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<td>Mikhaljova, Elena V.; Marusik, Yuri M.</td>
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Millipedes (Diplopoda) of the Kurile Islands

Elena V. Mikhaljova¹ and Yuri M. Marusik²

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Abstract  The millipede fauna of the Kurile Islands is reviewed, with 11 recognizable species involved, all arranged in a catalogue-like way. A brief historical account, new faunistic records, a comparative analysis, and zoogeographical notes are given. Remarks and illustrations are provided for all species encountered, including data on the taxonomy, distribution and ecology. All species currently known from Kurile Islands are keyed.

Key words: Diplopoda, fauna, keys, distribution, Kurile Islands

Introduction

The vast majority of millipedes (Diplopoda) are saprophages; they play important roles in the processes of decomposition of plant debris and in pedogeneses. Currently this class of Myriapoda contains over 11,000 described species classified to 144 families, 16 orders and two subclasses after the new family-level classification (Shelley 2003). However, actual quantity of species is suspected to be near 80,000 (Hoffman 1980).

Millipede fauna of the Russian Far East (= territory encompasses the Magadan, Kamchatka, Amurskaya and Sakhalin (Sakhalin Island + Kurile Islands) areas as well as the Khabarovsk and Primorsky provinces) can be considered as a fairly good investigated. At present the Far East of Russia supports 66 species, 28 genera, 15 families and 5 orders. Information on Diplopoda of this territory is summarized in the faunistical review of millipedes of the Asian part of Russia (Mikhaljova 2004). According to the faunistical list of Miyosi (1959) millipede fauna of Japan contains 180 species, 57 genera, 19 families and 6 orders.

The first record of a millipede in the Kurile Islands belongs to Golovatch (1980). He reported the genus Underwoodia from the Kunashir Island as plotted on a map only, but he did not treat this record as conspecific with Far Eastern species V. kurtsevae Golovatch, 1980 due to the absence of males. Since then additional and new species were reported or described by Enghoff (1985), Mikhaljova (1988, 1990, 1995, 1996, 1998a), Golovatch et al. (1995), Mikhaljova & Basarukin (1995), of which latter was exclusively devoted to the insular fauna of the Russian Far East (Sakhalin Island and Kuriles). In addition, reviews of the millipede faunas of the Asian part of Russia (Mikhaljova 1993, 2004) and the Russian Far East (Mikhaljova 1998b) contain the information on the diplopods of the Kuriles.

The millipede fauna of the northern part of the Kuriles is practically unknown (only one species has been reported from this territory) in contrast to fairly well investigated fauna of the Kunashir Island. Different specialists collected material in the Archipelago. Great contribution to the collection of Diplopoda of the Kurile and Sakhalin islands was made by the Russian outstanding naturalist Anatoly M. Basarukin as well as Kirill Yu. Eskov and the second author in the course of the International Kuril Island Project (IKIP) in 1994–1995 and the expedition of the second author in 1996–1997.

Materials and Methods

Unidentified material from the Kurile Islands deposited in the Institute of Biology and Soil Science, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok (IBSS) have been located and treated here. Examined and published samples were omitted.

Each species heading references to all published material from the Kuriles as well as original combinations are given. The list of taxa is given after the classification of Hoffman (1980).

Species surveyed

Order Polyzoniida
Family Polyzoniidae

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


Comments. This detrivorous species dwells in forest litter and mosses; also it has been reported in Sphagnum bogs.

Distribution. The species has the insular range including southernmost Sakhalin and Kuriles (Kunashir and Shikotan islands) (Mikhaljova 2004).

Order Julida
Family Nemasoniidae

Orinisobates microthylax Enghoff, 1985 [Figs 3–4]


Comments. This species mostly dwells under bark of logs. However, it occurs also in forest litter. O. microthylax is obligatory thelytokion species.

