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International Dragonfly Fund - Report

Journal of the International Dragonfly Fund

1 - 43

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Published: 12.06.2017

45 - 57

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Published: 13.06.2017

107

ISSN 1435-3393

The International Dragonfly Fund (IDF) is a scientific society founded in 1996 for the improvement of odonatological knowledge and the protection of species.
Internet: http://www.dragonflyfund.org/

This series intends to publish studies promoted by IDF and to facilitate cost-efficient and rapid dissemination of odonatological data..

Editorial Work:	Milen Marinov, Martin Schorr, Matti Hämäläinen, Jan van Tol, Malte Seehausen
Layout:	Martin Schorr
IDF-home page:	Holger Hunger
Printing:	Colour Connection GmbH, Frankfurt
Impressum:	Publisher: International Dragonfly Fund e.V., Schulstr. 7B, 54314 Zerf, Germany. E-mail: oestlap@online.de
Responsible editor:	Martin Schorr

Cover picture:	***Sympetrum sanguineum***
Photographer:	Oleg E. Kosterin

Published 12.06.2017

Odonata found in mid-summer 2015 and 2016 at the north-westernmost Black Sea Coast of the Caucasus, with the first record of *Cordulegaster picta* Selys, 1854 in Russian Federation

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Abstract

Results are presented of brief odonatological examination of the Black Sea coastal northwesternmost spurs of the Caucasus between Anapa and Gelendzhik (mostly at Kabardinka village), Russia, in late July/early August 2015 and early-mid July 2016. In total, 28 Odonata species were found, including *Cordulegaster picta* for the first time in Russia. For *C. picta* and *Caliaeschna microstigma*, the world's northernmost records were made. New localities of species rare in this area are reported: one for *Coenagrion scitulum* and three for *Selysiothemis nigra*, including their breeding habitat. Numerous migrant individuals of *Pantala flavescens* were observed in many localities in 2015 but none in 2016. Observations on trophic activity of *Aeshna affinis* and *A. mixta* are reported, the former showing predominantly matutinal and vespertinal activity and the latter diurnal activity. Occurrence of the *Chalcolestes* spp. in the Caucasus is discussed.

Key words: Russia, new country record, the West Caucasus, Black Sea coast, Krasnodarskiy Kray, Odonata, *Chalcolestes parvidens*, *Chalcolestes viridis*, *Coenagrion scitulum*, *Caliaeschna microstigma*, *Cordulegaster* picta, *Selysiothemis nigra*, *Pantala flavescens*, trophic swarming flight, crepuscular activity, matutinal activity, vespertinal activity.

Introduction

The Caucasus is a mountainous region between the Black and Caspian Seas and also between Europe and Asia. It is formed by two main subparallel and sublatitudinal mountain systems of the Great and Lesser Caucasus, each containing many secondary mountain ranges. The conventional border between Europe and Asia is drown either along the crest of the Great Caucasus or, alternatively, along the Kuma-Manych Depression along its northern foot in place of the antient straigt between

the two above mentioned region including Transcaucasia. The fauna of Odonata of the Caucasus in general, assessed by Belyshev et al. (1989), Ketenchiev & Haritonov (1998), Skvortsov (2010) and Boudot & Kalkman (2015), is rather well but very unevenly studied. The total amount of species recorded cannot be provided here because of some uncertainty of the conventional borders of the Caucasus per se and the Caucasian region. The above cited sources concerned larger territories, except for the guide of Ketenchiev & Haritonov (1998) devoted specifically to the Caucasian. Belyshev et al. (1989) counted 80 species and Ketenchiev & Haritonov (1998) - 82 species in the Caucaisan region.

The western part of the Great Caucasus stretched along the Black Sea Coast is concentionally called West Caucasus. Its part in the territory of Russia, namely in its Krasnodarskiy Kray Province, is still insufficiently studied, if to compare e.g. with Georgia neighbouring in the east (Schröter et al. 2015; Seehausen et al. 2016). In the very beginning of XX century it was intensively studied by a prominent Russian odonatologist A. N. Bartenev who published quite a number of papers and summarised the existing knowledge (mostly his own data but also those by A. Brauner and Y.M. Kolosov) on the dragonflies and damselflies of West Caucasus in a fairly large (138 pages, 3 tables and 2 maps) synopsys (Bartenev, 1930). Since that only scarce additional data from Krasnodarskiy Kray were published.

After Bartenev (1930) no further data seem to have been published for his conventional 'Novorossiysk District' which included the present Anapa, Novorossiysk and Gelendzhik Municipalities and Tuapse District of Krasnodarskiy Kray, situated, from the west to the east, along the Black Sea coast southerly of the Great Caucasus (being still very small mountains there). Although formally at the Asian side of the Great Caucasus, this area is important for consideration of the Odonata fauna of Europe. Bartenev (1930) reported for this westernmost coastal conventional district 27 odonate species reliably and 2 putatively. It was not excluded that for more than eighty years passed the climate and hence fauna of this district could somewhat change.

On July 27 – August 2, 2015 the first author, O.K. had a trip to the northernmost Caucasian Black Sea coast, visiting Anapa, Novorossiysk and Gelendzhik Municialities of Krasnodarskiy Kray, Russia. The main goal of the trip was to find wild pea (*Pisum sativum L.* subsp. *elatius* (Bieb.) Schmalh.), for until present the world germplasm collections miss any accessions of wild peas from the Russian part of the Caucasus; this goal failed. Odonata were not among the goals of that trip, and no stagnant water body was visited. Nevertheless, even unintentionally, some interesting enough Odonata were encountered while searching for wild peas. This motivated revisiting the same area in July 4-10, 2016. Most of the data came from environs of the village of Kabardinka (not to confuse with Kabardino-Balkarskaya Autonomous Province), with additions from other localities. Only two stagnant water bodies were examined, both situated at the Abrau Peninsula: the huge Lake Abrau and the small Lake Krugloe, the former very poor and the latter very rich in Odonata.

Materials and Methods

The area

The area visited is situated at the northernmost tip of the main range of the Great Caucasus, already low there (400-800 m a.s.l.). The Adegoy and Aderbiy Rivers separate it from the parallel Markotkh Range (up to 762 m a.s.l., to 350 m near Kabardinka) stretching from north-west to south-east along the Black Sea coast, with quite a steep coastal slope. Two additional coastal massifs (once a contiguous range, with its central part submerged to form the gate of the Tsimesskaya Harbour), the Navagir Range (up to 549 m a.s.l.) forming (together with the smaller Kuznya Range) the Abrau Peninsula, and the Doob Mt. (452 m), enclose two harbours, the larger Tsimesskaya Harbour in the north-west and the smaller Gelendzhik Harbour in south east. The Tsimesskaya Harbour, where the city and port of Novorossiysk and the village of Kabardinka are situated, is closed from the west by the Navagir Range, with a very steep coastal slope, while the Doob Kape massif separates the two harbours.

The Tsimesskaya Harbour is the driest place over the Caucasian coast, with the climate resembling that of the southern coast of Crimea and perfectly Mediterranean biota. For this reason, quite an area of the lower hill slopes is occupied by dry, almost grassless pure juniper forests formed mostly by *Juniperus excelsa* Bieb. with participation of *J. foetidissima* Willd. and *J. oxycedrus L.* s.l. (*J. rufescens* s. srt.). These forests range from Bol'shoy Utrish in the north-west to Gelendzhik in the south-east. The juniper forests alternate with dry juniper/downy oak (*Quercus pubescens* Willd.)/pistachio (*Pistacia vera* L.)/smoketree (*Cotinus coggygria* Scop.) parkland, downy oak/hornbeam (*Carpinus orientalis* Miller) thickets (local "sheblyak") and vast planted stands of the Pitsunda pine (*Pinus pithyusa* Stev.); the lowest foothills are covered with sparse dry Christ's thorn (*Paliurus spina-christi* Mill.) shrubbery. Humidity of the slopes increases with elevation so that gentler slopes became occupied by rich herbaceous meadows and oak/pine (*Pinus sosnovskyi* Nakai)/ash (*Fraxinus excelsior* L.) groves, while tall oak (*Quercus robur L.* s.l.)/beech (*Fagus orientalis* Lipsky)/maple/elm (*Ulmus caprinifolia* Rupr. ex Suczkov) forests appear in valleys. The small flat areas north-east of Kabardinka are wastelands in place of former vineyards, with wines still growing among ruderal vegetation.

The mountains in this area are formed by limestone and mergel, providing the extensive concrete production at Novorossiysk (which is also the main Black Sea port of Russia). Because of this rock, the rivulets descend from them to the sea over limestone beds in rather narrow, not easily permeable gorges, locally called 'shchel' (Russ. 'crevice'), overgrown with trees, bushes and thorny vines, mostly prickly-ivy (*Smilax excelsa* L.) and blackberry (*Rubus caesius L.* s.l.).

The Navagir Range closing the Tsimesskaya Harbour from the north has a moister climate and hence there is less juniper forest and more hornbeam and oak forests. The depression of large Lake Abrau is clad with oak/beach forests.

The valley between the Markotkh Range and Great Caucasus is totally covered by thick, dark and even beech forest with participation of other tall trees. The Adegoy River is clear and cold, partly shaded by forest.

At the season of O.K.'s visits, there were abundant and diverse Orthoptera and cicadas, medium amount and diversity of butterflies and surprisingly scarce Diptera. This area attracts immense number of tourists (although Kabardinka was still calm and peaceful when O.K. visited it in 1974 and even in 1990) so that the coast is a vast chain of resorts, entertainment promenades and unbelievably overcrowded stony beaches at the fairly cold sea (Fig. 1b), which contrasted to the absolutely and fortunately desolate hill slopes (Fig. 1a).

During the 2015 visit in late July/early August, the day temperatures were invariably over +30°C and sunshine was the predominating weather. In July 2016 the weather was the same temperature on July 4 but after a thunderstorm of July 5 changed to much cooler and windy on July 6-8.

Figure 1. The contrasts of Kabardinka: desolate mountains (the Krasnaya Shchel' valley, loc. 1, a habitat of *Calopteryx virgo, Platycnemis pennipes, Caliaeschna microstigma, Cordulegaster picta* and dispersed lentic species of Odonata), 30.07.3015 (a), and overcrowded beaches, 9.07.2016 (b).

Localities examined

Disposition of localities examined is shown in Fig. 2.

Figure 2. Disposition of localities examined in the area. For explanations of numerals see the text.

Figure 3. Lake Abrau (Loc. 4) as viewed from its SE bank, a putative habitat of *Ischnura elegans, Orthetrum albistylum*. 10.07.2016.

Anapa Municipality

Loc. 1. Sukko. The lowest reaches of a small river flowing in the housing estates of the town of Sukko, hidden under stripes of tall shady trees at banks; also low oak/hornbeam forest on a hill and its margins were examined. 44°47'18-57" N, 37°23'06"-24'30" E, 4-89 m a.s.l. 5.08.2015.

Loc. 2. Bol'shoy Utrish Nature Reserve. Open juniper/pistachio/downy oak/smoketree low forest above sea-faced cliffs, denser oak/hornbeam at flat surface, tall juniper stand at the steep mountain foot, with open cliffs and screes. 44°45'20-46" N, 37°23'12-55" E, 10-83 m a.s.l. 4.08.2015.

Novorossiysk Municipality

Loc. 3. Natukhaevskaya. A hill SE of Natukhaevskaya village, a part of the westernmost outpost of the Great Caucasus (464 m a.s.l.) and the northernmost outpost of the Mediterranean vegetation. Dry southern slope with rather sparse Christ's thorn/juniper shrubbery; northern slope covered with thick hornbeam/oak forest. 44°54'03-24", 37°34'47"-35'58" E, 60-158 m a.s.l. 3.08.2015, 5.08.2015.

Loc. 4. Abrau. S and E bank of Lake Abrau – a huge (3 x 1 km) lake, surrounded with woody mountains (Fig. 3), with clear warm water, a bottom of flat stones (with numerous small snails), barren banks with very scarce emergent rush (*Juncus* sp.) only at Abrau settlement. 44°41'06-32", 37°35'20"-36'00" E, 100 m a.s.l. 10.07.2016.

Figure 4. A small Lake Krugloe (Loc. 5), a habitat of *Coenagrion scitulum, Erythromma viridulum, Ischnura elegans, I. pumilio, Aeshna affinis, Anax imperator, A. parthenope, Crocothemis erythraea, Orthetrum albistylum, O. coerulescens, Selysiothemis nigra, Sympetrum meridionale, S. sanguineum*, 10.07.2016.

Loc. 5. Lake Krugloe. Remnants of a small lake in a lower part of intermontane valley, mostly destroyed and replaced with a large resort. The remnant is just 200 x 40 m, but with a very deep and clear water full of stonewort (Charales) and with sparse emergent vegetation over much of the surface, composed by *Typha angustifolia* L., *Butomus umbellatus* L., *Scirpus* sp. and some Poaceae (Fig. 4); large tadpoles in the water; the valley surrounded with woody mountain slopes. 44°40'34-40", 37°35'37-54' E, 72 m a.s.l. 10.07.2016.

Loc. 6. Ozereevka. Low downy oak/hornbeam/smoketree forest and patches of open juniper forest on the eastern mountain slope NW of Yuzhnaya Ozereevka village, tall oak/ash/hornbeam forest at the hill crest ending with a huge cliff to the Black Sea. (The Ozernaya River in the valley not studied.) 44°40'13-27", 37°35'28"-37'20" E, 21-248 m a.s.l. 10.07.2016.

Loc. 7. Sheskharis. The Sheskharis suburb of Novorossiysk at the cape of the same name. Very dry tall juniper forest, hornbeam thickets, ash groves on a southern slope above the housing estate, a dry open place on a slope ledge, with some water seeping from a pipe. 44°42'52-43'11", 37°40'53"-51'06" E, 73-140 m a.s.l. 10.07.2016.

Gelendzhik Municipality

Loc. 8. Adegoy. The Adegoy River (Fig. 5) in a valley between the parallel Markotkh and Great Caucasus Ranges; the river is ca 3 m wide, mostly ankle-deep with some knee-deep pools, the water clear and rather cool, with a considerable current speed,

Figure 5. The Adegoy River (Loc. 8), a habitat of *Calopteryx virgo, Sympecma fusca, Platycnemis pennipes, Onychogomphus forcipatus*, 7.07.2016.

Figure 6. The Krasnaya Shchel' valley (Loc. 9) with a small river being a habitat of *Calopteryx virgo, Platycnemis pennipes, Caliaeschna microstigma, Cordulegaster picta* and dispersed lentic species of Odonata. 4-6.07.2016.

