

A REVIEW OF THE ODONATA OF KAMCHATKA PENINSULA, RUSSIA

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Received May 25, 2004 / Reviewed and Accepted October 22, 2004

All knowledge of the odon. fauna of Kamchatka Peninsula (NE Asia) is reviewed, using literature data, miscellaneous collections and the results of an expedition by the authors in July 2003. In total, 27 spp. have become known, with *Lestes dryas*, *Coenagrion hastulatum*, *Aeshna serrata*, *Epitheca bimaculata*, *Somatochlora exuberata*, *S. alpestris*, and *Leucorrhinia intermedia* here reported for the first time. *Aeshna palmata* is dismissed; *Anax junius*, twice reported in the 19th century, is an American migrant that rarely reaches Kamchatka; the southern migrants, *Pantala flavescens* and *Sympetrum frequens*, are represented by one old record each, with specimens still preserved in Zool. Inst., St Petersburg. Very few more spp. may be expected in future, and it is concluded that the fauna is of an impoverished boreal extraction. This lack of endemism is understandable, since dragonflies could only begin reinvading the peninsula around 13,000 BP. 7 spp. are Holarctic, 1 is SE Palaearctic, 5 are NE Palaearctic, 1 is an American vagrant, 1 is a sub-cosmopolitan migrant, and the remainder are transpalaearctic.

INTRODUCTION

Kamchatka peninsula protrudes from North-East Asia into the northern Pacific. Situated between 60° and 51°N, it has a climate much more severe than expected, influenced by the cold Okhotsk and Bering Seas. The flora and fauna are impoverished, even compared to corresponding areas of continental Siberia, due to a peninsular situation, active volcanism, and much active volcanism in the past. Lava

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flows repeatedly exterminated biota over large areas: 40% of the territory is covered with quaternary basalt (SUSLOV, 1954). The Kamchatian flora has a number of Okhotian elements, shared with Sakhalin and the Kurile Islands, but the fauna lacks endemism and is North-East Siberian.

Few Odonata occur in cold climates, and thus the odonatofauna of Kamchatka is poor. At the same time, it has been little studied, although it was included in the first paper devoted to the Russian Far East (HAGEN, 1856). In this work, based on collections by W. Motschulsky and E. Menetries, eight species are listed: *Pantala flavescens*, *Libellula quadrimaculata*, *Cordulia aenea*, *Somatochlora arctica*, *Aeshna juncea*, *Aeshna palmata*, *Anax junius*, *Enallagma cyathigerum*. Two are American (*A. palmata* and *A. junius*) and one circumtropical (*P. flavescens*). In the same and later work, HAGEN (1861) reported two American species of *Sympetrum* for Ayan on the continental Okhotsk coast. There is doubt that those specimens really originated from Kamchatka; probably, they were obtained through the Russian American Company from Alaska (BELYSHEV, 1973; GLOYD, 1941). Half a century later, BARTENEV (1911) reported another specimen of *Anax junius* (a female without anal appendages), and thus at least this migrant species may occasionally reach Kamchatka. A paper on *Sympetrum* genus by BARTENEV (1915) included the record of *S. frequens* from Kamchatka. SJOSTEDT (1927) listed 9 species, and BELYSHEV (1964) reported on material collected by A. I. Kurentzov, which included the first record of *Aeshna subarctica*. Later, BELYSHEV et al. (1978) published on a collection from the Kamchatka River valley by N. S. Kostina. He pointed out that she collected 11 species but provided information on only 3 of them, *Coenagrion hylas*, *C. johanssoni* and *Somatochlora graeseri*, then new to the peninsula. His checklist included 18 species (but without *A. palmata*).

BELYSHEV & HARITONOV (1981) provide a new checklist of Kamchatian Odonata. It included 20 species, among which the first record for *Somatochlora sahlgbergi*, discovered by Haritonov in 1978 on the Pauzhetka River (the locality was published in KOSTERIN, 1992) but did not include his other findings viz. *Lestes dryas*, *Epitheca bimaculata*, and *Leucorrhinia intermedia*, which are included in the present paper.

The Kamchatian odonatofauna was also listed by BELYSHEV (1968; 1973), HARITONOV (1986), MALIKOVA (1995), and HARITONOV & MALIKOVA (1998), but none of these references contain exact records. Curiously, there thus appeared more reviews than papers with original material. As a result, a number of errors and suppositions became established. In a comprehensive guide for the insects of the Russian Far East, HARITONOV (1986) lists 24 species for Kamchatka, including *A. junius*, *S. frequens* and *P. flavescens* but excluding *A. palmata*. *Coenagrion lanceolatum*, *C. glaciale*, *Somatochlora alpestris* that were included by supposition, since no collection of these species from Kamchatka existed. In Table 1 of the paper by HARITONOV & MALIKOVA (1998), 28 species were mentioned for Kamchatka, but four of them, *Calopteryx japonica*, *Coenagrion lanceolatum*,

Somatochlora exuberata, and *S. uchidai* are errors and *C. japonica* and *S. uchidai* are not even to be expected. Also, one taxon was counted twice, under *Enallagma c. cyathigerum* (Charp.), and under *E. nigrolineatum* Bel. & Har.

It follows that there is a need for a reliable checklist of the Odonata of Kamchatka and for more investigations of its fauna. A compendium of records is attempted in this paper. In our annotated list, only those studies are cited that report factual material, while unpublished material known to us is also presented. Most specimens obtained by occasional collectors are preserved in the Institute of Systematics and Ecology of Animals, Novosibirsk (ISEA), the Zoological Institute, St Petersburg (ZISP), the Zoological Museum of Moscow State University, Moscow (ZMMSU), in Blagoveshchensk State Pedagogical University, Blagoveshchensk (BSPU) and in the Biology and Soil Institute, Vladivostok (BSI). Haritonov (manuscript) spent the summer of 1978 investigating the ecology of Odonata in the south of the Peninsula, exploring about a hundred pools and swamps in the Pauzhetka River valley and at Lake Kuril'skoe. Kosterin in 1991-1992 participated in botanical expeditions in S. Kamchatka and also recorded dragonflies. Dr. Klaus Reinhardt shared information obtained during his expedition in 1991. And finally, odonates were the main target of the project "Postglacial colonization of Eurasia: dragonflies as a model" (NATO Collaborative Grant 979506), which resulted in an expedition in July 2003 by the authors of this paper. This expedition revealed 20 species, including four new records.

THE COUNTRY OF KAMCHATKA

From the NE to the SW, Kamchatka is 1200 km long and up to 480 km wide; its western coast faces the Okhotsk Sea and its eastern coast the Bering Sea and Pacific Ocean. It narrowly links up with the continent in the north at 60°N and is part of the volcanic arch of the west coast of the Pacific, prolonged in the Kurile archipelago. It can be subdivided in five parts: the western coastal region, the central depression, the Sredinnyi [Russ. "Middle"] Mountain Range, the Vostochnyi [Eastern] mountain range and volcanic region, and the southern volcanic region (SUSLOV, 1954). The Sredinnyi Range is composed of folded mountains with flat tops peaking at 1200-1400 m, locally up to 2000-2500 m. It is formed by Palaeozoic rock rimmed with Mesozoic volcanics, including remnants of Cenozoic and Holocene volcanoes. Its western slope is gentle, the eastern one steep. The west coast has a smooth outline and bogged surface and is formed by Neogenic alluvium from the Sredinnyi Range, accumulated on ancient sea terraces. The Central Depression, wooded alluvial lowland, up to 50 km wide, is the valley of the Kamchatka River. The Vostochnyi Range is composed of a number of longitudinal mountains formed of crystalline and palaeovolcanic rocks without recent volcanoes. They represent an alpine relief with evidence of glaciation. Adjacent is the eastern volcanic region of high volcanic plateaus, 600-800 m a. s. l., with many active and extinct volcanoes. Among them there is the highest volcano in Eurasia, the Klyuchevskaya Sopka, about 4700 m above sea level. The eastern coast is irregular, its capes and Karaginskii Island represent remnants of a third sub-longitudinally oriented mountain chain, now submerged and destroyed. The southern volcanic region is similar to the eastern but is less elevated and has smooth coastlines. Except for the western coast, hot springs are common everywhere.

These parts enjoy quite different climates (KONDRATYUK, 1974; SUSLOV, 1954). The western coast is cold temperate marine: winters are severe, summers cold and wet, with permanently overcast weather, but low precipitation, so that snow cover is only about 40 cm deep. The eastern slope of the

Sredinnyi Range is situated in the orographic rain shadow and receives little precipitation. The climate of the central depression is moderately continental: in the Kamchatka valley mean January temperature is -25°C , that of July 15°C ; annual precipitation is 450 mm. The Vostochnyi Range and eastern volcanic region are characterized by reduced annual amplitudes in temperature (mean temperature of February -10.2°C , that of August 12.5°C) and precipitation varies from 300–400 mm on western slopes to 1500 mm on eastern slopes. The weather is mostly overcast, windy and rainy. The glaciers descend to 600–700 m above sea level, on the Kronotskii volcano to 300–400 m. The southern volcanic region has a moist climate, with annual precipitation up to 2500 mm and snow cover up to 3 m. The last winter snow in the eastern and southern regions melts in early June but the vegetation period extends to October.

