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Odonatological results of a trip across the southern Far East of Russia in the first half of July 2014

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Abstract

Odonatological results of a trip across the southern Far East of Russia, from nearly the border of North Korea to Khabarovsk from July 1st to 16th, 2014, are presented. In total, 50 species were recorded, including those with limited presence in Russia, such as *Paracercion calamorum*, *P. hieroglyphicum*, *P. plagiosum* (for this species the 3rd Russian locality is reported), *Pseudocoptera tokyoensis*, *Stylurus annulatus* (2nd Russian locality), *Sinictinogomphus clavatus*; *Trigomphus citimus*, *Macromia daimoji* (3rd Russian locality), *M. manchurica*, *Deielia phaon*, *Lyriothemis pachygastra* (2nd Russian locality). For *S. annulatus*, *M. manchurica* and *D. phaon* the northernmost known localities in the world are reported. *D. phaon*, earlier reported from one locality in Russia, have been found in five localities in Primorye and for the first time reported for Khabarovskiy Kray in general and Bol'shekhekhtsirskiy State Nature Reserve in particular. A trend of mutual exclusion of two abundant *Shaogomphus postocularis epophthalmus* and *S. schmidti* is supposed: the lowermost Ussuri River / Amur River, respectively. Variation in *Paracercion* spp. and *Macromia amphigena fraenata* is discussed.

Key words: Odonata, dragonflies, damselflies, Russia, Far East, Primorye, Primorskiy Kray, Khabarovskiy Kray, Khabarovsk, Bol'shekhekhtsirskiy State Nature Reserve, Lake Khanka, the Ussuri River, the Amir River, *Macromia amphigena fraenata*, *Macromia daimoji*, *Paracercion v-nigrum*, *Paracercion hieroglyphicum*, *Shaogomphus postocularis epophthalmus*, *Shaogomphus schmidti*, world northernmost records

Introduction

In Eurasia, the zone of temperate nemoral forests (composed of broadleaf trees, but note that birch/aspen forests belong to boreal forests) is split into the European and Far Eastern parts by a huge gap located in Siberia and Central Asia where the climate is not humid enough (Dubatolov, Kosterin 2000; Solovyev et al. 2015; Dubatolov & Kosterin 2015). In the eastern part of their zone, the primary nemoral forests (Fig. 1) are composed of diverse broad-leaf and some conifer (e.g. *Pinus koraiensis* Siebold et Zucc.) tree species, while secondary forests are nearly pure stands of Mongolian Oak (*Quercus mongolica* Fisch. ex Ledeb.) (Fig. 2). These forests support a very diverse biota



Figure 1. A nemoral (oak and other broadleaved tree species) forest on the hills at Andreevka village, Khasan District, Primorye.

mostly composed of species of the Manchurian (sometimes called Palaeoarchaeartic) biogeographical complex. The territory they occupy belongs to the East Asian Ecological Region of the Palaeartic Biogeographical Realm. In Russia, they grow in the southern Far East, implied to include Primorskiy Krai (less formally but more frequently called Primorye), southern parts of Khabarovskiy Krai, the Jewish Autonomous Region and Amur Province. This region harbours 60% of the Odonata fauna of Russia, with 26 % of species, belonging to the Manchurian faunal complex, present only there (Malikova & Kosterin 2019). Quite a number of these spe-

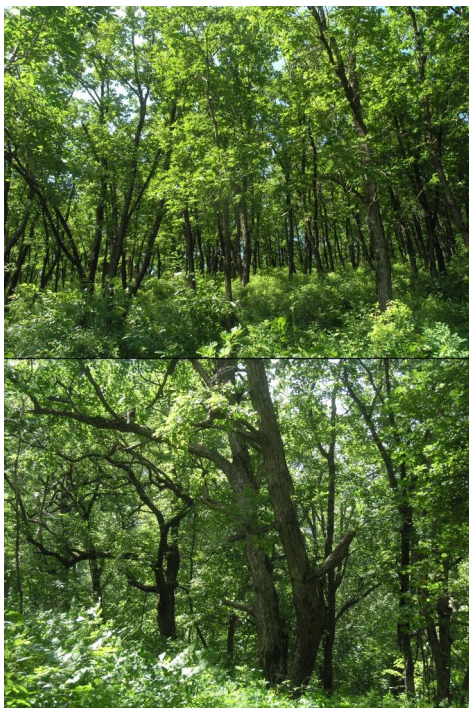


Figure 2. Mongolian oak (*Quercus mongolica*) forests at Gonye Klyuchi settlement, Primorye, (above) and Chirki River mouth, Khabarovskiy Krai (below).

cies have been recorded only once or just a few times on Russian territory. Their main ranges are in North China and/or Korea and/or Japan.

The fauna of the Russian Far East has been summarised, in Russian, for the first time in B.F. Belyshev's famous monograph 'Dragonflies of Siberia' (1973) and then in the thesis by E.I. Malikova (1995). An English translation of its 'autoreferate' (extended abstract), updated with newly found species, was published in IDF-Report (Malikova 2009). Unfortunately, a paper devoted to the same subject and published in *Odonatologica* (Haritonov & Malikova 1998) was awfully outdated even at the time of its publication, many important species were missing and the table contained serious errors. Therefore, we strongly advise against referring to this source. There is an array of subsequent useful papers on the Odonata fauna of the southern Far East of Russia. I will reference only those devoted to the regions concerned in this paper, Primorskiy Krai: Malikova & Ivanov (2001; 2005); Malikova (2005; 2007); Malikova & Seidenbusch (2001); Nagahata et al. (2017); Onishko (2019), and Khabarovskiy: Fukui (1998); Kosterin & Dubatolov (2005); Yakubovich (2007; 2008; 2010; 2014); Malikova et al. (2007); Yakubovich & Kapkaev (2009); Yakubovich & Koshkin (2016).

In 2014, I was happy to accept an invitation to join the car trip by my friend Nikita Vikhrev, a dipterologist from the Zoological Museum of Moscow State University, crossing the southern Far East of Russia from the environs of Khasan Town at the border of North Korea to Khabarovsk at the junction of the Ussuri and Amur Rivers. No species new to Russia were found, but one new for Khabarovskiy Krai. The trip lasted from July 1st to 8th. At Khabarovsk, I joined another friend, Vladimir Dubatolov, a lepidopterologist from the Institute of Systematics and Ecology of Animals, Novosibirsk, and spent the period from July 9th to 16th at the Bol'shekhekhtsirskiy Nature Reserve, the Odonata fauna of which was studied (mostly by Vladimir's collections) earlier (Fukui 1992; Kosterin & Dubatolov 2005; Malikova et al. 2007). However, my working power there was limited because of an undiagnosed infection, probably acquired in June in Cambodia (Kosterin 2016), so four days were lost completely. Our route was not far from the eastern border of China (Fig. 3), so it was not surprising that the fauna observed strongly resembled that of North-East China (Dōngbei Region). During the first half of July we observed mostly the earlier seasonal aspect of Odonata, with individuals of the genus *Sympetrum* spp. just having started to appear, some species of which we obviously missed. This was my first, but extremely informative, visit to the southern Far East of Russia allowing me to find many of the East Asian species rare in Russia. The results are presented hereby.

The area

The main impression from this region was omnipresence of forests. From a plane approaching Artem, the airport of Vladivostok, I had an amazing view of hills covered entirely by broadleaf forests. The hills along the roads in Primorye looked the same. The conifers present at higher elevations were not visible from roads. Only when approaching Khabarovsk from the south, some conifers (*Larix cayanderi* Meyer; *Pinus korajensis*) became visible constituents of forests while the Bol'shoy Khekhtsir Mountain was clad mostly by taiga (but also by broadleaf forests at the foothills). In the southern Khasan



Figure 3. The monumental hieroglyph 東 (Dōng, 'east') marking the easternmost point of China at the Ussuri River mouth as seen across it from the east (above) and a Chinese border guard boat in the Ussuri lowermost reaches (below).

District of Primorye the forests are replaced by lush green herbaceous moist grasslands and savannah with sparse oak (*Q. mongolica* and, in the very south, also by *Quercus dentata* Thunb.) and limes (*Tilia*, up to three species) trees with astonishingly large leaves; with fogs from the nearby Japanese Sea wandering over it (Fig. 4). In Ussuriysk and Khanka Districts, lowlands are covered with meadows and grassy swamps while hills are clad by Daurian birch (*Betula dahurica* Pall.) / oak (*Q. mongolica*) forests.

Localities visited

The localities, shown in Fig. 5 and listed from south to north, are briefly described below. Concerning this region one should take into account that in 1972, after the Russian-Chinese incident at Damansky Island, most aboriginal and Chinese toponyms, mostly hydronyms, were officially replaced by Russian toponyms (mostly in Primorye),



Figure 4. Moist and misty coastal grasslands at Andreevka (above) and Mayak (below) villages in the southernmost Khasan District of Primorye.

so in the locality list below the former ones are given, in parentheses and italics, after the latter ones. Below the districts of Primorskiy Krai are indicated; in Khabarovskiy Krai only the Khabarovsk environs were examined. Coordinates were obtained for one point in each locality with the Garmin eTrex GPS Navigator, but the actual ranges of coordinates examined in each locality, which are provided below (after the decimal point, in the decimal degrees format), as well as the elevations above sea level, were retrieved from Google Earth. The dates are provided in the dd.mm.yyyy format.

Khasan District

Loc. 1. Lake Lotos (Doritseni). A big (3.2×1.6 km, irregular in shape, 13.2 km²) lake among moist coastal savannah with solitary oaks and lime-trees, with very broad sedgy floating bog in bays (Fig. 6) and firm capes covered by lush meadows (Fig. 7); some narrow reed stripes, open water with lotus (*Nelumbo nucifera* Gaertn.), water caltrop (*Trapa incisa* Siebold et Zucc.) and *Salvinia* sp. Some brooks entering bays form long estuaries 2-3 m wide with rush at their banks, surrounded by floating bog. 3.4-4.6 km N of Khasan settlement. 42.460 472 N, 130.636 642 E, 4-7 m a.s.l. 1.07.2014 and 3.07.2014.

Loc. 2a. A relatively large (~300×300 m) former quarry 3.4 km NW of Andreevka village, separated from the sea by a road embankment; rather deep, with a firm sandy bottom, the banks with grass, *Typha latifolia* L., some *Alisma plantago-aquatica* L.; the water table with some patches of *Trapa incisa* and *Salvinia* sp. Numerous frogs (*Pelophylax nigromaculatus* (Hallowell, 1861)). 42.673 676 N, 131.109 112 E, 1-2 m a.s.l. 2.07.2014.

