Ketoi). North Korea.



Figures 38–42.
Sakhalineuma tuberculatum (Mikhaljova, 1995). 38 – gonopods (caudal view); 39–40 – gonopods (mesal view); 41–42 – gonopods (front view); B – prominence of colpocoxite. Scale in mm (after Mikhaljova 1998b).

Order Polydesmida
Family Paradoxosomatidae

***Oxidus gracilis* (C. L. Koch, 1847)** [Figs 56–58.]

Oxidus gracilis – Chamberlin & Wang, 1953: 7; Mikhaljova & Marusik, 2006: 125.

Remarks. This species is free-living in the subtropics and tropics, in the temperate conditions it largely occurs in the anthropogenic places. It has hitherto been reported from the Sakhalin Island only once, from an unspecified locality (Chamberlin and Wang 1953). Without any doubt, this species has been found in an anthropogenic habitat. At least numerous samples from natural habitats in Sakhalin fail to contain any *Oxidus gracilis* material.

Distribution. Subcosmopolitan.

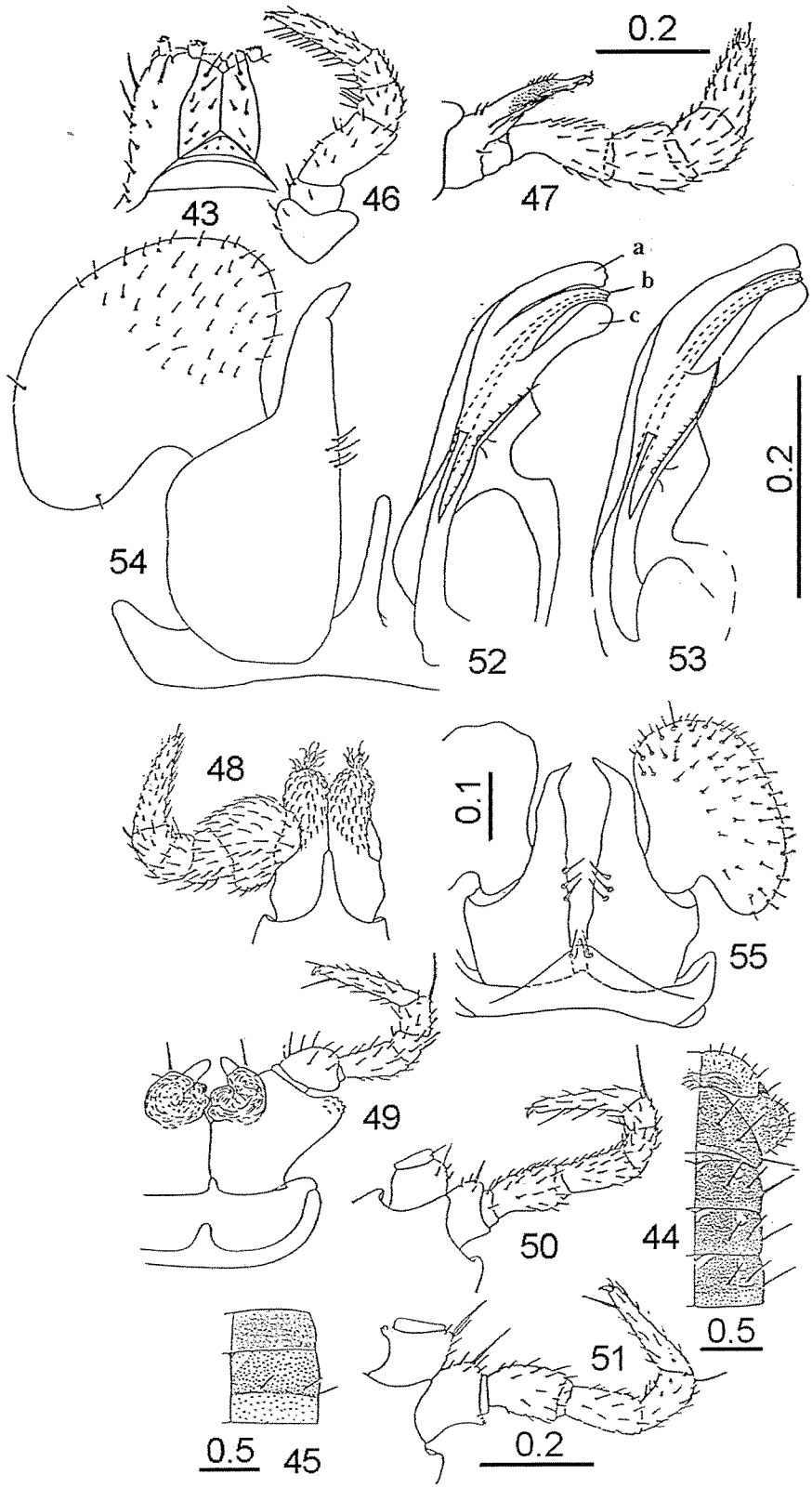
Family Polydesmidae

***Uniramidesmus septimus* Mikhaljova, 1990** [Figs 59–61.]

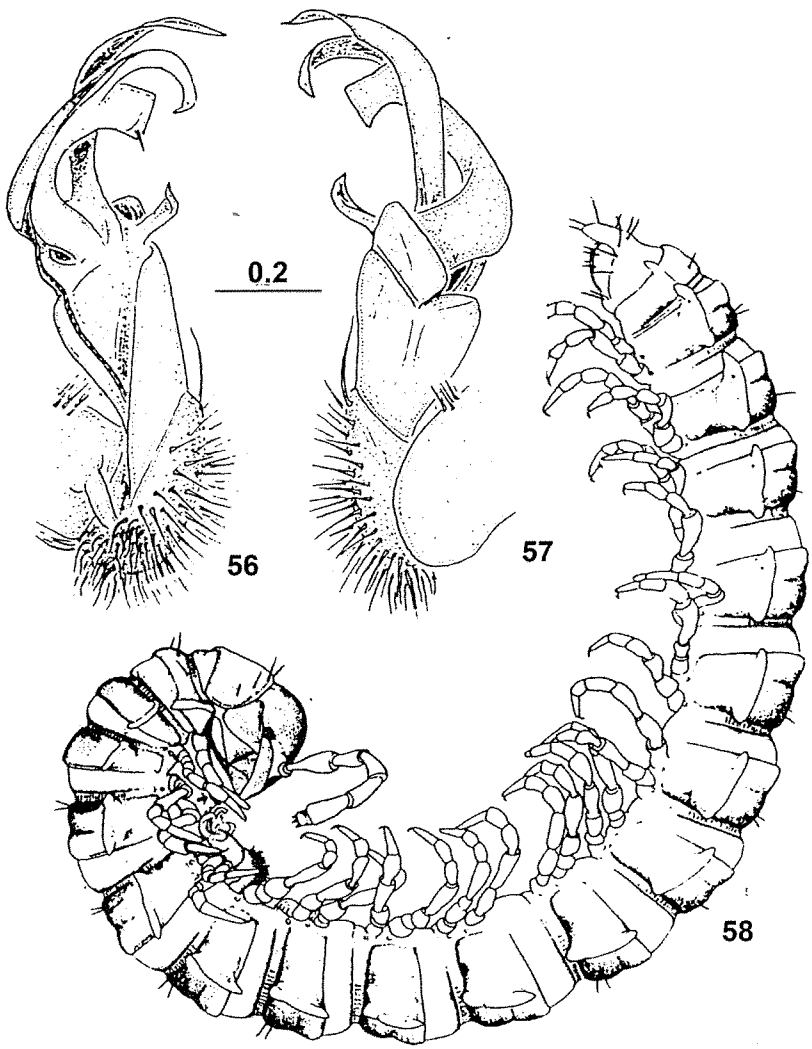
Uniramidesmus septimus Mikhaljova, 1990: 136–137, 137: fig. 2; 1993: 33, 32: fig. 56; 1998b: 50–51, 50: fig. 184–185, 48: map 11; 2004: 233–235, 234: fig. 585–587, 225: map 29; 2006: 203; Mikhaljova & Basarukin, 1995: 94–95, 95: map 4; Mikhaljova & Marusik, 2006: 122–125, 123: figs 46–48; Ganin, 1997: 133.