Different parts of Kamchatka differ in vegetation. The Central Depression was originally covered with a mixed taiga of larch (*Larix cajanderi*) / spruce (*Picea ajanensis*) / white birch (*Betula platyphilla* s. str. = *B. pendula* s. l.) taiga. Now the conifers are replaced with secondary white birch forests. Floristically, this region resembles continental Yakutia or Magadan. In the south, there are dry mossy and shrub tundras at low levels (the so-called "Ganal'skie Tundry"), bogs, and damp *Calamagrostis* meadows. In the mountains of the Sredinnyi Range, the taiga is replaced by tundra through a belt of dwarf pine (*Pinus pumila*) thickets. The Vostochnyi Range, eastern and southern volcanic regions are oceanic and have a peculiar flora: in lowlands stone birch (*Betula ermani*) with patches of a Okhotian tall herbage of *Filipendula kamtschatica*, *Senecio cannabifolia*, *Heraclium lanatum*, and patches of alder (*Alnus hirsuta*) forests occur. The mountain slopes are grown with elfin wood of dwarf alder (*Dushekia fruticosa*) that, with altitude, alternate with subalpine meadows and, at 900–1000 m, are replaced by mountain

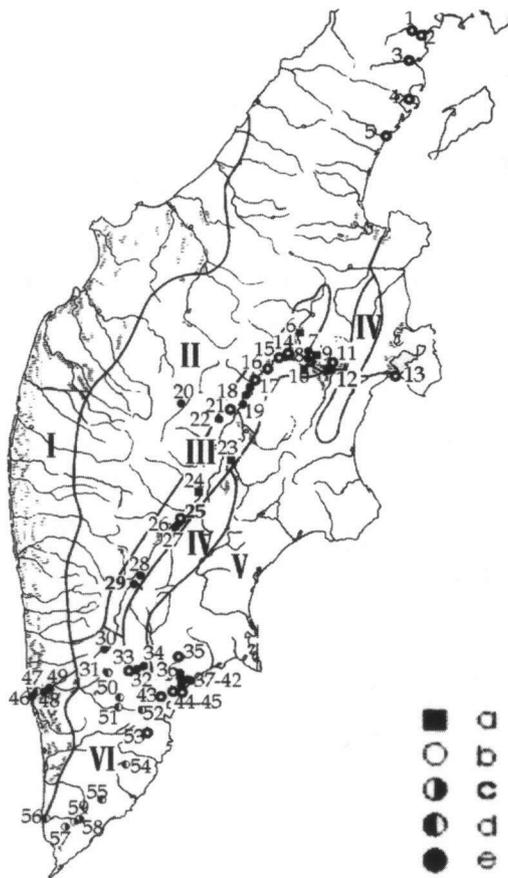


Fig. 1. Map of Kamchatka, showing the main natural areas (I–VI), as well as all localities from which dragonflies have become known (1–59). For explanation of the locality numbers see **List of localities**. a: localities known from literature; – b: miscellaneous records; – c: localities examined by A. Haritonov in 1978; – d: localities examined by O. Kosterin in 1991/1992; – e: localities examined by the authors in 2003. – Explanation of natural areas, I: the west coast; – II: the Central (Sredinnyi) Range; – III: the Central Kamchatkian Depression; – IV: the Eastern (Vostochnyi) Range; – V: the eastern volcanic region; – VI: the southern volcanic region.

tundra. The flat coast sections are bogged. The "continental" and "Okhotian" vegetation types replace each other on the western slopes of the eastern mountains, e. g. stands of white birch may be replaced by stone birch across a short distance of mixed stands. Along rivers, there are forests of poplar (*Populus suaveolens*), willow (*Salix*) and Korean willow (*Chosenia arbutifolia*). In the southern volcanic region the closeness of cold seas causes a reversed zoning i.e. the climate becomes harsher in the south. The altitudinal vegetation belts descend to the point that at the southern tip of Kamchatka, the coast is occupied by tundra. The western coast is a kingdom of peat moss marshes. There are also floodland forests, stone birch parklands with tall herbage, dwarf alder (mostly in the south) and dwarf pine (mostly in the north) thickets but they do not occupy much area. The "neck" of Kamchatka is devoid of forest and this hinders its colonization by boreal animals.

THE JULY 2003 EXPEDITION

In 2003, Kamchatka enjoyed an unusual sunny and hot summer, with day temperatures of 30° C at the coast and occasionally 40° C in the Central Valley, beating all records. O. Kosterin arrived at Petropavlovsk-Kamchatskii on July 10. The main team arrived on July 12, and next day all started to move north, to the Central Valley, sampling en route. Our northernmost site was a chain of lakes and pools near Ust'-Kamchatsk. Next we travelled to Esso village at the foot of the Sredinnyi Range and later returned to the main road of Central Kamchatka moving southwards until Pushchino village where we abandoned the road and moved towards the Ganaly mountain range. Having reached the main Kamchatian crossroad, we turned west, towards the Okhotsk coast. We returned to the west until Apacha village, and then started moving east, to reach Petropavlovsk-Kamchatskii and the Pacific coast on July 25. On July 26 the Belgian team left while the Russian team continued to explore sites around Petropavlovsk until July 29.

LIST OF LOCALITIES (Fig. 1)

Locations are enumerated according to latitude. Those studied by A. Haritonov in 1978 are marked with *, by O. Kosterin in 1991-1992 with **, by the 2003 expedition with ***. # stands for localities from the literature. All toponyms are transliterated following the British system.

- (1) Kichiga River floodland, 59°45'N, 163°00'-20'E. 23-VI-1990, 11-IX-1990; 28-VI-1994, 10, 15 and 20-VIII-1994, A. Smetanin leg.
- (2) Tovuvnan Mountain foot, 59°45'N, 163°20'E. 24-VII-1994; 14-VIII-1994, A. Smetanin leg.
- (3) Tymlat River floodland, 59°30'N, 162°50'-163°20'E, 3-IX-1994, A. Smetanin leg.
- (4) "Karaga" [the River and settlement at its mouth in NE Kamchatka], 59°07'-17'N, 162-163°E, summer 1930, Novograblenov leg.
- (5) "Dranka": there is the Dranka River in north-east of the peninsula descending from the Sredinnyi Range east and entering the Pacific 15 km NE of Ivashka village, perhaps there was a village called Dranka at its mouth, 58°42'-59°00'N, 161°30'-162°30' E, 19-VIII-1930, Novograblenov leg.
- (6) # Elovka River valley, ca 56°25'-40' N, 160°40'-50'. 13 and 29-VIII-1958, A. Kurentzov leg. (BELY SHEV, 1973). To this locality we also attribute the label "Kharchino, E. Kamchatka", 10-VII-1933, Koshkin leg., since Lake Kharchinskoe and the Kharchinskaya Mt. are situated at lower reaches of the Elovka.
- (7)*** Small lakes and ponds, connected by a brook, adjacent to northern end of Lake Kurazhechnoe in Kamchatka River valley. In one roundish mesotrophic lake surrounded by meadows and *Betula platyphylla* and *Alnus hirsuta* s. l., and by reed thickets, *Gasterosteus aculeatus* was abundant. Also winding ponds, locally with thickets of *Phragmites australis* or *Cicuta virosa*, surrounded by peat moss mires with *Betula divaricata*, *Chamaedaphne calyculata*, *Triglochin maritimus*, *Oxycoccus microcarpus*, and depleted larch taiga. 56°26'57" N, 160°57'06", 22 m a. s. l. 17-VII-2003.
- (8)*** Large mesotrophic Lake Kurazhechnoe 8 km NNE of Klyuchi village, with *Equisetum fluvia-*

- tile*, *Scirpus lacustris*, and sedge and reed marshes. *Gasterosteus aculeatus* noticed. 56°22'58" N, 160°53'47" E, 27 m a. s. l. 17-VII-2003.
- (9)# Lake Kamenskoe in Kamchatka River valley, 13 km NEE of Klyuchi village. 56°20-23' N, 161°00'. 19-VIII-1958, A. Kurentzov leg. (BELYSHEV, 1973).
- (10)# Klyuchi village environs (= "Klutchi" by SJÖSTEDT (1927)), 56°19'55" N, 160°50'20". 2-VIII-1908, A. Derzhavin leg.; 16-VII-1909, Sapozhnikov leg.; 26-27-VI-1921, 1-VIII-1921 (SJÖSTEDT, 1927); 12-VIII-1930, V. Pereleshina leg.; 7-VII-1933, Koshkin leg.; 19 and 22-VIII-1958, A. Kurentzov leg. (BELYSHEV, 1973).
- (11) "The Bekesh River, Shiveluch, Kamchatka" – there is Lake Bekesh at the Shiveluch volcano southern foot, which accepts the Kabeku River descending from this volcano, 56°19-21' N, 161°27-28', 23-VI-1908, A. Derzhavin leg.
- (12)# Kamchatka River 50 km downstream of Klyuchi village, 56°16' N, 160°40'. 19-VIII-1958, A. Kurentzov leg. (BELYSHEV, 1973).
- (13) Ust'-Kamchatsk settlement at the Kamchatka River mouth, 56°14' N, 162°32', 23-IX-1959, Gorodkov leg.
- (14) Environs of Kresty village (presently abandoned) at the Belaya River mouth, 56°25' N, 160°22', 10-VII-1929, Novograblenov leg.
- (15) 2 km downstream of Krasnyi Yar village (presently abandoned) along the Kamchatka River, 56°21'16" N, 160°16', 19-VII-1930, V. Pereleshina leg.
- (16) Maiskii collective farm, Ust'-Kamchatsk District, 56°15-20' N, 160°00-10' E, 70 m a. s. l. 1-VII to 30-VIII-1971, Kostina leg. See also (BELYSHEV, 1973).
- (17)*** Oligotrophic, cold Lake Domashnee at northern margin of Kozyrevsk village fed by strong springs and outflowing to Kamchatka River. At its northern end a sedge tussock swamp with *Hippuris vulgaris*. Odonata were collected on this swamp. 56°03'26" N, 159°52'04" E, 48 m a. s. l., 14 and 15-VII-2003. Also collections at Kozyrevsk by Novograblenov on 17-VII-1910, by V. Pereleshina on 16-VII-1930 and by A. Kurentzov at Kozyrevsk on 18-VII and 7-VIII-1958 (BELYSHEV, 1973)
- (18)*** Mesotrophic Lake Okhlonets (known also as Lake Okhmach) 4 km WWS of Kozyrevsk village, ancient Kamchatka River oxbow, with swampy banks; wide areas of *Equisetum fluviatile*. 56°02'31" N, 159°48'32" E, 43 m a. s. l., 14-VII-2003.
- (19)*** Sedge tussock swamp 17 km S of Kozyrevsk village. *Polygonum amphibium*, 55°55'40" N, 159°41'54" E, 57 m a. s. l., 18-VII-2003
- (20)*** Crater Lake Ikar 8 km from Esso village, mesotrophic, with peat moss quacking mires with *Betula divaricata*, *Spiraea salicifolia*, *Comarum palustre*, surrounded by *Pinus pumila* and larch taiga, 55°52'16" N, 158°40'09" E, 550 m., 19-VII-2003.
- (21) Environs of Krapivnaya village at the Bystraya River mouth, 55°52'35" N, 159°35' E, 12 and 29-VIII-1930, V. Pereleshina leg.
- (22)*** Kruten'kaya Rivulet, with dead larch forest on sedge tussock bog, numerous *Spiraea salicifolia*, and cold pools with abundant cyanobacteria, some *Hippuris vulgaris*. 20 km NW of Atlasovo village, 55°43'21" N, 159°24'39" E, 78 m a. s. l. 20-VII-2003.
- (23) Surroundings of Shchapino (= "Tchapina") village, 55°20' N, 159°27' E, ca 70 m a. s. l., 23-VII to 2-VIII-1921 (SJÖSTEDT, 1927); 26-VI-1960, Safronova leg.?
- (24)# Mashura ("Maschura") village at junction of Bol'shaya Kimitina River with Kamchatka River. 55°01'30" N, 158°59' E, 100 m a. s. l. 20-VII-1909, Protopopov leg.; 11-VIII-1921 (SJÖSTEDT, 1927).
- (25) Mil'kovo village, 54°42' N, 158°38' E, ca. 150-200 m a. s. l. 2-VIII-1991, K. Reinhardt leg.
- (26)*** Swamp near Zhupanka River, surrounded by willows, 10 km SW of Mil'kovo village, 54°39'33" N, 158°30'26" E, 200 m a. s. l. 20-VII-2003.
- (27)*** Swamp near Kamchatka River at bridge, inundated temporary branch or oxbow, with filamentous green algae, surrounded by willows and poplars, 15 km SW of Mil'kovo village, 54°37'21" N, 159°24'39" E, 78 m a. s. l., 20-VII-2003.