Loc. 2b. The southern bank of Lake Utinoe [Russ. 'lake of ducks'] (~700×600 m) separated from the above mentioned quarry by a sandy embankment; with patches of sedge

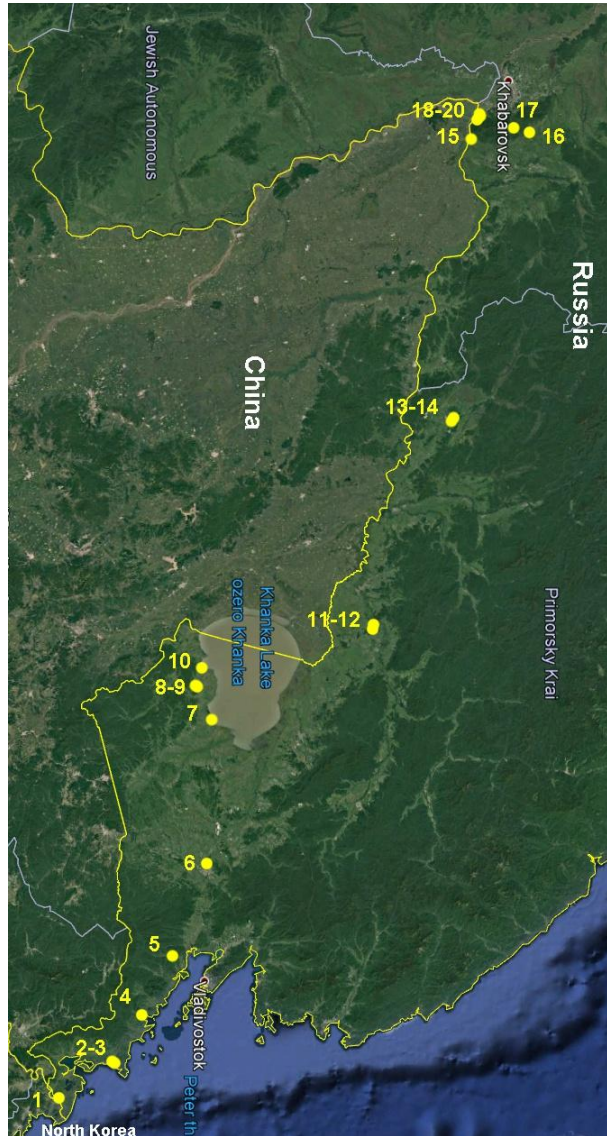


Figure 5. Disposition of the localities visited (for explanations see the text).



Figure 6. Sedge floating bogs in a bay of Lake Lotos (Doritseni) (Loc. 1), Khasan District, Primorye. Habitat of *C. johanssoni*, *N. speciosa*, *L. quadrimaculata*, *D. phaon* (other species occur at the water edge).

and cattail and bays with abundant flowering *Nymphaea tetragona* Georgi (Fig. 8); with an outlet as a very deep, barely flowing rivulet with some *A. plantago-aquatica* at banks. 42.674 678 N, 131.107 114 E, 2 3 m a.s.l. 2.07.2014.



Figure 7. Meadowy capes of Lake Lotos (Doritseni) (Loc. 1). Imaginal habitat of *A. longistigma*, *T. nigripes*, *L. quadrimaculata*, *L. pachygastra*.

Loc. 3. A small, shallow and rather cold stream at Andreevka village, mostly fast-running, surrounded by Mongolian Oak woods, some reaches slow and open. 42.651 852 947 N, 131.135 137 E, 30 70 m a.s.l. 2.07.2014.



Figure 8. A coastal Lake Utinoe 3.4 km NW of Andreevka village (Loc. 2b), Khasan District, Primorye. Habitat of *C. ecornutum*, *C. johanssoni*, *C. lanceolatum*.



Figure 9. The Amba River at Zanadvorovka village (Loc. 5), Khasan District, Primorye. Habitat of *C. japonica*, *C. lanceolatum*, *D. lunatus*.

Loc. 4. A cold brook with tall grassy banks at Bamburovo village, 42.946 947 N, 131.320 322 E, 11 m a.s.l. 1.07.2016.

Loc. 5. The Amba River at Zanadvorovka village below the bridge, medium-sized (10-30 m wide), cold, shallow, with shingle bottom and broad open shingle banks with willow groves; besides some very shallow semi-current black pools with flowering *Batrachium* sp. between the shingle river bank and forest (Fig. 9). 43.295 297 N, 131.606 614 E, 24 26 m a.s.l. 1.07.2014.

Ussuriysk District

Loc. 6. The Repyevka River in the northern suburbs of Ussuriysk Town, small (5-15 m wide), shallow, medium-fast, with an earthy bottom, banks partly barren, partly grassy, partly with *Scirpus* (*Schoenoplectus*) sp. and *Acorus calamus* L., with some willow trees; surrounded by open grassy plains. 43.873 875 N, 131.958 961 E, 21 25 m a.s.l. 3.07.2014.

Khanka District

Loc. 7. Kamen'-Rybolov village: a park, forest margins, including those on the high W bank of Lake Khanka (or Xingkai Hu, a major lake shared by China and Russia, 90×70 km, 3,030 km²) (Fig. 10), with some reed patches at the water edge; plus a brook in a deep dell. 44.732 746 N, 132.046 056 E, 70-96 m a.s.l. 4.07.2014.

Loc. 8. The Komissarovka (Sintuhe) River at the road Kamen'-Rybolov - Platono-Aleksandrovskoe near Ilyinka village: small (15-20 m wide), with gravel and silty bottom sections;

Figure 10. The high W bank of Lake Khanka at Kamen'-Rybolov village (Loc. 7), Khanka District, Primorye. Occasional imaginal habitat of *C. japonica*, *C. lanceolatum*, *S. graeseri*, *S. eroticum*, *S. striolatum imitoides*.





Figure 11. A big roadside lake near the Komissarovka (Sintuhe) River and Ilyinka village (Loc. 9a), Khanka District, Primorye. Habitat of *P. plagiosum*, *P. v-nigrum*, *S. clavatus*, *E. elegans*, *E. bimaculata*, *D. phaon*, *O. albistylum*.

there is a smaller arm with sticky silty bottom and abundant sedge (*Carex* sp.) in tussocks and stripes, separated from the main river by an embankment with a shady road. 44.911 917 N, 131.960 970 E, 81 83 m a.s.l. 4 5.07.2014.

Loc. 9a. A big (about 1×0.5 km) roadside lake (most probably of artificial origin) near the Komissarovka (Sintuhe) River (Loc. 7), deep already at banks (Fig. 11). 4.922 930 N, 131.958 962 E, 80 82 m a.s.l. 5 6.07.2014.

Loc. 9b. A small swamp at the opposite side of the road, surrounded by low non-tussock sedges. with tall sedge closer to the shallow water in the centre; some large pondweeds in it (Fig. 12). 44.923 924 N, 133.963 966 E, 82 m a.s.l. 6.07.2014.

Loc. 10. The W bank of Lake Khanka immediately to the north of Platono-Aleksandrovscoe village: formed by reddish marble detritus, barren, with scarce *Scirpus* (*Schoenoplectus*) sp., reeds and willows (Fig. 13). Near the bank, there is a broad (several dozen metres wide) grassy area with a series of small shallow pools with muddy bottom, grassy banks and tall sedges and cattail at middle (Fig. 14), also a former round swamp now filled with tall sedge. 45.059 065 N, 131.992 996 E, 67-75 m a.s.l. 4. 5.07.2014.

Kirovskiy District

Loc. 11. The Draguchina left arm of the Ussuri River at SE suburbs of Gornye Klyuchi settlement (at the sharp loop and upstream). A waist deep, 15-35 m wide river arm with a considerable flow speed, firm bottom with some stones, silty banks; much pondweed (Fig 15). Forest at the right bank, a road with solitary trees (mostly lime-trees) and old clearings with tall grass on the left bank. There is a shallow semilentic bay with sedges and cattail at the arm loop (examined on 7.07.2014) (Fig. 16), and a sedgy bog almost inside the town (examined on 8.07.2014). Surrounding hills are evenly clad with dense Daurian Birch/Mongolian Oak forests. 45.220 239 N, 133.512 530 E. 6 8.07.2014.



Figure 12. A swamp near the Komissarovka (Sintuhe) River and Ilyinka village (Loc. 9b), Khanka District, Primorye. Habitat of *C. ecornutum*, *C. lanceolatum*, *P. v-nigrum*, *D. phaon*, *S. eroticum*, *S. infuscatum*.

Loc. 12a. The right bank and an island of the main Ussuri River downstream the bridge. The river at the examined point was 200-300 m wide, warm, rather fast-flowing, shallow at shingle or sandy banks. 1.5-3 km N of Gornye Klyuchi settlement. 45.256 260 N, 133.499 502 E, 71 73 m a.s.l. 7.07.2014.

Loc. 12b. The adjacent broad right floodplain of the Ussuri River downstream the bridge, at the examined part grassy, with some willow shrubbery and four lines of oxbows of different depth, mostly very shallow, with silty banks with sedge (Fig. 17). 45.256 260 N, 133.592 507 E, 73 75 m a.s.l. 7.07.2014.

Pozharskiy District

Loc. 13. A warm (ca 40°C, becoming cooler downstream) 40-50 m broad channel flowing from Luchegorsk Power Station, with partly stony, partly clay bottom, water full of some submerged plant, one bay with *Trapa incisa*; the banks with reed; there



Figure 13. The Lake Khanka W bank N of Platono-Aleksandrovscoe village (Loc. 10), Khanka District, Primorye. Habitat of *D. phaon*, *S. schmidtii*, *O. albistylum*.

were numerous long-chelaeid shrimps, large and small bivalves, and some fish in water. A large water reserve nearby. 46.478 N, 134.310 E (the actual examined range uncertain), 73 m a.s.l. 8.07.2014.

Loc. 14. The medium-sized Kontrovod River ca. 1 km downstream of Luchegorsk Power Station, plus a swampy muddy pool with cattail among bushes near the bank. Coordinates uncertain. 8.07.2014.

Khabarovsk environs: Bychikha village and Bol'shekhkhtsirskiy State Nature Reserve

Loc. 15a. The right bank of the Ussuri River's lowermost reaches at the Chirki River mouth and Chirki ranger station of the Bol'shekhkhtsirskiy State Nature Reserve (28-29 km W of Korfovskiy settlement) (Fig. 18). The Ussuri is 600-800 m wide, with shingle banks but at the Chirki estuary they are silty with sedge tussocks and there is a large oxbow with tussock banks, mostly hidden in the forest. The Ussuri River outlines the western



Figure 14. Pools at the Lake Khanka W bank N of Platono-Aleksandrovskoe village (Loc. 10), Khanka District, Primorye. Habitat (at last a place of imaginal occurrence) of *L. sponosa*, *A. atrata*, *C. japonica*, *C. ecornutum*, *C. lanceolatum*, *A. longistigma*, *T. citimus*, *T. nigripes*, *C. aenea*, *S. graeseri*, *L. quadrimaculata*, *O. albistylum*, *S. flaveolum*, *S. pedemontanum*, *S. striolatum imitoides*.

foothills of the Bol'shoy Khekhtsir Mountain (Fig. 18 below), covered with thick forest and forming a rocky cliff at the northern end of the examined area (Fig. 18 above). The shrubbery at the lowermost forest margin was dead because of the disastrous flood in the previous year. Cormorants and egrets were seen. 48.183 194 N, 134.674 681 E, ~30 m a.s.l. 14 15.07.2014.

Loc. 15b. The narrow interfluvium between the Ussuri River right bank and the Chirki River left bank. It has an axis elevated for some 7-10 m above the rivers (loc. "relka") covered with open oak forest with participation of lime-trees (there we found a place where a bear had slept), from both sides surrounded by large grassy swamps (or inundated meadows) with ice-cold water not seen through the grass (Fig. 19) (and no zygoptera). The Chirki estuary was broad and shallow, with tussock banks and some *Nymphoides* and *Trapa rosettes* on the surface, many large silver carp (*Hipophthalmichthys molitrix* (Valenciennes, 1844)) jumped high from the water at the moving motor



Figure 15. The Draguchina left arm of the Ussuri River at Gornye Klyuchi village (Loc. 11), Kirovski District, Primorye. Habitat of *A. atrata*, *C. japonica*, *C. ecornutum*, *C. lanceolatum*, *P. v-nigrum*, *P. phyllopoda*, *P. tokyoensis*, *N. ruptus*, *S. postocularis epophthalmus*, *S. albardae*, *M. amphigena fraenata*, *M. daimoji*, *M. manchurica*, *E. bimaculata*, *L. quadrimaculata*, *O. albistylum*.

Figure 15b. Continuation



boat. 48.165 180 N, 134.673 681 E, ~30-43 m a.s.l. (coordinate intervals of the examined area uncertain). 15.07.2014.