Figure 7. The brook of the Tserkovnaya Shchel' valley (Loc. 12) in its lower reaches (a, 7.07.2016), habitats of *Calopteryx virgo, Platycnemis pennipes, Caliaeschna microstigma, Cordulegaster picta, Orthetrum coerulescens*, and the upper reaches (b, 28.07.2015), where dispersed males of *C. virgo* were observed.

banks formed by light-grey small boulders of rather rough shape, partly shaded by the beech forest; open shingle banks occupied by thickets of butterbur (*Petasites* sp.) with huge leaves. 44°43'13-16'', 37°57'33-38'' E, 183-187 m a.s.l. 7.07.2016.

Loc. 9. Krashaya Shchel' (Russ. 'Red Crevice') (Figs. 1a, 6). A small fast river with a shingle limestone bed, partly hidden under dense thickets of bushes (mostly blackberry), various grasses (including sedge, reed), fallen trees and thorny lianas of prickly-ivy (*Smilax excelsa* L.), in a considerable narrow woody gorge (mostly oak, also poplar (*Populus alba* L.), linden (*Tilia caucasica* Rupr.), maple (*Acer* sp.), willows (*Salix* sp.), ash, in the upper part elm and beech appear), bordered by hornbeam thickets and crossing hill slopes clad with pure juniper forest. In upper reaches the gorge becomes deep and narrow and the forest change to tall oak/beech/maple/elm. 44°39'55"-40'48" N, 37°55'04-39" E, 24-180 m a.s.l. 29-30.07.2015, 4.07.2016, 6.07.2016.

Loc. 10. Kastal'skaya Shchel'. A rivulet in a deep shady gorge clad with hornbeam thickets, with a large artificial pond (the so-called 'trout farm'); upstream of which the stream soon disappears in its half-open limestone shingly bed, leaving several clear pools. 44°39'35-47", 37°55'14-28" E, 16-36 m a.s.l. 30.07.2015.

Loc. 11. Mountain slopes above the village of Kabardinka, rather steep, covered with a planted pine forest in their lower parts, open downy oak/juniper parkland on crests and oak/hornbeam thickets in valleys. 44°39'07-40'32", 37°56'51-58'30" E, 16-60 m a.s.l. 27-28.07.2015, 4.07.2016, 6.07.2016.

Loc. 12. Tserkovnaya Shchel (Russ. 'Church Crevice') (Fig. 7). A small brook, about 0.5 m wide, in a gorge in rather steep foothills above Kabardinka, with a rocky limestone bed, temporarily dry above (Fig. 7b) and with a weak stream below, mostly hidden under trees or blackberry thickets, with an open pond in its lower part. Most of the water of the lower reaches (Fig. 7a) comes from wooden pipes which receive waters of three secondary gorges. 44°39'13-47", 37°57'08-41" E, 62-175 m a.s.l. 28.07.2015, 7.07.2016, 9.07.2016.

Loc. 13. Shady oak/hornbeam/dogwood thickets at the base of a small, temporarily dry valley in the foothills. 44°39'01-12", 37°58'14-22" E, 103-127 m a.s.l. 1.08.2015.

Loc. 14. The Doob River at its lowermost reaches (Fig. 8). A rocky limestone bed (barren rock or shingle), devoid of vegetation but scarce and small reed patches, with pools of different size. These are very cold, obviously because of ground springs, and connected with a small stream in the upper part at the road, small, clear, warmer and isolated in the middle part and large, warm, dirty and full of slime algae, again connected with a narrow stream in the lower part. There are a lot of frogs, bombinas and grass snakes in the lower pools, while at banks of middle and upper part turtles (Testudo graeca nikolskii Chkhikvadze et Tuniyev, 1986) are common. The barren limestone bed is surrounded by bushes and stripes of forest, generally crossing steppe-like wasting land. 44°38'26-53", 37°55'55"-57'58" E, 4-60 m a.s.l. 1-2.08.2015, 9.07.2016.

Loc. 15. Doob Cape. Western slopes of a large hill protruding to the sea, mostly covered with planted pine and also by tall beach/oak forest in valleys and hornbeam/downy oak thickets on slopes; some dry grassy glades with Christ's thorn. 44°37'38-49", 37°54'-56" E, 0-247 m a.s.l.5.07.2016.

Loc. 16. Maryina Roshcha. The hillside cemetery of Maryina Roshcha village, planted pine forest and hornbeam/downy oak thickets at the southern mountain slope above, meadows and ash groves in its upper part; two artificial trout ponds in a gorge nearby

Figure 8. The Doob River lowermost reaches (Loc. 14), a habitat of *Calopteryx splendens, C. virgo, Platycnemis pennipes, Orthetrum albistylum, O. coerulescens, Sympetrum pedemontanum*. (9.07.2016 above, 2.08.2015 below).

(these were not examined). 44°36'34"-37'32", 38°01'56"-04'26" E, 140-757 m a.s.l. 8.07.2016.

Methods

Well recognisable common species were recorded by the first author by sight; voucher specimens or small series of other species were collected, treated overnight in acetone and preserved on cotton layers with paper covers. Coordinates were recorded by Garmine eTrex H personal GPS navigator; ranges for the areas actually examined and elevations above sea level were revised using Google Earth. The dates are given below in the dd.mm.year format.

Odonata were photographed in purely natural conditions, in some cases also in hand, using Olympus Camedia C8080, Pentax WG10 and Canon EOS 350D cameras, the latter with Sigma 24-70 mm lens. The photos or specimen details were prepared from serial photographs obtained via lens Zeiss Stemi 2000-C with digital camera Canon PowerShot A640. Images with broad focus zones were obtained from serial photos with shifted focus using the software Helicon Focus 6.0.

DNA was kindly extracted by Anatoly V. Mglinets from a hind leg of a *Cordulegaster* female collected in 2015 following a protocol as described by Solovyev et al. (2015). Further molecular analysis was carried out by V.S. A fragment of the mitochondrial COI gene was amplified using the Eva and Barbara primers (Simon et al. 1994). PCR mixtures (30 µl) contained 0.2 mM of each dNTP, 1.5 mM MgCl2, 25mM KCl, 60 mM Tris-HCl (pH 8.5), 10 mM β-mercaptoethanol, 0.1% Triton X-100, 0.5 µM of each primer, 1 µl of genomic DNA solution and 1 U of Taq DNA polymerase or 1 U of Smart-Taq DNA Polymerase (by Laboratory Medigen, Novosibirsk, Russia). PCR was performed using a thermal cycler MyCycler (Bio-Rad, USA) with the following regime: 1) primary denaturation: 94 °C — 2 min 30 s, 1 cycle; 2) denaturation: 95 °C — 15 s, annealing: 47–55 °C — 30 s, elongation: 68 °C — 1 min, 35 cycles; 3) final elongation: 68 °C — 2 min, 1 cycle. The fragment was sequenced from the Eva primer for ca 520 base pairs. Sanger reaction was conducted in 30 µl volume of mixture containing 1 µl of BigDye Terminator, version 3.1 (Applied Biosystems), 100–200 ng of DNA, 3 pmol of primers and 6 µl of buffer solution for BigDye 3.1, with the following regime: 95 °C — 45 s, 50 °C — 30 s, 60 °C — 4 min; 26 cycles. Sequencing was made at the SB RAS Genomic Core Facility, Novosibirsk. The sequence obtained was submitted to European Nucleotide Archive (ENA) and received the accession number LT715983. It overlapped for 375 base pairs (corresponding to positions 1743-2117 of the reference sequence of *Drosophila yakuba* Burla, 1954) with fragments of the same gene sequenced by Froufe et al. (2014) and contained in public databases. This section of our sequence was compared with that of the following sequences by Froufe et al. (2014): gi|566082219|gb|KF584944.1, Coedulegaster *picta* Selys, 1854 from Greece; gi|566082211|gb|KF584940.1, *Cordulegaster heros pelionensis* Theischinger, 1979 from Greece; gi|566082199|gb|KF584934.1, *Cordulegaster* boltonii (Donovan, 1867) from Italy. Sequence alignment and calculation of simple p-distance were performed using MEGA 5.0 software package (Tamura et al. 2011).

Results

Odonata species recorded

Calopteryx splendens (Harris, 1780)

Loc. 14: 1.08.2015: 2 ♂♂, 2 ♀♀ collected, many seen; 9.07.2016: many ♂♂, ♀♀ seen

Remarks. Males have the dark wingspot starting at the level of node with a slightly uneven and somewhat indistinct inner border and extending almost to the wingtips, leaving transparent only a narrow (not more than 1 mm) hardly noticeable rim of 4-8 cells (Fig. 9). They seem to represent a transition from the nominotypical subspecies to *C. splendens intermedia* Selys, 1887, with the spot with an even inner border and occupying the wing tips entirely. In the Caucasus, there seems to be a cline from the former in the west to the latter in the east (Schröter et al. 2015).

Observations. Appeared among the next species but only at the lowermost Doob River reaches, with more but dirtier water.

Figure 9. Male specimens of *Calopteryx splendens* from the Doob River (Loc. 14), 1.08.2015.

Calopteryx virgo ssp.

Loc. 8: several ♂♂, ♀♀ seen. **Loc. 9:** 4.07.2016: several ♂♂ seen. **Loc. 10:** 2 ♂♂, 1 ♀ collected, 1 ♀ photographed. **Loc. 12:** 28.07.2015: 2 ♂♂ photographed (Fig. 11b); 7.07.2016 - many ♂♂, ♀♀ seen, 2 ♀♀ photographed (Fig. 12a,c-d). **Loc. 14:** 1.08.2015: many ♂♂, ♀♀ seen, 1 ♂ (Fig. 11a), 1 ♀ collected, 1 ♀ photographed; 9.07.2016: many ♂♂, ♀♀ seen, 2 ♀♀ photographed (Fig. 12b).

Remarks. Females had the distal one third of the hind wing dark brownish; males had the underside of S10 and of the cerci bases whitish. These characters used to be associated with an unavailable name feminalis Bartenev, 1910 (Bartenev 1910; 1930; Kalkman 2006), as discussed in Schröter et al., 2015). This taxonomical case will be further considered in a separate communication.

Observations. Found at any small stream or river, including the Adegoy River flowing through thick beech forest; a male was observed even at a temporarily completely dry rocky bed in the upper part of Tserkovnaya Shchel' valley (Loc.12).

? *Chalcolestes* sp.)

Loc. 9: 30.07:2015: 1 individual seen.

Observations. That green lestid was seen in a dense patch of reed interspersed by blackberry vines. O.K. failed to catch it but occurrence at flowing water in a woody valley in Europe suggests a representative of *Chalcolestes* Kennedy, 1920. In 2016 I thoroughly searched the same and other localities but failed to find a single specimen.

Chalcolestes parvidens (Artobolevskij, 1929) is the most probable option in this region. Ketenchiev & Haritonov (1998) reported for the Caucasian region only one representative of *Chalcolestes* (which they mentioned but did not accept as a genus), as *Lestes viridis parvidens*. Also Skvortsov (2010) claimed that all records of '*Lestes viridis*' from the former U.S.S.R. probably referred to *C. parvidens*, originally described as a subspecies of *L. viridis* (Vander Linden, 1825). Indeed, *C. parvidens* ranges from Corse (France) to Aserbaijan and Israel and is reliably known from several localities in Crimea (from where it was described) and Georgia (Boudot & Dyatlova 2015; Schröter et al., 2015), that is immediately to the west and to the east of the Russian part of the Caucasus. At the same time, *C. viridis* is widespread in Western and Central Europe but rare in Eastern Europe, e.g. Bulgaria, Romania and Ukraine (Boudot & Villigalla 2015). The closest to Kabardinka reliable record of the true *C. viridis* is at Yampil village near Severskiy Donets in the eastern Ukraine (Martynov 2010; Boudot & Villigalla 2015) which is too far, 520 km, and across the Azov Sea.

The recent 'Atlas of the European Dragonflies and Damselflies' (Boudot & Kalkman 2015) still contain some confusion concerning the two *Chalcolestes* species in the Caucasus. For both *C. parvidens* (Boudot & Dyatlova 2015) and *C. viridis* (Boudot & Villigalla 2015), the only and the same locality is indicated in the territory of Russian Federation, at about the middle of the part of the Caucasus along the Russian section of the Black Sea coast. It is uncommented for *C. viridis* (Boudot & Villigalla 2015), while the text for *C. parvidens* just says "Only one record is avail-

able between Ukraine and the Caucasus range" (Boudot & Dyatlova 2015: p. 52), althouth the dot indicated was by no means 'between the Ukraine and the Caucasis range" but well in the mountains of the Caucasus. Jean-Pierre Boudot (pers. comm.) kindly informed me that this was an erroneous duplication of the record of '*Lestes viridis*' for Goryachiy Klyuch by Bartenev (1910), once presented under the original identification and the second time as interpreted by Skvortsov (2010).

It should be noted that in his later paper, Bartenev (1930) reported already four localities of '*L. viridis*' for the West Caucasus, at Goryachiy Klyuch, Maikop, Sochi and Adler. These records were missed from the 'Atlas' (Boudot & Kalkman 2015). Interpretation of Bartenev's Caucasian records of '*L. viridis*' as *C. parvidens* (Ketenchiev & Haritonov 1998; Skvortsov, 2010) is natural: it should be taken into account that '*Lestes viridis parvidens*' was described in 1929 (Artobolevskij 1929), that is 19 years after Bartenev (1910) and most probably when the preparation for publication of the text of Bartenev (1930) was already completed. Unfortunately, almost all Bartenev's specimens were lost (Medvedev et al. 2013) and cannot be reexamined. This is a pity that I failed to catch the Kabardinka specimen.

Sympecma fusca (Vander Linden, 1820)

Loc. 2: 1 ♂ photographed (Fig. 10). **Loc. 4.** several ind. seen. **Loc. 6:** many ind. seen. **Loc. 7:** several ind, seen. **Loc. 8:** 1 ind. seen. **Loc. 11:** 27.07.2015: 1 ♂, 1 ♀ collected, 1 more ind. seen; 28.07.2-15: 1 ind. seen. **Loc. 9:** 6.07.2016: 1 ♂ seen; **Loc. 14:** 9.07.2016: many ind. seen; **Loc. 15:** quite many ind. seen. **Loc. 16:** many ind. seen.