- (28)*** System of lakes at hill foot along main road in Pravaya Kamchatka River basin, partly with peaty banks (*Drosera*, *Oxycoccus*, *Chamaedaphne*, *Betula divaricata*), alternating with birch and alder groves and willow thickets. *Nymphaea tetragona* and *Potamogeton*. 54°04'20" N, 157°42'44" E, 78 m a. s. l., 21-VII-2003.
- (29)*** Large mesotrophic lake, with boggy banks and abundant *Carex*, *Eleocharis*, *Hippuris vulgaris*, near Bystraya River, in so-called «Ganal'skaya Tundra», forestless area at foot of Ganaly Range. 53°58'02" N, 157°44'50" E, 480 m a. s. l., 13-VII-2003.
- (30)*** Large oligotrophic lake near Malki village, without water plants, surrounded by peat-moss mire with sedge, *Drosera*, *Oxycoccus microcarpus*, *Rubus chamaemorus*, *Comarum palustre*, *Pinus pumila*, *Chamaedaphne calyculata*, *Betula divaricata*, *Pentaphylloides fruticosa* etc. Many *Gasterosteus aculeatus*. Remarkable for abundance of *Aeshna crenata* and *Somatochlora graeseri*. Malki is famous for its mineral water sources, so the lake may be mineralized. 53°18'09" N, 157°58'21" E, 270 m a. s. l., 21-VII-2003.
- (31)** Valley of right tributary of Bannaya River between Khalzan and Balaganchik Ranges, 52°69' N, 157°49' E, 500 m a. s. l., O. Kosterin leg.
- (32) Lake Maloe Nachikinskoe 53°01' N, 157°50' E, 348 m a. s. l., 4-VIII-1959, Kononov leg.
- (33)*** Medium-sized mesotrophic lake with *Sparganium*, *Potamogeton polygonifolium*, surrounded by peat-moss mire, with *Drosera*, *Chamaedaphne*, *Betula divaricata*, *Comarum palustre*; situated within stone birch forest at foot of Vachkazhets Mt. A smaller round lake nearby. 53°05'22" N, 157°52'43" E, 500 m a. s. l., 23 and 24-VII-2003.
- (34)*** Polovinka River valley, descending from Vachkazhets mountain range, 13 km ESE of Elizovo city valley: stone birch (*Betula ehrmanni*) alternating with *Chamenerion angustifolium* meadows. 53°10' N, 158°19' E, ca. 400 m. 27-VII-2003.
- (35) Valley between Koryakskii and Avachinskii volcanoes, ca. 53°15' N, 158°44' E. Late VIII-1992, H. Weingart leg.
- (36)*** Large mesotrophic Lake Sinichkino at NE margin of Petropavlovsk-Kamchatskii surrounded by *Eriophorum* sp., *Baeotriion alpinum*, *Chamaedaphne calyculata*, *Drosera anglica*, with *Potamogeton polygonifolium*, *Menyanthes trifoliata* and *Comarum palustre*, surrounded with stone birch. 53°05'00" N, 158°41'35" E, 150 m a. s. l., 29-VII-2003.
- (37)** Petropavlovsk-Kamchatskii. 2-5-VII. and 11-22-VII-1920 (SJÖSTEDT, 1926); 16-X-1930, V. Pereleshina leg.; sedge boglet in city, 27-VIII-1992, O. Kosterin leg.; 23-VII-1993, Novikova leg..
- (38)*** Large Lake Kultuchnoe in centre of Petropavlovsk-Kamchatskii, separated from sea by sand spit. Earlier polluted with city sewage, now moderately clean, with abundant filamentous green algae, *Lemna minor* and scarce *Potamogeton perfoliatum* and *Gasterosteus aculeatus*. A sedge/ *Equisetum fuviatile* swamp at one end. 53°02' N, 158°39' E, sea level, 28-VII to 6-VIII-1991, K. Reinhardt leg.; 10-12 and 29-VII-2003, O. Kosterin leg..
- (39)*** Large mesotrophic Lake Bannoe at Bol'shaya Okeanskaya (Bol'shaya Lagernaya) abandoned settlement, 12 km SSE of Petropavlovsk-Kamchatskii, with sedge, *Comarum palustre* and *Naumburgia thyrsoflora* or (at hill foot) dwarf alder shrub along banks, separated from Avachinskii Bay by sand spit, 53°01'00" N, 158°41' E, sea level, 11-VII-2003.
- (40)*** Mesotrophic warm-water (partly outflux of power station) Lake Khalaktyrskoe, scarce filamentous green algae and *Potamogeton perfoliatum*. Slightly green by planktonic algae. Among aquatic animals, *Gasterosteus aculeatus* and introduced *Rana ridibunda*; also *Anodonta piscinalis*. SE of Petropavlovsk-Kamchatskii, 53°01'00" N, 158°44'30" E, close to sea level. 26-VII-2003.
- (41)*** Ditches with rusty water and pools draining marshy plain between Zaozernyi settlement and Khalaktyrskii Beach. 52°53'00" N, 158°49' E, sea level. 28-VII-2003.
- (42)*** Khalaktyrskii Beach of Pacific Ocean coast 13 km SE of Petropavlovsk-Kamchatskii, 52°58'30" N, 158°49'10" E. Dragonflies washed in by waves, 25-VII-2003, O. Kosterin leg., 28-VII-2003, N. Pavlova leg.

- (43) Environs of Paratunka settlement, wrongly referred to as “Klyuchi village on the Paratunka River”, 52°58' N, 158°15' E, 21-VI-1908, “Kamchatian expedition by Ryabushinskii”.
- (44)# Tarya [= “Tarja, Avatscha Bay”] Bay, presently Krashenninnikova Bay, western part of Avacha Harbour, 19 km SW of Petropavlovsk-Kamchatskii. ca 52°53-57' N, 157°24-34' E. 24-26-VII-1921 (SJÖSTEDT, 1927).
- (45) Bezymyanni Bay: brackish water, 18 km S of Petropavlovsk-Kamchatskii, ca 52°52' N, 157°35' E, 5-VIII-1991, K. Reinhardt leg.
- (46)*** Levashova Cape on western Okhotsk coast. Marshes and swampy pools with *Comarum palustre*. 52°47'38" N, 156°11'30" E, few m above sea level, 22-VII-2003.
- (47)** Pools in coastal bog 5 km NW of Ust'-Bol'sheretsk, 52°51' E, 156°17' N, sea level, 9-VIII-1992, O. Kosterin leg.
- (48)*** Small swamp at road to Ust'-Bol'sheretsk, with willow thickets and *Equisetum fluviatile*. 52°50'53" N, 156°20'01" E, 20 m a. s. l., 22-VII-2003.
- (49)*** Pools with filamentous green algae, *Equisetum fluviatile*, sedge and small fish. 52°54'02" N, 156°30'45" E, 45 m a. s. l., 22-VII-2003.
- (50)** Open willow and alder stand in floodland at junction of Pravaya Karymchina and Levaya Karymchina Rivers, 52°41'35" N, 157°43'20" E. 270 m a. s. l., 20-VIII-1992, O. Kosterin leg.
- (51)** Small shallow sedge bog at SW bank of Lake Tolmachevo e, 52°37' N, 157°43' E, 650 m a. s. l., 23-VIII-1992, O. Kosterin leg.
- (52)** Paratunka River valley at E foot of Vilyuchinskaya volcano, 52°42'30", N, 158°15'30" E, 25 m a. s. l., 6-VIII-1991, O. Kosterin leg.
- (53) Surroundings of Mutnovskii volcano, 52°26-28' N, 158°10-12' E, 21-26-VII-1991, K. Reinhardt leg.
- (54)** Hot springs at western foot of Khodutka volcano (at Priemysht mt.): long and 10-20 m wide lake with muddy bottom; water cold at bottom, c. +40°C at surface. *Potamogeton*, banks with *Eleocharis camtchatica*, 52°06'30" N, 157°38'42" E. 300 m a. s. l., 30-VIII-1991, O. Kosterin leg.
- (55)** Vestnik River valley, dwarf alder thickets alternating with open heath. 51°45'30" N, 157°25' E. c. 500 m a. s. l. 22-VIII-1991, O. Kosterin leg.
- (56)** Surroundings of Ozernovskii settlement on southern Okhotian coast; small ponds with *Potamogeton* aff. *natans*, *Juncus*, *Eriophorum* in depressions of coastal terrace and *Carex/Myriophyllum/Comarum* swamps at Ozernaya River. 50°30' E, 156°30' N, sea level, 12-VIII-1991, O. Kosterin leg.
- (57)* Oxbows of Pauzhetka River at Pauzhetka village, ca. 51°28' E, 156°54' N, 100 m a. s. l., 24-VI to 15-VIII-1978, A. Haritonov leg.
- (58)* Lake Kuril'skoe near Ozernaya River origin, small marshes, 51°29' E, 157°03' N, 81 m a. s. l., 15-VII-1978, A. Haritonov leg.
- (59)* Small pools on bank of large Lake Kuril'skoe, 52°51' E, 157°05' N, sea level. 51°31' E, 157°05' N, 81 m a. s. l., 16-VII-1978, A. Haritonov leg.