Loc. 16. The Bol'shaya Chirka River 9 km SE of Korfovskiy settlement at the railroad bridge and its right bank downstream: 5-15 m wide, meandering, water brown, bottom silty, at some places stony, banks boggy with sedges or firm with sparse oak stands (Fig. 20), adjacent to vast inundated meadows and open larch



mires (these were surprisingly lacking odonates except for 3 individuals of *Sympetrum cordulegaster*). 48.145 147 N, 135.119 128 E, 60-61 m a.s.l. 11.07. 2014.

Loc. 17a. A former marble quarry in Korfovskiy settlement: 170×140 m, water warm, with *Elodea*, *detritus* banks, with tiny swamplets with *Alisma plantago-aquatica*, horse-tail and sedge. 48.211 213 N, 135.042 044 E, 149 m a.s.l. 11.07.2014.

Loc. 17b. A roundish (150×120 m) pond in the centre of Korfovskiy settlement: bottom firm, sometimes with stones, banks grassy, at some places with sedge. 48.222 224 N, 135.062 064 E, 102 205 m a.s.l. 11.07.2014.



Figure 15c. Continuation



Loc. 18a. The Sosnenskiy brook at the Bol'shekhkhtsirskiy State Nature Reserve visit centre (ca 600 m E of the eastern margin of Kazakevichevo village): a glade in a poly-dominant broadleaf forest with a small and fast but warm brook and a deep stagnant pool. 48.280 N, 134.758 E, 46 m a.s.l. 9.07.2014.

Loc. 18b. The right bank of the Amurskaya Protoka right arm (500 m wide) of the Amur River (formed by the junction of the Kazakevichevskaya Protoka of the Amur River and the Ussuri River) at the Sosnenskiy Brook mouth; broad shingle banks (Fig. 21). 48.282-283 N, 134.757-758 E, 35-36 m a.s.l. 9.07.2014.

Loc. 19. A pond (ca 100×40 m) in the southern suburbs of Bychikha village (Fig. 22): abundant submerged vegetation (?*Ceratophyllum* sp.), cattail at banks, surrounded by inundated grass and bushes, then by broadleaf forest; a shallow swamplet with firm bottom and reed nearby. 48.291-292 N, 134.828 829 E, 81 83 m a.s.l. 9.07.2014.

Loc. 20. The Amurskaya Protoka (the Amur River right arm; here 850-950 m wide) at the Ussuri Resort in Bychikha village: very slow, warm and dirty, the bank formed by detritus and shingle, for some 30 m flat, with some pools and grass, then bordered with a high earthy bluff. 48.303-311 N, 134.804 821 E, 37 m a.s.l. 16.07.2014.



Figure 16. A semilent bay of the Draguchina left arm of the Ussuri River at Gornye Klyuchi village (Loc. 11), Kirovskiy District, Primorye. Habitat of *C. ecornutum*, *C. lanceolatum*, *A. longistigma*, *S. graeseri*, *L. dubia orientalis*, *L. quadrimaculata*, *S. eroticum*.



Figure 17. Right oxbows of the Ussuri River near Gornye Klyuchi village (Loc. 12b), Kirovskiy District, Primorye. Above: habitat of *C. ecornutum*, *C. lanceolatum*, *N. speciosa*, *P. phyllopoda*, *P. tokyoensis*; below: habitat of *N. speciosa*, *A. longistigma*.



Figure 18. The Ussuri River at the Chirki River mouth (below) (Loc. 15a), Khabarovsk env. The Bol'shoy Kheksir Mountain is seen on the lower photo. Habitat of *A. atrata*, *C. japonica*, *C. lanceolatum*, *N. ruptus*, *S. postocularis epophthalmus*, *S. flavipes*, *M. amphigena fraenata*, *E. bimaculata*, *O. albistylum*, *S. cordulegaster*, *S. eroticum*, *S. infuscatum*.



Figure 19. Cold grassy swamps on the interfluvium of the Chirki and Ussuri Rivers (Loc. 15b), Khabarovsk env. Habitat of *L. quadrimaculata*, *S. cordulegaster*, *S. eroticum*, *S. flaveolum*, *S. infuscatum*.



Figure 20. The Bolshaya Chirka River 9 km SE of Korfovskiy settlement (Loc. 16), Khabarovsk env. Habitat of *A. atrata*, *C. japonica*, *C. johanssoni*, *T. nigripes*, *S. cordulegaster*



Figure 21. The Amurskaya Protoka right arm of the Amur River downstream of Kazakevichevo village, at the Sosnesnkiy brook mouth (Loc. 18b) Khabarovsk env. Habitat of *S. schmidti*, *M. amphigena fraenata*, *E. bimaculata*, *D. phaon*, *L. quadrimaculata*.



Figure 22. The pond in the southern suburbs of Bychikha village (Loc. 19), Khabarovsk env. Habitat of *L. dryas*, *L. sponsa*, *C. johanssoni*, *C. lanceolatum*, *N. speciosa*, *A. juncea*, *T. nigripes*, *E. bimaculata*, *L. dubia orientalis*, *L. quadrimaculata*, *S. cordulegaster*, *S. eroticum*, *S. flaveolum*, *S. infuscatum*.

Annotated list of species recorded

Below, 'photographed' means in natural conditions without any restriction of dragonflies' freedom. If necessary, collected specimens were photographed in hand and such photos are not mentioned in the text, although sometimes shown in figures. (Mostly Olympus Camedia C8080, sometimes Canon EOS 350D were used.)

Nikita Vikhrev had occasionally collected several odonate specimens in June 2014 before I joined him in four localities, three of which did not coincide with the above. These data are included into the list with their full labels, without 'Loc.'.

The specimens collected are with the authors and (doublets, if any) in Naturalis Biodiversity Center, Leiden, the Netherlands. All dragonfly photos made will soon be available at <http://pisum.bionet.nsc.ru/kosterin/odonata/odonata.htm>.

LESTIDAE (2 species)

1. *Lestes dryas* Kirby, 1890

Loc. 19: many mature ♂♂ seen (1 locality).

2. *Lestes sponsa* (Hansemann, 1823)

Loc. 7: 1 ♂, 1 ♀ seen. **Loc. 10:** 1 mature ♂, 2 teneral ♂♂, 2 teneral ♀♀ collected at the pools. **Loc. 19:** many teneral, still discoloured ♂♂, ♀♀ seen (3 localities).

Observations. Both *Lestes* spp. were found in sedge.

CALOPTERYGIDAE (2 species)

3. *Atrocalopteryx atrata* (Selys, 1853)

Loc. 6: 1 ♂, 3 ♀♀ collected, 1 ♀ photographed, many ♀♀ seen (all teneral). **Loc. 8:** 1 ♂ seen. **Loc. 10:** 1 teneral ♂ photographed (Fig. 23) and collected at a pool. **Loc. 11:** 1 teneral ♂ collected at a shallow bay. **Loc. 13:** many ♂♂ seen (one at the channel, the rest at the pond). **Loc. 15a:** 1 young ♀ collected; quite many young ♂♂, ♀♀ seen. **Loc. 16:** several teneral ♂♂ seen. **Loc. 18a:** 1 teneral ♂ seen (8 localities).

4. *Calopteryx japonica* Selys, 1869

Loc. 5: 1 ♂ photographed ♂ (Fig. 24 above), many more ♂♂ seen. **Loc. 6:** 1 ♂, 1 ♀ collected, 1, 1 ♀ photographed (Fig. 24 below), few ♂♂, many ♀♀ (all mature). Anuchino village env., 43.95 N, 133.05 E: 1 ♂ (N. Vikhrev leg.). **Loc. 7:** 2 ♂♂, 1 ♀ seen. **Loc. 8:** 1 ♂, 1 ♀ (ovipositing into a stem) photographed, several ♂♂, ♀♀ seen. **Loc. 10:** 1 ♂, 2 ♀♀ collected, few seen. **Loc. 11:** 1 ♀ photographed, many ♂♂, ♀♀ seen. **Loc. 12a:** very many ♂♂, ♀♀ seen. **Loc. 12b:** several seen. **Loc. 15a:** 1 ♂ seen in a gap of the forest near the bank. **Loc. 16:** several ♂♂, ♀♀ seen. **Loc. 19:** 1 ♂ seen, with an abnormal abdomen (11 localities).

Observations. Both demoiselle species were quite common at streams and occurred also at pools most probably by dispersal; the former species mostly being represented by immature individuals.



Figure 23. *Atrocalopteryx atrata*, a male, at pools near the Lake Khanka W bank N of Platono-Aleksandrovscoe village (Loc. 10).



Figure 24. *Calopteryx japonica*: a male at the Amba River at Zanadvorovka village in Ussuriysk (Loc. 5) (above) and a female ovipositing into the the Repyovka Rivulet in Ussuriysk (Loc. 6) (below).

COENAGRIONIDAE (10 species)

5. *Coenagrion ecornutum* (Selys, 1872)

Loc. 1: 2 ♂♂, 2 ♀♀ collected. **Loc. 2a:** 1 copula photographed (Fig. 25), 1 more copula observed in shallowly inundated grass. **Loc. 2b:** 6 ♂♂, 3 ♀♀ collected, numerous ♂♂, ♀♀ seen. **Loc. 8/9:** 2 ♀♀ collected on the road between these localities. **Loc. 9b:** 2 ♂♂, 1 ♀ collected, many seen. **Loc. 10:** 2 ♂♂, 1 ♀ collected, several seen at pools, including tandems. Also 2 ♂♂ collected here by N. Vikhrev on 15.06.2014. **Loc. 11:** several seen at the sedgy bog. **Loc. 12b:** 1 ♂ collected, several seen. Khabarovsk env., 48.59 N, 135.04 E, 2-5.06.2014: 1 ♂ collected (N. Vikhrev leg.). (7 localities).

Observations. Rather widespread but not abundant, always in grass or sedge at lentic, usually small habitats.



Figure 25. *Coenagrion ecornutum*, a copula at a former quarry 3.4 km NW of Andreevka village (Loc. 2a).



Figure 26. *Coenagrion johanssoni*, a male in the floating bog by Lake Lotos (Doritseni) (Loc. 1).

6. *Coenagrion johanssoni* (Wallengren, 1894)

Loc. 1: 5 ♂♂, 5 ♀♀ collected, 2 ♂♂ photographed (Fig. 26), many seen. **Loc. 2b:** 1 ♂, 1 ♀ collected. Ussuriyskiy District, Kamenushka village, 43.62 N, 132.23 E., 22 24.06.2014: 1 ♂ (N. Vikhrev leg.). **Loc. 10:** 2 ♂♂ collected, several seen at pools. **Loc. 16:** quite many ♂♂, ♀♀ seen. **Loc. 19:** several ♂♂ seen at a shallow reed swamplet. (6 localities).

Observations. Many specimens were obtained by sweep-netting in the floating bog sedge at Lake Lotos (Doritseni), but inferior in number to *Nehalennia speciosa*; occurred also in the surrounding herbage and at the banks of the brook estuaries. In other localities the species was rare and scarce, found in sedge/reed at a small lake (Loc. 2b), a pond (Loc. 19), small pools (Loc. 10) and a small river (Loc. 16). At the last locality *C. johanssoni* was more abundant, perhaps because it neighboured a vast mire – a habitat that the species is fond of elsewhere; surprisingly it was not found in the mire itself, in spite of quite an extensive search.



Figure 27. *Coenagrion lanceolatum*, a male (above) and copula (below) at a small coastal lake 3.4 km NW Andreevka village (Loc. 2b).