Distribution. The species is distributed in central and southern parts of Kamchatka Peninsula, the southern part of the Kuriles, Sakhalin Island, the southern part of Khabarovsk Province and Primorsky Province; it has also...
Figures 3–4. *Orinisobates microthylax* Enghoff, 1985: 3 lamellae linguales and promentum of female gnathochilarium; 4 left vulva; rs receptaculum seminis with a pair of internal flaps; sc sclerotisations at base of receptaculum seminis. Scale in mm (after Enghoff 1985).

Figures 5–10. *Orinisobates soror* Enghoff, 1985: 5 male first right leg (front view); 6 male midbody leg; 7 anterior gonopods (caudal view); 8 distal part of flagellum; 9 right posterior gonopod (lateral view); 10 right vulva; 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).

Orinisobates soror Enghoff, 1985 [Figs 5–10]


Comments. This species lives mostly in lake- and seashore. Also, it was collected in gramineous meadow (Mikhaljova & Basarukin 1995).

Distribution. Like some other species, this species has the insular range. It is known from the South Sakhalin Island and southern-middle Kuriles (Mikhaljova 2004).

Family Julidae

*Cylindroiulus latestriatus* (Curtis, 1845) [Fig. 11]


Comments. This is anthropochorous subcosmopolitan species. In the Kuriles, it has been only found sandy seashore hull near Yuzhno-Kurilsk, Kunashir Island (Mikhaljova 1998a). This record is the definitely been recorded in Buryatia, Siberia (Mikhaljova 2004). Its occurrence in Northeast China and Hokkaido Island is very likely.

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introduction through human agency.

**Distribution.** The species is widely distributed in Europe and introduced to the North and South America as well as the northern part of Asia. The Asian localities of *Cylindroiulus latestriatus* are rare (Altai Mts, Tomsk City, Kunashir Island) (Mikhaljova 2004).

**Order Chordeumatida**

**Family Diplomaragnidae**

![Figure 11. *Cylindroiulus latestriatus* (Curtis, 1845): gonopods (mesal view). Scale in mm (after Mikhaljova 1998b).](image)

*Sakhalineuma curvaturn* (Mikhaljova, 1995) [Figs 12–16]


**Comments.** The species lives mainly in the litter of broad-leaved forests with bamboo undergrowth. It has been collected on vegetation and seashores.

**Distribution.** This species has the insular range embracing south Sakhalin and the southern Kuriles (Mikhaljova 2004).

*Sakhalineuma tuberculatum* (Mikhaljova, 1995) [Figs 17–21]


**Material examined.** 1 ♂, 1 ♀ (IBSS), Kuriles, Paramushir Island, NE shore, environs of Severo-Kurilsk, 50°40′N, 156°06′E, 13.09.1996, leg. Marusik Yu. M.

**Comments.** Originally described from the southern Sakhalin Island and Kunashir Island, this species appears to be widespread here; it has not hitherto been recorded.

![Figures 12–16.](image)

*Sakhalineuma curvaturn* (Mikhaljova, 1995): 12 gonopods (caudal view); 13 gonopods (mesal view); 14–16 gonopods (front view); b prominence of colpocoxite; dg distal groove of colpocoxite. Scales in mm (12–14 after Mikhaljova 1998b; 15–16 after Mikhaljova 1995).
in the northern part of the Kuriles. This species dwells in leafy forests as well as on seashores and lake banks.

**Distribution.** The range of this species is restricted to the Kuriles (Kunashir and Paramushir islands) and the southern part of Sakhalin Island (Mikhaljova 2004).

**Family Caseyidae**

**_Underwoodia kurtschevae_** Golovatch, 1980 [Figs 22–34]


**Comments.** This is rather common species in the southern part of the Russian Far East. It is characterized by thelytoky with males almost absent in populations. This species has hitherto been reported from Urup Island, Ketai Island and Chirpoi Island, all plotted on a map; corresponding materials have not been given (Mikhaljova 1998b). These samples are given above.

