

## Description of the female of *Somatochlora borisi* with distributional notes on the species (Odonata: Corduliidae)

Jean-Pierre Boudot<sup>1</sup>, Daniel Grand<sup>2</sup>, Burkhard Grebe<sup>3</sup>, Nurten Hacet<sup>4</sup> & Milen Marinov<sup>5</sup>

<sup>1</sup> LIMOS, UMR CNRS 7137, Université Henri Poincaré Nancy I, Faculté des Sciences,  
B.P. 239, F-54506, Vandoeuvre-lès-Nancy Cedex, France.

<jean-pierre.boudot@limos.uhp-nancy.fr>

<sup>2</sup> 3 B Impasse de la Voûte, F-69270, Saint-Romain-au-Mont-d'Or, France.

<robertegrand@chello.fr>

<sup>3</sup> Oberdorfallée 7a, D-53909 Zülpich, Germany. <burkhard.grebe@epost.de>

<sup>4</sup> Trakya University, Faculty of Arts and Sciences, Department of Biology,  
Tr-22030 Edirne, Turkey. <nhacet@hotmail.com>

<sup>5</sup> P.O. Box 134, BG-1000 Sofia, Bulgaria. <mg\_marinov@yahoo.com>

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### ABSTRACT

The morphology of the hitherto unknown female of *Somatochlora borisi* is described and illustrated basing upon eight adults from Bulgaria, Greece and Turkey. A key is provided which allows the determination of the females of all West Palaearctic *Cordulia* and *Somatochlora* spp. A list of the presently known localities and a distribution map show the range of the species as currently known. The species is new to Turkey.

### INTRODUCTION

According to available information, *Somatochlora borisi* Marinov, 2001 appears to be a corduliid of high endemism from the Balkan area. Published records (Marinov 2001; Grebe et al. 2005) are very scarce and originate all from the eastern Rhodopes, a mountain range pertaining both to NE Greece and S Bulgaria. Until now, the female remained unknown. During several trips in NE Greece, SE Bulgaria and NW Turkey from July 1992 to mid May 2004, we found the species in all three countries, where it was fairly common at some places. In this paper we compile all localities where the species has been found, describe the female and differentiate it from *Cordulia aenea* (Linnaeus, 1758) and all other West Palaearctic *Somatochlora* females. The latter are *S. m. metallica* (Vander Linden, 1825), *S. m. abocanica* Belyshev, 1955, *S. m. meridionalis* Nielsen, 1935, *S. flavomaculata* (Vander Linden, 1825), *S. arctica* (Zetterstedt, 1840), *S. alpestris* (Selys, 1840) and *S. sahlbergi* Trybom, 1889.

## METHODS

Several streams in the region between the eastern Rhodopes, the Aegean Sea and the Black Sea coast were investigated. A pond was also included. Eight females of *Somatochlora borisi* were caught, either alone or in copula, for examination. For comparison with the females of *Cordulia aenea* and other West Palaearctic *Somatochlora* species, we referred to Valle (1931), Sahlén (1985), Schneider (1986), Sandhall (1987), Askew (1988), Lohmann (1994), Holuša (1995, 1997) and Karjalainen (2002), and to our own collection (coll. G. Jacquemin & J.P. Boudot).

## RANGE

Up to May 2004, seven streams were found to be inhabited by *Somatochlora borisi* (Fig. 1), all being in an area with a hot and humid climate and surrounding forest:

- (1) Deimin Dere River near Byal Gradetz (41°25'N, 25°54'E) (type locality) (Marinov 2001), eastern Rhodopes of SE Bulgaria, 260 m a.s.l., May/June 2000, July 2003 and mid-May 2004.
- (2) Byala Reka near Gougoutka (41°25'N, 25°56'E) (Marinov 2001), eastern Rhodopes of SE Bulgaria, 180 m, June 2000/2003.
- (3) Ropotamo River near its mouth into the Black Sea (42°18'N, 27°42'E) (present paper), SE Bulgaria, 25 m, June 2003.
- (4) Diavolorema River near Dadia (41°08'N, 26°09'E) (Grebe et al. 2005), NE Greece, 100-150 m, May 2001 and 2004.
- (5) Stream of Protokklision (41°17'N, 26°19'E) (Grebe et al. 2005), NE Greece, 40 m, May 2001.
- (6) Diavolorema River near Mikron Dherion (41°17'N, 26°05'E) (present paper), despite the identical name, not the same river as the previous one, NE Greece, 100-190 m, May/June 2003, early May 2004.
- (7) Pabuç River near Kıyıköy (41°38'N, 28°05'E) (present paper), Trakya, Turkey, 5 m, July 1992.