Observations. Individuals of this species occurred on dispersal on hill slopes regardless the actual environments, in grass of open places, among shrubbery and in forests. They appeared especially numerous in the ash belt at the upper part of the slope above Maryina Roshcha, occurring at the meadowy margins of ash groves.

Figure 10. Male of *Sympecma fusca* in a low oak forest at Bol'shoy Utrish (Loc. 2), 4.08.2015.

Coenagrion scitulum (Rambur, 1842)

Loc. 5: 1 ♂ collected, 1 more ♂ seen.

Remarks. Bartenev (1930) did not report this species for West Caucasus at all; Ketenchiev & Haritonov (1998) characterised it as local in the Caucasus.

Observations. Found, as scarce, in emergent vegetation of Lake Krugloe.

Erythromma viridulum Charpentier, 1840

Loc. 5: 1 ♂ collected, 1 tandem seen.

Observations. Found in emergent vegetation of Lake Krugloe.

Ischnura elegans Vander Linden, 1820

Loc. 4: 2 ♂♂ seen. **Loc. 5:** very many ♂♂, ♀♀ seen, 2 ♂♂, 2 ♀♀ collected. **Loc. 7:** 1 ♂ seen. **Loc. 9:** 4.07.2016: 1 ♂ collected

Observations. Very numerous at grassy banks, less in emergent vegetation at the breeding place of Lake Krugloe. Singular specimens found at large Lake Abrau, in the Krashaya Shchel' valley and on a juniper branch in a juniper open stand on a slope above Sheskharis most probably dispersed from elsewhere.

Figure 11. Female of *Platycnemis pennipes* at a brook at Kastal'skaya Shchel' valley (Loc. 10), 31.07.2015.

Ischnura pumilio (Charpentier, 1825)

Loc. 5: 1 ♂ collected.

Observations. A male collected above the water surface in emergent vegetation of Lake Krugloe, among more numerous individuals of the previous species.

Platycnemis pennipes pennipes (Pallas, 1771)

Loc. 8: several ♂♂, ♀♀ seen. **Loc. 9:** 4.07.2016: several ♂♂, ♀♀ seen. **Loc. 10:** 2 ♂♂, 3 ♀♀ collected, 2 ♂♂, 1 ♀ (Fig. 11) photographed, many ♂♂, ♀♀ seen. **Loc. 14:** 1.08.2015: many ♂♂, ♀♀ seen; 14: 9.07.2016: many ♂♂, ♀♀ seen, 1 tandem photographed. **Loc. 16:** 2 ♂♂ (at the slope foot).

Observations. Common rheophylic species found at minor rivulets, including partly disappearing in their stony beds (Loc. 10, 14); for some reason not found at the Tserkovyana Shchel' valley (Loc. 12).

Aeshna affinis Vander Linden, 1820

Loc. 5: 1 ♂ captured and released, 2 more ♂♂ seen. **Loc. 9:** 30.07:2015: 1 ♂ collected; 4.07.2016: extremely numerous ♂♂, ♀♀ seen, 1 ♂, 1 ♀ collected, a swarm photographed; 6.07.2016: 2 ind. seen. **Loc. 11:** 4.06.2016: ca 15 dead specimens of both sexes on the road killed by traffic examined. 2 ♀♀ collected; 6.06.2016: 1 ♂ captured and released. **Loc. 12:** 7.07.2016: very numerous ♂♂, ♀♀ seen; 9.07.2016: many ♂♂, ♀♀ seen, 1 ♂, 1 ♀ captured and released. **Loc. 14** (a woody slope): 9.07.2016 – several seen, 1 ♂ photographed (Fig. 12). **Loc. 15:** 1 ♂ captured and released.

Observations. See the section 'Aeshnid trophic activity' below.

Figure 12. Male of *Aeshna affinis* at the Doob River valley (Loc. 14), 9.07.2016.

Aeshna mixta (Linnaeus, 1758)

Loc. 6: extremely numerous, 1 ♂ (Fig. 13b) and a swarm photographed. **Loc. 7:** many ind. seen. **Loc. 9:** 4.07.2016: many ♂♂, ♀♀ seen, 1 ♂, 1 ♀ collected; 6.07.2016: very many ♂♂, ♀♀ seen, 1 ♂ photographed. **Loc. 12:** 7.07.2016: many ind. seen. **Loc. 13:** 1 ♀ photographed (Fig. 14) and collected. Loc. 14 (a woody slope): many ♂♂, ♀♀ seen, several captured and released, or photographed. **Loc. 15:** many ♂♂, ♀♀ seen, 3 captured and released, 4 ♂♂ photographed (Fig. 13a). **Loc. 16:** many seen, 1 ♂ photographed.

Observations. See the section 'Aeshnid trophic activity' below.

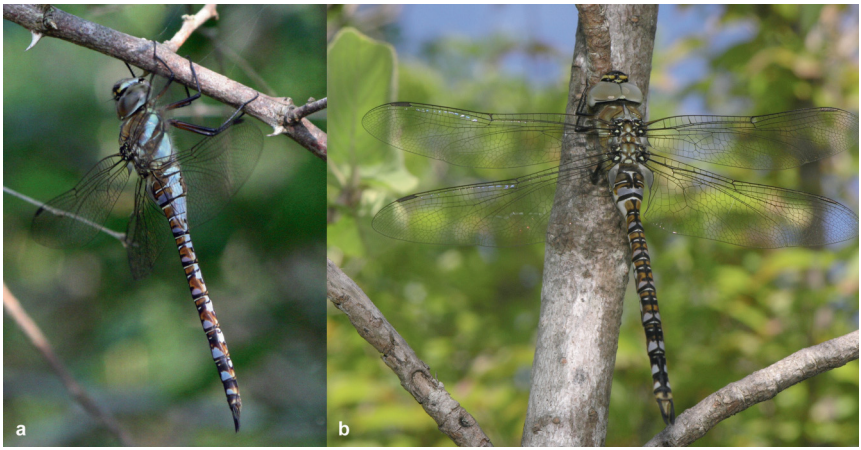


Figure 13. Males of *Aeshna mixta* on hill slopes of Doob Cape (Loc. 15), 6.07.2016 (a) and at Yuzhnaya Ozereevka village, 10.07.2016 (Loc. 6) (b).

Figure 14. Female of *Aeshna mixta* at Loc. 13, 1.08.2015.

Anax imperator Leach, 1815

Loc. 5: 1 ♂, 1 ♀ collected. **Loc. 11:** 27-28.07.2015: several ♂♂ seen. **Loc. 16:** several ♂♂ seen.

Observations. A male with worn out wings ranged among emerging vegetation above the surface of Lake Krugloe, a female also flew there with the abdomen curved, perhaps after oviposition. Solitary males were observed passing by above ridges of the mountain slopes above Kabardinka (visual identification not so certain) and Maryina Roshcha (visual identification doubtless).

Anax parthenope parthenope Selys, 1839

Loc. 5: several ♂♂ seen, 1 ♂ collected. **Loc. 10:** 1 ♂ seen. **Loc. 11:** 1 ♀ collected (roadkill). **Loc. 13:** 1 ♀ photographed (Fig. 15), 2 more seen.

Observations. Several males ranged steadily among sparse emergent vegetation above the surface of Lake Krugloe. A male patrolled a large pond at the Kastal'skaya Shchel'. Both those territorial males were observed at midday. A still alive female bumped by traffic was found at dusk on the road between Kabardinka and foothills (along with many roadkilled *A. affinis*).

Figure 15. Female of *Anax parthenope* at Loc. 13, 1.08.2015.

Caliaeschna microstigma (Schneider, 1845)

Loc. 9: 29.07:2015: 2 ♂♂ collected, several seen; 30.07.2015 - 2 ♂♂ seen; 4.07.2016: 2 ♂♂, 1 ♀ collected, 1 ♂ photographed (Fig. 16), several ♂♂ seen; 6.07.2016: 2 ♂♂ seen. **Loc. 12:** 7.07.2016 –2 ♂♂ seen, 2 ♀♀ collected; 9.07:2016: 1 ♂, 1 ♀ collected, 1 more ♂ seen.

Figure 16. Male of *Caliaeschna microstigma* resting in shade of a bluff the rivulet in the Krasnaya Shchel' valley (Loc. 9), 4.07.2016.

Figure 17. Shaded reaches of the rivulet in the Krasnaya Shchel' valley (Loc. 9) preferred by *Caliaeschna microstigma* and also inhabited by *Cordulegaster picta*, 30-31.07.2015.

Observations. Males patrolled the rivulets in the Krasnaya Shchel' (Loc. 9, Fig. 17) and Tserkovnaya Shchel' (Loc. 12, Fig. 7a) valleys, flying fast immediately above the water along its course, partly hidden by herbage and shrubbery growing at the banks. They easily penetrated into tangled branches and were hard to follow by sight. They were active all the day, but at sunny weather flew only over shaded stream sections, and both sexes could be startled from shaded bush twigs, bluffs, or roots hanging from shady bluffs (Fig. 16). In dusk, males appeared more active, e.g. at Loc. 9 on 29-30.07:2015 and at Tserkovnaya Shchel' (Loc. 12) on 7 and 9.07.2016. On both 7 and 9.07.2016 at the latter date and locality, three females in sum were flying (at 19:55-20:07) low above the nearby road section.
Interestingly, at the same Loc. 9, O.K. observed many individuals of both sexes on 4.07.2016 but only two males on 6.07.2016. The former day was hot, the latter rather cool, that suggests a strong dependence of *C. microstigma* activity on temperature (which, unfortunately, was not measured).

Cordulegaster picta Selys, 1954

Loc. 9: 30.07.2015: 1 ♀ collected (Fig. 18); 4.07.2016: not less than 3 ♂♂ seen; 6.07.2016: 2 ♂♂ collected, 1 ♂ photographed (Fig. 19), 2 more ♂♂ seen. **Loc. 12:** 7.07.2016: 2 ♂♂ collected, 1 more ♂ seen.

Figure 18. Female of *Cordulegaster picta* collected in the Krasnaya Shchel' valley (Loc. 9) on 30.07.2015.

Remarks. Identification of males is doubtless as based on the shape of the anal appendages (Theischinger 1979): long (as S10) strongly divaricate cerci, slightly turned along their axes subapically (an important character!), in dorsal view not touching each other and not showing the medioventral teeth, in lateral view thin but looking inflating before the apex (because of the turn); a thick, truncated epiproct with a very robust double dorsal tooth (Fig. 20). The colorational characters of the female, which was collected in 2015, were rather misleading with respect to specific cha-

racters given by Van Pelt (2006) in the 'Field Guide to the Dragonflies of Britain and Europe'. It had the occipital triangle entirely yellow (as in *C. boltonii* (Donovan, 1807)), while presumed (Van Pelt 2006) to be predominantly black in *C. picta*. Its light dorsal

Figure 19. Male of *Cordulegaster picta* perching at the rivulet in the Krasnaya Shchel' valley (Loc. 9), 4.07.2016.

synthoracic stripes had strongly angulated dorsolateral corners (Fig. 21a) as in *C. heros* Theischinger, 1979 (with the angulation is even more expressed!) while said rounded in *C. picta* (Van Pelt 2006). In the four males collected, these corners are very slightly angulated in three (Fig. 21c-e) and blunt in one (Fig. 25b), while the occipital triangle has two separate yellow spots in two males and a united yellow spot in the other two males. However, Boudot (2014: p. 79) emphasised "the need to identify *Cordulegaster* species based on structural characters rather than on colour pattern alone as is often still done". Later Boudout et al. (2015: p. 219) extended that statement as follows: "*Cordulegaster picta* shows striking regional variation in the extent of its abdominal yellow spots ...[for instance] ... Populations from northwest Turkey resemble in colour pattern *C. boltonii* ... Specimens ... found in the eastern Rhodope ... can easily be confused with *C. heros*. The correct identification of any *Cordulegaster*, and especially *C. picta*,

Figure 20. Anal appendages of a male of *Cordulegaster picta* collected at the brook in the Tserkovnaya Shchel' valley (Loc. 12) on 7.07.2016: dorsal view (top), lateral view (middle), lateroventral view (bottom).

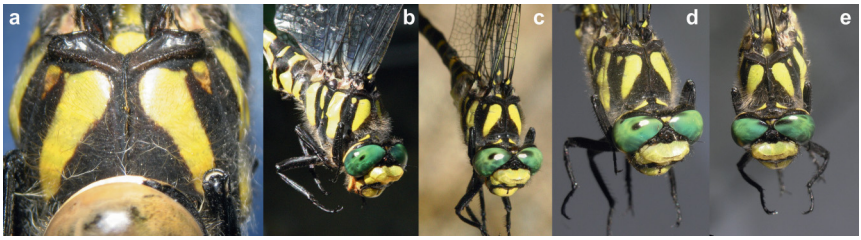


Figure 21. Front of synthorax of the five specimens, a female (a) and four males (b-e) of *Cordulegaster picta* collected at Krasnaya Shchel, Loc. 9 (a-c) and Tserkovnaya Shchel', Loc. 12 (d-e).

is therefore dependent on the examination of the terminal appendages rather than colour pattern".

Since species identity of the female specimen collected in 2015 was ambiguous, in the same year we attempted its molecular analysis. The 235 base pair long

mtCOI fragment overlapping with the sequences by Froufe et al. (2014) appeared to have only two substitutions (p = 1.31) as compared to the corresponding sequence of *C. picta* from Greece, but 21 substitutions (p = 4.53) as compared to *C. heros* pelionensis from Greece and 27 substitutions (p = 4.26) as compared to *C. boltonii* from Italy. So we identified the female as *C. picta*. In 2016, male specimens were obtained which confirmed the identification.

This is the first record of *C. picta* for the territory of Russian Federation and for the time being its northernmost record (see 'Discussion').

Observations. The species was found at lower parts of two streams in gorges (locally called shchel') dissecting the coastal foothills at the northern (Krasnaya Shchel', Loc. 9, Figs. 1a, 6, 15) and southern (Treskovnaya Shchel', Loc. 12, Fig.7 left) suburbs of Kabardinka. Both have limestone beds and are partly hidden under trees, bushes and lianas (blueberry and pricky-ivy), but that of Krasnaya Shchel' is a larger rivulet ca 2 km long (Fig. 6, 17), while that in Tserkovnaya Shchel is a short (ca 0.4 km) smaller brook (Fig. 7a) which gets its water mostly through wooden pipes from three secondary gorges above. At the former the males were scarce, on 4 and 6.07.2016 seemingly four (including those collected) were present for its whole length. At the latter, on the other hand, they were denser at so short a stream: on the early morning of 7.07.2016 for ten minutes (6:50-7:00, surely the time of the first appearing) O.K. collected two and observed a third one while standing at the same point.