Material examined. 3 females, many juveniles (IBSS), Russia, Sakhalin Island, Aniva District, ca. 7–8 km E of Novoaleksandrovsk, 28.V.1988, leg. A. M. Basarukin. – 4 juveniles (IBSS) Russia, Sakhalin Island, Aniva District, ca. 5–7 km E of Novoaleksandrovsk, 5.VI.1992, leg. A. M. Basarukin. – 1 male, 2 females, 2 juveniles (IBSS), same locality, 11.IX.1992, leg. A. M. Basarukin. – 2 males, 1 female (IBSS), Russia, Sakhalin Island, Aniva District, ca. 5–7 km E of Novoaleksandrovsk, bilberry-bush, 17.VI.1994, leg. A.M. Basarukin. – 2 males (IBSS), Russia, Sakhalin Island, Aniva District, Mt. Chekhova, N-W slope, coniferous forest, 8.IX.1994, leg. A. M. Basarukin. – 1 male (IBSS), Russia, Sakhalin Island, Aniva District, ca. 7 km NE of Bereznyaki, *Betula* forest, 11.IX.1994, leg. A.M. Basarukin. – 1 juvenile (IBSS), Russia, Sakhalin Island, Dolinsk District, near Anna River, 13–14. VI.1993, leg. A. M. Basarukin. – 1 male, 1 juvenile (IBSS), Russia, Sakhalin Island, SE part, ca. 27 km E of Sokol Field Station, Belaya River, 47°15.347' N 142°48.397' E, 17.VII.2001, leg. Yu.M. Marusik.

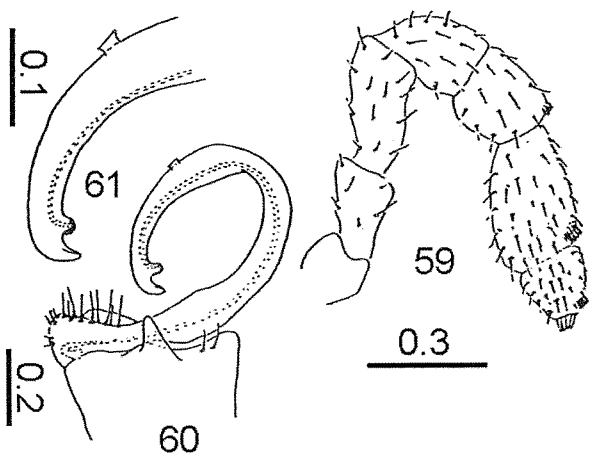
Distribution. Russia: Far East (southern part of Khabarovsk Province, Sakhalin Island, Moneron Island, Kurile Islands: Kunashir).



Figures 43–55.
Underwoodia kurtschevae Golovatch, 1980. 43 – gnathochilarium; 44 – fore part of male body (dorsal view); 45 – male midbody segment (dorsal view); 46 – male leg of pair 1; 47 – male leg of pair 2 and gonapophysis; 48 – male leg pair 3; 49 – male leg pair 10; 50 – male leg pair 4; 51 – male leg pair 11; 52–53 – anterior gonopods (caudal view); 54 – posterior gonopod (caudal view); 55 – posterior gonopods (front view); a – mesal branch of colpocoxite; b – lateral branch of colpocoxite; c – posterior branch of colpocoxite. Scales in mm (43–51, 55 – after Golovatch 1980; 52–54 – after Mikhaljova and Basarukin 1995).