Figure 1: Map of all localities known for *Somatochlora borisi* at mid May 2004. The numbers refer to the text order of localities.

## The female of *Somatochlora borisi* (Figs 2-5; Plate I)

### Specimens studied

One ♀, loc. 7, 05 vii 1992, leg. N. Hacet, deposited in Department of Biology, Faculty of Arts and Sciences, Trakya University. — One ♀, loc. 4, 26 v 2001, leg. B. Grebe, designated for deposition in Hessisches Landesmuseum Darmstadt, Germany. — Six ♀, loc. 6, 01 vi 2003, 6-8 v 2004, leg. D. Grand and J.-P. Boudot. In this locality, three females were caught in copula during a windy day (07 v 2004), one was caught after oviposition, when it was going to perch (01 vi 2003), and the last two were immature (with brown eyes), either maturing in sun-shine close to the stream (06 v 2004) or gliding above a stony way ca 200 m apart from the stream (06 v 2004). — Four other females were seen in copula at the latter two Greek rivers during windless days but, flying rapidly to the top of trees, could not be secured.

### Description

**Head:** Colour pattern as in the male; no difference between sexes. Eyes shining green at maturity. Vertex, front of the frons and front of the occipital triangle dark with metallic green shine. Side of frons entirely yellow. Lower edge of frons blackish in the middle in front, shortly yellow on the sides. Ocelli yellow. Postclypeus metallic green to blackish in the middle, yellow on both sides. Anteclypeus yellow. Labrum black, mandibles and labium yellow (Fig. 2). Back of head wholly blackish.

**Thorax:** Prothorax in dorsal view with an anterior yellow ring, then black, finally with a more or less triangular yellow posterior area. Synthorax shining metallic green with dense pale hair. Legs entirely black, coxae of the fore legs yellow on their dorsal side. All tibiae without keel. Wings (Fig. 3) with mostly black venation, slightly brownish on the first three Ax. Pt black. One cubito-anal crossvein in Fw, two in Hw. Seven to nine Ax in Fw, five in Hw. Seven Px between nodus and Pt in Fw, seven or eight in Hw. Discoidal cell (wing triangle) crossed by one or two nervules in Fw, free or crossed by one nervule in Hw, then discoidal cell 2- to 3-celled in Fw, 1- to 2-celled in Hw. The same variability was also observed in males. Base of wings with pale amber extending along the main veins up to slightly more or to slightly less than the first Ax and cubito-anal crossveins in both Fw and Hw. Rest of both Fw and Hw either hyaline or with faint amber on its whole surface, especially along the entire wing costal area. Membranula mostly whitish, darkening downwards.

**Abdomen:** Dark metallic green, even somewhat blackish on S1-2 and S8-10, almost parallel-sided in dorsal view, with only a very weak narrowing on S3 and two very weak widenings on S2 and S7 in vivo, then decreasing gradually to S10. S2 decidedly widened and S8 weakly widened in lateral view. Distinct yellow dorso-lateral spots on S2-3, near their posterior and anterior margin, respectively, together with large yellow ventrolateral patches from S2 to S4 (Fig. 4). Medium- to minute-sized ventrolateral yellow spots on S5, from well apparent to hardly

visible. Optional minute yellow dots on S6-8, not always visible in lateral view, sometimes present only on one side. Superior anal appendages black, longer than the dorsal length of S9 but shorter than the total length of S9+10, apically rounded, very slightly curved outwards, the external side straight, slightly sinuous or weakly concave, the internal side more or less straight or convex. Vulvar scale flat, slightly curved towards the ventral side of the abdomen in lateral view but not tight fitting over it, entirely black, short, semicircular, less than half as long as the dorsal length of S9, not reaching the middle of S9 in ventral view, with a deep and narrow median cleft reaching almost its base, the two lateral halves contacting or even slightly overlapping each other so that the median incision will not always be apparent and the vulvar scale will appear at first sight regularly rounded at tip (Fig. 5). S9 with two distinct bulges about in the middle of segment and near the apex of vulvar scale.

**Dimensions [mm]:** Total length (incl. appendages) 45-49.3; total wingspan 67.5-71.2. Fw length 31.7-33.75; Hw length 31.5-33.5; abdomen length (excl. appendages) 31-34; appendages length 2.5-2.72.