Males ranged fast along the stream course some 20-70 cm above the water. At Loc. 9 they were repeatedly observed resting on sunlit dry branches (once on a green branch) above or near the water (with the abdomen inclined at ca 45°), never returned to the same one and were cautious. In the evening of 4.07.2016, at 17:50, a male was seen to land for a little while on a green branch at a road above the rivulet and immediately to proceed towards the tree crowns; most probably it was abandoning the breeding place to overnight apart.

The female was captured while slowly flying over the road going along the rivulet.

Onychogomphus forcipatus forcipatus (Linnaeus, 1758)

Loc.6: 1 ♂, 1 ♀ collected. **Loc. 5:** 1 teneral ♀ collected. **Loc. 8:** many ♂♂ seen, 1 ♂ collected, 1 ♂ photographed. **Loc. 14:** 1.08.2015: several ♂♂ seen, 2 ♂♂ collected, 1 ♂ photographed (Fig. 22a); 9.07.2016: many ♂♂ seen, 1 ♂ collected, 2 ♂♂ photographed (Fig. 22b).

Remarks. In all males collected, the subterminal dorsal projection of the epiproct arms is 1.5-2 times as long as thick that corresponds to the nominotypical subspecies rather than ssp. *albotibialis* Schmidt, 1954 (Kalkman 2006) which occurs in Georgia and other Transcaucasian countries, Turkey and Iran (Schröter et al. 2015; Boudot & Proess 2015).

Observations. Widespread over the territory, found commonly both at the Adegoy River surrounded by dense beech forest and at the Doob River flowing nearly

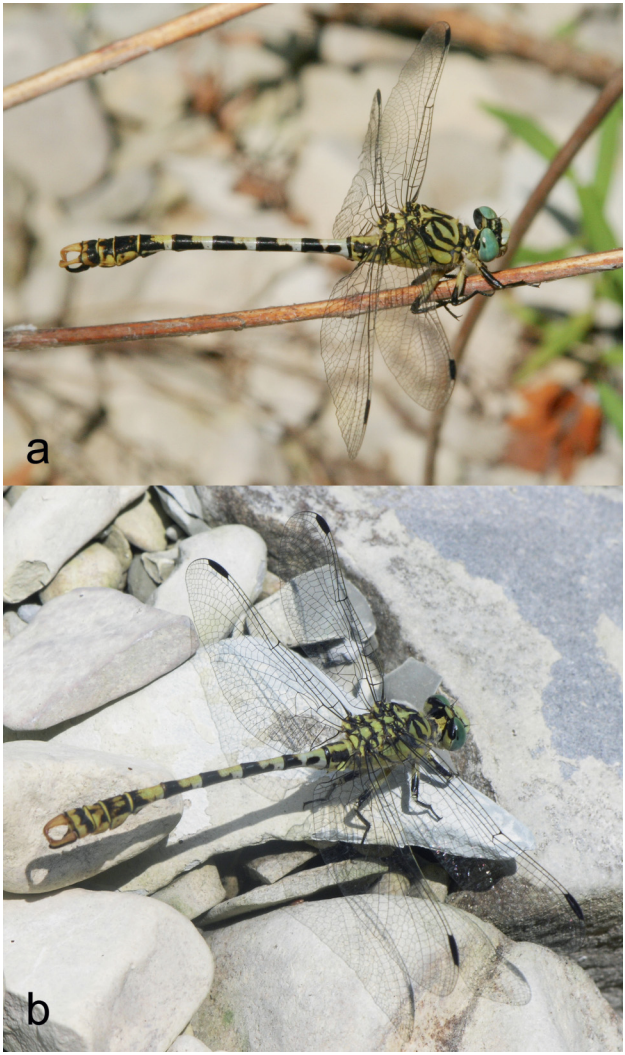


Figure 22. Males of *Onychogomphus forcipatus* at the Doob River lowermost reaches (Loc. 14) on 1.08.2015 (a) and 9.07.2016 (b).

openly to the sea; dispersed individuals found at slopes of the Ozernaya Rivulet valley with oak/hornbeam/juniper open stand. The status of a teneral female found at Lake Krugloe is unclear: there is no stream in that valley, on the other hand conditions of that cold and clear lake fed by ground water could correspond rather to a lotic than a lentic habitat.

The males perched on boulders (Fig. 22b), limestone rocky bed, or horizontal blueberry twigs (Fig. 22a).

Crocothemis erythraea (Brullé, 1832)

Loc. 5: 1 ♂, 1 ♀ collected, 1 more ♂ seen.

Observations. Found only at Lake Krugloe, being an open lentic water body preferred by the species.

Orthetrum albistylum (Selys, 1848)

Loc. 5: 1 ♂ collected, 2 more seen. **Loc. 4:** 1 ♂ seen. **Loc. 14:** 1.08.2015: 1 ♂ photographed (Fig. 23), 1 more seen. **Loc. 15:** 1 ♂ seen. **Loc. 16:** 1 ♂ seen.

Observations. Solitary males were found at lakes, pools of the dried out section of the limestone bed of the Doob River, and even at the Maryina Roshcha cemetery not far from the unvisited trout ponds.

Figure 23. Male of *Orthetrum albistylum* at a pool remained of the Doob River in its lowermost reaches (Loc. 14), 1.08.2015.

Orthetrum coerulescens anceps (Schneider, 1845)

Loc. 5: 2 ♂♂ collected, 1 ♀ seen. **Loc. 10:** 1 ♀ photographed. **Loc. 11:** 28.07.2015: 1 immature ♂ collected and photographed (Loc. 26c). **Loc. 12:** 28.07.2015: 1 ♂ collected, 1 ♂ photographed (Fig. 24a-b). **Loc. 14:** 1.08.2015: many ♂♂ seen. **Loc. 16:** 1 ♂ seen.

Observations. The species appeared abundant in the lowermost reach of the Doob River, with larger and dirtier pools. Two territorial males and a female kept

to a part of the Lake Krugloe bank with the water shallower and sedge denser, a territorial male was found at a brook of Tserkovnaya Shchel' at the foothills. Mature and immature males were met at dry roadside pine forest margins at hillside foots at Kabardinka (Fig. 24) and Maryina Roshcha.

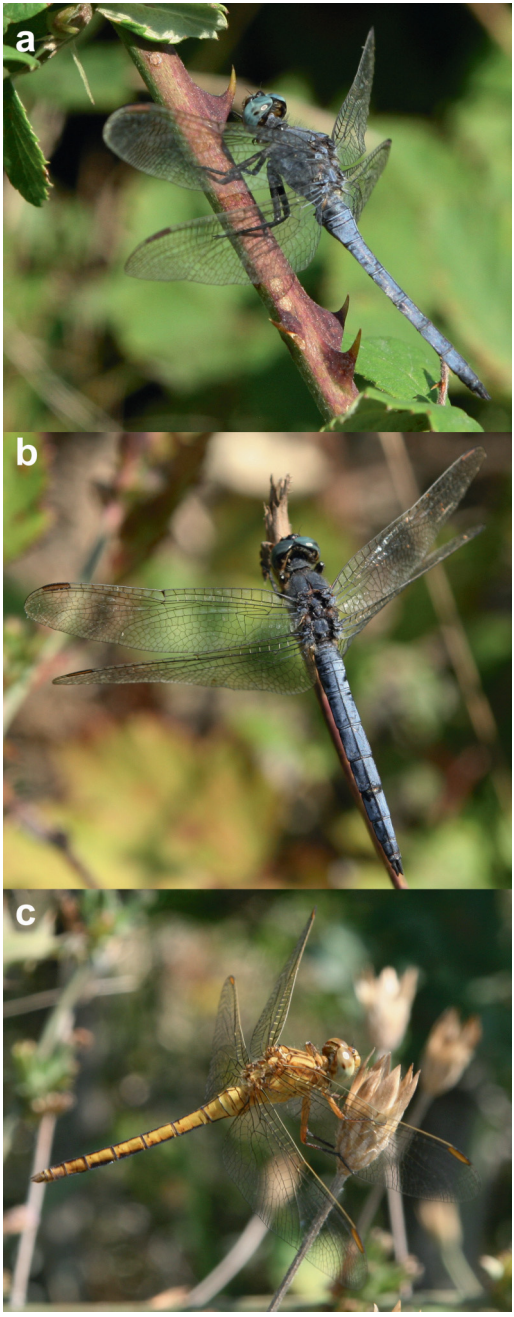


Figure 24. Mature (a-b) and immature (c) males of *Orthetrum coerulescens anceps* at the brook of Tserkovnaya Shchel' (Loc. 12) (a-b) and at a pine plantation edge at Kabardinka (Loc. 11), (c). 28.07.2015.

Orthetrum brunneum (Fonscolombe, 1837)

Loc. 9: 6.07.2016: 1 ♂ photographed, 1 ♀ collected. **Loc. 14:** 1.08.2015: 1 ♂ collected, 1 ♂ photographed (Fig. 25a), several seen; 9.07.2016: many ♂♂, several tandems and 2 ♀♀ seen, 1 ♂ collected, 1 copula photographed (Fig. 25b). **Loc. 16:** 1 ♂ seen.

Observations. Many territorial males, some tandems and females were found only at the Doob River lower reaches. A male and female were seen at different parts of the Krasyana Shchel' valley; a singular male was found, along with those of the two other *Orthetrum* species, at the foothills at Maryina Roshcha.

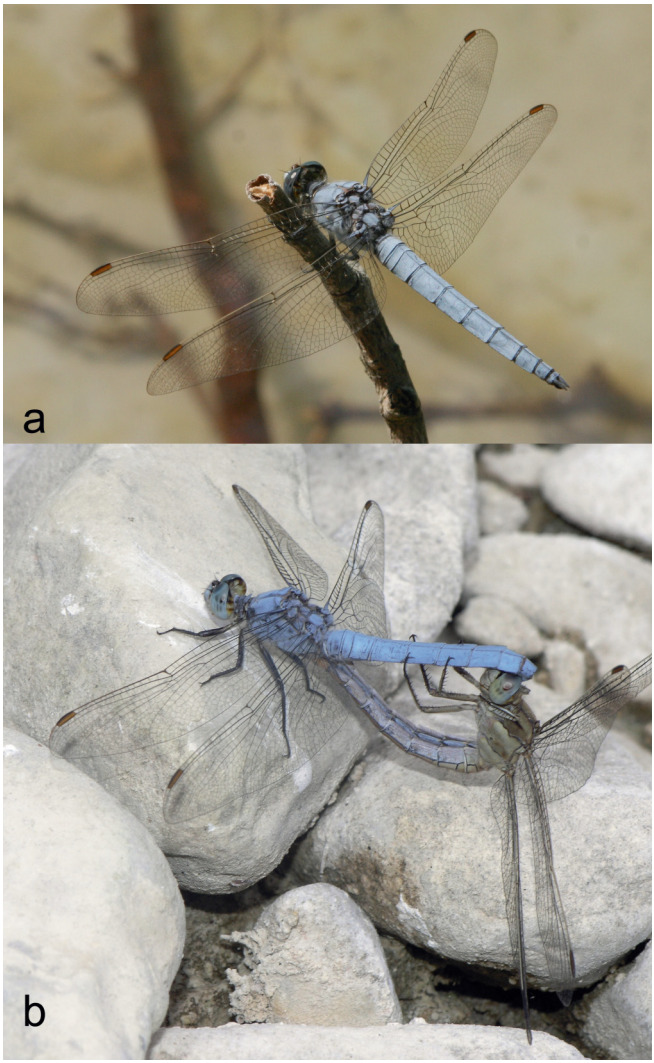


Figure 25. Male (a) and copula (b) of *Orthetrum brunneum* at the Doob River lowermost reaches (Loc. 14), 1.08.2015 (a) and 9.07.2016 (b).

Pantala flavescens (Fabricius, 1798)

Loc. 3: several ind. seen. **Loc. 11:** 1 ♂, 1 ♀ collected on 28.07.2015, quite many ind. seen.

Remarks. According to Ketenchiev & Haritonov (1998: 30) "in the Caucasus everywhere but occurs sporadically". These are obviously stray individuals, as permanent populations cannot exist in the temperate climate.

Observations. Observed only on the 2015 visit. Several individuals flew over the crest of the hill at the eastern side of Natukhaevkaya village. Many individuals permanently flew over a gentler section of a stony byroad going along the crest of a slope fold above Kabardinka, above a planted pine forest and not at a high elevation (Fig. 26). The same road attracted another large flying hilltopping insect, the Kite *Iphiclides podalitius* (Linnaeus, 1758), individuals of which flew side by side with *P. flavescens*.

Figure 26. A road along a crest of a fold of a mountain slope above Kabardinka where many individuals of *Pantala flavescens* permanently flew at daytime in late July 2015 (27-29.07.2015).

Selysiothemis nigra (vander Linden, 1825)

Loc. 5: 1 mature ♂ collected, at least 2 more ♂♂, 1 tandem seen. **Loc. 7:** 1 immature ♂ collected. **Loc. 11:** 28.07.2015: 1 mature ♂ photographed (Fig. 27) and collected.

Observations. A small Lake Krugloe (Loc. 5, Fig. 4) appeared to be a breeding place of this rare species. Amidst this lake, at least two mature, black males for a long time perched on protruding sprouts or ears of sparse emerging grass. They rarely got into the air, hovered over the water surface for quite a long time and returned to about the same place but occupied another sprout, showing no perch fidelity. Once, one of them chased the other. Twice, oviposition was observed over the water surface among the same sparse emergent vegetation: once by a solitary female; once in tandem with a black male (females were brownish). At the same time two black males kept to a white gravel road at the nearby bank, they rested on gravel and frequently chased each other. Lake Krugloe is similar to the breeding places of *S. nigra* in NE Italy as described by Uboni et al. (2015).

An old, worn out male was found at a dry roadside pine forest margin at Kabardinka (Fig. 27). An immature male with ochraceous and contrasted black stripy pattern was seen in open juniper forest at a ridge above Sheskharis. Occurrence of the species in the region examined is in accordance with the preference of this species to coastal habitats (Kalkman & Bogdanovic 2015).

Figure 27. A mature male of *Selysiothemis nigra* and at a pine plantation edge at Kabardinka (Loc. 11), 28.07.2015.