We failed to locate the following sites:

- found on labels by V. Pereleshina who collected along the Kamchatka River in 1930: Dolgii Ples, Lake Kham-Situ, villages Kamenka and Beloyansk.
- mentioned by BELY SHEV (1964): “Kamchatskaya MTS”, “environs of Central State farm” (these toponyms concerning Soviet agriculture should refer to the area near Mil'kovo, the only agricultural area in Kamchatka) and “Zhupanovo at the Kamchatka River” (this may be the Zhupanka River, but there is also an abandoned settlement Zhupanovo at the east coast).
- Miscellaneous old records: “The Chernovaya River headwaters, Ust'-Kamchatskii Uezd [District]”, 29-VII-1897, Silant'yev leg.; “The Kamchatka River (?between Krot'y and Chikhly), 1-VIII-1908, V. Bianchi leg. [there is no trace of such toponyms]; “Elovka, 32 km from Klyuchi village by Kamchatka

River. 8-VII-1933, Koshkin leg. [there is the Elovka River north of Klyuchi, but there is no Elovka on the Kamchatka River at this distance];

ANNOTATED LIST OF SPECIES

Asterisks indicate first records for the Peninsula. Minus stands for species dropped from the checklist. Most specimens mentioned in "Miscellaneous records. – " are in the collection of ISEA, Novosibirsk. If kept in ZISP, ZMMSU, BSI or BSPU, this is indicated in parenthesis. Collectors can be inferred from the list of localities but if a locality was studied by several, the collector is indicated. Specimens obtained in 2003 have been lumped. They are kept in ISEA, BSPU, in the collection of Henri Dumont, and in the Royal Institute of Natural Sciences, Brussels.

**Lestes dryas* Kirby, 1890

Miscellaneous records. – 1 ♂, loc. 58, 15-VII-1978.

That only one specimen of *Lestes* has become known from Kamchatka is striking. Kamchatka provides numerous suitable habitats for *Lestes*, as a rule inhabited by *Sympetrum flaveolum* and *S. danae*, which often co-occur with it elsewhere across its range. The single specimen obtained proves that the genus did penetrate the peninsula but, for reasons that are unclear, remained rare.

Coenagrion lunulatum (Charpentier, 1840)

Miscellaneous records. – 10 ♂, loc. 16, 20-VII-1971; 2 ♂, 2 ♀, loc. 17, 17-VII-1910 (Novograblenov leg.) (ZIN).

2003 collection. – 4 ♂, 3 ♀, loc. 7, 17-VII; 64 ♂, 25 ♀, loc. 17, 14-VII; 23 ♂, 8 ♀, 11 exuviae, loc. 17, 15-VII; 33 ♂, 11 ♀, loc. 18, 14-VII; 34 ♂, 6 ♀, loc. 19, 18-VII; 18 ♂, 1 ♀, loc. 20, 19-VII; 47 ♂, 2 ♀, loc. 28, 21-VII.

Common species on swamps in central Kamchatka.

Coenagrion armatum (Charpentier, 1840)

SIÖSTEDT, 1927: 3 ♂, "Klutchi" [loc. 10], 26/27-VI-1921.

Miscellaneous records. – 119 ♂, 113 ♀, loc. 16, 1-VII - 22-VII-1971; 18 ♂, 8 ♀, loc. 57, oxbows, 1-VII-1978.

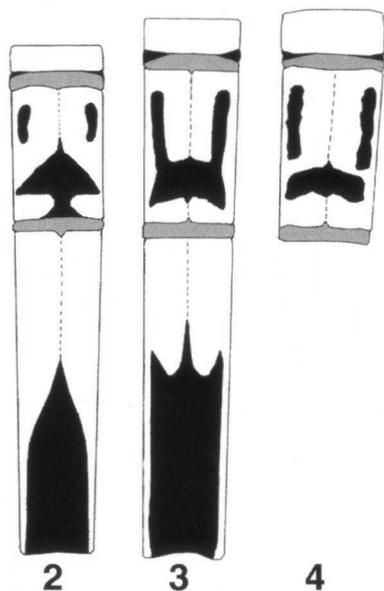
2003 collection. – 9 ♂, 8 ♀, loc. 7, 17-VII; 10 ♂, 4 ♀, loc. 8, 17-VII; 4 ♂, 8 ♀, loc. 17, 14-VII; 9 ♂, 9 ♀, loc. 17, 15-VII; 4 ♂, loc. 18, 14-VII; 5 ♂, loc. 19, 18-VII; 1 ♂, loc. 22, 20-VII; 8 ♂, 7 ♀, loc. 39, 11-VII.

Mostly at sedge tussock swamps, often on larger lakes. As a rule with *C. lunulatum* but less abundant. Prefers pools of open water and avoids dense sedge, in contrast to *C. lunulatum*. Also on lakes close to the sea while *C. lunulatum* is restricted to central Kamchatka.

**Coenagrion hastulatum* (Charpentier, 1825) (Figs 2-4)

2003 collection. – 14 ♂, 3 ♀, loc. 28, 21-VII.

A West Palaearctic species, common in Yakutia (BELYSHEV, 1973; KOSTERIN, 2004b) and rare east of the Yenisei River at lower latitudes, but reaching the Pacific in Primorye (MALIKOVA, 1995) and Korea (ASAHINA, 1979). Some males had a more melanic pattern: the black marking on segment II is enlarged, with well expressed lateral strokes, and that on the other segments is widened, so that the pattern



Figs 2-4. *Coenagrion hastulatum*: (2) typical male from Glubokoe lake near Moscow; — (3) male from the Pravaya Kamchatka River basin (loc. 21) with the three black elements of segment 2 coalesced; — (4) male from the same population, with the lateral spots of segment 2 enlarged but not merged with the central spot.

resembles that of *C. lunulatum* (Figs 2-4). Possibly, the same slow larval development as was found in *Enallagma* (see hereunder) occurs here, with a similar effect. Found at a system of lakes with peaty banks, alternating with birch and alder groves and willow thickets situated along the main road of Central Kamchatka. Not abundant.

Coenagrion johanssoni Wallengren, 1894 (Fig. 11)

BELYSHEV et al., 1978: (*Agrion concinnum bartenevi* Belyshev), 29 ♂, 5 ♀, Ust'-Kamchatsk District, Maiskii collective farm [loc. 16], 1-VIII-1971 (Kostina).

Miscellaneous records. — 1 ♂, loc. 1, 28-VI-1994; — 2 ♂, loc. 58, a small marshy pond, 15-VII-1978.

2003 collection. — 1 ♂, loc. 17, 15-VII; 57 ♂, 17 ♀, loc. 20, 19-VII; 5 ♂, 3 ♀, loc. 27, 20-VII; 10 ♂, loc. 28, 21-VII; 9 ♂, loc. 33, 23-VII; 28 ♂, 2 ♀, loc. 33, 24-VII.

An inhabitant of waters with peat moss banks. Prefers small pools but still common along peaty banks of lakes.

Coenagrion hylas (Trybom, 1889)

BELYSHEV et al., 1978: 2 ♀, Ust'-Kamchatsk District, Maiskii Collective Farm [loc. 16], 20-VII-1971 (Kostina).

July 2003 collection. — 12 ♂, 10 ♀, loc. 20, 19-VII; 5 ♂, loc. 22, 20-VII; 3 ♂, loc. 27, 20-VII; 3 ♂, loc. 29, 13-VII; 6 ♂, loc. 33, 21-VII.

On lakes with peat-moss but less frequent than previous species.

Enallagma c. cyathigerum (Charpentier, 1840)

HAGEN, 1856: (*Agrion cyathigerum*) Petropavlovsk [loc. 30]; — SJÖSTEDT, 1927: (*Enallagma cyathigerum*) "Klutchi" [loc. 8], 1-VIII-1921; "Tchapina (am Flussufer)" [loc. 23], 29-VII-2-VIII-1921"; 11 ♂, 1 ♀, "Tarja, Avatcha Bay" [loc. 36], 24-26-VII-1920; — BELYSHEV, 1964: 58-59 (*Enallagma c. cyathigerum* Charp.), 23 ♂, 1 ♀, Lake Kamenskoe [loc. 9]; 19-VIII-1958; 5 ♂, 2 ♀, Kamchatka River 50 km downstream of Klyuchi [loc. 9], 19-VIII-1958, (Kurentzov); — HARITONOV, 1975: (*Enallagma nigrolineata* [sic] Belyshev et Haritonov, sp. nov.) 4 ♂, 2 ♀, Ust'-Kamchatsk District, Mikhailovskii collective farm [Note: In fact this was Maiskii Collective Farm] [loc. 16], 5-VII-1971; 21 ♂, 5 ♀, same site, 3-VIII-1971 (Kostina).

Miscellaneous records. — 1 ♂, the Kamchatka River left bank, Dolgii Ples, 25-VIII-1930; 3 ♂, the Kamtshatka River, 16-VIII-1930 (V. Pereleshina leg.) (ZMMSU); 1 ♂, loc. 1, 20-VIII-1994; 4 ♂, 5 ♀, loc. 6 ("Kharchino") (ZISP); 4 ♂, loc. 10, 7-VII-1933 (Koshkin leg.) (ZIN); 4 ♂, loc. 14, 10-VII-1929 (ZISP); 1f, loc. 17, 16-VII-1933 (ZMMSU); 1 ♂, loc. 32, 4-VIII-1959 (in coll. BSI); series, loc. 38, 28-VII/6-VIII-1991 (K. Reinhardt, leg.); series, loc. 45, 5-VIII-1991; series, loc. 53, 23-VII-1991; 52 ♂, 50 ♀, loc. 57, 2 km N of Pauzhetka village, 24-VI/15-VIII-1978.