**Distribution.** This species is widespread in the southeastern part of the Russian Far East and reaches as far north as the central part of the Kamchatka Peninsula. The most southern locality is North Korea. In the west border of the species range coincides with Maliyi Khingan Mt. Range, in the east – with the Kurile Islands.

Figures 17–21. _Sakhalineuma tuberculatum_ (Mikhaljova, 1995): 17 gonopods (caudal view); 18–19 gonopods (mesal view); 20–21 gonopods (front view); b prominence of colpocoxite. Scale in mm (after Mikhaljova 1998b).
Figures 22–34. *Underwoodia kurtshchevae* Golovatch, 1980: 22 gnathochilarium; 23 fore part of male body (dorsal view); 24 male midbody segment (dorsal view); 25 male first leg; 26 male second leg; 27 male leg pair 3; 28 male leg pair 4; 29 male leg pair 10; 30 male leg pair 11; 31–32 anterior gonopods (caudal view); 33 posterior gonopod (caudal view); 34 posterior gonopods (front view); a mesal branch of colpocoxite; b lateral branch of colpocoxite; c posterior branch of colpocoxite. Scales in mm (22–30, 34 after Golovatch 1980; 31–33 after Mikhaljova and Basarukin 1995).
Figures 35–40. *Haplogonosoma implicatum* Brölemann, 1916: 35 fore part of male body; 36 male body segment 10; 37 lamina between male coxae 4; 38 gonopod (lateral view); 39 distal part of gonopod (subventral view); 40 gonopod (mesal view). Scales in mm (after Golovatch *et al.* 1995).

Figures 41–43. *Epanerchodus kunashiricus* Mikhaljova, 1988: 41 gonopod (lateral view); 42 gonopod (ventral view); 43 gonopod telopodite and postfemoral process (43 cephalic and caudal distofemoral processes, according to Golovatch 1991 and Djursvoll *et al.* 2001). Scale in mm (after Mikhaljova 1988).
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0.5

(Mikhaljova 2004). Its occurrence in the adjacent territory of Hokkaido Island is very likely.

Order Polydesmida
Family Paradoxosomatidae

Haplogonosoma implicatum Brölemann, 1916 [Figs 35–40]


Comments. This species was originally described from Japan (Brölemann 1916). Based on material from Kunashir Island it has later been redescribed more adequately (Golovatch et al. 1995).

Distribution. The species has the insular range; it is known from Japan (Central Honshu Island) and Russia (the Kuriles, Kunashir Island) (Mikhaljova 2004).

Family Polydesmidae

Epanerchodus kunashiricus Mikhaljova, 1988 [Figs 41–43]


Comments. This is a typical inhabitant of forest litter and different plant debris; also it occurs on seashores and lake banks.


Uniramidesmus septimus Mikhaljova, 1990 [Figs 46–48]


Comments. Like congeners this species inhabits the litter of coniferous, mixed and broad-leaved forests.

Distribution. Originally described from Sakhalin Island and Kunashir Island, this species appears to be widespread there; also it occurs in the southern part of Khabarovsk Province (Mikhaljova 2004), being relatively common (Ganin 1997).

Key to orders, families and species

1 (2) Head very small, elongated anteriorly into a rostrum. Body strongly flattened dorsoventrally, without paraterga. External edge of coxal process of anterior gonopods with a small unciform outgrowth (Figs 1–2) ............ Order Polyzoanidae