Sympetrum fonscolombii (Selys, 1840)

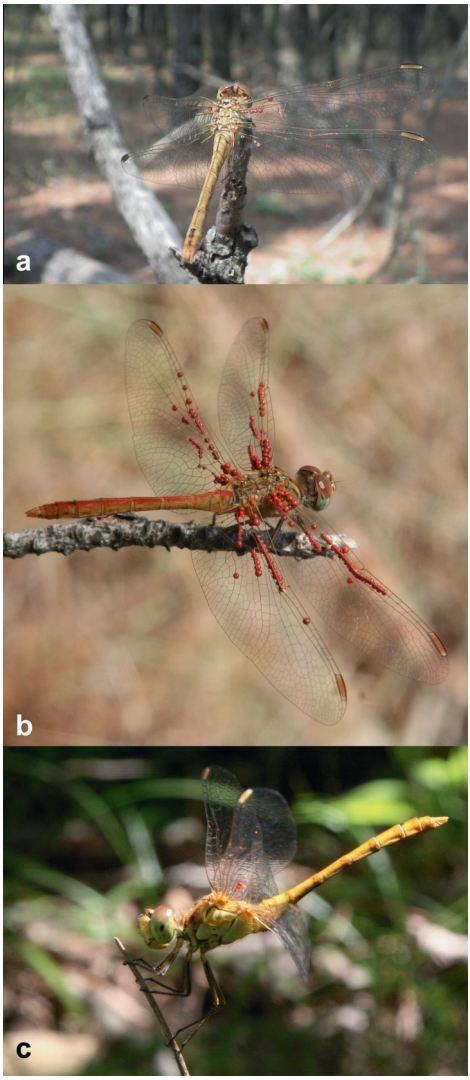
Loc. 2: 1 ♂ collected, 1 ♂, 1 ♀ photographed (Fig. 28), many ind. seen. **Loc. 3:** several ind. seen. **Loc. 9:** 6.07.2016 – several ♂♂ seen, 1 ♂ collected. **Loc. 11:** 2 ♂♂, 1 ♀ collected on 27.07.2015, many ind. seen. **Loc. 15:** several ♂♂ seen.

Observations. Common on dispersal at coast, dry foots and lower elevations of mountain slopes, at wasting lands and oak/hornbeam/juniper parkland, also occurred in the Krasnaya Shchel' valley. Readily recognised among other local *Sympetrum* by a somewhat larger size and a strong tendency to adopt the 'obelisk' posture.

Figure 28. Male (a) and female (b) of *Sympetrum fonscolombii* in an open juniper/oak/pistachio stand over the sea at Bolshoy Utrish village (Loc. 2), 4.08.2015.

Sympetrum meridionale (Selys, 1841)

Loc. 2: several ind. seen. **Loc. 5:** 2 teneral ♀♀ collected. **Loc. 6:** many still yellowish ♂♂, ♀♀ seen. **Loc. 9:** 4 and 6.07.2016: many still yellowish ♂♂, ♀♀ seen, 2 ♂♂, 1 ♀ collected, 2 ♂♂ photographed. **Loc. 11:** very many seen in 2015; 28.07.2015: 2 ♂♂, 2 ♀♀ collected, 1 ♀ collected, 1 ♀ photographed (Fig. 29a). **Loc. 13:** 2 mature ♂♂ photographed (Fig. 29b). **Loc. 14:** 9.07.2016: many ind. seen, 1 ♀ collected. **Loc. 15:** several ♂♂, ♀♀ seen. **Loc. 16:** several ind. seen.



Observations. The most numerous *Sympetrum* dispersed over the mountains. Teneral individuals were abundant at Lake Krugloe, obviously a breeding place. In early July 2016 most individuals were immature, still yellowish (Fig. 29c), and evenly dispersed over the terrain. In late July 2015 almost all individuals were mature (Fig. 29b) and more abundant at higher elevations, at meadowy forest margins.

Figure 29. Female (a) and mature (b) and immature (c) males of *Sympetrum meridionale*, in an open pine plantation at Kabardinka (Loc. 11), 28.07.2015 (a), margins of a hornbeam-/oak thickets (Loc. 13), 1.08.2015 (b), and the Krasnaya Shchel' valley (Loc. 9), 4.07.2016 (c).

Sympetrum sanguineum (Müller, 1764)

Loc. 1: 1 immature ♂ photographed (Fig. 30b) and collected, 1 ♀ collected; **Loc. 3:** 5.08.2015: 1 mature ♂ photographed (Fig. 30a). **Loc. 5:** 1 mature ♂, 1 immature ♂ collected.

Observations. Found in the western part of the area studied: at margins of hornbeam/oak groves at two sites in Anapa District and in sedge of Lake Krugloe, which should be a breeding place.

Figure 30. Mature (a) and immature (b) males of *Sympetrum sanguineum*, at the Natukhaevskaya village (Loc. 3) (a) and in the town of Sukko (Loc. 1) (b), 5.08.2015.

Sympetrum striolatum striolatum (Charpentier, 1840)

Loc. 9: 29.07.2015: 1 ♀ collected; 4.07.2016: 1 ♂ photographed (Fig. 31); 6.07.2016: several ♂♂, ♀♀ seen; 1 ♂, 1 ♀ collected. **Loc. 11:** 27.07.2015: 1 ♀ collected.

Observations. Persisted but not abundant in the Krasnaya Shchel' valley with a rivulet, that is in line with the ability of this species to breed in flowing water, unlike other local *Sympetrum*. Besides, a female was found among nine specimens collected in 2015 on mountain slopes above Kabardinka.

Figure 31. Male of *Sympetrum striolatum* at the rivulet in the Krasnaya Shchel' valley (Loc. 9), 4.07.2016.

Sympetrum vulgatum vulgatum (Linnaeus, 1758)

Loc. 11: 27.07.2015: 1 ♂ collected.

Observations. A male was found among the nine specimens collected on mountain slopes in 2015. Actual abundance unclear but surely very inferior in number to *S. meridionale*, the males of which well differ visually, even at distance, by a more expressed 'waist' and a more yellowish hue of the abdomen.

Sympetrum pedemontanum (Müller in Allioni, 1766)

Loc. 14: 1.08.2015: 1 mature (red) ♂ seen in the lower part.

Observations. A single observation at a small river near the coast.

Aeshnid flying activity

A. affinis and *A. mixta* were extremely numerous during the 2016 visit, while on 2015 visit their abundance remained unclear and was probably less (their presence was proved by two specimens each: a male of *A. affinis* at Loc. 9 at dusk and a female of *A. mixta* at Loc. 13, at sunny midday, although many individuals of perhaps the former were observed).

In 2016, numerous flying individuals of *A. mixta* were observed commencing trophic flight high in the air, without conflicts between individuals, throughout sunny days.

Figure 32. A loose swarm of *Aeshna mixta* commencing trophic flight over the road in the Krasnaya Shchel' valley (Loc. 9) on midday of 4.07.2016.

For instance, from few to dozen males were permanently observed flying above the Krasnaya Shchel' rivulet (Loc. 9; 4 and 6.07.2016), while above some sections of the road going along the river they congregated into loose unstable swarms of several dozens of individuals (Fig. 32); these swarms were slowly moving, splitting, merging and dissolving. The same was observed in the village of Yuzhnaya Ozereevka (Loc. 6), while at the top of a high vertical cliff over the sea north of Yuzhnaya Ozereevka, a huge swarm of maybe a thousand individuals was observed at about 10 a.m. on 10.07.2016 (Fig. 33). It was 'anchored' to a tall roof of a large pavilion and was slowly moving to and fro to its different sides.

Figure 33. A huge trophic swarm of *Aeshna mixta* at a pavilion ontop a coastal cliff north of Yuzhnaya Ozereevka village (Loc. 6) on 10.07.2016.

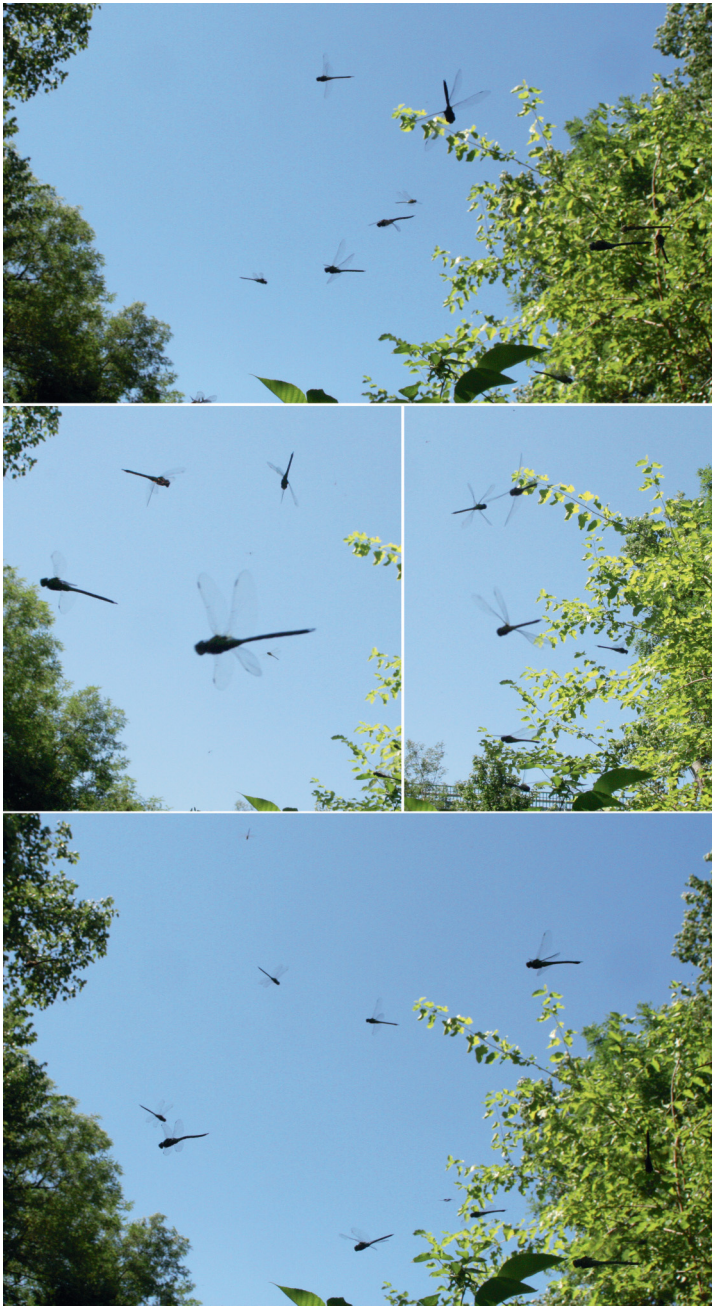


Figure 34. A tight swarm of *Aeshna affinis*, with an admixture of *A. mixta*, at a bank of the rivulet in Krasnaya Shchel' valley (Loc. 9) near its mouth in the morning (10:30) of 4.07.2016.

Whenever and wherever flying individuals of *A. mixta* were observed, quite many of those were found resting on branches of (at least) small trees, landing or getting into the air. When the sun disappeared behind a cloud, few individuals remained flying (while most landed) but remained quite alert and were easily startled. On the other hand, on 5.07.2016, more of those appeared in the air above a short hornbeam/downy oak thickets at Cape Doob (Loc. 15) under a weak and short rain but not before and after it. Among resting *A. mixta*, *A. affinis* can be seen, very rare at midday and more frequent at the end of the day (e.g. at the Doob River valley woody slope on 6.07.2016).

Individuals of *A. affinis* formed similar unstable, fluctuating temporary swarms but in the morning and at dusk. Thus, at ca 10:30 on 4.07.2016, a tight congregation of about a hundred flying individuals were observed in the Krasnaya Shchel' Valley (Loc. 9) near the mouth: they concentrated above a blackberry bush at the rivulet bank between a larger bush and a large branchy tree, as if attracted by something at the blackberry bush (Fig. 34). In this swarm, some individuals of both sexes of *A. mixta* also participated, recognisable (but checked in hand) by their darker coloration and slower flight. Nothing like this was observed there two days later, on 6.07.2016, when O.K. started observations at 9:00; maybe since that day was cooler, despite the same sunshine. On 7.07.2016, in the lower part of the Tserkovnaya Shchel' Valley (Loc. 12), at 6:49 O.K. observed an almost immediate formation of a swarm of about half a hundred individuals flying at about 30 m of a planted pine forest margin, which dissolved already to 7:06.

In the very warm evening of 4.07.2016, many individuals of *A. affinis* were seen flying in the town of Kabardinka in the dusk, since 20:00. Many of them, of both sexes, were found killed by traffic on the road going along the town. O.K. checked about 15 and found no *A. mixta* among them, but a female of *A. parthenope*. Later evenings were cooler and only few individuals of *A. affinis* were flying over the road and glades in pine plantations (e.g. on 6.07.2016). In dusk of 9.07.2016 O.K. observed (and checked) several individuals of *A. affinis* flying in the Tserkovnaya Shchel Valley, at 20:07 a small swarm of about a dozen of those was formed but dissolved very soon.

Hence *A. affinis* has mostly a bimodal, matutinal and vespertinal diel trophic activity, or crepuscular in a strict sense (Borkenstein et al. 2016). The vespertinal activity of this species was also observed in West Siberia (Kosterin et al., 2001).

It is noteworthy that territorial males of *A. affinis* were observed at Lake Krugloe (Loc. 5) and their reproductive activity did not resemble their trophic activity: they very slowly flew among emergent vegetation low above the water surface at midday sunshine.

In 2015, O.K. thrice observed evening swarming activity of small aeshids which were most probably *A. affinis*, that he failed to prove because of problems with nets. On 20.07.2015 very numerous such dragonflies formed two swarms, at a pine forest margin facing an open area with the road at the NE margin of Kabardinka and above a small open area of a power distributing station inside that forest, in the lower foothills (Loc. 11). On 4.08.2015 he observed mass twilight flight of aeshnids of the same size ca 10-15 m above a road and houseyards along the lowermost reaches of the Sukko River at Sukko village (Loc. 1). The sunset was at 6:50 p.m. of local time. The first dragonflies

appeared at 7:35 p.m., ten minutes later they appeared in mass quantities, at 8:01 p.m. they almost simultaneously disappeared, although it still was not dark, and O.K. saw only two more individuals at ca. 8:10. Among them he noticed 1-2 somewhat larger aeshnids with an uneven flight with slight frequent 'jumps' while individuals of the predominant species, obviously *A. affinis*, flew evenly and easily.