7. *Coenagrion lanceolatum* (Selys, 1872)

Loc. 1: several seen. **Loc. 2a:** 1 ♂ collected, several seen. **Loc. 2b:** 1 ♂, 1 copula photographed (Fig. 27), several seen. **Loc. 4:** several ♂♂, ♀♀ seen. **Loc. 5:** 2 ♂♂, 1 ♀ collected, several more seen at black semi-current pools near the river. **Loc. 6:** 1 ♀ collected, a tandem seen. **Loc. 7:** several seen at a brook. **Loc. 8:** 1 ♂, 1 ♀ collected, many seen at the sedgy arms. **Loc. 9b:** several seen. **Loc. 10:** many seen, including tandems, mostly at pools. **Loc. 11:** 1 ♂, 1 ♀ collected, many seen at bays and the sedgy bog. **Loc. 12b:** many seen. **Loc. 14:** several seen. **Loc. 15a:** several seen in sedge at the oxbow. **Loc. 16:** many ♂♂, ♀♀ seen. **Loc. 17a:** several seen at the swamplands. **Loc. 17b:** many seen in sedge. **Loc. 19:** 2 ♀♀ seen (16 localities).

Observations. The most widespread odonate species among those recorded on the trip, found at 16 of 20 localities, prefers slow bays of streams, but also occurs in sedge at lentic habitats, e.g. at the banks of the great Lake Khanka (where it prefers shallow pools near the main bank), the former quarries and a small lake near the sea at Andreevka village and a former quarry in Korfovskiy settlement (where it was confined to tiny sedgy swamplands), at the Ussuri River oxbows etc. At Lake Lotos common at the brook estuaries but not found at the floating bog or the banks of the lake itself.

8. *Erythromma najas humerale* Selys, 1887

Loc. 2a: 2 ♂♂ collected, 1 ♂ photographed (Fig. 28), several ♂♂ seen. **Loc. 6:** several ♂♂. **Loc. 17a:** 2 ♂♂ collected, many mature ♂♂, very many immature ♂♂ seen (3 localities).

Observations. Two of the three localities where the species was recorded were former quarries and one was a small rivulet. As elsewhere, males perched on the floating vegetation (Fig. 28); in the former quarry near Andreevka village it was mostly represented by water caltrop but in two other cases there were no specialised floating leaves and the males had to perch on occasional stems.



Figure 28. *Erythromma najas humerale*, a male on a water caltrop rosette at an inundated former quarry 3.4 km NW Andreevka village (Loc. 2a).

9. *Nehalennia speciosa* (Charpentier, 1840)

Loc. 1: 4 ♂♂, 6 ♀♀ collected, numerous seen. **Loc. 12b:** 1 ♂, 1 ♀ collected. **Loc. 19:** 1 ♂, 1 ♀ collected (3 localities).

Observations. Obtained in great numbers by sweep-netting the floating bog sedge at Lake Lotos; some individuals also in herbage at its margins. Found at the Ussuri River right bank floodplain at Gornye Klyuchi village, but only two specimens were obtained by sweep-netting sedge at the banks of two different oxbows (one considerable, one just a small pool). Also, two specimens were obtained by sweep-netting the sedge at the bank of the pond in Bychikha village at Khabarovsk.

10. *Paracercion calamorum calamorum* (Ris, 1916)

Loc. 2a: 6 ♂♂ (2 teneral) collected, 1 ♀ (Fig. 30 a b) collected; 1 ♂ photographed (Fig. 29a), many ♂♂ seen. **Loc. 9a:** at least 1 ♂ seen but not collected (2 localities).

Observations. At the former quarry at Andreevka village, the mature males (inferior in number to *P. v-nigrum* + *P. hieroglyphicum*) perched on floating vegetation (mostly water caltrop) while immature, still non-pruinose ones kept to the grass at an open sandy bank.

Remarks. Male specimens of *Paracercion* spp. well differ in the pattern and coloration and strongly differ in structural characters, which in our specimens corresponded perfectly to the descriptions and drawings in Dumont (2004). At the same time the female structural characters do not fit well to those in the cited reference. Dumont (2004: page 370 and fig. 28) characterised the pronotum hind lobe of *P. calamorum* as "not widened before the median constriction" and the triangles of lamina mesostigmalis "with raised anterior-external margins", showing this accordingly in his fig. 28, reproduced here in Fig. 30h. The female collected in Loc. 2b does not show these characters (Fig. 30b). According to the description, key and drawing by Dumont (2004), it corresponds to *P. melanotum* (Selys, 1876) (see Fig. 30h) in having two strong prominences with wavy lateral sides and not having raised margins of the triangles of lamina mesostigmalis. Nevertheless this is *P. calamorum* (the males of which were numerous at Loc. 2a): it was kindly identified so by photos by Xin Yu, a similar female pronotum is seen in a small photo in Cho (2018: fig. 3 on page 110), and a very similar principal structure of the pronotum is seen even in a female of *P. calamorum dyeri* (Fraser, 1919) from Cambodia (which is almost twice as small, hw 13 mm vs 22 mm in the Primorye specimen) (Fig. 30c).

11. *Paracercion hieroglyphicum* (Brauer, 1865)

Loc. 1: 3 ♂♂ collected, most probably many seen. **Loc. 2a:** 1 ♂ collected, 1 ♂ photographed (Fig. 29b), many ♂♂ of *P. v-nigrum* + *P. hieroglyphicum* seen (2 localities).

Observations. Unfortunately, in the field this species was not recognised among *P. v-nigrum*, so the relative abundance of *P. hieroglyphicum* and *P. v-nigrum* remained unclear. Males appeared equally represented in the collections from Khasan District (Locs 1 and 2a) while females of *P. hieroglyphicum* were not collected. At least at the former quarry near Andreevka (Loc. 2a), both species obviously shared the same habitat and male behaviour (also with *P. calamorum* and *E. najas*).

Figure 29. Males of *Paracercion* spp. at the inundated former quarry 3.4 km NW Andreevka village (Loc. 2a): a – *P. calamorum*, b – *P. hieroglyphicum*, c – *P. v-nigrum*.



12. *Paracercion plagiosum* (Needham, 1930)

Loc. 8: 3 ♀♀ collected, 1 of them photographed, 1 ♂ photographed (Fig. 31).

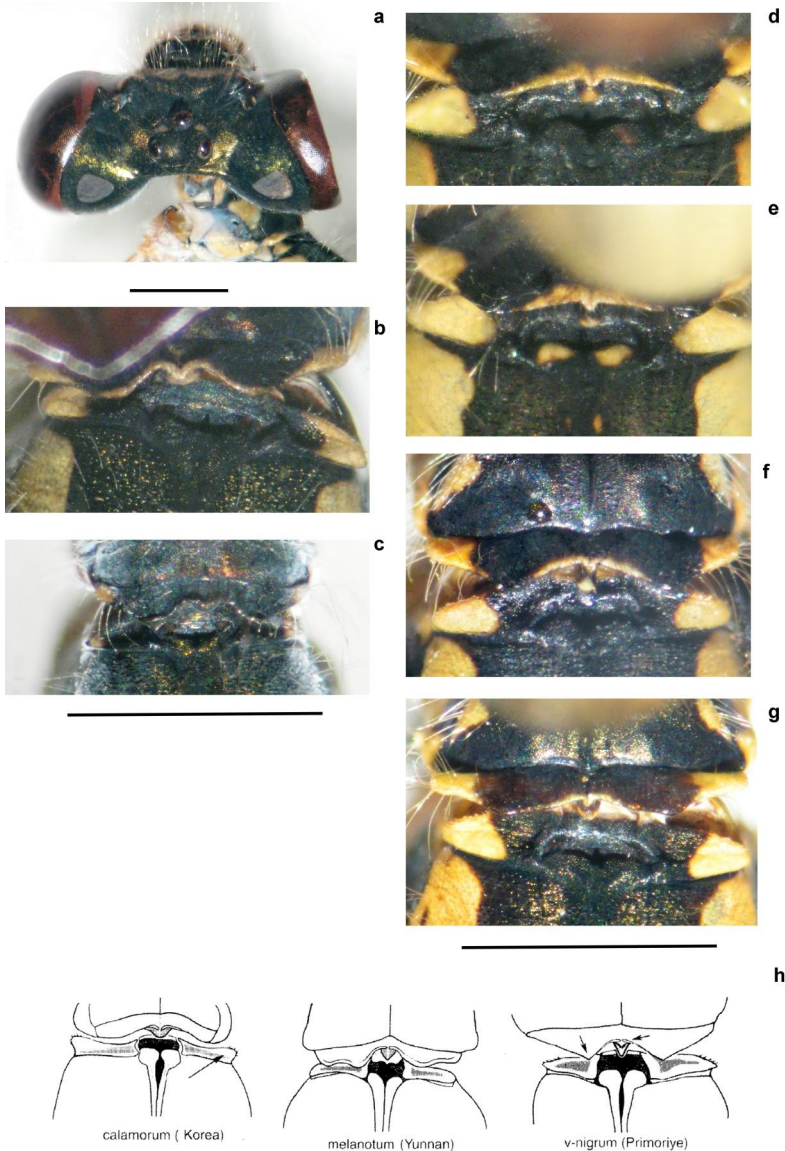
Loc. 9a: 5 ♂♂, 1 ♀ collected, many ♂♂, several ♀♀ seen (2 adjacent localities).

Observations.

Many males and some females occurred at the grassy banks of the large roadside lake near the Komissarovka River, and three females but only one male at the nearby sedgy river arm; it was unclear if they reproduced there or dispersed from the lake.



Figure 30. Structures of females of *Paracercion* spp.: a – head; b-h – hind lobe of pronotum and mesostigmal plate; a-b – *P. calamorum calamorum*, Primorye, Khasan District, the former quarry 3.4 km NW Andreevka village (Loc. 2a); c – *P. calamorum*



dyeri, Cambodia, 11 km SE of Sihanoukville, Kbal Chhay waterfall env, a pond at the Prek Teuk Sap River right bank, 26.05.2013; d-g – *P. v-nigrum*; d – Russia, Primorye, Lake Lotos (Loc. 1); e Russia, Primorye, Khanka District, the Komissarovka River valley at Ilyinka village (Loc. 8); f-g – Russia, Transbaikalia, SE Chita Province, the Onon River right floodplain 7 km upstream ov Nizhniy Tsasuchey village, 5.07.1996, h – drawings from Dumont (2004: figs 28, 30-31).

Figure 31. A male (above) and female (below) of *Paracercion plagiosum* in the Komissarovka (Sintuhe) River valley at Ilyinka village (Loc. 8).



13. *Paracercion v-nigrum* (Needham, 1930)

Loc. 1: 2 ♂♂, 4 ♀♀ collected, 1 ♂ photographed, numerous (together with *P. hieroglyphicum*) seen. **Loc. 2a:** 1 ♂ collected, 2 ♂♂ photographed (Fig. 29c), many ♂♂ of this species and *P. hieroglyphicum* seen. **Loc. 8:** 1 ♂ collected. **Loc. 9a,** 2 ♀♀ collected, many ♂♂ seen. **Loc. 9b:** several seen (6.07.2014). **Loc. 11:** 2 ♂♂ collected, quite many seen on floating vegetation (5 localities).

Observations. At Lake Lotos, *P. v-nigrum* and *hieroglyphicum* were very numerous at the banks of the brook estuaries and the lake itself. At the former quarry at Andreevka village, they were the most numerous damselflies, while *P. calamorum* were fewer and *E. najas* much fewer. Males of all these three species perched on floating vegetation, mostly water caltrop (Fig. 29), but also occurred in grass on the banks.

Remarks. Male specimens of *P. hieroglyphicum* and *P. v-nigrum* were doubtlessly identified by structural characters according to Dumont (2004). Both species occurred at Lake Lotos (Loc. 1) and Andreevka village (Loc. 2a), while at the Komissarovka River (Locs 8/9) and at the Draguchina arm near Gornye Klyuchi (Loc. 11) only *P. v-nigrum* was found.