July 2003 collection. — 6 ♂, 1 ♀, loc. 7, 17-VII; 3 ♂, loc. 17, 14-VII; 5 ♂, 1 ♀, loc. 18, 14-VII; 47 ♂, 5 ♀, loc. 20, 19-VII; 3 ♂, loc. 26, 20-VII; 1 ♂, loc. 27, 20-VII; 17 ♂, 5 ♀, loc. 28, 21-VII; 1 ♂, loc. 30, 21-VII; 32 ♂, 11 ♀, loc. 33, 23-VII; 89 ♂, 5 ♀, loc. 33, 24-VII-38 exuviae, loc. 33, smaller lake, 24-VII; 22 ♂, 7 ♀, loc. 38, 10-VII; 62 larvae, loc. 38, 12-VII; 5 ♂, 2 ♀, loc. 38, 29-VII (O. Kosterin); 4 ♂, 6 ♀, loc. 39, 11-VII; 14 ♂, 2 ♀, loc. 48, 22-VII.

The taxonomic position of Kamchatian *Enallagma* used to be problematic. BELYSHEV (1964) stressed that his numerous specimens from the Kamchatka River showed no deviation from the typical form. At the same time, specimens by Kostina from the same Kamchatka River valley (the Maiskii collective farm) were included into the type series of *E. nigrolineatum* Belyshev & Haritonov (HARITONOV, 1975), although this taxon was a junior objective synonym to some older available taxon name that will be discussed elsewhere. This taxon is characterized by extended melanization manifested as variably expressed black lateral stripes on the abdomen, like in *E. circumlatum* Selys, 1883. However, the Maiskii series generally is not melanized and the main reason for including it into this taxon was the structure of the male cerci. In fact, their structure is typical for *cyathigerum* s. s., but BELYSHEV (1973), who dealt mostly with another structural type, *risi* Schmidt, 1964, mistook *risi* for the typical form (KOSTERIN, 1999; 2004a). SAMRAOUI et al. (2002) discuss the status of *risi*, based on morphology and DNA-work, and conclude it is best regarded as a subspecies of *cyathigerum*.

We had ample opportunity to evaluate the degree of melanization throughout the Peninsula. In most localities, males were not melanized and looked European. In some, traces of narrow black lateral lines along the abdomen were noticed. On the lakes in the Pravaya Kamchatka River basin (loc. 42), melanized specimens flew among normal ones. Variable but usually melanized specimens occurred at the lake at Vachkazhets mountain, and in the south, the Pauzhetka river valley. These localities are characterized by harsh environmental conditions: one is rather high up while the other is situated on a narrow land strip between cold seas. In 1978, HARITONOV (1990) investigated series of larvae in the Pauzhetka River valley; from their size distribution he deduced that the life cycle here is triennial. In 2003, Kosterin measured 62 larvae at Lake Kultuchnoe in Petropavlovsk-Kamchatskii at a moment when numerous adults had already emerged and found that 59 of them were between 8 and 15 mm of the body length (without gills), with the mode at 12 mm. In 26, the wing sheaths covered the first abdomen segment or slightly more, in 33 the two first abdomen segments or slightly less. They were supposedly third and second instar. Three exceptional larvae were 17-18 mm long and their wing sheaths covered part (up to half) of the third abdominal segment. These were no doubt last instar larvae. Abundance of earlier instars and scarcity of the last instar at the time when most of the adults had emerged (few teneral were observed at the date of collecting) suggests a biennial life-cycle. We hypothesize that in the severe conditions of Kamchatka, this species has a slower life cycle, and this life history could influence the degree of melanization, with more heavily melanized individuals among those whose development took three years.

Most females were gynochromes, the blue form was rare.

Found at lakes with much open water, as a rule not abundant but in massive numbers at polluted Lake Kultuchnoe within Petropavlovsk, and less abundant but still dominant at Lake Bannoe south of Petropavlovsk. Both lakes are separated from Avachinskii Bay by a narrow sand spit. According to Dr K. Reinhardt (pers. comm.), this species was also common in brackish waters of Bezymyanni Bay and predominated on small ponds about 20 km from the Okhotsk coast. This species' occurrence close to the sea, in sites vacated by most other odonates, is well-known. Recently, it was found to successfully breed in the brackish Baltic Sea (KALKMAN et al., 2002). Beside resistance to salinity, *Enallagma* also responds well to factors such as winds, overcast weather or high humidity. Dr K. Reinhardt found that at the Mutnovskii volcano these damselflies were abundant among birch forest (900 m a.s.l.) with only running water in the surroundings. We also found this species commonly in mountains, like at Lake Ikar and on the Vachkazhets massif.

Aeshna caerulea (Ström, 1783)

Miscellaneous records. – 1 ♂, loc. 1, 15-VIII-1994; 2 ♂, loc. 2, 24-VII-1994.

2003 collection. – 1 ♂, 3 ♀, loc. 20, 19-VII; 1 ♂, loc. 36, 29-VII.

Of three ovipositing females at Lake Ikar, one missed one cercus and one both cerci. Occurs at rather large lakes with banks of peat-moss mire, on pools in which females oviposit. A female was recorded on a road through forest, several km from Lake Sinichkino. This small aeshnid behaves rather alike a gomphid, scarcely flying and tending to sit on birch branches.

Aeshna juncea (Linnaeus, 1758)

HAGEN, 1856: Petropavlovsk; – SJÖSTEDT, 1927: ♂, ♀, "Tarja, Avatcha Bay" [loc. 44], 24-26-VIII-1920; "Tchapina" [loc. 23], 23-30-VII-1921; "Maschura" [loc. 24], 11-VIII-1921; – BELYSHEV, 1964: 4 ♂, 1 ♀, Kamchatka R. at Zhupanovo, 5/6-IX-1958 (Kurentzov leg.).

Miscellaneous records. – 1 ♂, "the Kamchatka River (?between Krotzy and Chikhly)", 1-VIII-1908 (V. Bianchi leg.) (ZISP); 1 ♂, 1 ♀, loc. 1, 10-VIII-1994, 5 ♂, loc. 1, 15-VIII-1994; 17-VIII-1994; 2 ♂, loc. 2, 24-VII-1994, 1 ♂, 1 ♀, loc. 2, 14-VIII-1994; 3 ♂, 1 larva, loc. 3, 3-IX-1994; 1 ♂, loc. 5, 19-VIII-1930 (ZISP); 2 ♀, loc. 11, 23-VI-1930 (ZISP); 3 ♂, 2 ♀, loc. 16, 19-VII-1971; 3 ♂, 3 ♀, loc. 16, 3-19-VIII-1971; 1 m (teneral), loc. 31, 16-VIII-1992; - exuviae, loc. 38, 28-VII – 6-VIII-1991 (K. Reinhardt, leg.); series, loc. 45, 5-VIII-1991; 1 ♂, loc. 47; 9-VIII-1992; 1 ♂, loc. 51, 22-VIII-1992; 1 ♂, 1 ♀, loc. 54, 30-VIII-1991; 1 ♂, loc. 55, 22-VIII-1991; 2 ♂, 1 ♀, loc. 56, 12-VIII-1991; 918 larvae, 936 exuviae; 75 ♂, 69 ♀, loc. 57, 2 km N of Pauzhetka village, 24-VI/15-VIII-1978.

2003 collection. – 3 ♂, 1 ♀, loc. 7, 17-VII; 2 ♂, loc. 17, 14-VII; 1 ♂, 1 ♀, loc. 17, 15-VII; 22 ♂, 4 ♀, loc. 20, 19-VII; 3 ♂, loc. 22, 20-VII; 1 ♂, loc. 26, 20-VII; 2 ♂, loc. 27, 20-VII; 12 ♂, 3 ♀, loc. 28, 21-VII; 1 ♂, loc. 29, 13-VII; 3 ♀, loc. 30, 21-VII; 84 ♂, 15 ♀, loc. 33, 23-VII; 22 ♂, 4 ♀, loc. 33, 24-VII; 5 ♂, 2 ♀, 13 exuviae, loc. 33, the smaller lake, 24-VII; 1 ♂, 1 ♀, loc. 34, 27-VII; 4 ♂, loc. 36, 29-VII; 1 ♂, loc. 38, 10-VII (O. Kosterin); 1 ♂, loc. 39, 11-VII; 1 ♂, loc. 40, 26-VII; 3 ♂, loc. 41, 28-VII; 1 ♀, loc. 49, 22-VII.

Females had either a blue or green ground colour. Abundant at various types of waters. Larvae were found even in small pools at the Okhotsk coast, where weather is almost permanently overcast and foggy. Rare at lakes with *A. crenata* or *A. serrata* present, confirming BELYSHEV's (1973) observation that *A. crenata* may

exclude *A. juncea*. Males of *A. juncea* patrol the banks of lakes and pools, flying just above the water, along the line of vegetation. Individual territories overlap such that many individuals pass the same point at the bank one by one. Males attack and even hunt for smaller anisopterans such as *Somatochlora*; on the lake on the Vachkazhets massif this activity intensified in the evening.

Aeshna subarctica Walker, 1908

BELYSHEV, 1964: 58 (*Aeshna subarctica elisabethae*) 1 ♂, 1 ♀, Kamchatskaya MTS, 29-VII-1958 (Kurentzov leg.); – REINHARDT, 1994: Mutnovskaya volcano [loc. 53].

Miscellaneous records. – 1 ♂, loc. 1; 15-VIII-1994; 1 ♀, loc. 24, 20-VII-1909 (Protopopov leg.) (ZIN); series, loc. 53, 800–1800 m a. s. l., 21-26-VII-1991; 2 ♂, loc. 57, 5-VII-1978; 1 ♂, loc. 59, 16-VII-1978.

In spite of the large number of aeshnids collected by the 2003 expedition, we failed to collect a single specimen of this species. However, it should be noted that most of the previous records were from places south of the area investigated by us. K. Reinhardt (pers. comm.) observed feeding on *Cidaria* moths.

Aeshna crenata (Hagen, 1856)

SJOSTEDT, 1927: 1 ♂, “Tchapina” [loc. 23], 30-VII-1921

Miscellaneous records. – 1 ♂, loc. 10, 2-VIII-1908 (A. Derzhavin leg.) (ZIN); 2 ♂, loc. 16, 3-VIII-1971; 1 ♂, loc. 16, 4-VIII-1971; 1 ♂, loc. 57, 8-VIII-1978.

2003 collection. – 1 ♂, loc. 7, 17-VII; 1 ♂, 1 ♀, loc. 17, 15-VII; 2 ♂, loc. 18, 14-VII; 3 ♂, 14 ♀, loc. 28, 21-VII; 18 ♂, 8 ♀, loc. 30, 21-VII.