Genus Angarozonium, A. aduncum

2 (1) Head larger, more or less ovoid, devoid of a rostrum. Body more or less cylindrical, with
or without paraterga.......................... 3
Telson with a pair of spinnerets. Each metatergite with 3+3 macrochaetae .......... 14 (11)
Order Chordeumatida
Body segments with medium-sized paraterga. Posterior gonopod bearing colpocoxite with a
front prominence (b) (Figs 13, 18–19) .............. .
................................. Family Diplomaragnidae
Genus Sakhalinumuma
Male coxa 11 with a digitiform process. Gonopods as in Figs 17–21; lateral sheath process of posterior gonopod colpocoxite tuberculiform (Figs 18–19) .... S. tuberculatum
6 (5)
Male coxa 11 without processes. Gonopods as in Figs 12–16; lateral sheath process of posterior gonopod colpocoxite cylindrical, curved (Fig. 13) .................. S. curvatum
7 (4)
Body segments without paraterga or bulges (Fig. 24). Gonopods, including posterior ones, different, as in Figs 31–34 .... S. tuberculatum
.................................. Family Caseyidae
Genus Underwoodia, U. kurtsechevae
Telson without spinnerets. Metatergites without macrochaetae or with simple setae ........ 9
8 (3)
Metatergites with paraterga. Eyes absent. Adult body with 20 segments, including telson ......
................................. Order Polydesmida
Paraterga well-developed, serrate at lateral margin, without peritremata. Body relatively
10 (15)
slender; metaterga relatively flat, with three transverse rows of bosses. Gonopod coxites
fused medially ............... Family Polydesmidae
Paraterga broad. Body relatively large (adults >15 mm long). Gonopods as in Figs 41–43, 44–45 .......... Genus Epanerchodus
12 (13)
Gonopod telopodite [= Cephalic distofemoral process, using modern terminology (Golovatch
1991; Djursvoll et al. 2001)] with two branches apically (Figs 41–43) ............ E. kunashiricus
Paraterga narrow. Body relatively small (adults < 15 mm long). Gonopods as in Figs 47–48
15 (10)
................. Genus Uniramidesmus, U. septimus
Paraterga relatively poorly-developed, with peritremata, non-serrate at lateral margin (Fig.
36). Body stout, metaterga strongly convex, arched, without traces of bosses. Gonopods
(Figs 38–40) free from each other basally
16 (9)
................................. Family Paradoxosomatidae
Genus Haplogonosoma, H. implicatum
Metatergites without paraterga, body subcylindrical. Eyes present. Adult body with more than 20 segments .......... Order Julida
Surface of metazonites completely striate. Gonopods as in Fig. 11 ............ Family Julidae
17 (18)
Genus Cylindroiulus, C. latestriatus
Surface of metazonites clearly striate only below opzope level. Gonopods different ......
18 (17)
................................. Family Nemasomatidae
Genus Orinisobates
Setae on metazonites distinctly visibly. Gonopods as in Figs 7–9............... O. soror
19 (20)
Setae on metazonites not or hardly visible even at high magnification. Male unknown. Female
receptaculum seminis reduced (Fig. 4) ....
20 (19)
................................. O. microthylax

Results and Discussion

At present, 11 species from 8 genera, 7 families and 4 orders of Diplopoda are known to occur in the Kurile Islands (see Table 1 and Map 1). Millipedes have been reported from 11 of 30 islands. Rather this pattern expresses the degree of Diplopod’s fauna study. Within the Archipelago millipedes are restricted to the southern Kuriles (Shikotan-Kunashir-Iturup) and the southern part of middle Kuriles (Urup-Ushishir); only one species has been registered in Paramushir of all northern islands.
Like other animals and plants (cf. Pietsch et al. 2003) the highest species diversity is recorded in Kunashir Island. Actually the millipede fauna of this island incorporates all species known from the Archipelago. This pattern contrasts the faunas of other invertebrate groups.

Majority of regional species (63.6% of the total number of species) have insular ranges. The distribution areas of three species (27.3%) cover both continental territories and islands. Thus, *Underwoodia kurtscchevae* are widely distributed in the Far East of Russia; also it has been reported in North Korea. *Orinisobates microthylax* has the large range covering East Siberia and the Russian Far East. Such pattern probably being accounted for by parthenogenesis characteristic of these species. *Uniramidesmus septimus* is known from the Kuriles, Sakhalin Island and Khabarovsky Province, Far East of Russia.