The postocular maculation used in the key by Malikova (1995) is found to be quite helpful indeed for identification of males: in *P. v-nigrum* the postocular spots are large and elongate towards the mid-occipital blue streak which they, however,

never touch (but in the male from the Andreevka env. the streak is split into two pieces); while in *P. hieroglyphicum* the postocular spots are smaller, rounded triangular in shape, while the mid-occipital streak is absent (however, in one male from Lake Lotos there are two blue spots).

The series of both species appeared to vary in some characters but are too small to sufficiently characterise this variation. The black V-mark on S8 in males is variable and non-diagnostic in both species. In *P. v-nigrum*, it is well developed in both specimens from Lake Lotos (Loc. 1) and a male from the Komissarovka River (Loc. 8), while in both specimens from the Draguchina arm (Loc. 11) it is reduced to two tiny bulges of the black hind rim of S8. In *P. hieroglyphicum*, the V-mark is well developed in the specimen from Andreevka (Loc. 2a) and two males from Lake Lotos (Loc. 1) while in one more male from the same place it is reduced to two dots.

The large black dorsal spot on S2 in males is identical in all three collected specimens of *P. hieroglyphicum* in being the broadest at the S2 proximal margin, but is very variable in *P. v-nigrum*: it is as described above in the male from Andreevka (Loc. 2a), constricted near the proximal segment margin in both males from Lake Lotos (Loc. 1), the male from Komissarovka (Loc. 8) and one male from the Draguchina arm (Loc. 11) but is truncated before the segment anterior margin and connected to it with only a narrow black stem in the second male from Loc. 11.

Out of 5 females of *P. v-nigrum*, one had pale streaks along the anterior part of the middorsal carina of the synthorax and a pair of roundish pale spots at the carinal fork; in other females these dorsal areas are continuous black (note that the pale streaks along the middorsal carina of the synthorax are considered as a character of females of *P. hieroglyphicum*).

The pronotum hind lobe structure in *P. nigrum* females collected fits the characters described by Dumont (2004); however, its central incision is much shallower than shown in his fig. 31 (reproduced here in Fig. 30h) and nearly straight (Fig. 30d-e). This is curious since Dumont (2004) depicted a specimen from Lake Khasan, which is just 2 km W of Lake Lotos (Loc. 1), from where the female depicted in Fig. 30d originated. Here I also provide photos (Fig. 30f-g) of two females of *P. v-nigrum* from SE Transbaikalia from where other *Paracercion* species are absent (Kosterin 2004): the incision in question is deeper in the female of Fig. 30g (but still shallower than shown by Dumont, see Fig. 30h), while in that of Fig. 30f it is shallow and uneven.

A more detailed study of female morphological characters of *Paracercion* spp. would certainly be most welcome.

PLATYCNEMIDIDAE (2 species)

14. *Platycnemis phyllopoda* Djakonov, 1926

Loc. 2a: 3 ♂♂, 1 ♀ collected, 1 ♂ photographed (Fig. 32 above), numerous ♂♂, ♀♀ seen (all immature). **Loc. 6:** 1 ♂, 1 tandem, many ♀♀ seen. Locs 8/9: 1 ♂ collected, quite many seen on the road separating these localities. **Loc. 11:** 1 ♂ collected, 1 ♀ photographed (Fig. 32 below), many ♂♂ seen. **Loc. 12b:** 1 ♂, 1 ♀ collected, many ♂♂, ♀♀ seen (6 localities).

Observations. At the former quarry near Andreevka village, these damselflies, still immature, were for some reason confined to sand mounds covered with grass, where they were very numerous.

Remark. Loc. 6 is in Ussuriysk (formerly Nikol'sk-Ussuriyskiy) Town, which is the type locality of the species (Djakonov 1926).



Figure 32. A male (above) and female (below) of *Platycnemis phyllopoda* at the inundated former quarry 3.4 km NW Andreevka village (Loc. 2a) (male) and at the Dragucniha right arm of the Ussuri River at Gornye Kpyuchi settlement (Loc. 11) (female).



Figure 33. A female (above) and male (below) of *Pseudocopera tokyoensis* at a large right oxbow of the Ussuri River at Gornye Klyuchi settlement (Loc. 12b).

15. *Pseudocopera tokyoensis* (Asahina, 1948)

Loc. 1: 2 teneral ♂♂, 1 teneral ♀ collected, several more seen. **Loc. 9a:** 1 ♀ collected. **Loc. 11:** 1 ♂ collected. **Loc. 12b:** 1 ♂ collected, 1 ♂, 1 ♀ photographed (Fig. 33), many ♂♂, ♀♀ seen (4 localities).

Observations. Found at three localities with rather dissimilar environments: at small grassy pools at the water edge of the floating bog in bays of Lake Lotos; at a larger oxbow of the Ussuri River right floodplain (many); at the bank of the Draguchina arm of the same river (one male) at Goryachie Klyuchi settlement.

AESHNIDAE (4 species)

16. *Aeschnophlebia longistigma* Selys, 1883

Loc. 1: 3 ♂♂ collected, several more seen. **Loc. 10:** 4 ♂♂, 1 ♀ collected, quite many ♂♂, 2 copulae photographed (Fig. 34), 4 more copulae (for two days) seen. **Loc. 11:** 1 ♂ seen at the shallow bay, 1 ♂ seen at the sedgy bog. **Loc. 12b:** 1 ♂ collected (4 localities).

Observations. At Lake Lotos, males were repeatedly startled from sedge of the floating bog at the water edge, one also from the surrounding meadows. At Lake Khanka, reproductive males were common at the shallow pools (Fig. 14), a tall sedge area in place of a former swamp, and the grassy area near the lake. They flew slowly over dense sedge or other grass and scrutinised it as if intending to land. Formed copulae sat either in grass (Fig. 34) or quite high on tree branches. The only male seen at a small oxbow of the Ussuri River at Gornye Klyuchi settlement (Fig. 17 below) demonstrated the same behaviour of searching among large tussocks (incidentally, that oxbow was the only one among those examined that had such tussocks).



Figure 34. *Aeschnophlebia longistigma*, a copula at pools near the Lake Khanka W bank N of Platono-Aleksandrovskoe village (Loc. 10).

17. *Aeshna crenata* Hagen, 1856

Loc. 10: 1 territorial ♂ seen at the grassy area (1 localities)

18. *Aeshna juncea* (Linnaeus, 1758) ssp.

Loc. 16: uncertain sighting of 1 ♂. **Loc. 19:** 1 ♂ collected, 1 tandem seen (2 localities, 1 of them uncertain).

Remarks. As elsewhere in the southern Far East of Russia, the collected specimen has extended pale markings: very broad thoracic stripes (Fig. 35) and enlarged and dentate first pair of dorsal spots on the abdominal segments. At the same time there are no distinct pale spot(s) at the thoracic spiracle but just a very slightly paler area. This may represent an East Asian subspecies but the subspecific subdivision of this species has not yet been clarified.



Figure 35. Head and thorax of a male of *Aeshna juncea* spp. collected at the pond in the suburbs of Bychikha village, Khabarovsk env. (Loc. 19).

19. *Anax parthenope julius* Brauer, 1865

Loc. 10: 1 ♂ seen (1 locality).

Observations. At Lake Khanka on 5.07.2014, a male patrolled a much larger territory of a grassy meadow between the lake and forest margin than that patrolled by a male of *A. crenata* at the same place a day before.

GOMPHIDAE (10 species)

20. *Davidius lunatus* (Bartenev, 1914)

Loc. 5: 1 ♀ collected, 1 ♂, 1 more ♀ seen (1 locality). Ussuriyskiy District, Kamenushka village, 43.62 N, 132.23 E., 22 24.06.2014: 1 ♂ (N. Vikhrev leg.). Anuchino village env., 43.95 N, 133.05 E: 2 ♀♀ (N. Vikhrev leg.) (3 localities).

Observations. These dragonflies were found in grass, on willow bushes and lower tree branches at a medium-sized, cold and shallow Amba River with shingle bottom.

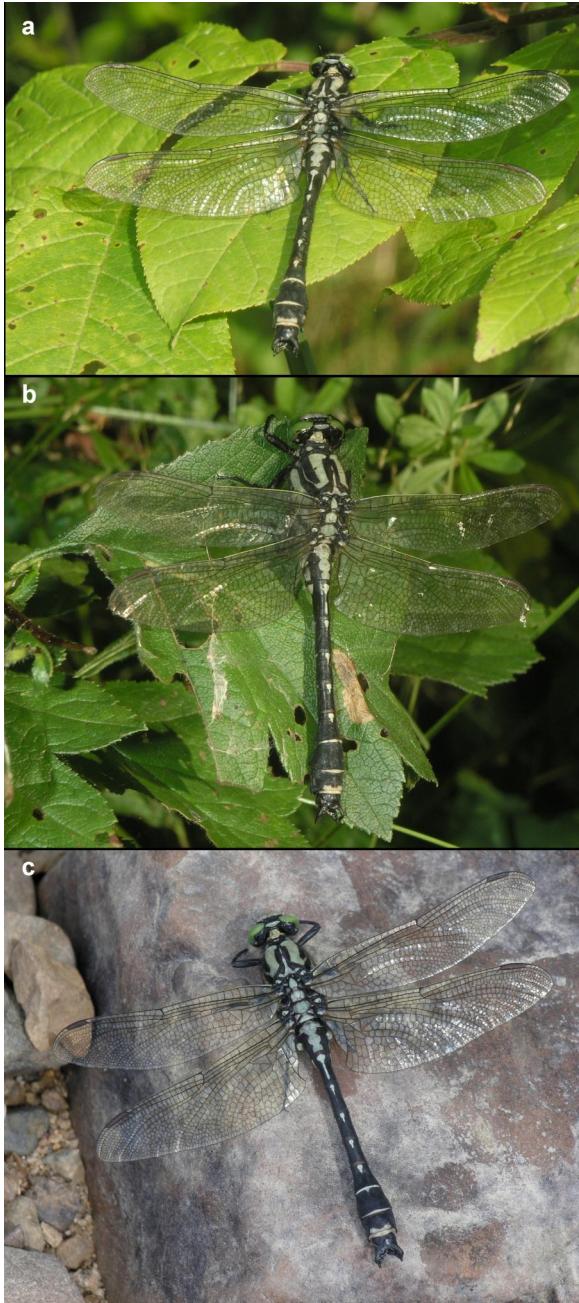
21. *Nihonogomphus ruptus* (Selys et Hagen, 1858)

Loc. 11: 1 ♀ collected. **Loc. 12a:** 2 ♂♂ collected, 1 ♂ photographed (Fig. 36 above), 3 more seen. **Loc. 15a:** 1 ♂ collected, 2 ♂♂ photographed (Fig. 36 below), 4 ♂♂ captured and released, several more seen (3 localities).

Observations. Found only at the Ussuri River. Five males were found in tall grass (Fig. 36 above) and one on the road on a grassy and bushy Ussuri right bank at Gornye Klyuchi settlement; no individuals seen at water. A female was found at the Draguchina arm. Much downstream the same river, at Chirki, ranger station males occurred mostly on shingle banks and branches of coastal bushes, or sat on the rocky cliff (Fig. 36 below).



Figure 36. Males of *Nihonogomphus ruptus* at the Ussuri River right bank: at Gornye Klyuchi settlement (Loc. 12a) (above) and on a rock downstream Chirki ranger station (Loc. 15a) (below).



22. *Shaogomphus postocularis epophthalmus* (Selys, 1872)

Anuchino village env., 43.95 N, 133.05 E: 1 teneral ♂ (N. Vikhrev leg.).