On 7 and 9.07.2016, at 19:55-20:07 at Tserkovnaya Shchel (Loc. 12), females of *C. microstigma* were observed flying low above the road near the breeding stream. On 2.08.2015 O.K. observed aeshnids of the same rather small size fast and evenly flying at the darkest twilight very low above the roads not far from the Doob lowermost reaches going over open land at forest margins (Loc. 14). They were abundant but their flight lasted for not more than 7-10 minutes, then they suddenly disappeared, still before complete darkness fell. Unfortunately, all the nets were broken, and O.K. failed to get a specimen by other means. Supposedly they were *C. microstigma* as well, since their flight mode was identical to that of the males of this species above breeding streams, since the above mentioned females were observed above the road at Loc. 12, and since such a crepuscular flying activity very low over the ground was described for this species in the West Caucasus by Bartenev (1930). However, no male of that species patrolled the Doob River surface either at the daytime or in the evening. In early July 2016, O.K. revisited this place in dusk on 5, 9 and 10.07.2016 but saw (and missed) only one dragonfly above the road on 5.07.2016.

Appendix

On 9.06.1990 O.K. happened to visit surroundings of Grushovaya Balka settlement (ca 44°46'-37°52' E), in the same area but deeper into the mountains. It was surrounded by beech forest with participation of oak, maple and linden. He saw a male of *A. imperator* ranging above shrubbery at a forest cutting, and a female of *Libellula depressa* Linnaeus, 1758 at the settlement. The latter species was not recorded on our trips in 2015-2016, perhaps because of its early flight period.

Discussion

1. The most interesting record made is no doubt *Cordulegaster picta*, which has never been reported to the territory of Russian Federation before. No *Cordulegaster* have been so far recorded in the Caucasus northerly of the Sochi City environs, in spite of abundance of suitable habitats. The geographically closest known locality of *C. picta* is Zoreti River in Georgia (41°46' N, 43°15'' E) (Schröter et al. 2015), which is 550 km SE from our site. From this point of view, the record was expectable. This is the world's northernmost (44°40' N) record of *C. picta*. Before this, the northernmost record was in NE Bulgaria at ca 44°37' N (Boudot et al. 2015).

2. The here reported record of *C. microstigma* is by now the northernmost in the world (ca 44°40' N). The previous one (ca 44° N) was in the northernmost Bulgaria (Kalkman & Jovič 2015). It is noteworthy that in the region examined, *C. microstigma* was recorded at the same two streams as *C. picta*, for which these also appeared the world northern-

most record (see above). No doubt both species have similar ecological standards and share the common northern range border.

There exist only three previous records of *C. microstigma* for the present territory of Russian Federation: for a locality between Adler and Golitsynka and for the environs of Krasnaya Polyana made by Bartenev (1930), and for Matsesta made by Skvortsov (2010) by collections of S.K. Kotachkov. Those sites are at the SE extremity of Krasnoyarskiy Kray. Ketenchiev & Haritonov (1998) stated the species to occur in Transcaucasia and the 'eastern part of North Caucasus', without explanations.

3. *P. flavescens* was reported by Ketenchiev & Haritonov (1998) to occur 'everywhere' but 'sporadically' in the Caucasus. Skvortsov (2010) provided only one record of the species in Krasnodarskiy Kray, made at its SE extremity at Khosta by *S.* Kotachkov. Note that Bartenev (1930) did not report *P. flavescens* for the West Caucasus at all. In 2015, we found this species common above crests of the coastal mountain slopes, and even at the hill at Natukhaevskaya near Anapa, that is at the north-westernmost outpost of the Great Caucasus and the Mediterranean biota. Generally those landscapes seemed very suitable as imaginal habitats for the species, but of course no permanent population is possible to exist anywhere in the temperate zone. It is noteworthy that being abundant and widespread in late July 2015, *P. flavescens* was not seen at all in early July 2016. This suggests that its migration from elsewhere are unstable and depend on unknown factors, most probably related to weather.

4. In the USSR times, *S. nigra* was considered as occurring in that country only in Central Asia and limitedly penetrating into Kazakhstan (Belyshev et al. 1989). Ketenchiev & Haritonov (1998) did not list the species for the Caucasus at all. Recently it is obviously extending its range northwards as registered in South Ural (quite unexpectedly) in 2000 (Yanybaeva et al. 2008), in Kalmykia (the NW Caspian area) in 2007 (Skvortsov & Kuvaev 2007), at the banks of Azov Sea in 2008-2015 (Khorkalo et al. 2009; Savchuk & Karolinskiy 2013; Martynov et al. 2015), at the southern coast of Crimea in 2008 (Matushkina 2007) and 2013 and of Nikolaev Province of Ukraine in 2002 (Titar 2007), for a review see Martynov et al. (2015). However, the species has not been so far reported from the Black Sea coast of the Caucasus, from where it could be expected as tending to sea coasts, so the present records are the first ones.

5. For a 10 day long visit in 2015, as many as 23 Odonata species were found even without visiting any lentic habitat. Five species were added in 2016, all in Abrau Peninsula (*I. elegans* also elsewhere). The large Lake Abrau (Fig. 3) was nearly 'empty' as providing only scanty *S. fusca*, *I. elegans*, *S. meridionalis* and *O. albistylum*, neither of which proved to breed in that lake. On the other hand, a 200 x 40 m remnant of Lake Krugloe at the same peninsula (Fig. 4), small but deep, with cold crystal-clear water obviously of a ground origin, the purity of which was approved by the abundant stonewort, provided 14 species (4 Zygoptera and 10 Anisoptera), including such interesting species as *C. scitulum* and *S. nigra* which obviously breed there. Besides, O.K. noticed there but failed to reach up to three more dragonflies: 1) an aeshnid smaller than *Anax* ssp. but seemingly larger than *A. mixta* and *A. affinis*, ranging among sparse emerging vegetation; 2) something looking like a corduliid, with the same behaviour; and 3) seemingly *Lestes*

sp. in the bank sedge. So as many as 17 species could actually be present on that lake on 10 vii 2016. Totally for both visit, 28 species of Odonata were registered.

Following information by O.K., Kabardinka was also visited, at later dates of July 2016, by the odonatologist Vladimir E. Skvortsov (Moscow) who is interested in the taxonomy of *Cordulegaster*; he also collected there *Cordulegaster picta* and *Caliaeschna microstigma* (pers. comm.).

6. Much earlier, in 1926-1929, this area was thoroughly investigated by A.N. Bartenev (1930). Since ours was only a short glance at the fauna while his was a systematical study, it would be worthless to consider species which he found and we did not. On the other hand it is of interest to consider the opposite, the species we found and Bartenev did not find in 10 localities examined in his 'Novorossiysk District' including the present-day Anapa, Novorossiysk and Gelendzhik Municipalities and Tuapse District (Bartenev, 1930), as they could indicate some change in the local Odonata fauna for the last century. Bartenev (1930) did not register in his 'Novorossiysk District' the following ten species found by us: *C. splendens*, *C. scitulum*, *A. affinis*, *C. microstigma*, *O. forcipatus*, *C. picta*, *O. coerulescens anceps*, *S. striolatum*, *P. flavescens*, *S. nigra*. Of them *C. scitulum*, *C. picta*, *P. flavescens* and *S. nigra* were not found by him elsewhere in West Caucasus. For *O. c. anceps* and *S. striolatum*, Bartenev specially indicated Tuapse (110 km SE of Kabardinka) as the northern limit of their occurrence (very sharp for *S. striolatum*) along the Black Sea Coast (but not in the Caucasus in general), hence our finding evidence for some expansion of at least the two latter species. Bartenev rather reasonably considered the absence of records of *A. affinis* as only a matter of chance. He explained absence of *O. forcipatus* through rareness of the species at the Black Sea coast, oppositely to our recent observations. Bartenev noted that he specially looked for *C. splendens* in 'Novorossiysk District' but did not find it and interpreted this fact as its vanishing because of unfavourable conditions.. Note that Bartenev (1930) extensively speculated on the dynamics of the ranges of particular species basing on the shape of their borders and existence of isolated populations, but most of his hypotheses look insufficiently grounded and based on incomplete data, so they do not warrant discussing at present.

It is still unclear if our northernnost record of *C. microstigma* and recent West Caucasian records of *S. nigra* and stray *P. flavescens* indicate northwards range extensions because of the global warming, whatever be its reasons, which are well documented for butterflies and dragonflies elsewhere and discussed for *S. nigra* by Uboni et al. (2015),. The area considered no doubt offered seemingly good habitats for both *C. picta* and *C. microstigma* also in the past. So their putative absence there in the past could result from insufficient data the area, which seems strange in view of the popularity of the place among tourists from all over Russia. Bartenev also did not examine localities at Kabardinka.

Acknowledgements

The work by O.K. was supported by International Dragonfly Fund and, partly, project No. 0324-2016-0002 at his institute; the work by V.S. by project 16-34-00845 by Russian

Fund for Fundamental Research. Sequencing was carried out at the SB RAS Genomic Core Facility, Novosibirsk. O.K. is grateful to Vladimir Skvortsov for discussion concerning *Cordulegaster*, to Gerard Chartier for taking a labour of linguistic editing of the text, to his wife Natalya Priydak for a great help in the field in 2015 and to his son Valentin for agreeing to participate in 2015 fieldwork and fitting it well. Milen Marinov and Malte Seehausen made useful comments and suggestions as to the text.

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Published 13.06.2017

Calopteryx virgo feminalis subsp. nov., a long known under the same name but hitherto formally nameless subspecies from the Caucasian Black Sea Coast

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Abstract

The populations of *Calopteryx virgo* of the Black Sea Coast of the Caucasus have females with the distal hindwing part darkened and males with the underside of S10 and appendages whitish, They are known for more than a century and deserve a subspecific status but since the name *feminalis* Bartenev, 1910 proposed to them is unavailable, a new subspecies is formally erected under the same name, *Calopteryx virgo feminalis* Kosterin subsp. nov., with the following type locality: Russia, Krasnodarskiy Kray, Gelendzhik Municipality, Kabardinka village, the Doob River lowermost reaches, 44°38'26-53", 37°55'55"-57'58" E.

Key words: West Caucasus, Black Sea coast, Krasnodarskiy Kray, Odonata, *Calopteryx virgo festiva* var. *feminalis*, unavailable name, new subspecies.

Introduction

Taxonomy of the two widespread trans-Palaearctic species groups of the genus *Calopteryx* Leach, 1815, the *splendens*-group and *virgo*-group, especially of the former, is complicated owing to individual and geographical variation of their representatives, complicated history of their spread over northern Eurasia during the periodic climatic changes in the Pleistocene and Holocene, and unclear limits of the species, most probably because of their imperfect reproductive isolation and a degree of genetic introgression between them (see e.g. Bartenev 1912; Sadeghi et al. 2010; Karjalainen & Hämäläinen, 2013; Sadeghi & Dumont 2014; Dijkstra & Kalkman 2015; Hämäläinen 2017). A great number of taxa, many of unclear status, have been proposed in the *splendens*-group. Variation in the *virgo*-group is moderate but this group no doubt has not less complicated evolutionary history and phylogeography, just less manifested in the most noticeable character, the wing coloration (Bartenev 1912; Karjalainen & Hämäläinen, 2013; Dijkstra & Kalkman 2015; Hämäläinen 2017). Hence, putting forward any taxonomical solution, treatment or an opinion concerning these two groups is always a challenge. Nevertheless, I dare to propose solution of a very particular nomenclatorial

problem concerning the populations at the Black Sea coast of the well known and widespread species *Calopteryx virgo* Linnaeus, 1758. These populations exhibit specific peculiarities of both male and female phenotypes and deserve a subspecific rank. Actually this subspecies has been known for more than a century but still lacks an available name.

Below, I first outline the history of the taxonomical taxon in question, that is of researchers' opinions on its existence in nature, its characters, rank and range (see Glossary at International Code of Zoological Nomenclature 1999, further ICZN), and then consider the formal nomenclatorial issues concerning names and their status.

The history of investigations of the *C. virgo* populations of the Caucasian Black Sea coast

Bartenev (1910) described, in Russian, "*Calopteryx virgo* var. ♀ *feminalis* nov." from Goryachiy Klyuch, a town in Krasnodarskiy Kray Province of Russia (44°38' N, 39°08' E). Because of some taxonomically important moments, here I provide my English translation of the entire description (which lacked any illustrations):

"21. *Calopteryx virgo* L. - a) Goryachiy Klyuch, a gorge behind the cemetery, 5 males and 3 females, 10 VI 06; 1 male, 2 VI 06; 3 females, 18 VI 06; 1 male, 29 VII 06; b) on the road from Goryachiy Klyuch to Pyatigorskoe village, 1 male, 6 VIII 04. In all males present in the collections, the blue band occupies almost the entire wing, and the apices of the latter are not lighter than middle. In some males, the wing base remains somewhat more transparent until the quadrangular. However, in these specimens it is still less transparent than in var. *meridionalis*, so that the lighter area occurs in the anterior wing part, while the postcostal field remains non-transparent also at the base. All females in the collections differ from the type in the following: labrum black, costal vein from dark metallic to non-metallic brown colour, other veins dark brown in old and yellow in young specimens. Pterostigma 2 mm, its width 1 mm. Fore wings in all but one females entirely transparent, in some with a hardly noticeable darkening along the wing anterior margin. Hind wing transparent in basal part and occupied by a smoky band only in their apical one third. In three females the inner margin of the band is very sharply expressed and forms almost a straight line. In three other females the band is here less sharply margined. In general, the wings of the Kubanian females [that is originated from the Kub'an area] of *C. virgo* fascinatingly resemble in coloration the females of the West European *C. haemorrhoidalis* Lind. Selys Longchamps in his "Monographie des Calopterygines" (p. 42) says that "hind wings in females of *C. virgo* are somewhat darker than the fore ones, always in their last third" but, as far as I know, in typical females of *C. virgo* the dark coloration of the hind wing apices always weakens very gradually and disappears completely much closer to the base, and never forms any just clear straight inner border. In view of stability of these characters in the Kubanian specimens. I suggest to isolate them into specific var ♀ *feminalis* nov. (alae anteriores pellucentes concolores, posteriores triente apicali fascia introrsum rectilineatim atque argute terminata adumbratae [fore wings uniformly translucid, hind ones in the posterior one third with a coloured band terminating innerly with a sharp straight border])."