Figures 56–58.
Oxidus gracilis (C. L. Koch, 1847). 56 – gonopod (mesal view); 57 – gonopod (lateral view); 58 – male habitus (lateral view). Scale in mm (56–57 – after Golovatch and Enghoff 1993; 58 – after Blower 1985).



Figures 59–61.
Uniramidesmus septimus Mikhaljova, 1990. 59 – antenna; 60 – gonopod (lateral view); 61 – distal part of gonopod telopodite. Scales in mm (after Mikhaljova 1990).

Key to Orders, Families, Genera and Species:

1 (4) Head very small, elongated anteriorly into a rostrum. Body strongly flattened dorsoventrally, without paraterga. .... Order Polyzoniida, Family Polyzoniidae, Genus *Angarozonium*

2 (3) External edge of coxal process of anterior gonopod with a small unciform outgrowth (Fig 1). ..... *A. aduncum*

3 (2) External edge of coxal process of anterior gonopod without any outgrowths (Figs 3, 7). .. .. *A. amurense*

4 (1) Head larger, more or less ovoid, devoid of a rostrum. Body more or less cylindrical, with or without paraterga. 5

5(18) Telson with a pair of spinnerets. Each metatergite with 3+3 macrochaetae. .... Order Chordeumatida

6(17) Body segments with medium-sized paraterga. Posterior gonopod bearing colpocoxite with a front prominence (B) (Figs 20, 39). ....Family Diplomaragnidae, Genus *Sakhalineuma*

7 (8) A flagelliform telopodite of anterior gonopod

spiralling (Figs 19–20). ..... *S. basarukini*

8 (7) A flagelliform telopodite of anterior gonopod not coiled into a spiral. 9

9(10) Male coxa 11 with a digitiform process. Lateral sheath process of posterior gonopod colpocoxite tuberculiform (Fig 39). .... *S. tuberculatum*

10 (9) Male coxa 11 without processes. Lateral sheath process of posterior gonopod colpocoxite different. 11

11(12) Lateral sheath process of posterior gonopod colpocoxite globuliform (Figs 29–30). .... *S. globuliferum*

12(11) Lateral sheath process of posterior gonopod colpocoxite different. 13

13(14) Front prominence of colpocoxite well-developed, dictinctly delimiting a distal hollow (Figs 25–28). Lateral sheath process of colpocoxite cylindrical, curved (Fig 25). ... . *S. curvatum*

14(13) Front prominence of colpocoxite either poorly expressed or obliterated distally, not demarcated by a hollow. Lateral sheath process of colpocoxite different. 15

15(16) Lateral sheath process of colpocoxite broad, with a blunt apex (Fig 33). ..... *S. molodovae*

16(15) Lateral sheath process of colpocoxite conical, with a pointed apex (Fig 36). .... *S. sakhalinicum*

17 (6) Body segments without paraterga or bulges (Fig 45). Gonopods, including posterior ones, different, as in Figs 52–55. ....Family Caseyidae, Genus *Underwoodia*, *U. kurtschevae*

18 (5) Telson without spinnerets. Metatergites without macrochaetae or with simple setae 19

19(22) Metatergites with paraterga. Eyes absent. Adult body with 20 segments, including telson. ..... Order Polydesmida

20(21) Paraterga serrate at lateral margin, without peritremata. Body relatively slender; metaterga relatively flat, with three transverse rows of bosses. Gonopod coxites as in Fig 60. ..... Family Polydesmidae, Genus *Uniramidesmus*, *U. septimus*

21(20) Paraterga non-serrate at lateral margin, with peritremata (Fig 58). Body stout, metaterga strongly convex, arched, without traces of bosses. Gonopods as in Figs 56–57. ....Family Paradoxosomatidae, Genus *Oxidus*, *O. gracilis*

22(19) Metatergites without paraterga, body subcylindrical. Eyes present. Adult body with more than 20 segments. Surface of metazonites clearly striate only below ozopore level. .....Order Julida, Family Nemasomatidae, Genus *Orinisobates*