Kamchatian males differ from Siberian ones in coloration: their face and stripes on the thorax are bluish, and the abdominal blue has a violet tinge. Perhaps, the Kamchatian population is thus a separate subspecies. In Siberian specimens, the face and stripes are yellowish while the abdomen ground colour is blue. Females as a rule have darkened wings, the degree of darkening in Eurasia showing a cline, increasing to the east (BELYSHEV, 1973). Our females have a variable but moderate degree of darkening. Prefers lowland lakes with abundant trees on the banks but found on not so many of these. If present, as a rule abundant. Males have distinct territories sized about 10-20 m between sparse trees or bushes, along or close to the bank, which they patrol by regular flying to and fro about 1.5-2 m above the ground.

**Aeshna serrata* (Hagen, 1856)

Miscellaneous records. – 1 ♀, “Kamchatka” without specification, 1898 (Voznesenskii leg.) (ZIN), 1 ♂, 3 ♀, loc. 10, 2-VIII-1908 (A. Derzhavin leg.) (ZIN); 1 ♀, loc. 10, 16-VII-1909 (Sapozhnikov leg.) (ZIN).

2003 collection. – 28 ♂, 1 ♀, loc. 7, 17-VII; 1 ♂, loc. 19, 18-VII.

Kamchatian specimens are somewhat smaller than Siberian ones but do not differ in coloration. The discovery of this species is significant. BELYSHEV (1973) supposed it did not to extend east of Lake Baikal. Later, it was found in SE Transbaikalia (GORB et al., 1996) and Central Yakutia (FUKUI, 1996), but was still thought not to reach the Far East. Believed to prefer open landscapes (BELYSHEV, 1999) and inferior in woods to its close relative *A. crenata*. Abundant in steppe and for-

est-steppe lakes of South Ural, Kazakhstan and West Siberia but in 2003 found in two localities in northern Central Kamchatka as well as among a hundred year old material, from the same area, in ZIN collection. At both sites we visited it co-occurred with *A. crenata*, but in a small lake adjacent to the large Lake Kurazhechnoe it was the more numerous of the two.

Aeshna palmata Hagen, 1856

HAGEN, 1856: Petropavlovsk [loc. 37].

HAGEN (1856) thought the type specimen of this species was from Kamchatka, but it is purely North American and abundant in Alaska and further south (NEEDHAM & WESTFALL, 1975). It is quasi-certain that the types were collected in Alaska by the Russian-American Company and mislabeled subsequently (BELYSHEV, 1973; GLOYD, 1941).

Anax junius Drury, 1770

HAGEN, 1856: Petropavlovsk [loc. 37]; – BARTENEV, 1911: Kamtschatka, 1 ♂ (Voznesenskii).

This American species may occasionally reach Kamchatka since HAGEN's (1756) record was later confirmed by BARTENEV (1911), and the species has managed to penetrate China (BELYSHEV, 1966). A well-known migrant that travels large distances and recently even reached Britain (CORBET, 2000).

**Epitheca bimaculata* (Charpentier, 1825)

Miscellaneous records – 1 ♂ (exuviae), loc. 57, 15-VIII-1978.

The species is recorded here for the first time from the southern tip of the Peninsula.

Cordulia amurensis (Selys, 1887) (Figs 5-6)

HAGEN, 1856: Petropavlovsk [loc. 30].

Miscellaneous records – 1 ♂, loc. 37, 23-VII-1993 (Novikova) (BSPU); 1 ♀, loc. 43, 21-VI-1908 (ZISP).

2003 collections – 4 ♂, loc. 20, 19-VII; 10 ♂, 3 ♀, loc. 28, 21-VII; 2 ♂, 2 ♀, loc. 30, 21-VII; 16 ♂, 4 ♀, loc. 33, 23-VII; 14 ♂, 2 ♀, loc. 33, 24-VII; 2 ♂, 3 ♀, loc. 33, the smaller lake nearby, 24-VII; 1 ♂, loc. 42, 28-VII (N. Pavlova).

Recently, JÖDICKE et al. (2004) used molecular markers to support the view that *amurensis*, described from the Amur province, refers to a valid taxon, which they rank at the species level. We provisionally accept this position, although data from the huge but key territory between the Ob' and Amur province where the putative taxa should meet or intergrade, were not included in the study. Indeed, comparing the fore-wing length of nine specimens from Kamchatka with eight specimens from Poland and France, we found specimens from Kamchatka to be significantly smaller (28.6 ± 0.22 mm against 34.9 ± 0.24 mm, t test, $p < 0.001$) The mean fore-wing length in 15 males from Amur province, from where *amurensis* has been described, was close to the Kamchatian value: 28.33 ± 0.29 mm. However, this may reflect extremities of the range of a continuous taxon. A preliminary analysis of

the small series of specimens available in ISEA showed that mean wing length shows a longitudinal clinal increase in samples taken in Primorye (the Monkhukhai River valley), Irkutsk province, Novosibirsk environs and Sverdlovsk province (Beregovaya station) (mean fore wing lengths 30.42 ± 0.22 , 31.44 ± 0.15 , 33.46 ± 0.27 , 34.19 ± 0.11 mm, respectively; mean hind-wing length 29.63 ± 0.20 , 30.99 ± 0.15 , 33.46 ± 0.27 , 33.71 ± 0.15 mm, respectively, $p \ll 0.001$), but with no sign of latitudinal variation in the eastern range (samples from Primorye, the Okhotsk Sea coast and transpolar Yakutia) and a longitudinal cline in abdomen length which was much less significant. Careful studies involving large samples are needed to clarify the meaning of these meristic characters. The Kamchatian specimens as well as specimens from the Amur basin furthermore differ from European ones in colour: their bodies are dark but live green, without reddish sheens as in “western populations”. Another difference is seen in the male hamuli: in *amurensis* from Kamchatka and Amurland the dorsal surface shows a concavity, absent in specimens from Germany (Figs 5-6). This character too has not been examined across the tremendous range separating these sites, and its validity needs further testing.

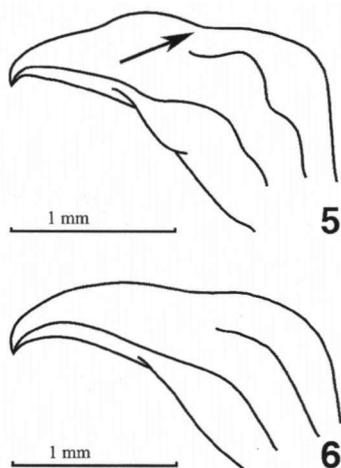
Common on lakes with peat-moss along their banks, mixed to *Somatochlora* species. The specimen found dead at the Ocean shoreline must have come from a considerable distance. Like *Somatochlora*, the males patrol the banks, low above the water.

Somatochlora arctica (Zetterstedt, 1840)

HAGEN, 1856: Petropavlovsk [loc. 37] (*Cordulia arctica*); – SJÖSTEDT, 1927: 2 ♂, 2 ♀, Petropavlovsk [loc. 37], 2-5-VII. and 11-22-VII-1920; – BELY SHEV, 1964: 1 ♂, 1 ♀, Kamchatka R. at Zhupanovo, 6-IX-1958 [Note: there are 2 ♂ and 1 ♀ in the ISEA collection with this label]; 1 ♂, 1 ♀, Kamchatka River at Kozyrevsk [loc. 17], 7-VIII-1958 (Kurentzov leg.); – REINHARDT, 1994: Mutnovskaya Sopka volcano [loc. 53].

Miscellaneous records. – 1 ♂, Kamchatka (not specified), 20-VIII-1960 (Safronova leg.) (BSI, Vladivostok); 1 ♂, loc. 1, 11-IX-1990; 1 ♂, loc. 1, 23-VI-1990; 1 ♂, 1 ♀, loc. 1, 10-VIII-1994; 1 ♂, 1 ♀, loc. 1, 15-VIII-1994; 1 ♂, loc. 2, 24-VII-1994; 2 ♂, loc. 16, 1-5-VIII-1971; 1 ♂, loc. 23, 26-VII-1960 (Safronova leg.?) (BSI); series, loc. 53, 800-1800 m a.s.l., 21/26-VII-1991; 2 ♂, loc. 57, a small lake, 11-VIII-1978.

K. Reinhardt (pers. comm.) found that the length of the appendices superiores in Kamchatian specimens is between those of Japan and Europe. Like *A. subarctica*, this species was not encountered by the 2003 expedition.



Figs 5-6. Lateral view of hamuli: (5) *Cordulia amurensis*, from locality 33, Kamchatka; – (6) *C. aenea* from Amurland, Lower Saxony Germany, 16 June 2003.

Somatochlora graeseri Selys, 1887

BELYSHEV et al., 1978: (*Somatochlora g. graeseri* Selys) 5 ♂, 5 ♀, Ust'-Kamchatsk district, Maiskii Collective Farm [loc. 16], 29-VII/14-VIII-1971 (Kostina leg.).

Miscellaneous records. — 1 ♂, loc. 54, 30-VIII-1991; 4 ♂, loc. 57, 30-VII-1978; 2 ♂, loc. 57, a small lake, 11-VII-1978.

2003 collections. — 69 ♂, 5 ♀, loc. 7, 17-VII; 5 ♂, 2 ♀, loc. 18, 14-VII; 2 ♂, loc. 20, 19-VII; 1 ♂, loc. 22, 20-VII; 1 ♂, loc. 26, 20-VII; 1 ♂, loc. 27, 20-VII; 7 ♂, loc. 28, 21-VII; 50 ♂, 2 ♀, loc. 30, 21-VII; 74 ♂, 6 ♀, loc. 33, 23-VII; 34 ♂, 3 ♀, loc. 33, 24-VII; 35 ♂, 12 exuviae, loc. 33, the smaller lake nearby, 24-VII; 3 ♂, loc. 38, 10-VII (O. Kosterin leg.); 5 ♂, loc. 39, 11-VII; 3 ♂, loc. 40, 26-VII; 1 ♂, loc. 41, 28-VII.

One of the most common dragonflies in Kamchatka, even at moderately hot water, either natural or artificial: a female was found on the edge of a pond of the Khodutkinskie hot springs while males flew along a hot channel from Petropavlovsk power station. Males slowly patrol banks low above the water. Females are seen much less frequently, ovipositing onto shallow water or mud close to water, often in the shade of willows.