#### DIFFERENTIAL DIAGNOSIS:

key to the females of the West Palaearctic *Cordulia* and *Somatochlora* species

1. Hw with one cubito-anal crossvein; abdomen with a yellow or whitish medioventral area on S2-3, but without yellow separate ventrolateral patches on each side of S3; vulvar scale deeply cleft in its distal half, with the two parts clearly separated by a distinctly widened notch, tight fitting over the ventral side of the abdomen and scarcely visible in lateral view ..... *C. aenea*
- 1'. Hw with two cubito-anal crossveins ..... 2
2. Abdomen with large yellow ventrolateral patches on each side of S2-4 or S2-5 and wide yellow dorsolateral patches on S2+3; medioventral part of S3 black; vulvar scale flat, short, not reaching the middle of S9, semicircular, with a deep and narrow median cleft reaching almost its base, the two parts contacting or even slightly overlapping each other so that the median cleft is not well apparent and the general appearance of the vulvar scale seems to be regularly convex at tip ..... *S. borisi*
- 2'. Abdomen with a yellow or whitish medioventral area on at least S3; no yellow separate ventrolateral patches on each side of S3; vulvar scale not cleft almost up to its base, but either notched, truncated or convex at tip, or beak-shaped, pointed and directed at right angle to the abdomen ..... 3
3. Vulvar scale very long and pointed, equalling about the length of S9+10 and running at right angle to the abdomen; frons with a complete yellow band on its lower margin, connecting the yellow sides; three subspecies ..... 4

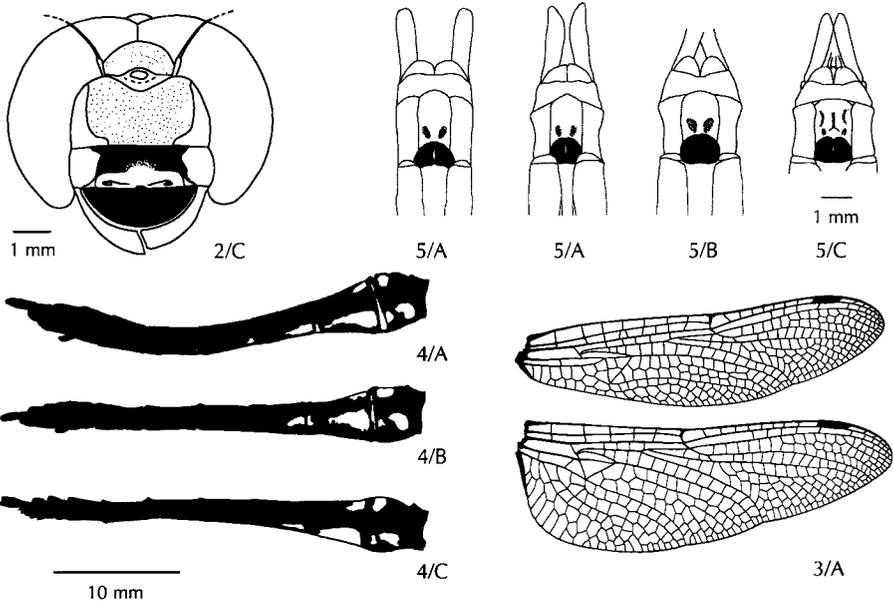
- 3<sup>?</sup>. Vulvar scale different, running obliquely or tight fitting as a groove over the ventral side of the abdomen; frons with yellow sides but without a complete yellow band in front on its lower margin ..... 6
4. Sides of synthorax each with one or two yellow elongated spots; Pt blackish; base of Hw clear along the membranula in mature females, but anterior margin of both Hw and Fw generally yellowish; abdomen always with wide dorsolateral yellow spots on S2+3 ..... *S. metallica meridionalis*
- 4<sup>?</sup>. Sides of synthorax without yellow marks; abdomen with or without dorso-lateral yellow spots on S2+3 ..... 5
5. Pt light brown; base of Hw pale amber in mature females; both Hw and Fw generally yellowish either on their anterior side or on their whole surface ..... *S. metallica metallica*
- 5<sup>?</sup>. Pt blackish; base of Hw clear in mature females ..... *S. metallica abocanica*\*
6. Vulvar scale clearly notched at the apex ..... 7
- 6<sup>?</sup>. Vulvar scale not notched at the apex but either truncated or convex ..... 8
7. Vulvar scale reaching about the middle of S9, blackish with a yellow apical margin; S1-8 (-9) with distinct yellow lateral spots, ventral part of S1-3 widely yellow; sides of synthorax green with yellow patches in young individuals, these patches vanishing progressively with maturity ..... *S. flavomaculata*
- 7<sup>?</sup>. Vulvar scale short, not reaching to the middle of S9, more or less semicircular, black; abdomen without yellow dorsolateral spots; synthorax without yellow patches ..... *S. sahlbergi*
8. Fw with one cubito-anal crossvein; S3 with two distinct dorsolateral yellow dots; vulvar scale yellow to light brown, reaching from 2/3 to the entirety or slightly more of the ventral side of S9, more or less tight fitting as a groove over the ventral side of S9, scarcely visible in lateral view ..... *S. arctica*
- 8<sup>?</sup>. Fw with two cubito-anal crossveins; S3 without yellow dorsolateral spots; vulvar scale black at base, yellowish in its apical half, reaching about the middle of S9, extending obliquely from the abdomen and clearly visible in lateral view ..... *S. alpestris*