23(24) Setae on metazonites distinctly visibly. Gonopods as in Figs 13, 15. ..... *O. soror*

24(23) Setae on metazonites not or hardly visible even at high magnification. Male unknown. Female receptaculum seminis reduced (Fig 10). ..... *O. microthylax*

Results and Discussion

At present, 13 species from 6 genera, 6 families and 4 orders of Diplopoda are known to occur in the Sakhalin Island (see Table 1). The highest species diversity is recorded in the southern part of the island. The northern and central parts of the Sakhalin Island support six species. The millipede species complex of Southern Sakhalin sufficiently differs from one of Northern-Central Sakhalin. Only three species appear to be common for these parts of the island. These species have the large distribution ranges covering the different regions of the Asian part of Russia. However, at the family and generic levels the millipede faunas of Southern Sakhalin and Northern-Central Sakhalin are almost identical (excluding the family Paradoxosomatidae and genus *Oxidus* represented by the synanthropic *O. gracilis* introduced to Sakhalin).

Generally, the fauna of Diplopoda of the Sakhalin Island is relatively original. Four species (30.8% of the island's total number of species) are endemic to the Sakhalin Island. Eight species (61.5% of all species of Sakhalin) have the insular ranges. Thus, *Angarozonium aduncum* is known only from the Sakhalin and Kurile islands. Two (or three) species (*Orinisobates soror*, species of *Sakhalineuma*) have been reported only from the Sakhalin, Moneron and Kurile islands. At the generic level *Sakhalineuma* is endemic to Sakhalin-Moneron-Kuriles.

The distribution areas of the other five species (38.5% of the island's total species diversity) cover both the continental territories and the Sakhalin Island. Thus, *Angarozonium amurense* is widely distributed in the Asian part of Russia; it also penetrates Northeast China and Mongolia. *Underwoodia kurtschevae* occurs in the different parts of the Russian Far East. Also it has been recorded in North Korea. *Orinisobates microthylax* is known from East Siberia and the Russian Far East. The range of *Uniramidesmus septimus* covers the Kuriles, Sakhalin Island and Khabarovsky Province in the Far East of Russia. The synanthropic species *Oxidus gracilis* has been introduced to the island of Sakhalin through human agency (Mikhaljova 2004).

The genera *Orinisobates*, *Underwoodia* and subfamily Polyzoniinae represented by the genus *Angarozonium* in the Sakhalin Island demonstrate of trans-Beringian connections (Mikhaljova 2004). *Uniramidesmus* is endemic to the Asian part of Russia; it is represented by nine species in the southern Far East of Russia and one species in East Siberia. The genus *Sakhalineuma* is the peripheral member of the family Diplomaragnidae; a presumed origin centre of this family is Central Asia (Shear 1990).

The diplopods of the Sakhalin Island and the adjacent territories are given in table 2. The millipede complexes of the Moneron and Sakhalin islands form the organic whole.

A comparison of the millipede taxonomical

Table 1. The millipedes (Diplopoda) of Sakhalin.

Order, family, species	Northern-Central Sakhalin	Southern Sakhalin	Other territories
Polyzoniida			
Polyzoniidae			
Angarozonium aduncum (Mikhaljova, 1995)		●	KU
Angarozonium amurense (Gerstfeldt, 1859)	●		KP, IA, ChA, B, RS, KhP, JAR, K, NCh, NM
Julida			
Nemasomatidae			
Orinisobates microthylax Enghoff, 1985	●	●	B, K, KU, KhP, PP, AA, JAR,
Orinisobates soror Enghoff, 1985		●	KU, MO
Chordeumatida			
Diplomaragnidae			
Sakhalineuma basarukini (Mikhaljova, 1995)	●		
Sakhalineuma curvatum (Mikhaljova, 1995)		●	KU, ?MO
Sakhalineuma globuliferum (Mikhaljova, 1995)	●		
Sakhalineuma molodovae Golovatch, 1976		●	
Sakhalineuma sakhalinicum (Mikhaljova, 1995)		●	
Sakhalineuma tuberculatum (Mikhaljova, 1995)		●	KU, ?MO
Caseyidae			
Underwoodia kurtschevae Golovatch, 1980	●	●	PP, KhP, AA, JAR, K, KU, NK, MO
Polydesmida			
Polydesmidae			
Uniramidesmus septimus Mikhaljova, 1990	●	●	KhP, KU, MO
Paradoxosomatidae			
Oxidus gracilis (C.L. Koch, 1847)		●	Subcosmopolitan
Total	6	10	