The main feature of *feminalis* according to Bartenev (1910) was a distinctly dark distal part of the hindwing, so resembling *Calopteryx haemorrhoidalis* (Vander Linden, 1825). Twenty years later in his very detailed, 138 page long paper devoted to Odonata of the West Caucasus, Bartenev (1930) reported more specimens attributed to *feminalis* from 20 localities at the Black Sea coastal part of the Caucasus in the present day southern Krasnodarskiy Kray of Russia, Abkhazia and Samergelo-Zemo Svaneti, Guria and Imereti Provinces in western Georgia, from Abrau village (presently Abrau-Dyurso, 44°42' N, 37°36' E, 14 km W of Novorossiysk) in the north-west to 'Tkvibuli' (Tkibuli, 42°20' N, 43°00' E, 26 km NE of Kutaisi) in the south-east. Besides, Bartenev (1930: 52) added a character of *feminalis* referring to both sexes, narrower wings: "(10) – 11 - 11.5 – (11.75) mm in male and 10 – 10.5 – (11) in female" versus 12-13.5 mm in males and 13 mm in females of *C. virgo festiva* (see Bartenev 1912). Bartenev (1930: p. 52) also mentioned a smaller false pterostigmata in *feminalis* females: "1-1.5- <2 mm instead of 1.5 – 3 mm". He considered specimens collected further south-east, at Batumi, as transitory from *feminalis* to *C. virgo festiva* (Brullé, 1832) (the wings narrow and the pterostigma small as in the former but the female wing coloration as in the latter).

Much later Kalkman (2006: 17) in his key to Odonata of Turkey mentioned, with reference to a personal communication by Henri Dumont, the subspecies *Calopteryx virgo feminalis* Bartenev, 1910 as "found along the eastern part of the Turkish Black sea coast", and additionally characterised this taxon as follows: "Underside of S9 black (sometimes with small reddish spots); S10 and underside of inferior appendages whitish", versus "underside of S9, S10 and underside of lower appendages red in *C. virgo festiva*".

There are several reports on populations existing elsewhere at the Black Sea coast where both presumed male and female diagnostic characters co-occurred with those of *C. virgo festiva* (Brullé, 1832). The first came from Bartenev (1930: 52) themself: "[specimens] transitory to *feminalis* (by the width of wings and pterostigma, individuals from the environs of Batum fall here)".

Miroğlu at al. (2011: 119) reported that both versions of the abdominal tip underside in males "co-exist in specimens collected from coastal parts of the eastern Black Sea and from anywhere else within the study area [which was the eastern subregion of Black Sea Region of Turkey, between the Melet River and the border of Georgia]. Because of impossibility of co-occurrence of two subspecies in the same locality, we consider the colour differences in S9, S10 and inferior appendages as an individual variation of *festiva*."

Schröter et al. (2015) reported a small population of *C. virgo* in Ombolo, at the Black Sea coast of Adjaria Province of Georgia, where females had conspicuously darkened distal hindwing part corresponding to Bartenev's *feminalis*. However, in some females the wings were evenly coloured throughout as should be in *C. virgo festiva*. Also four more populations of *C. virgo* found in Adjaria. Guria, Imereti and Kakheti Provinces of Georgia showed only the characters of *C. virgo festiva*. These data somewhat contradict to Bartenev (1930) who reported *feminalis* from the present day Guria and Imereti Provinces.

Malte Seehausen (pers. comm.) kindly informed me that males with the whitish underside of S10 and appendages also occurred all over Georgia along with those with the underside yellow to reddish, as normally in *C. virgo festiva*. Also the whitish underside

of the abdomen tip occurs in some specimens of *C. virgo meridionalis* Selys, 1873 in Crete and France. Grand & Boudot (2006) reported that in southern France some females of *C. virgo meridionalis* have the wings coloured as in *C. haemorrhoidalis*. Hence, both male and female character are not decisive and occurs at low frequency far beyond the Black Sea coast.

However, the concept of subspecies do not and cannot exclude introgression even of diagnostic characters between subspecies, as subspecies are normally not separated by any reproductive barriers and at most are isolated by geographic barriers, such as mountains or water bodies, or just by distance. These data may be interpreted as existence of a broad transition zone between the here considered subspecies and *C. virgo festiva*. If there are subspecies, then existence of an introgression zone between them somewhere is taken for granted.

Hence the hitherto available data (Bartenev 1910; 1930; Schröter et al. 2015; this paper) rather vote, although not unequivocally, for existence at the West Caucasian Black Sea coast of a subspecies of *C. virgo* characterised by narrow wings, a dark hindwing distal part in most females and whitish underside of S10 and appendages in most males. Further east and south there is a transition zone to *C. virgo festiva* in Georgia (Bartenev 1930; Schröter et al. 2015) and at the Turkish Black Sea coast (Miroğlu at al. 2011).

Nomenclatorial problems around *C. virgo* populations of the Caucasian Black Sea coast

Schröter et al. (2015) were first who pointed at the problem of nomenclatorial status of the name *feminalis* Bartenev, 1910. They claimed it unavailable according to Article 45.6.4 of the International Code on Zoological Nomenclature (1999), because it had been proposed for an infrasubspecific entity. Opening this discussion, they made a doubtless statement: "The nomenclatural status of *feminalis* can be derived from the fact that Bartenev introduced the name in combination with the term »var. ♀ nov.«" (Schröter et al. 2015). Indeed, the sign "♀", after "var.", alone formally indicates that the name was intended to be applied to females only and hence cannot be considered as subspecific. However, further in the text Schröter et al. (2015) did not mention this sign but instead provided weak arguments for their correct conclusion:

1). Schröter et al. (2015) referred to Bartenev's "Latin description" which in fact was a short Latin diagnosis while the actual original description was given immediately above in the same publication in Russian, as translated above in this paper. This description refers to the characters of both sexes, and stability of characters (in plural) in specimens from certain area, without specification of their sex, that is fully conforms the modern concept of subspecies. It is the designation "var. ♀ nov." which contradicts, not the description. One can see that the statement by Schröter et al. (2015: p. 313) that "the description (Bartenev 1910) strictly refers to the female and does not mention characters for males" was misleading.

2) Etymological argument by Schröter et al. (2015: p. 313) that the Latin name *feminalis* means "referring to females only" and "that the infrasubspecific rank of »*feminalis*« was implicit although not explicited" is irrelevant since this is only a guess ("implicit") rather than any evidence.

3) A case of the later work by Bartenev (1930) is interesting. Schröter et al. (2015: p. 312) wrote: "This infrasubspecific rank in our opinion became unambiguous in 1930, when the author used the heading »*Calopteryx virgo festiva* var. *feminalis* Bart« in his compilation of the Odonata of the Western Caucasus (Bartenev 1930)". Indeed, the use of a name in addition to a trinomen unequivocally indicates at an infarsubspecific status. It is however curious that in the next page 52 Bartenev (1930) also used it as the third name of the trinomen, "Cal. *virgo feminalis*". Since in Bartenev's times the clear distinction between species group names and infrasubspecific names still did not exist we have to rely only on formal interpretations of his text from the point of view of the modern nomenclatorial concept regulated by ICZN. We could interpret the text by Bartenev (1930) in terms of Art. 45.6.4 as if he used the name *feminalis* as subspecific and infrasubspecific altogether and consider the name *feminalis* Bartenev 1930 available. However, the next phrase by Bartenev lives no doubt in his intention to consider the name *feminalis* as infrasubspecific (Bartenev 1930: 52): "Perhaps *Cal. virgo festiva* should be divided into 1) typ[us], 2) transitory to *feminalis* (by the width of wings and pterostigma, individuals from the environs of Batum fall here) and 3) var. *feminalis* (narrow wings, small pterostigma, characteristic wing coloration in females) (specimens from all over Black Sea coast from Natanebi to Abrau and Zakubanskiy Kray)". Hence the author's treatment of *feminalis* as an infrasubspecific entity is explicit here and according to ICZN Art. 45.6.4 this name did not become available even when used in trinomen before 1961 ("45.6.4. ... or the content of the work unambiguously reveals that the name was proposed for an infrasubspecific entity, in which case it is infrasubspecific").

Kalkman (2006) used this name as subspecific, *Calopteryx virgo feminalis*. However, according to ICZN Art. 45.6.4.1, the use of the name in trinomen by Kalkman (2006) did not made the name available with the new author and date since it took place after 1985.

Hence, the subspecies of *C. virgo* in question, used to be known under the unavailable name *feminalis*, still has no valid available name.

In mid-summer 2015 and 2016 I made a survey of Odonata at the village of Kabardinka, Gelendzhik Municipality, Krasnodarskiy Kray Province of Russia (Kosterin & Solovyev 2017), situated at the Black Sea Coast and being 95 km SW from Goryachiy Klyuch from where Bartenev's specimens of *C. virgo* originated which were associated with the name *feminalis* (Bartenev 1910). Both male and female diagnostic characters mentioned by Bartenev (1910; 1930) and Kalkman (2006) were found in Kabardinka specimens (the female character of dark hindwing tips was visually confirmed for all of quite many female individuals seen). This material provided an opportunity to resolve the taxonomical problem around the still nameless subspecies of *C. virgo*.

To get an available name, it needs to be formally proposed complying demands of ICZN Chapter 4. It seems reasonable to use the same name which was associated to it before. That name was unavailable but with fulfilment of the ICZN conditions of availability it can become available on the rights of a new name, with the new author and date. According to ICZN Art. 13, the proposition of the new available name could be done with reference to a previously published description (in our case the

old descriptions by Bartenev 1910; 1930) or with a new original description or definition (diagnosis). The first option would have certain drawbacks as Bartenev's descriptions are (i) in Russian, (ii) split in two papers (Bartenev 1910; 1930), (iii) include many irrelevant characters variable in the species, (iv) miss an important male character (the colour of the underneath of the end of the abdomen) and (v) based on specimens no more existing (for the fate of Bartenev's type specimens see Medvedev et al. 2013). Therefore, below I propose the available name associated with a new type series. Choosing among the optional conditions of availability provisioned byICZN Art. 13.1, I abstain from a detailed description, which would include many details irrelevant for the intra-species taxonomy of the variable species *C. virgo*, and instead provide below a new concise definition (diagnosis) of the taxon based on obvious male and female characters.

Methods

The specimens were collected and more individuals observed in Russia, Krasnodarskiy Kray Province, Gelendzhik Municipality, Kabardinka village env. The localities (Loc. 8-10, 12, and 14) are described in a faunal paper in the same issue (Kosterin & Solovyev 2017).

The demoiselles were photographed in purely natural conditions using Olympus Camedia C8080 and Canon EOS 350D cameras, the latter with Sigma 24-70 mm lens. The photos or specimen details were prepared from serial photographs obtained via lens Zeiss Stemi 2000-C with digital camera Canon PowerShot A640. Images with broad focus zones were obtained from serial photos with shifted focus using the software Helicon Focus 6.0.

***Calopteryx virgo feminalis* Kosterin, subspecies nova**

(Figs. 1-4)

Synonyms

Calopteryx virgo var. ♀ *feminalis* nov. – Bartenev, 1910 (unavailable).
Calopteryx virgo festiva var. *feminalis* Bart. – Bartenev, 1930 (unavailable)
"Cal. *virgo feminalis*" – Bartenev, 1930 (unavailable)
Calopteryx virgo feminalis Bartenev, 1910 – Kalkman 2006 (unavailable)
Calopteryx virgo festiva sensu Schröter et al. (2015) non Brullé, 1832. – Schröter et al. (2015)

Type material

Holotype (Fig. 1a): ♀ – Russia, Krasnodarskiy Kray, Gelendzhik Municipality, Kabardinka village, the Doob River lowermost reaches, 44°38'26-53", 37°55'55"-57'58" E, 4-60 m a.s.l. (Loc. 14 in Kosterin & Solovyev 2017), 1.08.2015, O. Kosterin leg. (in Naturalis Biodiversity Centre, Leiden, RMNH). Paratypes: 2 ♂♂ (Fig. 1b), 1 ♀, Russia, Krasnodarskiy Kray, Gelendzhik Municipality, Kabardinka village, Kastal'skaya Shchel' gorge at the main crossing road, 44°39'35-47", 37°55'14-28" E, 16 m a.s.l. (Loc. 10 in Kosterin & Solovyev 2017), 30.07.2015, O. Kosterin leg. (in RMNH and the author's collection).

Additional data (all from Russia, Krasnodarskiy Kray Province, Gelendzhik Municipality. Kabardinka village env.): The Adegoy River, 44°43'13-16", 37°57'33-38" E, 183-187 m a.s.l. (Loc. 8 in Kosterin & Solovyev 2017), 7.07.2016: several ♂♂, ♀♀ seen. Krashaya Shchel' valley at NW suburbs of Kabardinka village, 44°39'55"-40'48" N, 37°55'04-39" E, 24-180 m a.s.l. (Loc. 9 in Kosterin & Solovyev 2017), 4.07.2016: several ♂♂ seen. Kastal'skaya Shchel' Valley, 30.07.2015: 1 ♀ photographed. Tserkovnaya Shchel Valley, 44°39'13-47' N', 37°57'08-41" E, 62-175 m a.s.l. (Loc. 12 in Kosterin & Solovyev 2017): 28.07.2015: 2 ♂♂ photographed (Fig. 2b); 7.07.2016 - many ♂♂, ♀♀ seen, 2 ♀♀ photographed (Fig. 3a,c-d). The Doob River at its lowermost reaches (the type locality, Loc. 14 in Kosterin & Solovyev 2017): 1.08.2015: many ♂♂, ♀♀ seen, 1 ♂ (Fig. 2a), 1 ♀ photographed; 9.07.2016: many ♂♂, ♀♀ seen, 2 ♀♀ photographed (Fig. 3b).