*Orinisobates soror* and *Underwoodia kurtscchevae* are the most widespread species in the Archipelago, they have been reported from 6–7 islands within the South Kuriles and the southern part of the middle Kuriles.

Synantropic *Cylindroiulus latestriatus* is not the natural component of the fauna. This species has definitely been introduced to Kunashir Island through human agency. It was collected in the semi-natural habitat (Mikhaljova 1998a). *Cylindroiulus latestriatus* is widespread in Europe, introduced into North and South America as well as the Asian part of Russia (Mikhaljova 2004).

Generally, the fauna of Diplopoda of the Kuriles is sufficiently original. The number of species endemic to Sakhalin-Kurile Islands attains 36.4% of the region’s total species diversity. *Epanerchodus cuspidatus* and *E. kunashiricus* are endemic to the Kuriles, all accounting 18.2% of all regional species, and all found in Kunashir Island. Of 8 millipede genera currently known from the Kuriles, only *Sakhalineuma* (12.5%) occurs in Sakhalin Island and Kuriles.

As a result, 37.5% of genera (including endemic *Sakhalineuma*) and 45.5% of species are distributed in

<table>
<thead>
<tr>
<th>Table 1. A list of Diplopoda of the Kurile Islands.</th>
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<td>Order, family, species</td>
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<tr>
<td>------------------------</td>
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<tr>
<td><strong>Polyzoniida</strong></td>
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<tr>
<td>Polyzoniidae</td>
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<tr>
<td><em>Angarozonium aduncum</em> (Mikhaljova, 1995)</td>
</tr>
<tr>
<td><strong>Julida</strong></td>
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<tr>
<td>Nemasomatidae</td>
</tr>
<tr>
<td><em>Orinisobates microthylax</em> Enghoff, 1985</td>
</tr>
<tr>
<td><em>Orinisobates soror</em> Enghoff, 1985</td>
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<tr>
<td><strong>Julidae</strong></td>
</tr>
<tr>
<td><em>Cylindroiulus latestriatus</em> (Curtis, 1845)</td>
</tr>
<tr>
<td><strong>Chordeumatida</strong></td>
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<tr>
<td>Diplomaragnidae</td>
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<tr>
<td><em>Sakhalineuma curvatum</em> (Mikhaljova, 1995)</td>
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<tr>
<td><em>Sakhalineuma tuberculatum</em> (Mikhaljova, 1995)</td>
</tr>
<tr>
<td><strong>Caseyidae</strong></td>
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<tr>
<td><em>Underwoodia kurtscchevae</em> Golovatch, 1980</td>
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<tr>
<td><strong>Polydesmida</strong></td>
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<tr>
<td>Paradoxosomatidae</td>
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<tr>
<td><em>Haplogonosoma implicatum</em> Brölemann, 1916</td>
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<tr>
<td><strong>Polydesmidae</strong></td>
</tr>
<tr>
<td><em>Epanerchodus kunashiricus</em> Mikhaljova, 1988</td>
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<tr>
<td><em>Epanerchodus cuspidatus</em> Mikhaljova, 1996</td>
</tr>
<tr>
<td><em>Uniramidesmus septimus</em> Mikhaljova, 1990</td>
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<td><strong>Total</strong></td>
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Table 2. A list of Diplopoda of the Kuriles and adjacent territories (Hokkaido Island, Sakhalin Island and Kamchatka Peninsula).