AA – Amurskaya Area, B – Buryatia, ChA – Chita Area, IA – Irkutsk Area, JAR – Jewish Autonomous Region, K – Kamchatka Peninsula, KhP – Khabarovsk Province, KP – Krasnoyarsk Province, KU – Kurile Islands, MO – Moneron Island, PP – Primorsky Province, RS – Republic of Sakha (Yakutia) (all within Russia). NCh – Northeast China. NK – North Korea. NM –North Mongolia.

composition of the Sakhalin Island with that of the Kuriles has revealed their resemblance and difference. Thus, the millipede generic diversity of the Kurile Islands (8 genera) appears to be highest. In addition, the generic composition of this archipelago incorporates all genera (with the exception of *Oxidus* represented by the synanthropic *O. gracilis* introduced to Sakhalin) known from Sakhalin. However, the species composition of Diplopoda of the Sakhalin Island is higher than that of the Kuriles. This pattern can be changed in the future because of the currently relatively poorly known millipede fauna of the Kurile Islands. Seven species appear to be common for the Sakhalin and Kurile islands. The representatives of the East Asian genera *Epanerchodus* and *Haplogonosoma* have not been recorded in Sakhalin, while in Kuriles they are known to occur.

Kamchatka Peninsula supports only three species. These species are known from the Sakhalin Island too. They have the large distribution ranges.

One genus (*Oxidus*) and one synanthropic species (*O. gracilis*) are common for Sakhalin and Hokkaido. At the family level only 27.3% of all families of these islands appear to be shared by Sakhalin and Hokkaido.

Acknowledgements

This work was supported in part by the Far Eastern Branch of the Russian Academy of Sciences (grant # 06-I-OBN-0100). I am most grateful to all collectors who gave the materials for the present study.

Table 2. The millipedes (Diplopoda) of Sakhalin and the adjacent territories (Hokkaido, Moneron, Kuriles, Kamchatka Peninsula).

Order, family, species	Hokkaido	Sakhalin	Moneron	Kamchatka	Kuriles
Polyzoniida					
Polyzoniidae					
Angarozonium aduncum (Mikhaljova, 1995)		●			●
Angarozonium amurense (Gerstfeldt, 1859)		●		●	
Julida					
Nemasomatidae					
Orinisobates microthylax Enghoff, 1985		●		●	●
Orinisobates soror Enghoff, 1985		●	●		●
Mongoliulidae					
Kopidoiulus longus Shinohara, 1963	●				
Julidae					
Cylindroiulus latestriatus (Curtis, 1845)					●
Japanopachyiulus niponicus Miyosi, 1957	●				
Amblyiulus lobatus (Verhoeff, 1937)	●				
Pseudonemasomatidae					
Pseudonemasoma femorotuberculata Enghoff, 1991	●				
Chordeumatida					
Diplomaragnidae					
Sakhalineuma basarukini (Mikhaljova, 1995)		●			
Sakhalineuma curvatum (Mikhaljova, 1995)		●	? ●		●
Sakhalineuma globuliferum (Mikhaljova, 1995)		●			
Sakhalineuma molodovae Golovatch, 1976		●			
Sakhalineuma sakhalinicum (Mikhaljova, 1995)		●			
Sakhalineuma tuberculatum (Mikhaljova, 1995)		●	? ●		●
Diplomaragna gracilipes (Verhoeff, 1914)	●				
Diplomaragna tsurusakii Shear, 1990	●				
Maritimosoma hokkaidense (Verhoeff, 1939)	●				
Conotylidae					
Japanosoma scabrum Verhoeff, 1914	●				
Yasudatyla yasudai Shear & Tsurusaki, 1995	●				
Yasudatyla shariensis Shear & Tsurusaki, 1995	●				
Yasudatyla hidakaensis Shear & Tsurusaki, 1995	●				
Caseyidae					
Underwoodia kurtschevae Golovatch, 1980		●	●	●	●
Polydesmida					
Xystodesmidae					
Levizonus montanus (Takakuwa, 1941)	●				
Levizonus takakuwai (Verhoeff, 1941)	●				
Paradoxosomatidae					
Oxidus gracilis (C.L. Koch, 1847)	●	●			
Haplogonosoma implicatum Brölemann, 1916					●
Polydesmidae					
Epanerchodus cuspidatus Mikhaljova, 1996					●
Epanerchodus fontium Verhoeff, 1940	●				
Epanerchodus furculiger Verhoeff, 1937	●				
Epanerchodus gracilis Takakuwa, 1954	●				
Epanerchodus kunashiricus Mikhaljova, 1988					●
Epanerchodus orientalis (Attems, 1901)	●				
Uniramidesmus septimus Mikhaljova, 1990		●	●		●
Total	18	13	3 (?5)	3	11