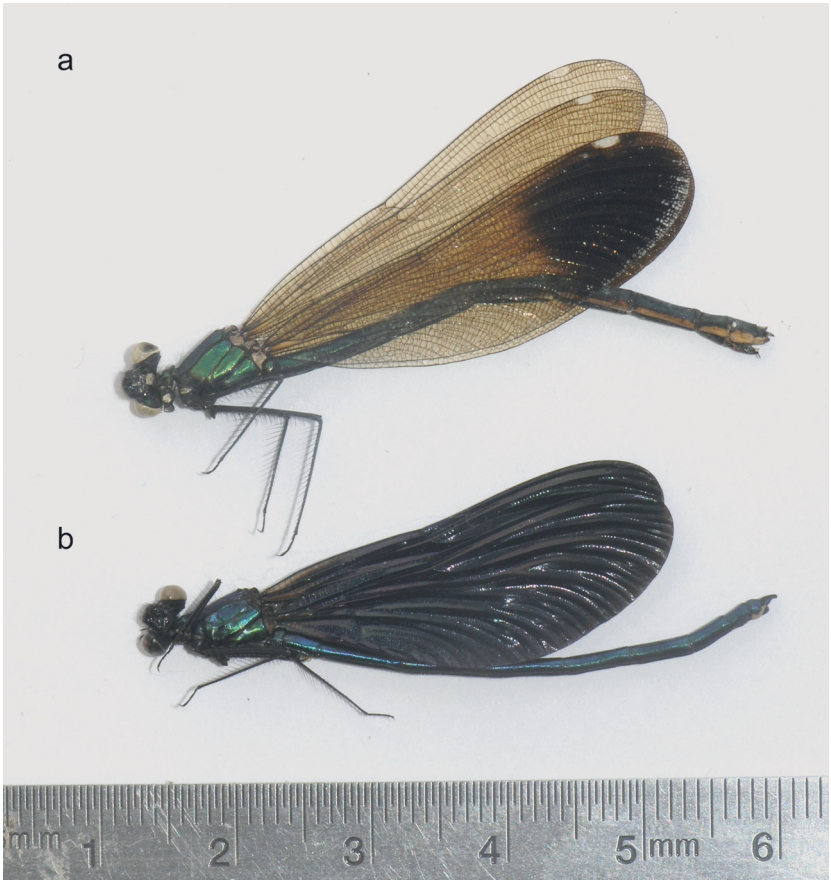

Figure 1. The holotype, female (a, the Doob River lowermost reaches, 1.08.2015) and a male paratype (b, the Kastal'skaya Shchel' Valleygorge, at the main crossing road, 30.07.2015) of *Calopteryx virgo feminalis* subsp. nov.

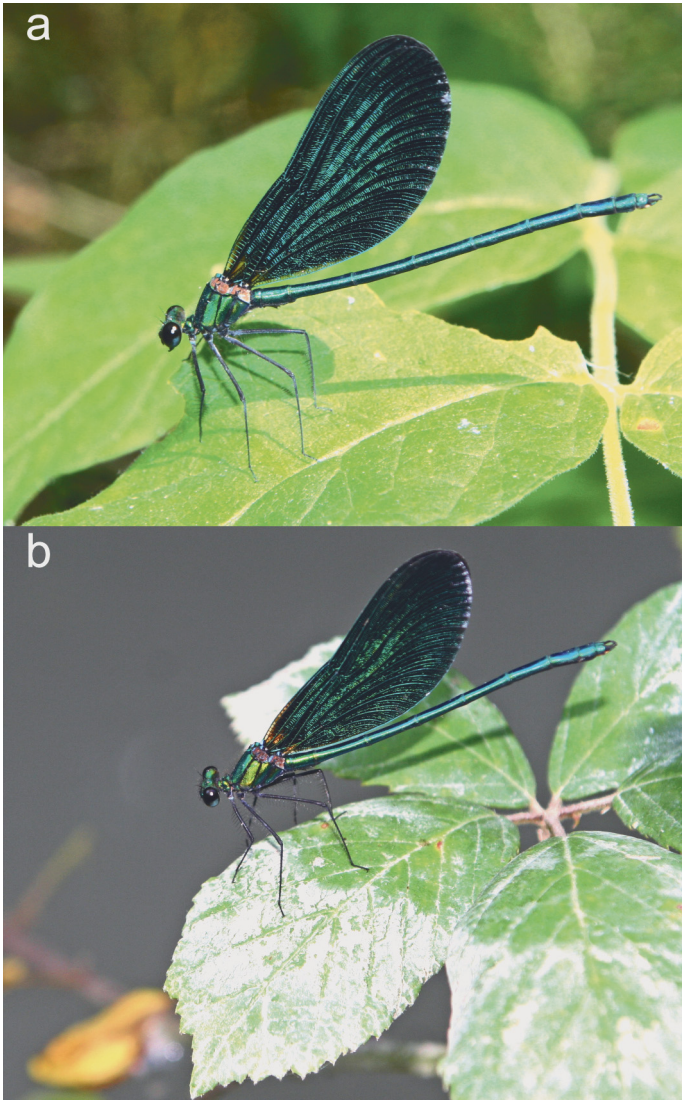

Figure 2. Males of *Calopteryx virgo feminalis* at the Doob River lowermost reaches, 1.08.2015 (a) and Tserkovnaya Shchel' Valley, 28.07.2015 (b).

Measurements of the type series

Males: hind wing 31 mm long, 10.5-11 mm wide, abdomen without appendages 37-39 mm, total length 48-51 mm. Females: hind wing 34.5 (holotype) - 36 mm long, 11 mm wide, abdomen 38.5-39,5 mm, total length 50-51 mm.

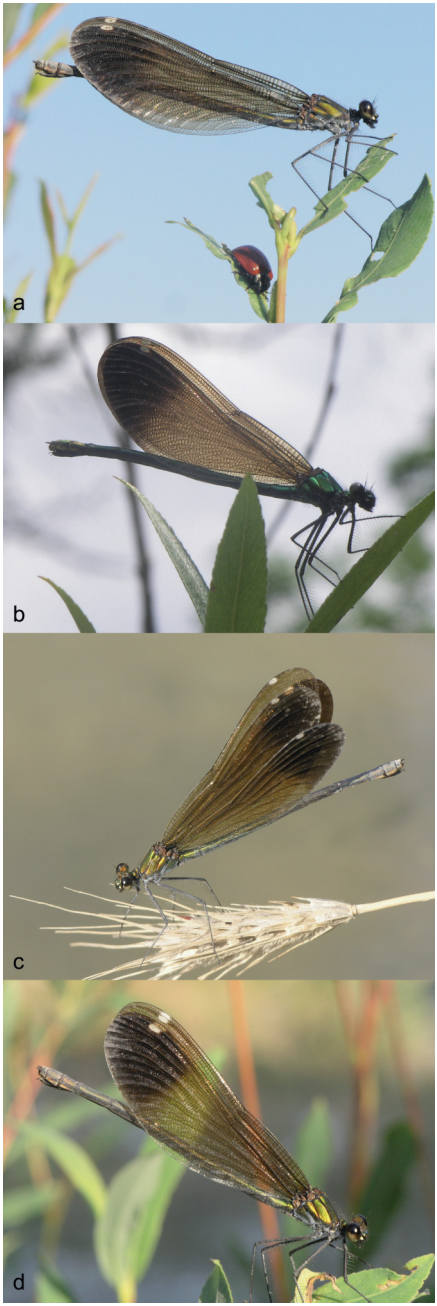

Figure 3. Females of *Calopteryx virgo feminalis* at Tserkovnaya Shchel' Valley, 7.07.2016 (a,c,d) and the Doob River lowermost reaches, 9.07.2016 (b).

Diagnosis

Both sexes differ from other subspecies of *Calopteryx virgo* (Linnaeus, 1758), including *C. virgo festiva* Brullé, 1832, as follows: males have the underside of S10 and the basal halves of cerci whitish (Fig. 4) rather than reddish; females have the distal one third of the hind wing dark brownish, with quite a distinct border of that colour (Fig. 1a, 2), rather than evenly brownish or with intensity of pigmentation gradually increasing towards the wing apex, as in other subspecies; in both sexes the hind wing width is less than 12 mm. The diagnostic characters fererring to the coloration of female wings and male abdomen are not absolute and occur at some frequency, as distinct alternative morphs without transitions, beyond the pure populations of the new subspecies in a broad transitional zone; the whitish underside of the male abdominal tip seemingly being more widespread.

Distribution and discussion

Schröter et al. (2015: 314) considered that "females of the *feminalis* type from the Colchis at the eastern coast of the Black Sea might represent an atavistic female type with alleles inherited from the last common ancestor of *C. virgo* and the Western Mediterranean *C. haemorrhoidalis*". In fact, this may be true not only for a 'female type' but for the gene pool in general, containing alleles for the above mentioned diagnostic characters for both sexes as well as many others not manifested in the phenotype. This relic

Figure 4. End of abdomen of a male paratype of *Calopteryx virgo feminalis* (see Fig. 1b). Scale bar 1 mm.

gene pool deserves a subspecies status. Hence, the subspecies *feminalis* is defined here as embracing the populations where overwhelming majority of the constituent individuals of both sexes manifest the above mentioned diagnostic characters. The subspecies seems to have a considerable range stretched along the Black Sea coast of the Caucasus, but its borders are still to be clarified.

Such populations are mostly known from the paper by Bartenev (1930: 51-52) who reported his "*Calopteryx virgo festiva* var. *feminalis* Bart." for 20 localities in the West Caucasus between 37°36' and 43°00', presently in the southern Krasnodarskiy Kray of Russia, Abkhazia and Samergelo-Zemo Svaneti (Mingrelia), Guria and Imereti Provinces in western Georgia. All but one localities were at the southern principal slope of the Great Caucasus except for one, Maikop (44°37' N, 40°07' E, 1 ♀), which is at its northern foot. Schröter et al. (2015) added a population with the characters of ssp. *feminalis* at Ombolo in Adjaria Province of Georgia.

Bartenev (1930: 52) claimed all his specimens from the West Caucasian localities except for those from Batumi in Adjaria to be *feminalis*, as having "narrow wings, small pterostigma, characteristic wing coloration in females". At the same time, Schröter et al. (2015) reported four populations from Adjaria. Guria, Imereti and Kakheti Provinces of Georgia which corresponded to *C. virgo festiva*, save some males with whitish underside of S10 and appendages (M. Seehausen, pers. com.); but also a population of *feminalis* from Ombolo, Adjaria. Although range shifts of some Odonata for the last century cannot be excluded, this seeming contradiction should be more likely interpreted so that western Georgia is a broad zone of transition between sspp. *feminalis* and *festiva*, with a mosaic of populations where one of these types predominate and/or populations where diagnostic characters of both co-occur at certain frequency. This zone of introgression continues to the eastern Black Sea coast of Turkey, as the whitish

vs reddish underside of the male abdomen tip were reported by Miroğlu at al. (2011) to co-occur between the Melet River and the border of Georgia.

So, at present the conventional geographical border of the range of *C. virgo feminalis*, embracing populations with the diagnostic characters predominating, cannot be drawin with certainty. The northern border is expected to follow the crest of the Great Caucasus or also to embrace some part of its northern principal slope in the Krasnodarskiy Kray. The eastern border most probably should be sought for in the southeasternmost Krasnodarskiy Kray or Abkhazia.

Populational studies of *C. virgo* in West Caucasus are most welcome, including analysis of population frequencies of both visual and molecular characters, as well as studies on the wing morphometry.

Remarks

1. From the nomenclatorial point of view, the new name *feminalis* Kosterin, 2017 can neither be considered a junior primary homonym nor a junior subjective synonym of the name *feminalis* Bartenev, 1910, since the latter is unavailable and hence is not governed by ICZN (Art. 1.3.4) and cannot compete with an available name with respect to both the principles of priority (Art. 23.3.4) and homonymy (Art. 54.2).

2. Those who assume that subspecies should have at most narrow transition zones between them (or none) have to consider *C. virgo feminalis* Kosterin, 2017 as a junior subjective synonym of *C. virgo festiva*.

3. Matti Hämäläinen (pers. comm.) kindly pointed out at an available species group name to consider: von Eichwald (1837) described *Agrion colchicus* von Eichwald, 1837 (incorrect gender coordination, should be *A. colchicum*) by individuals observed at "Ssatschura" (Sachkhere Town in the present day Imereti Province of Georgia; 42°21' N, 43°25' E') on 15.05.1826. The main text referred to this species is as follows: "Auch Libellen waren hier in Menge, einige grün metallisch glänsend *), andere blau, von gleicher Größe." [There were also dragonflies, some glittering metallic green, others blue, of a great size.] (von Eichwald, 1837: 272). The actual description is given, in Latin, in a footnote as follows: "Diese grüne Art schien mir neu zu seyn, ihr Charakter ist folgender [This green species seems new to me, its characters are the following]: *Agrion colchicus*, aeneo-viridis, thorace altiore sulcis inter areas aeneo.virides nigris notato, inferne nebuloso-coeruleo, trunco superne aeneo-viridi, ultimis segmentis minitis tumidioribus, flavidis, alis omnibus aequalibus medio postice dilatatis, apicibus rotundatis, aeneo-viridi-nigrescentibus, omnibus antice parvula macula marginali nivea notatis; pedibus nigris, subtus nebuloso-coeruleis, antice longis setis piliformibus nigris, subtus nebuloso-coeruleis, antice longis setis piliformibus instructis; veins alarum parvis [*Agrion colchicus*, bronze green, with a rather high thorax, marked with black furrows between bronze green areas, beneath cloudy blue, the body above bronze green, the smallest last segments a little more swollen, yellowish, the wings all alike, behind the middle dilatated with rounded ends, bronze-green-blackish, each marked frontally with a very small white marginal spot; with black legs, underneath cloudy blue, in front with long hairlike bristles; with small veins of the wings.]." It is unclear if any specimens were collected, perhaps not. This species was synonymised to '*Agrion virgo*' still by Kirby (1890) but for our

topic it is of interest which subspecies it corresponds to. The bronze-green-blackish wings with a false pterostigma suggest a female of *C. virgo*; no distinct distal darkening is mentioned, hence these insects corresponded to normal females of *C. virgo festiva* which also occur in this region of Georgia (Schröter et al. 2015). Imereti Province is in the presumed transitional zone between sspp. *festiva* and *feminalis*. Moreover, Sachkhere is situated 35 km more easterly than Tkibuli (42°20' N, 43°00' E), the eastern-most locality of *feminalis* reported by Bartenev (1930). Anyway, this is far beyond the core range of *feminalis* as defined above (although still unclear itself). Description from beyond the range of *C.* vigro *feminalis* as defined in this paper, and phenotypic correspondence to *C. virgo festiva* rule out a possibility that *colchicus*/*colchicum* Eichwald, 1837 is a name available for *C. virgo feminalis* in the sense of this paper.

4. Although the populations of *C.* vigro *feminalis* subsp. nov. at Kabardinka are thriving, the type series is very small. This is because when being in the field I still assumed the name *feminalis* Bartenev, 1910 as available and valid and saw no need to collect many specimens.

Acknowledgements

The work was supported by International Dragonfly Fund and, partly, project No. 0324-2016-0002 at the author's institute. I am deeply grateful to Jan van Tol, Matti Hämäläinen, Milen Marinov, Malte Seehausen and Martin Schorr for fruitful discussion and important suggestions, although I should make a reservation that neither of them agreed with all my solutions. I also thank Matti for providing the English translation of the Latin text made by Heinrich Fliedner.

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