<table>
<thead>
<tr>
<th>Order, family, species</th>
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<th>Sakhalin</th>
<th>Kamchatka</th>
<th>Kuriles</th>
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<td>Polyzoniiidae</td>
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<tr>
<td>Angarozonium adunccum (Mikhaljova, 1995)</td>
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<tr>
<td>Angarozonium amurense (Gerstfeldt, 1859)</td>
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<tr>
<td><strong>Julida</strong></td>
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<tr>
<td>Nemasomatidae</td>
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<tr>
<td>Orinisobates microthylax Enghoff, 1985</td>
<td>*</td>
<td>*</td>
<td>+</td>
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<tr>
<td>Orinisobates soror Enghoff, 1985</td>
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<tr>
<td><strong>Mongoliulidae</strong></td>
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<tr>
<td>Kopidoiulus longus Shinohara, 1963</td>
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<tr>
<td><strong>Julidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylindriulus latestriatus (Curtis, 1845)</td>
<td>*</td>
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<td></td>
<td></td>
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</tbody>
</table>
| Japanopachyiulus niponicus Miyosi, 1957 | * | | | *
| Amblyiulus lobatus (Verhoeff, 1937) | * | | | |
| **Pseudonemasomatidae**|          |          |           |         |
| Pseudonemasoma femorotuberculata Enghoff, 1991 | * | | | |
| **Chordeumatida**      |          |          |           |         |
| Diplomaragnidae        |          |          |           |         |
| Sakhalineuma basarukini (Mikhaljova, 1995) | * | | | |
| Sakhalineuma carvatum (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 kartschevae Golovatch, 1980 | * | * | | *
| **Polydesmida**        |          |          |           |         |
| Xystodesmidae          |          |          |           |         |
| Levizonus montanus (Takakuwa, 1941) | * | | | *
| Levizonus takakuwai (Verhoeff, 1941) | * | | | *
| **Paradoxosomatidae**  |          |          |           |         |
| Oxidus gracilis (C.L. Koch, 1847) | * | | * | *
| Haplogonomosoma implicatum Brölemann, 1916 | * | | | *
| **Polydesmidae**       |          |          |           |         |
| Epanerchodus cuspidatus Mikhaljova, 1996 | * | | | *
| Epanerchodus fontam 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 11

* Oxidus gracilis has hitherto been reported from Sakhalin Island only after the sample collected by Takakuwa in 1933 (Chamberlin & Wang, 1953). Unfortunately, the more detailed locality has not been indicated; most likely it is an anthropogeneous habitat.
the Palaearchaeartic Subregion of the Palaeartic Region (zoogeographical subdivisions adopted here is those of Semenov-Tian-Shansky in 1936). Thus, the center of species diversity for the prolific Epanerchodus is Japan and Korea. Only two endemic species are known from the Kuriles. The genus Haplogonosoma shows connections with the faunas of East and Southeast Asia. Orinisobates, Underwoodia and subfamily Polyzoniliinae demonstrate faunal connections between the Kuriles and North America (Mikhaljoova 2004).

The genera Uniramidesmus and Sakhalineuma are endemic to the Asian part of Russia. Uniramidesmus with its nine species is more abundantly represented in the southern part of the Russian Far East. Only one species occurs in East Siberia. The genus Sakhalineuma is confined to Sakhalin Island and the Kuriles; it is the peripheral member of the family Diplomaragnidae, of which the presumed origin centre lies in Central Asia according to Shear (1990).

Table 2 shows a list of the diplopods encountered in territories adjacent to the Kuriles (Hokkaido Island, Sakhalin Island, and Kamchatka Peninsula). The highest species diversity is observed in Hokkaido Island. However, a single species common for Hokkaido Island and the Kuriles has not hitherto been found. In contrast, regional faunas of some other groups of animals contain common species. The only species (Haplogonosoma implicatum) is common for the Kuriles and Japan. This species has been recorded in the southern Kuriles and Central Honshu Island. At the generic level only 25% of all regional genera (Haplogonosoma and Epanerchodus) appear to be shared by the Kurile Islands and Japan.

The Kamchatka Peninsula supports only three species, which are most widespread in Siberia and the Russian Far East. Two species and two genera are common for the Kurile Islands and the Kamchatka Peninsula.

The millipede fauna of Sakhalin Island is most close to the Kurile fauna as compared with the other adjacent territories. It contains seven common species. At the generic level 62.5% of the total number of Kurile genera are distributed in both Sakhalin and Kurile Islands.

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