References

BLOWER, J.G., 1985. *Millipedes. Keys and notes for the identification of the species. Synopses of the British Fauna.* Avon: Bath Press. 242 p.

CHAMBERLIN, R.V. AND WANG, Y.M., 1953. Records of millipeds (Diplopoda) from Japan and other Oriental areas, with description of new genera and species. *American Museum Novitates* 1621, 1–13.

ENGHOFF, H., 1994. Geographical parthenogenesis in millipedes (Diplopoda). *Biogeographica* 70 (1), 25–31.

ENGHOFF, H., 1985. The millipede family Nemasomatidae, with the description of a new genus, and a revision of *Orinisobates* (Diplopoda: Julida). *Entomologica Scandinavica* 16, 27–67.

GANIN, G.N., 1997. *Soil animals of the Ussuri region.* Vladivostok and Khabarovsk: Dalnauka Publ. 159 p. (in Russian, English summary).

GOLOVATCH, S.I., 1976. A new species, *Sakhalineuma molodovae* Golovatch (Chordeumida, Diplopoda), from South Sakhalin. *Doklady Akademii nauk SSSR* 227 (6), 1489–1492 (in Russian).

GOLOVATCH, S.I., 1980. New forms of Diplopoda from the Soviet Far East and their zoogeographical relationships. *Zoologicheskii Zhurnal* 59 (2), 199–207 (in Russian, English summary).

GOLOVATCH, S.I. AND ENGHOFF, H., 1993. Review of the millipede genus *Tylopus*, with description of new species from Thailand (Diplopoda, Polydesmida, Paradoxosomatidae). *Steenstrupia* 19 (3), 85–125.

HOFFMAN, R.L., 1980 (for 1979). *Classification of the Diplopoda.* Muséum d'Histoire Naturelle de Genève, 237 p.

MIKHALJOVA, E.V., 1981. New species of the genus *Polyzonium* (Diplopoda, Polyzoniidae) from Siberia and the Far East. *Zoologicheskii Zhurnal* 60 (5), 778–782 (in Russian, English summary).

MIKHALJOVA, E.V., 1990. On the fauna of Diplopoda of the USSR Far East. *Zoologicheskii Zhurnal* 69 (5), 134–138 (in Russian, English summary).

MIKHALJOVA, E.V., 1993. The millipedes (Diplopoda) of Siberia and the Far East of Russia. *Arthropoda Selecta* 2 (2), 3–36.

MIKHALJOVA, E.V., 1995. The millipede genus *Diplomaragna* Attems, 1907, on the Sakhalin and Kurile islands (Diplopoda Chordeumatida Diplomaragnidae). *Arthropoda Selecta* 4 (3/4), 79–87.