Loc. 11: 5 ♂♂, 2 ♀♀ collected, 4 ♂♂ (Fig. 37a b), 1 ♀ (Fig. 38) photographed, very many ♂♂, few ♀♀ seen. **Loc. 12a:** many ♂♂ seen. **Loc. 15a:** 1 ♂ collected. **Loc. 18b:** 1 ♂ photographed (Fig. 37c) (5 localities).

Observations. Males flew slowly over the surface of the Draguchina arm of the Ussuri River, often 'picking' the water; this flight mode contrasted to the faster flight of numerous *Macromia amphigena*, *Epitheca bimaculata* and *Sieboldius albardae* over the same river. One male was observed flying slowly among pondweed in-

Figure 37. Males of *Shaogomphus postocularis epophthalmus*: a-b – at the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11); c - on the right bank of the Amurskaya Protoka left arm of the Amur River right bank at the Sosnenskiy brook mouth downstream Kazakevichevo village (Loc. 18b).

florescences protruding from the water and sometimes landed on them for a little while. However, only a small fraction of males were flying while most individuals rested on tree branches hanging over the water (Figs 37a-b, 38). Individuals of both sexes were also common on a meadow near the river, where males preferred to perch on barren ground. One of these males, which I was photographing, took off, grasped a mosquito from my forehead and landed back. Observations made by the Ussuri River itself in the same area were similar: several males were observed to very slowly hover over the surface of the shallow river section between its right bank and an island (but no observations made elsewhere) while the majority of them rested at the bank, on vegetation or at a small sandy beach. A male (Fig. 37c) was unexpectedly seen resting on a stone and photographed, among numerous males of *Shaogomphus schmidtii* on the Amurskaya arm of the Amur River at the Sosnenskiy brook mouth.



Figure 38. A female of *Shaogomphus postocularis ephthalmus* at the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11).

23. *Shaogomphus schmidtii* (Asahina, 1956)

Loc. 10: 1 ♀ photographed (Fig. 39 above) and collected at the lake bank. **Loc. 18a:** 1 ind. seen. **Loc. 18b:** 3 ♂♂, 3 ♀♀ collected, 2 ♂♂ photographed (Fig. 39 below), many ♂♂, ♀♀ seen. **Loc. 20:** 6 ♂♂ captured and released, very many seen (3 localities).

Observations. At the Amurskaya Protoka arm, males of this species behaved like those of the previous one: a minority hovered low over the water surface, the majority rested, but on stones (Fig. 39 below) rather than vegetation. At the same arm at Bychikha village all males were found on the bank shingle, again some of them were hovering above the water. The female from Lake Khanka bank rested in riparian herbage (Fig. 39 above).



Figure 39. A female (above) and male (below) of *Shaogomphus schmidtii*, on the Lake Khanka bank at Platono-Aleksandrovscoe village (Loc. 10, female) and on the right bank of the Amurskaya Protoka left arm of the Amur River right bank at the Sosnenskiy brook mouth downstream Kazakevichevo village (Loc. 18b, male).

24. *Sieboldius albardae* Selys, 1886

Loc. 11: 2 ♂♂ collected, 1 ♂ photographed (Fig. 40), many ♂♂ seen (1 locality).

Observations. Males flew fast over the Draguchina Arm of the Ussuri River chasing

and being chased by *Macromia amphigena* and *Epitheca bimaculata*. One male sat on buttresses of the low bridge several times (and flew below it) but only for a little while since it was permanently disturbed by other dragonflies. Several times males landed on my shoulder when I walked in the water. Another male was twice startled from a certain road section near the water. At sunset, *S. albardae* started to frequently rest on stones on the bank (Fig. 40) while the two other mentioned species continued to fly over the river.



Figure 40. A male of *Sieboldius albardae* at the bank of the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11).

25. *Sinictinogomphus clavatus* (Fabricius, 1775)

Loc. 9a: 1 ♂ photographed (Fig. 41), several more seen (1 locality).

Observations. Found only at one deep lake with open water; males perched on sticks, as is common for this species, but spent much more time chasing other large dragonflies.

26. *Stylurus annulatus* (Djakonov, 1926)

Loc. 8: 1 ♀ collected (15.07.2014) (1 locality).

Observations. An incorrectly expanded female, already coloured but with still unexpanded wings and abdomen (Fig. 42), was found crawling on a sticky, silty open bottom of the Komissarovka River at midday of 4.07.2014. No exuvia was found nearby.

27. *Stylurus flavipes* (Charpentier, 1825)

Loc. 15a: 1 ♀ collected (4.07.2014) (1 locality).

Observations. Curiously, this was the case exactly as above although at a different place: a female already coloured but with unfolded wings was found at the transition of a silty and stony Ussuri bank in some 30 cm from the water edge.



Figure 41. A male of *Sinictinogomphus clavatus* at the bank of a roadside lake near the Komissarovka (Sintuhe) River and Ilyinka village (Loc. 9a).



Figure 42. An incorrectly expanded female of *Stylurus annulatus* on the bank of the Komissarovka (Sintuhe) River near Ilyinka village (Loc. 8).



Figure 43. A male (above) and female (below) of *Trigomphus citimus* at the Repyovka village in the Ussuriysk Town northern suburbs (Loc. 6, male) and at pools by the Lake Khanka W bank near Platono-Aleksandrovka village (Loc. 10, female).

28. *Trigomphus citimus* (Needham, 1931)

Loc. 6: 1 ♂ photographed (Fig. 43 above) and collected. **Loc. 10:** 1 ♀ photographed (Fig. 43 below) and collected (2 localities).

Observations. Both specimens found among the more abundant following species.

29. *Trigomphus nigripes* (Selys, 1887)

Loc. 1: 4 ♂♂ collected (2 of them photographed; Fig. 44 below), 1 ♀ photographed and collected, 1 more ♀ photographed (Fig. 45). **Loc. 2a:** 1 ♂ collected; **Loc. 2b:** 1 ♂, 1 ♀ seen. **Loc. 6:** 2 ♂♂, 1 ♀ collected, 1 of those ♂♂ photographed. **Loc. 9b:** 1 ♂ collected. **Loc. 10:** 1 ♀ collected. **Loc. 16:** 1 ♂ photographed (Fig. 44 above), several exuviae (Fig. 46) seen. **Loc. 19:** 1 ♂ collected. Khabarovsk env., 2-5.06.2014, 48.59 N, 135.04 E: 2 ♂♂ collected (N. Vikhrev leg.) (9 localities).

Observations. At Lake Lotos (Loc. 1) found at margins of the floating bog in bays, both at the water edge (Fig. 44 below) and herbaceous slope bases; preferred to sit on barren ground patches or grass. At Repyovka (Loc. 6) and Bolshaya Chirka (Loc. 16; Fig. 44 above) rivulets these dragonflies rested on vegetation, at Andreevka village a male was noticed landing on a stone, in Bychikha village – on tall grasses on the pond bank.



Figure 44. Males of *Trigomphus nigripes* at the Bolshaya Chirka River, Khabarovsk environs (Loc. 16) and Lake Lotos (Doritseni), Primorye (Loc. 1).

Figure 45. Females of *Trigomphus nigripes* Lake Lotos (Doritseni), Primorye (Loc. 1).



Figure 46. An exuvia of *Trigomphus nigripes* at the Bol'shaya Chirka River, Khabarovsk environs (Loc. 16).



Figure 47. An exuvia of *Epophthalmia elegans* by the inundated former quarry 3.4 km NW Andreevka village (Loc. 2a).

MACROMIIDAE (4 species)

30. *Epophthalmia elegans* (Brauer, 1865)

Loc. 2a: several ♂♂, numerous exuviae (Fig. 47) in grass at the banks seen, 1 photographed. **Loc. 9a:** 1 ♂ collected, several ♂♂ seen. **Loc. 10:** 2 exuviae on the lake bank, 15.06.2014 (N. Vikhrev leg.). **Loc. 14:** 1 ♂ seen. **Loc. 17b:** 1 ♂ collected, many ♂♂ seen (5 localities).

Observations. Found only at large water bodies with open banks.

31. *Macromia amphigena fraenata* Martin, 1906

Loc. 11: 5 ♂♂, 1 ♀ collected, 13 ♂♂ captured and released, many ♂♂, several ♀♀ seen. **Loc. 15a:** 1 ♂, 1 ♀ collected, 8 ♂♂ captured and released, many more ♂♂,



several ♀♀ seen. **Loc.**

18b: 1 ♂ collected, 2 ♂♂ captured and released, 1 ♂ photographed (Fig. 48), many more seen.

Loc. 20: 2 ♂♂ captured and released, many seen (4 localities).

Observations. Found only at the Ussuri River, its arms and an Amur River arm (that which accepted the Ussuri). At daytime males patrol water courses rather slowly but chase each other quite fast, so when

Figure 48. A male of *Macromia amphigena fraenata* on the Ussuri River right bank at the Sosnenskiy brook mouth downstream Kazakevichevo village (Loc. 18b).



Figure 49. A road along the left bank of the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11), patrolled by males of *Macromia amphigena fraenata* along with the river itself.

they are abundant they have to fly over the water on average quite fast. At the Draguchina Arm of the Ussuri River on 6.07.2014, they also patrolled the road along its left bank (Fig. 49) (avoiding road patches separated from the river by sedge areas), flying low and slowly, so that 15 individuals were examined in hand. Next day I was in the same place at ca 4 p.m. just after a strong hour-long shower. This time these dragonflies were scarce over the road (so that I managed to catch only 3) but still numerous over the water. Also a female was caught flying fast and low over a very small glade with tall grass between the bushes. At the Amurskaya Arm at Bychikha village males flew over the water and some over the flat bank along the high earth bluff.

At the Chirki ranger station on 15.07.2014, the first male appeared at 9:18 a.m., the first ovipositing female observed at 9:50 a.m. At the Amurskaya Arm at Bychikha village the males were already on the wing at 8:30 a.m. At the Draguchina arm on 6.07.2014, the last individual was captured over the bank in dark dusk. Before the sunset, some individuals also appeared flying fast and erratically 1.5-5 m above the meadow, most probably feeding females (not captured).

Remarks. The continental subspecies *M. amphigena fraenata* differs from the Japanese nominotypical subspecies *M. amphigena amphigena* by retaining twin yellow spots inside the frons cleft in mature specimens (Asahina 1964). I examined

in hand 19 individuals at Gornye Klyuchi settlement, 9 individuals at Chirki ranger station, 3 at the Sosnenskiy brook mouth and 2 at Bychikha village, 33 individuals in total (31 males, 2 females), and all had these spots. Besides, in one male (of 18) from Gornye Klyuchi and two males (of 8) and one female (the only from there, one of the two collected in total) from Chirki there were also yellow spots at the frons sides, one more male from Chirki had them vestigial. I abstain from judgement if these spots were age-related and would disappear with maturity. The S3 yellow pattern was examined in the nine collected specimens: in two males from Gornye Klyuchi the yellow stripe is interrupted at its narrowest points at the segment sides, in all other specimens it is continuous.

32. *Macromia daimoji* Okumura, 1949

Loc. 11: 1 ♂ collected on 6.07.2014 (Fig. 50) (1 locality).

Observations. Curiously, this was the first of 17 *Macromia* males caught while they patrol over the road along the left bank of the Draguchina arm of the Ussuri River (one was the next species, the 15 rest - the previous next species).



Figure 50. A male of *Macromia daimoji* captured at the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11).

33. *Macromia manchurica* Asahina, 1964

Loc. 11: 1 ♂ collected on 6.07.2014 (Fig. 51). **Loc. 12a:** 1 ♀ collected (Fig. 52) (2 localities).