\* The occurrence of *S. m. abocanica* in the western Palaearctic (Lohmann 1994) has been questioned by Kalkman & Dijkstra (2000), but one of us (JPB) found a well defined population of this subspecies in N Norway, at lakes in the Skibottselva Valley ca 8 km N of the Finnish border, 400 m a.s.l., 26 July 2003.

## CONCLUSION

The female of *Somatochlora borisi* may be easily recognized, due to its extensive abdominal yellow patches and to the shape of its vulvar scale. No other West Palaearctic *Somatochlora* or *Cordulia* exhibits such a unique yellow pattern on the ventral and ventrolateral side of the abdomen. Among all the West Palaearctic *Somatochlora* spp., only *S. sahlbergi* and *S. borisi* share a short and semicircular vulvar scale. But that of *S. borisi* is much more deeply and narrowly incised than that of *S. sahlbergi*, so that the incision is hardly visible at first sight. The overall variability of the female of *S. borisi* is deemed to be low and involves the size of the yellow marks on S5, the occurrence or lack of small yellow dots on S6-8 and the extension of the yellow tinge on the wings.

Although males of *S. borisi* superficially look like those of *Cordulia aenea* in their general appearance, the species has been ascribed to the genus *Somatochlora* thanks to the structure of the male inferior appendage, the lack of a mesotibial keel and the wing venation. However, the shape of the male superior appendages, blunt at apex, is unusual for *Somatochlora* species and superficially comes closer to that of *Cordulia*. As far as the female is concerned, the wing venation pattern – number of cubito-anal crossveins in Fw, discoidal cell free or crossed – fits *Somatochlora*.



Figures 2-5: Details of different females of *Somatochlora borisi* — (2) head; (3) wing venation; (4) general pattern of the abdomen; (5) vulvar scale. Collecting sites of the specimens: (A) Mikron Dherion, Greece; (B): Dadia, Greece; (C): Kıyıköy, Turkey.

The vulvar scale structure seems to be slightly different, however, being much more deeply and narrowly divided in *S. borisi* than in any *Cordulia* and *Somatochlora* species in the world, for which the female is known and sufficiently described; for non-European females, see Uhler (1858), Selys (1883), Förster (1909), Bartenef (1910, 1912), Valle (1932), Schmidt (1957), Walker & Corbet (1975), Asahina (1982), Zhu & Zhang (1999), Needham et al. (2000), Sugimura et al. (2001) and Cannings (2002). For a separation at the generic level, this character is regarded not to be sufficiently strong. Whether the current generic assignation of *S. borisi* will be maintained or whether this species should be placed in a new genus is a question that should be preferably addressed by future DNA studies.

All the streams where *S. borisi* was found pertain to both the eastern Rhodopes and the northern and southern foothills of the Istranca Mountains, the latter being an eastern continuation of the Rhodopes range. The species was found neither at the streams running from the Sélo Mounts – the highest easternmost elevation in the eastern Rhodopes – to the south directly towards the Aegean Sea, nor, more to the west, at the Xanthos River. It was also not found associated with stagnant water, e.g. there was no occurrence at a pond near Mikron Dherion (41°18'N, 26°07'E). Therefore it may be confined to stream systems running into the Black Sea and from the eastern Rhodopes to the east and to the north. Typical of the localities where the species has been recorded are a hot and humid climate and either a surrounding woodland on each side of the river or a fully forested watershed. Such a restricted area in wooded country argues for the setting up of a special conservation plan in this area, including the protection of the remaining deciduous forests and the control of water pollution.

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