MIKHALJOVA, E.V., 1998a. On new and poorly-known millipedes (Diplopoda) from the Far East of Russia. *Far Eastern Entomologist* 60, 1–8.

MIKHALJOVA, E.V., 1998b. The millipedes of the Far East of Russia (Diplopoda). *Arthropoda Selecta* 7 (1), 1–77.

MIKHALJOVA, E.V., 2000 (for 1999). Review of the millipede family Diplomaragnidae (Diplopoda: Chordeumatida). *Arthropoda Selecta* 8 (3), 153–181.

MIKHALJOVA, E.V., 2002 (for 2001). On some poorly-known millipedes from Siberia (Diplopoda). *Arthropoda Selecta* 10 (3), 201–207.

MIKHALJOVA, E.V., 2004. *The millipedes (Diplopoda) of the Asian part of Russia.* Sofia-Moscow: Pensoft Publ. 292 p.

MIKHALJOVA, E.V., 2006. The millipedes (Diplopoda) of the Moneron Island. *Flora and fauna of Moneron Island (Materials of International Sakhalin Island Project).* Vladivostok: Dalnauka Publ. 202–203.

MIKHALJOVA, E.V. AND BASARUKIN, A.M., 1995. The millipedes (Diplopoda) of the Sakhalin and Kurile islands. *Arthropoda Selecta* 4 (3/4), 89–96.

MIKHALJOVA, E.V. AND GOLOVATCH, S.I., 2001 (for 2000). A review of the millipede fauna of Siberia (Diplopoda). *Arthropoda Selecta* 9 (2), 103–118.

MIKHALJOVA, E.V. AND KORSÓS, Z., 2003. Millipedes (Diplopoda) from Korea, the Russian Far East, and China in the collection of the Hungarian Natural History Museum. *Acta Zoologica Hungarica* 49 (3), 225–252.

MIKHALJOVA, E.V. AND MARUSIK, YU.M., 2004. New data on taxonomy and fauna of the millipedes from the Russian Far East, Siberia and Mongolia (Diplopoda). *Far Eastern Entomologist* 133, 1–15.

MIKHALJOVA, E.V. AND MARUSIK, YU.M., 2006. Millipedes (Diplopoda) of the Kurile Islands. Biodiversity and Biogeography of the Kuril Islands and Sakhalin, vol. 2. *Bulletin of the Hokkaido University Museum* 3, 115–127.

MOLODOVA, L.P., 1973. Soil invertebrate fauna of South Sakhalin. *Ekologiya pochvennykh bespozvonochnykh.* Moscow: Nauka Publ. 60–74 (in Russian).

MOLODOVA, L.P., 1974. The zoogeographical composition and altitudinal belt distribution of soil invertebrates in southern Sakhalin. *Zoologicheskii Zhurnal* 53 (8), 1178–1186 (in Russian, English summary).

MOLODOVA, L.P., 1976. Pedozoological data for characterization of soil types on the Southern Sakhalin. *Pedobiologia* 16 (6), 401–417.

SHEAR, W.A., 1990. On the Central and East Asian milliped family Diplomaragnidae (Diplopoda, Chordeumatida, Diplomaragnoidea). *American Museum Novitates* 2977, 1–40.

SHELLEY, R.M., 1993. The milliped genus *Underwoodia* (Chordeumatida: Caseyidae). *Can. J. Zool.* 71, 168–176.

SHELLEY, R.M., 1998 (for 1997). The milliped family Polyzoniidae in North America, with a classification of the global fauna (Diplopoda Polyzoniida). *Arthropoda Selecta* 6 (3/4), 3–34.

SHELLEY, R.M., SIERWALD, P., KISER, S.B. AND GOLOVATCH, S.I., 2000. *Nomenclator generum et familiarum Diplopodorum II. A list of the genus and family-group names in the class Diplopoda from 1958 through 1999.* Sofia-Moscow: Pensoft Publ. 167 p.