Somatochlora sahlbergi Trybom, 1889 (Fig. 12)

KOSTERIN, 1992: Pauzhetka R. [loc. 57] (Haritonov leg.).

Miscellaneous records. — 1 ♂, loc. 2, 24-VII-94; 3 ♂, 1 ♀, loc. 3, 3-IX-94; 1 ♂, loc. 57, 25-VI-1978; 4 ♂, 1 ♀, loc. 57, 11-VII-1978; 2 ♂, loc. 57, 12-VII-1978.

2003 collection. — 60 ♂, 5 ♀, loc. 33, 23-VII; 15 ♂, 3 ♀, loc. 33, 24-VII; 3 exuviae, loc. 33, the smaller lake nearby, 24-VII (see below).

The three exuviae had reduced dorsal spines: only segment IX has a spine and segments IV and V have knobs. They should belong to this species, although BELYSHEV (1973) describes the larva as having no dorsal spines. They cannot be *S. graeseri* or *S. exuberata*, which have well developed dorsal spines, nor *S. alpestris* or *S. arctica* which have no lateral spines, while in our exuviae these are well expressed on segments VIII and IX. Recorded from both the very north and south of the peninsula but appears to be local. In the Pauzhetka valley it occurred on many pools. Indicative for its presence was a semiaquatic plant, *Comarum palustre*. In 2003, we met it at a mesotrophic lake on the Vachkazhets Mts, surrounded with peat moss mire and, partly, birch forest. The lake had a solid sandy bottom. Here, *S. sahlbergi* flew with other corduliids (*S. graeseri*, *Cordulia aenea* and *S. exuberata*). It behaved as other corduliids but more readily abandoned the bank to freely fly low above the open water, from time to time returning to patrol the bank.

**Somatochlora exuberata* Bartenev, 1911

2003 collection. — 1 ♂, loc. 33, 23-VII.

The only specimen from Kamchatka was found on the same lake as *S. sahlbergi*. This male is indistinguishable from Siberian representatives.

**Somatochlora alpestris* (Selys, 1840)

2003 collection. — 5 ♂, loc. 20, 19-VII.

Found on a small bog near Lake Ikar. Seems to prefer small waterbodies.

Libellula quadrimaculata (Linnaeus, 1758)

HAGEN, 1856: Petropavlovsk [loc. 37]; – SJÖSTEDT, 1927: 1 ♂, «Tarja, Avatcha Bay» [loc. 44], 25-VII-1920.

Miscellaneous records – 3 ♂, 1 ♀, loc. 57, 2-VII-1978.

2003 collection. – 11 ♂, 2 ♀, loc. 7, 17-VII; 2 ♂, loc. 17, 15-VII; 15 ♂, 1 ♀, loc. 18, 14-VII; 1 ♂, loc. 19, 18-VII; 3 ♂, loc. 20, 19-VII; 2 ♂, loc. 27, 20-VII; 29 ♂, 3 ♀, loc. 28, 21-VII; 3 ♂, loc. 30, 21-VII; 1 ♂, loc. 33, 23-VII; 1 ♂, 3 ♀, loc. 33, 24-VII; 3 ♂, loc. 38, 10-VII (O. Kosterin leg.); 1 ♂, loc. 39, 11-VII.

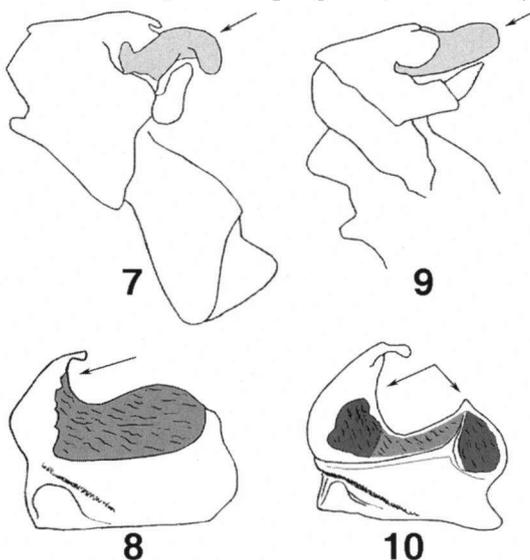
Found throughout July. Ubiquitous. Males perch on branches, or on emergent vegetation such as *Equisetum fluviatile*, and chase each other vigorously.

**Leucorrhinia intermedia* Bartenev, 1910. (Figs 9-10)

Miscellaneous records – 2 ♂, 1 ♀, loc. 57, small lake, 5-VII-1978; 1 ♂, same site, 7-VII-1978.

2003 collection. – 1 ♂, loc. 7, 17-VII; 1 ♂, loc. 8, 17-VII; 3 ♂, 1 ♀, loc. 17, 14-VII; 16 ♂, 2 ♀, loc. 17, 15-VII; 1 ♂, loc. 19, 18-VII; 3 ♂, loc. 22, 20-VII; 3 ♂, loc. 27, 20-VII.

Eastern *L. intermedia* Bartenev, 1910 is close to western *L. rubicunda* (Linnaeus, 1758). The main difference in males consists in the hamuli, but in Japanese representatives from N Hokkaido, *L. intermedia ijimai* Asahina, 1961, the hamuli resemble those of *rubicunda* (BELYSHEV, 1973). Our specimens show the diagnostic characters of *intermedia*: hamuli more deeply hollowed out than in *rubicunda*, making the anterior hook appear longer and more slender, and posterior side of hamulus angular, while rounded in *rubicunda*. Hence, the crumpling zone, which evenly extends from the fore to the back in *rubicunda* is narrowed in the middle in *intermedia* (Figs 8, 10). The alae of the vesica seminalis in *rubicunda* are curved apically and comparatively much smaller than in *intermedia*, where the alae are straight (Figs 7, 9). In specimens with the vesica half extruded, the crumpling zone may become deformed almost beyond recognition, with the hamular hook pressed outwards and downwards. Females of *intermedia* well differ by having the valvula vulvae resembling that in *L. dubia* group while in *rubicunda* s. str. it has very short lobes. A hybrid zone may exist in Central Siberia, but also



Figs 7-10. Males: (7-8) *Leucorrhinia rubicunda* (Kalmthout, Belgium), lateral view of vesica spermatis and hamulus; – (9-10) *L. intermedia*, from Kamchatka (loc. 20). – [diagnostic differences arrowed]

records of *rubicunda* from western and central China may be expected. The closeness or identity of western (*rubicunda*) and Japanese (*ijimai*) populations remains to be proved. If confirmed, these taxa may be remnants of a transpalaeartic range south of Siberia in the Pleistocene, when those areas were much less arid. Found commonly throughout Kamchatka, associated with sedge swamps or sedge marshes at lake banks.

Leucorrhinia dubia orientalis Selys, 1887

SIÖSTEDT, 1927: 4 ♂, "Kamchatka", without further data.

Miscellaneous records. — 1 ♀, "Elovka, 32 km from Klyuchi village by Kamchatka River", 8-VIII-1933 (Koshkin leg.) (ZISP); 2 ♀, loc. 43, 21-VI-1908 (ZISP).

2003 collection. — 6 ♂, loc. 7, 17-VII; 44 ♂, 8 ♀, loc. 20, 19-VII; 5 ♂, 1 ♀, loc. 27, 20-VII; 26 ♂, 6 ♀, loc. 28, 21-VII; 2 ♂, loc. 30, 21-VII; 7 ♂, 1 ♀, loc. 33, 23-VII; 23 ♂, 8 ♀, loc. 33, 24-VII; 2 ♂, 2 ♀, 22 exuviae, loc. 33, the smaller lake, 24-VII.

Described as *L. orientalis* Selys, 1887 but close to *L. dubia* (Vander Linden, 1825), and considered a subspecies of the latter by earlier authors and by Japanese authors (INOUE & TANI, 2001). The taxa differ in larval armament, and is much enhanced in *orientalis* (BELYSHEV, 1973; MALIKOVA, 1995) but this trait may be inducible by predation. Our imagines are clear-cut *orientalis*: the males have no spots on segments IV-VI or only a vestigial spot on VII, black pterostigma, and hamuli with a straighter tip than in *L. dubia*; females have an entirely black labrum. The status of both remains to be elucidated by studies in Central Siberia. More local than the previous species, found only at lakes and ponds with peat mires. Only in two cases both *Leucorrhinia* species were found together.

Sympetrum frequens (Selys, 1883)

BARTENEV, 1915, pp. 183-188: Kamchatka, litus oriental, (1 ♂, 1 ♀), IX.07, Smirnov; — VALLE, 1932, p. 13: Sakhalin, and a note: "this species was known from Japan, Korea, Vladivostok and Kamchatka."

A male and female with labels (in Russian!) "Kamchatka, Vostochnyibereg, IX 1910, Smirnov" [the eastern coast of Kamchatka, Smirnov leg.], with A. Bartenev's determination labels "S. frequens" are still preserved in the ZISP collection. Only bodies with wing remnants are retained, but the size and a degree of expression of the black thoracic stripes correspond indeed to the Japanese *S. frequens* rather than continental *S. depressiusculum* (Selys, 1841). No doubt, these were occasional migrants from the south, and the late date corresponds to the time when in Japan *S. frequens* descends from the mountains to lowlands.

Sympetrum danae (Sulzer, 1776)

SIÖSTEDT, 1927: "17 exempl., die meisten ♀, liegen vor. Tchapina" [loc. 23], 29-VII - 2-VIII-1921; "Klutchi" [loc. 10], 1.VIII.1921; — BELYSHEV, 1964: (*Sympetrum scoticum* Don.), 6 ♂, 15 ♀, Kamchatka River at Klyuchi [loc. 10], 22-VIII-1958; 2 ♂, 1 ♀, Kamchatka R. at Kozyrevsk [loc. 17], 7-VIII-1958; 4 ♂, 4 ♀, Elovka R. [loc. 6], 13 and 29-VIII-1958; 1 ♂, 4 ♀, Lake Kamenskoe [loc. 9], 19-VIII-1958 (Kurentzov leg.).