Observations. A male was also caught over the road along the Draguchina arm of the Ussuri river, among fifteen *M. amphigena* and one *M. daimoji*. The female



Figure 51. A male of *Macromia manchurica* captured at the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11).

oviposited at the main Ussuri River right bank in the same area. For this it broadly ranged over the surface of the shallow river but some part of its trajectory were over the bank as well.



Figure 52. A female of *Macromia manchurica* captured at the Ussuri River right arm at the bridge near Gornye Klyuchi settlement (Loc. 12a).



Figure 53. A male of *Cordulia aenea* at pools near the Lake Khanka W bank N of Platono-Aleksandrovskoe village (Loc. 10).



Figure 54. A teneral female of *Somatochlora graeseri* at pools near the Lake Khanka W bank N of Platono-Aleksandrovskoe village (Loc. 10).

CORDULIIDAE (3 species)

34. *Cordulia aenea* (Linnaeus, 1758)

Loc. 1: 1 ♀ collected, several ♂♂ seen. **Loc. 10:** 1 ♂ photographed (Fig. 53) in a grassy area (2 localities).

Observations. At Lake Lotos, males patrolled along banks over open water; the female startled from the surrounded meadows.

35. *Epitheca bimaculata* (Charpentier, 1825)

Loc. 9a: several ♂♂ seen. **Loc. 11:** 1 ♂ collected, many ♂♂ seen. **Loc. 15a:** 2 flying ind., 2 dead ♀♀ seen (in a pool). **Loc. 15b:** 1 ind. seen over the Chirki estuary. **Loc. 17a:** many ♂♂, several tandems seen. **Loc. 17b:** several seen. **Loc. 18b:** 1 ♂, 2 ♀♀ collected, many more seen. **Loc. 19:** 1 ♂ with distorted abdomen photographed and collected, 1 more ind. seen (6 localities).

Observations. Prefers large water bodies. Both sexes of these dragonflies swarmed above the Sosnenskiy Brook mouth at the Amurskaya Protoka right arm, by this behaviour resembling *Pantala flavescens* (Fabricius, 1798); solitary individuals also occurred further downstream above the shingle bank and bushes. Many males and some tandems flew over the large former quarry in Korfovskiy settlement. In other localities not numerous; at the Chirki ranger station observed ranging over an oxbow.

36. *Somatochlora exuberata* Bartenev, 1910

Loc. 10: 15.06.2014: 1 teneral ♂ (N. Vikhrev leg.) (1 locality).

37. *Somatochlora graeseri* Selys, 1887

Loc. 7: 1 ♂, 1 ♀ seen. **Loc. 10:** 1 ♂, 3 ♀♀, 1 teneral ♀ photographed (Fig. 54) and collected, several ind. seen. **Loc. 11:** ?1 ♂ uncertain sighting at the sedgy bog (3 localities).

Observations. At Lake Khanka near Platono-Aleksandrovskoe, all individuals were found on a grassy area between the lake bank; they (perhaps males) ranged along the forest margin, approximately at the level of eyes. At the high bank of the same lake in Kamen'-Rybolov, a male and female were observed on high trophic flight on a forest glade in the evening (ca 7 p.m.).

LIBELLULIDAE (14 species)

38. *Deiella phaon* (Selys, 1883)

Loc. 1: 1 ♂, 2 red-winged ♀♀ collected, 1 more red-winged ♀ photographed. **Loc. 8:** 2 ♂♂ collected, 2♂♂, 1 ♀ photographed (Fig. 55), many more ♂♂, 2 ♀♀ seen. **Loc. 9a:** 1 ♂ collected, many seen. **Loc. 9b:** 1 red-winged ♀ collected, many seen. **Loc. 10:** 1 ♂ collected, 1 red-winged ♀ photographed, several more ♂♂ seen. **Loc. 18b:** 1 teneral red-winged ♀ collected (Fig. 56) (5 localities).

Observations. At Lake Lotos, few individuals were found on a sedgy floating bog and a reed stripe at its margin; at the barren bank of Lake Khanka males also kept to scarce reeds. At the Komissarovka River these dragonflies mostly kept to open silty banks with very shallow pools and to the sedgy and muddy arm of this



Figure 55. A female (above) and males (middle and below) of *Deielia phaon* in the Komissarovka (Sintuhe) River valley at Ilyinka village (Loc. 8).

Figure 56. A teneral female of *Deiella phaon* collected on the Ussuri River right bank at the Sosnenskiy brook mouth downstream Kazakevichevo village (Loc. 18b).



river, where they sat on sticks or bush branches. The only female at the Amurskaya arm bank rested on shingle.

39. *Leucorrhinia dubia orientalis* Selys, 1887

Loc. 11: 1 ♀ seen at the shallow bay, 1 ♀ collected at the sedgy bog. **Loc. 12b:** 2 ♂♂ collected (the specimens with A.N. Medvedev) at a road between two small ox-bow swamps. **Loc. 19:** many ♂♂, ♀♀ seen, including 2 teneral ♀♀ with yellowish wings (some collected, the specimens with A.N. Medvedev) (3 localities).

40. *Leucorrhinia intermedia* Bartenev, 1910

Loc. 1: 1 ♂ collected (the specimen with A.N. Medvedev) (1 locality).

Observations. Found only once, on a sedgy floating bog at Lake Lotos.

41. *Libellula quadrimaculata* Linnaeus, 1758

Loc. 1: 1 ♀ photographed, several ind. seen. **Loc. 6:** many seen, some ab. *praenubila*. **Loc. 9b:** several seen. **Loc. 10:** 1 teneral ♀ photographed, numerous seen at a pool (some females of ab. *praenubila*). **Loc. 11:** 2 ind. seen at road pools at the shallow bay. **Loc. 14:** several seen. **Loc. 15b:** several seen on grassy swamps. **Loc. 18a:** several seen. **Loc. 18b:** several seen at bushes. **Loc. 19:** several seen. **Loc. 20:** several seen (9 localities).

Observations. At Lake Lotos, females (only) were repeatedly startled from the sedge of the floating bog water edge, one also from the surrounding meadows. At the pond in Bychikha old individuals kept to cattail in its middle. In other places they were always found at small and shallow pools with rush and cattail.

42. *Lyriothemis pachygastra* (Selys, 1878)

Loc. 1: 1 ♂, 1 ♀ collected, 1 more ♀ photographed (Fig. 57), 1 more ♂ seen (1 locality).

Observations. Found at Lake Lotos (Doritseni) on gentle herbaceous cape slopes; rather scarce.



Figure 57. A female of *Lyriothemis pachygastra* on a meadow near Lake Lotos (Doritseni) (Loc. 1).



Figure 58. A tandem of *Orthetrum albistylum* on the bank of the Draguchina left arm of the Ussuri River at Gornye Klyuchi settlement (Loc. 11).

43. *Orthetrum albistylum* (Selys, 1848)

Loc. 2a: 1 teneral ♂ collected, 2 mature ♂♂ seen at an open sandy bank. **Loc. 7:** 1 ♂ seen. **Loc. 9a:** many seen. **Loc. 10:** 1 tandem collected. **Loc. 11:** 1 copula photographed (Fig. 58), several ♂♂ (1 teneral) seen. **Loc. 12a:** 1 ♂ seen. **Loc. 13:** 2 ♂♂ seen at the channel. **Loc. 14:** several ♂♂ seen. **Loc. 15a:** several ♂♂ seen. **Loc. 17a:** several ♂♂ seen. **Loc. 17b:** 3 ♂♂ collected, many ♂♂ seen. **Loc. 18a:** 1 ♂ seen (12 localities).

Observations. Prefer open barren banks where they perch and patrol water sections.

44. *Pantala flavescens* (Fabricius, 1798)

Loc. 2a: 1 ind. patrolling a small round pool. **Loc. 2b:** 1 ind. seen. **Loc. 3:** 2 solitary ind., 1 ovipositing tandem seen. **Loc. 10:** many aggregated ind. seen at the lake (3 localities).

Observations. Observed only in the south, habitat independent, in this time of the year still not abundant.

45. *Sympetrum cordulegaster* (Selys, 1883)

Loc. 15a: 1 young ♀ photographed (Fig. 59 below), quite many young ind. seen. **Loc. 15b:** several young ind. seen. **Loc. 16:** 2 ♂♂, 1 ♀ seen at the larch mire. **Loc. 17a:** 1 teneral ind. seen. **Loc. 18a:** 1 teneral ♂ collected, several seen. **Loc. 19:**



Figure 59. A male (above) and female (below) of *Sympetrum cordulegaster* at a pond in Bychikha village (Loc. 19) and at Chirki Ranger station environs (Loc. 15a), Khabarovsk env.

1 ♂, 1 ♀ collected, 1 ♂ photographed (above), many seen (some teneral) (4 localities).

Observations. At the time of our visit, *Sympetrum* spp. just started to emerge, so the failure to meet this common species in Primorye could be due to us visiting it first.

46. *Sympetrum eroticum* (Selys, 1883)

Loc. 7: 1 ♂, 1 ♀ collected (Fig. 60 above), 1 ♀ photographed, several ♂♂, ♀♀ seen (all teneral), mostly in a brook valley. **Loc. 9b:** many tenerals seen. **Loc. 11:** two teneral ind. seen. **Loc. 12b:** many tenerals seen. **Loc. 14:** 1 teneral ♂ seen. **Loc. 15a:** quite many tenerals seen. **Loc. 15b:** several young and mature (already red) ind. seen. **Loc. 18a:** several seen. **Loc. 19:** 1 ♀ photographed (Fig. 60 below), several young ind. seen (8 localities).

Observations.

Perhaps the earliest emerging *Sympetrum* spp. in this area hence seemingly most common during our visit.



Figure 60. A female (above) and male (below) of *Sympetrum eroticum*, near the Lake Khanka in Kamen'-Rybolov village, Primorye (Loc. 7, female) and at a pond in Bychikha village, Khabarovsk env. (Loc. 19, female).

47. *Sympetrum flaveolum* (Linnaeus, 1758)

Loc. 7: a teneral ind. seen. **Loc. 10:** 1 teneral ♀ collected, several teneral ind. seen at a forest margin. **Loc. 15b:** several young ind. seen. **Loc. 19:** 1 teneral ind. seen (3 localities).

48. *Sympetrum infuscatum* (Selys, 1883)

Loc. 9b: 2 teneral ♂♂ collected at a very shallow grassy swamp. **Loc. 15a:** several tenerals seen. **Loc. 15b:** several young ind. seen. **Loc. 18a:** 1 ♀ photographed (Fig. 61), several seen. **Loc. 19:** 1 ♂, 1 ♀ photographed, 3 young ind. seen (4 localities).



Figure 61. A young male of *Sympetrum infuscatum* at the Bol'sjkekhtsirskiy State Nature Reserve visit centre at the Sosnenskiy brook (Loc. 18a).

49. *Sympetrum pedemontanum pedemontanum* (Müller in Allioni, 1776)

Loc. 10: 1 teneral ♀ photographed (Fig. 62) at a pool (1 locality).

50. *Sympetrum striolatum imitoides* Bartenev, 1919

Loc. 7: 1 teneral ♂ photographed (Fig. 63 below), 2 more ind. seen. **Loc. 10:** 1 teneral ♂ collected, 1 teneral ♀ photographed (Fig. 63 above), several teneral ind. seen at a forest margin and pools (2 localities).

Observations. We saw this (and the previous) species only at Lake Khanka.

Discussion

Species recorded

In total the fortnight-long trip in two provinces of the Russian Far East revealed 50 odonate species. This is 33% of the total Odonata fauna of Russia and 55% of the



Figure 62. A teneral female of *Symptetrum pedemontanum* at pools near the Lake Khanka W bank N of Platono-Aleksandrovskoe village (Loc. 10).