Miscellaneous records. — 1 ♂, 1 ♀, the Chernovaya R. headwaters, Ust'-Kamchatskii Uezd [district], 29-VII-1897, (Silant'yev leg.) (ZISP) 2 ♀, Kamchatka River right bank, 24-VIII-1930 (V. Pere-

leshina leg.) (ZMMSU); 1 ♂, Kamchatka R. left bank, Dolgii Ples, 25-VIII-1930 (V. Pereleshina leg.) (ZMMSU); 2 ♀, Kamchatka R. right bank, Lake Kham-Situ, 11-IX-1930 (ZMMSU); 3 ♂, 3 ♀, Kamchatka R. right bank, at a lake, 21-IX-1930 (V. Pereleshina leg.) (V. Pereleshina leg.) (ZMMSU); 1 ♀, loc. 4, summer 1930 (ZISP); 1 ♀, loc. 10, 12-IX-1930 (V. Pereleshina leg.) (ZMMSU); 1 ♂, loc. 35, late VIII-1992; 1 ♂, 1 ♀, loc. 13, 23-IX-1959; 2 ♂ (teneral), loc. 15, 19-VII-1930 (ZMMSU); 1 ♂, loc. 16, 1-VIII-1971; 1 ♀, loc. 37, 16-X-1930 (V. Pereleshina leg.) (ZMMSU); 1 teneral ♂, loc. 37, boglet, 27-VIII-1992 (Kosterin leg.); 2 ♀, loc. 43, 21-VI-1908 (ZISP); 2 ♂, 1 ♀, loc. 57, 29-VII-1978; 5 ♂, 4 ♀, loc. 57, 5-VIII-1978; 3 ♂, 4 ♀, loc. 57, 14-VIII-1978.

2003 collection. — 1 ♂ (teneral), loc. 7, 17-VII; 1 ♂, loc. 22, 20-VII; 8 ♂, 3 ♀, loc. 30 (a boglet), 21-VII; 2 m (teneral), loc. 38, 10-VII; 4 larvae, loc. 38, 12-VII; 2 ♂, 2 ♀, loc. 38, 29-VII.

A common late-flying species of small eutrophic pools and peat-moss mires. Often together with *S. flaveolum* but less omnipresent.

Sympetrum flaveolum (Linnaeus, 1758)

SJÖSTEDT, 1927: "1 ♂, 4 ♀, "Tarja, Avatcha Bay" [loc. 44], 25-VII-1920"; — BELYSHEV, 1964: 57 (*Sympetrum f. flaveolum* L.), 10 ♂, 10 ♀, Kamchatka R. at Klyuchi [loc. 10], 19-VIII-1958; 6 ♂, 15 ♀, Kamchatka R. at Kozyrevsk [loc. 17], 18-VII-1958 and 7-VIII-1958; 1 ♂, 8 ♀, Elovka R. [loc. 6], 13-VIII-1958; 9 ♂, 7 ♀, loc. 9, 19-VIII-1958; 1 ♂, 3 ♀, Kamchatian mountains, 29-VII-1958; 1 ♂, 18 ♀, environs of Central State Farm, 7-VIII-1958 (Kurentzov leg.).

Miscellaneous records. — 2 ♀, Kamchatka R. at Kamenka village (V. Pereleshina leg.) (ZMMSU), 4-VIII-1930; 1 ♂, 1 ♀, Kamchatka R. left bank at Beloyansk village, 15-VIII-1930 (V. Pereleshina leg.) (ZMMSU); 2 ♀, Kamchatka R. right bank, 24-VIII-1930 (V. Pereleshina leg.) (ZMMSU); 1 ♂, 5 ♀, the same label but "at lakes", 21-IX-1930 (V. Pereleshina leg.) (ZMMSU); 2 ♀, loc. 15, 19-VII-1930 (ZMMSU); 25 ♂, 24 ♀, loc. 16, 24-VII/30-VIII-1971; 2 ♂, loc. 21, 12 and 29-VIII-1930; series, loc. 25, 2-VIII-91; 1 ♂, loc. 37, 27-VIII-1992; exuviae, loc. 38, 28-VII/6-VIII-1991 (K. Reinhard leg.); series, loc. 45, 5-VIII-1991 (K. Reinhard leg.); 9 spec., loc. 50, 20-VIII-1992; 4 ♂ (freshly hatched), loc. 52, 6-VIII-1991; 7 ♂, 5 ♀, loc. 57, 5-VIII-1978; 3 ♂, 3 ♀, loc. 57, 10-VIII-1978.

2003 collection. — 3 ♂, loc. 7, 17-VII; 1 ♂, 2 ♀, loc. 8, 17-VII; 3 ♂, loc. 17, 14-VII; 1 ♂, loc. 17, 15-VII; 2 ♂, 8 ♀, 49 exuviae, loc. 18, 14-VII; 4 ♂, 10 ♀, 12 larvae, loc. 19, 18-VII; 3 ♂, loc. 20, 19-VII; 1 ♂, loc. 22, 20-VII; 12 ♂, 11 ♀, loc. 26, 20-VII; 4 ♂, 5 ♀, loc. 27, 20-VII; 4 ♂, 3 ♀, loc. 28, 21-VII; 5 ♂, 1 ♀, loc. 30, 21-VII; 1 ♂, 2 ♀, loc. 33, 24-VII; 2 ♂, 2 ♀, loc. 38, 29-VII; 1 ♂, 1 ♀, loc. 39, 11-VII; 1 ♂, loc. 42, 25-VII.

An omnipresent and very abundant species, breeding in tussock sedge swamps, and seen emerging at such a site. Avoids open water: found all around the banks of eutrophic Lake Kultuchnoe in Petropavlovsk, with *S. flaveolum* only at a tussock swamp close to the sea.

Pantala flavescens (Fabricius, 1798)

HAGEN, 1856: Petropavlovsk [loc. 30].

The only female specimen with the label «Kamtchatka» is preserved in the ZISP collection. BELYSHEV (1973) and BELYSHEV & HARITONOV (1981) suppose that this pantropical species was carried to Kamchatka by typhoons.

DISCUSSION

It can be safely accepted that Kamchatka was hostile to dragonfly life throughout the height of the Wurm III glaciation. Only around 13,000 BP, deglaciation had

proceeded far enough to allow the first species to recolonize the territory, possibly contemporaneous with man.

Twenty-seven odonate species have now been reliably recorded for the peninsula (including migrants); six of them are reported for the first time in the present paper. We exclude from the list one dubious species: *Aeshna palmata*. Such vagrants as *Anax junius*, *Pantala flavescens* and *Sympetrum frequens* seem to reach Kamchat-



Figs 11-12. T o p: *Coenagrion johanssoni*, tandem, at loc. 19, Kamchatka (phot. O. Kosterin); – B o t t o m: *Somatochlora sahlbergi*, male perching at loc. 33, Kamchatka (phot. O. Kosterin).

ka so rarely that they cannot be taken as native to the area. Twenty species were recorded by the July 2003 expedition. Of these, five were recorded from more than ten localities (only one among these was a zygopteran), but four were found only at a single, and two at two localities. The presence of such singletons and doubletons permits us to estimate the total species richness from our samples ($n = 23$). We used three formulas, Chao's second estimator, and first and second order jackknife estimates (see DUMONT, 2003, for formulas), and found that four, four, and six species had been missed by our survey. The overall total of 25 species may thus be considered to be close to the ultimate total for the peninsula. Few extra species should be expected.

We also find that the fauna is of an impoverished boreal extraction, with surprisingly little inflow from the south, and no traces of endemism. Seven, possibly eight species are shared with North America (*Lestes dryas*, *Enallagma cyathigerum*, *Aeshna juncea*, *A. subarctica*, *A. caerulea*, *Somatochlora sahlbergi*, *Sympetrum dan-ae*), one is East Palaearctic (*Somatochlora exuberata*), two are occasional southern vagrants (*Pantala flavescens*, *Sympetrum frequens*), one is an American vagrant (*Anax junius*), and the remaining 16 are transpalaearctic. This large share of holarctic species is not surprising, in view of the nearness of Alaska, and the fact that the recolonisation of the peninsula could only start about 13,000 years ago. Only seven species are zygopterans: six coenagrionids and one lestid. Why Lestidae did not spread widely over the peninsula and the one species that penetrated its very south remained so rare is enigmatic. The eighteen anisopteran species belong to three families: six Aeshnidae, seven Corduliidae, and five Libellulidae. This is a poor set, with species richness shifted to the Corduliidae instead of the Libellulidae as in most areas of the world.

There are no Gomphidae or Calopterygidae in Kamchatka. Odonata are rather warm-climate animals, and so the rarity of lotic species in areas where running water is cold throughout the year is not a total surprise. But at the same latitude in Central and East Siberia, under a climate sometimes more severe than that of Kamchatka, the southern elements *Calopteryx japonica* and *Nihonogomphus ruptus* penetrate as far north as 60° (BELYSHEV, 1973; MALIKOVA, 1995). Therefore, specific factors should apply to the peninsula. Perhaps these are linked to its almost insular isolation, i.e. there has not been enough time since deglaciation for species to recolonize the land through its narrow neck. Additionally, volcanism may render the water chemistry of rivers unsuitable for lotic dragonflies. And lastly, the headwaters of almost all rivers of Kamchatka are spawning sites for abundant *Oncorhynchus* salmon, which die and decay after spawning, polluting the water in summer.

A most striking finding of our expedition was that *Aeshna serrata* turned out to be abundant in the lower Kamchatka River valley. The distribution of this species extends further and further as we learn more about it.

ACKNOWLEDGEMENTS

The 2003 expedition to Kamchatka was supported by NATO Collaborative Grant 979506, "Postglacial recolonisation of Eurasia: dragonflies as a model" and by the King Leopold III Foundation of Belgium. The field work was organized by Dr S. GRISHIN (Institute of Biology and Soil Science, Far Eastern Division, Russian Academy of Sciences, Vladivostok. We are grateful to the field team, Mr J. VERMEIR, Dr A. BRANCELJ, Dr G. LAZAREV, Mr D. YAKOVISHIN, and Mrs L. SHAPOVALOVA. O. Kosterin is grateful to Dr V. YAKUBOV and Dr S. GRISHIN for a possibility to join their botanical expeditions to Kamchatka in 1991 and 1992, and to the former for help with tracing some localities of miscellaneous records. E. Malikova is grateful to Dr V.A. KRIVOKHATSKII for help during her work in the Zoological Institute of St Petersburg. We thank Mr A.N. SMETANIN for dragonflies collected in the north of the peninsula and Ms O.G. BEREZINA for preparing the map of Figure 1.

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