Figure 63. A teneral female (above) and teneral male (below) of *Symptetrum striolatum imitoides* near the Lake Khanka W bank at pools N of Platono-Aleksandrovskoe village (Loc. 10, female) and in Kamen'-Rybolov village (Loc. 7, male).

species occurring in the southern Far East of Russia (Malikova & Kosterin 2019). The time of our visit to the Far East was obviously too early to register some late flying species, e.g. some *Sympetrum* spp.; in general representatives of this genus were just starting to emerge.

D. phaon is for the first time reported for Khabarovskiy Kray Province in general and the Bol'shekhhechtsirskiy State Nature Reserve in particular. This species was also found by me in five localities in southern Primorye. For some reason, I could find in literature only one reported locality of this species in the Russian territory: 1 ♂, Primorskiy Kray, Pogranichnyy District, Grodekovo village, E.S. Stepanchuk coll., 23.08.1962 (Belyshev 1973; Malikova 1995).

The trip provided rather scanty new faunistic information, nevertheless I managed to observe many species with limited presence in Russia and considered rare. *P. tokyoensis* was known from few points in southern Primorye (Malikova & Ivanov 2001); the same refers to *P. calamorum*, and *P. hieroglyphicum*, which also occur in southern Amur Province (Malikova & Ivanov 2001; Malikova 2010). *T. citimus* was known from three localities in Primorye and one in Khabarovskiy Kray (summarised in Malikova et al. 2007). The localities reported above for these species are new except for *P. hieroglyphicum* and *P. tokyoensis* at Lake Lotos (Doritseni).

P. plagiosum was only known from Russia from the Lefu (Ilistaya) River at Lake Khanka (as *Agrion striatum* Bartenev, 1956, junior synonym) and Ussuriysk (Malikova 1995; Malikova & Ivanov 2001). I did not find it at Ussuriysk but found at the Komissarovka (Sintuhe) River which is some 60 km NW of the Ilistaya River fall to Lake Khanka, and is the northernmost known record of this species in the world.

S. clavatus was known from Russia from Lake Doritseni (Lotos), Putyatin Island in southern Primorye (Malikova 1995), Lake Venevitinovo (an Ananyevka (Elduga) River oxbow) in Nadzhdinskiy District of Primorye and, quite unexpectedly, from Progress settlement in Bureya District of Amur Province (Malikova 2010). According to the personal communication by Sergey Borisov, Belyshev's collection at the Siberian Zoological Museum at the Institute of Systematics and Ecology of Animals, Novosibirsk, contains the following specimens of this species: Primorye, Khasan Station, Lake Doritseni, 30.06.1964, Nochvina leg. 8 exuviae; the same place and collector, 2.07.1964: 1 ♀ (damaged by skin beetles); the same place and collector, 19.07.1964: 1 ♀ (damaged by skin beetles, sex putative); the same place and collector, 8.08.1964: 4 exuviae; Primorye, Putyatin Island, 7.08.1966: 1 specimen damaged by skin beetles, sex unclear. For some reason, Belyshev (1965) reported only two larvae from Khasan Station collected by L. Nochvina but never reported findings of imagines, as well as the finding at Putyatin Island (perhaps the imagines had been damaged already when he got them). Anyway, the here reported locality of this species is the fifth in Russia. Unfortunately I did not manage to take a specimen since I decided first to get a natural photo (Fig. 41).

S. annulatus was known from Russia by only two males (one being the holotype, the other not in the type series) collected on 23.07.1924 at the Suifun (Razdol'naya) River lower reaches (Djakonov 1926; Malikova 2005). Hence the Komissarovka (Sintuhe) River becomes the second Russian locality known for this species situated some 130 km N of the previous one, hence the northernmost in the world. (The report of

S. annulatus from Khabarovsk by Yakubovich (2006) was in error and was later re-identified as *S. occultus* by its author (Yakubovich 2008) himself.)

M. daimoji was known in Russia only from two localities: The Ilistaya (Lefu) River at Lake Khanka in Primorye and Bychikha village in Khabarovskiy Kray (Malikova et al. 2007). For the former locality the cited paper mentions a male specimen; this is an error for this specimen was in fact female (E.I. Malikova, pers. comm.) Here the third locality and the first male from Russia are reported, at Gornye Klyuchi settlement in Kirovskiy District in Primorye.

M. manchurica, was known in Primorye by provisionally identified larvae from the Sintuhe (Komissarovka) River near Ilyinka village (Asahina 1964), which is exactly my Loc. 8, and a female from Novogeorgievka village, Oktyabr'skoe District (Malikova & Seidenbusch 2001). Its finding at the Ussuri River and its Draguchina Arm at Gornye Klyuchi settlement, Kirovskoe District, is the third, and the northernmost, (200 km NE of the latter) species' locality in Russia and in the world. Later than the here considered trip *M. manchurica* was found at Boismann and Baklan Harbours in Khasan District of Primorye (Onishko 2019).

L. pachygastra was reported from Russia only by 2 ♀♀ collected at Primorskiy Kray, Khasan District, the Barabashevka (Bol'shoy Mongugay) River on 24.07.1962 by B.F. Belyshev (Belyshev 1973; Malikova 1995). I found this species at another locality in the same District, Lake Lotos (Doritseni).

Kosterin & Dubatolov (2005) reported *S. flavipes* for the Bol'shekhekhtsirskiy State Nature Reserve in error since it was a misidentified *Stylurus occultus* (Malikova et al. 2007). However, *S. flavipes*, as well as *Somatochlora arctica* (Zetterstedt, 1840) which we missed from our assessments of the Reserve fauna (Kosterin & Dubatolov 2005; Malikova et al. 2007), had been already reported for this reserve as found on the Khekhtsir Mountain by Fukui (1998) in 1989 (both species) and 1992 (*S. arctica*). Now the true *S. flavipes* was again collected in the Reserve, at the Chirki ranger station. Yakubovich (2010) added *O. albistylum* for the Reserve fauna as found at the same ranger station (and I have now observed it there as well). *E. elegans* is now found almost at the border of the Bol'shekhekhtsirskiy Reserve border, which embraces Korfovskiy settlement from the west, but still beyond the Reserve. Nevertheless, I would abstain from claiming its presence in the Reserve since the (?artificial) lake in Korfovskiy where it was found is somewhat unique and may not have analogs in the Reserve territory per se. (It is noteworthy that the fauna of this lake differed from that of the former marble pit just 1.9 km apart in the same settlement in presence of *E. elegans* and absence of *E. najas*.) *E. elegans* was earlier reported from the Tunguska Rivulet at Priamurskiy settlement 14 km NE of Khabarovsk (Yakubovich 2006).

Occurrence of *Macromia* spp. and *Shaogomphus* spp.

Macromia spp. were met on this trip only at the Ussuri River and its continuation as the Amurskaya Protoka arm of the Amur River. *M. amphigena fraenata* was abundant at all examined localities but the main Ussuri at Gornye Klyuchi settlement, while at Gornye Klyuchi two more species were found in addition. Males of *M. daimoji* and *M. manchurica* (one per each species) were occasionally collected along with

15 males of *M. amphigena* patrolling the road going along the Draguchina Protoka left arm of the Ussuri River. Such co-occurrence and seemingly identical behaviour of males of the three rather unrelated species of *Macromia* (*M. amphigena* and *M. manchurica* are considered in the *moorei*-group while *M. daimoji* in the *calliope*-group) was striking.

According to the author's experience (see also Kosterin 2005), in West and Central Siberia *M. amphigena* is always accompanied with *S. postocularis epophthalmus* and vice versa, that is the two species occur at the same habitat and found together, with the only exception of *S. postocularis epophthalmus* at the Iksha River in Tomsk Province (Bernard & Kosterin 2010). According to the observations in this trip, at the Ussuri River and Amurskaya Protoka, *M. amphigena fraenata* was invariably accompanied by either of the *Shaogomphus* species, but not vice versa (*M. amphigena* was not found at Lake Khanka).

S. postocularis was abundant at the Ussuri River and very abundant at its Draguchina arm at Gornye Klyuchi settlement, one male was found at the lowermost Ussuri at the Chirki ranger station and one male occasionally photographed (Fig. 37c) at the Amurskaya Protoka right arm of the Amur River at the Sosnenskiy brook mouth among numerous males of *S. schmidtii*. Only *S. schmidtii* was found at the same arm near Bychikha village. These circumstances are very curious if we consider the following: near Khabarovsk, the great Amur (Heilongjiang) River produces a right arm called Ussuriyskaya Protoka. The Ussuri River joins it at Kazakevichevo village to produce the common water course called Amurskaya Protoka, which then re-joins the main Amur. Hence the Amurskaya Protoka at its origin gets waters from both Amur and Ussuri. Note that the Sosnenskiy brook mouth is situated just 2.7 km downstream of the origin of Amurskaya Protoka, and is full of *S. schmidtii*. At the same time the Chirki ranger station is upstream the Amurskaya Protoka–Ussuri, situated just 12 km SW of Sosnenskiy but (i) is situated at the pure Ussuri River (no water from Amur) and (ii) revealed only *S. postocularis* (1 male). We can conclude that the Ussuri River is inhabited by *S. postocularis* while the Amur River – overwhelmingly by *S. schmidtii*, and immediately when the waters of these rivers mix the joint Amurskaya arm becomes inhabited by the latter, that is *S. schmidtii* follows the Amur water and nearly, but not completely excludes *S. postocularis*.

The only locality from where both *Shaogomphus* species were reported is Poltavka village at a small Razdolnaya (Suifun) River in southern Primorye (Malikova & Ivanov 2001). However, this record is somewhat suspicious since *S. postocularis epophthalmus* was reported by one male collected on 24.06.1992 by T.S. Vshivkova while *S. schmidtii* by one larva and one exuvia collected on the same day by the same person (Malikova & Ivanov 2001). The Amurskaya Protoka at the Sosnenskiy brook mouth is the second known case of co-occurrence of both *Shaogomphus* species, with *S. schmidtii* predominating overwhelmingly.

The general range of *S. schmidtii*, summarised by Kosterin (2019) confirms this supposition: this appears a purely potamic species nearly confined to the main Amur River lower reaches until its mouth (Yakubovich 2007; Kosterin 2019). Beyond Amur, this species occurs at Lake Khanka (Bartenev 1956; Malikova & Ivanov 2003; Kosterin 2019),

which is a great lake providing conditions somewhat resembling a major river. (The unclear report from Komissarovka (Sintuhe) River (Malikova & Ivanov 2001) probably referred to Lake Khanka which it enters.)

S. postocularis epophthalmus was also found at another locality in the Ussuri River: at Pokrovka village in Khabarovskiy Kray (46.71 N, 134.03 E, 180 km SSW of the Ussuri mouth, not to confuse with Pokrovka at the Amur River origin) (Yakubovich 2014), as well as from a number of rivers smaller than Amur: Zeya in Amur Province (Malikova et al. 2007), Ilistaya (Lefu) in Primorye (Malikova et al. 2007), Komarovka (Suputinka) (unpublished: 1♀, 25.06.2011, A. Korshunov leg.) and some river at Sovetskaya Gavan' in Khabarovskiy Kray (Malikova et al. 2007). This species was also reported from the Amur River itself: from Krasnoe village in Tambov District and Blagoveshchensk in Amur Province and Nikolaevsk-na-Amure and Ubiennyi Cape in Khabarovsk Province (Malikova et al. 2007; Yakubovich 2007; 2008) specially noted a large population at Nikolaevsk-na-Amure, while *S. schmidtii* has not been reported from that locality.

So, *S. schmidtii*, as a specialised potamic species, tends to exclude *S. postocularis* from the Amur River (and its Amurskaya arm), but this exclusion is not complete and populations of the latter exist along this major river.

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