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The Easternmost Record of *Somatochlora borisi* Marinov, 2001 from Turkish Thrace, with a Zoogeographic Assessment on the Distribution of the Species (Odonata: Corduliidae)

Nurten HACET

Trakya University, Faculty of Arts and Sciences, Department of Biology, Tr-22030 Edirne TURKEY, e-mail: nhacet@hotmail.com

ABSTRACT

This article discusses a new location for the Bulgarian Emerald, *Somatochlora borisi* Marinov, 2001, in the Turkish Thrace. A synopsis of the known distribution of this endemic species is given. The present records add an additional locality, which is the easternmost one for this species not only for Turkey, but also for its whole range. The morphological features of the species are discussed, and its distribution is mapped. A zoogeographic evaluation on the distribution of *S. borisi* in the Balkans is included. The localization of this species underlines the biologic and zoogeographic importance of the Balkans in terms of biodiversity for the whole Eurasia.

Key words: Odonata, Corduliidae, *Somatochlora borisi*, the Balkans, zoogeography, Turkish Thrace, Turkey.

INTRODUCTION

So far in Turkey, four Corduliidae species are known, belonging to the genera *Cordulia* Leach, 1815 and *Somatochlora* Selys, 1871, both showing an Holarctic distribution. These are: *Cordulia aenea* (Linnaeus, 1758), *Somatochlora borisi* Marinov, 2001, *S. flavomaculata* (Vander Linden, 1825) and *S. meridionalis* Nielsen, 1935.

Somatochlora borisi was first described from the Eastern Rhodopes Mountains in Bulgaria (Marinov, 2001). All known records of this species are confined to the Eastern Rhodopes in Bulgaria and Greece, the southern Black Sea coast in Bulgaria and the foothills of the Istranca Mountains in Turkish Thrace (Boudot *et al*., 2004, 2009; Grebe *et al*., 2005; Fleck *et al*., 2007; Wildermuth, 2008) (Fig. 1). Until now, there has been only one locality of this species, documented in Turkey – Turkish Thrace, Kıyıköy (Boudot *et al*., 2004; Kalkman & Van Pelt, 2006). Specimen of *S. borisi* from the above locality is the first record of a female of this species (Boudot *et al*., 2004). According to available records, this species is currently considered to be a highly endemic one, restricted to the South-East region of the Balkans (Boudot *et al*., 2004, 2009; Grebe *et al*., 2005; Fleck *et al*., 2007; Wildermuth, 2008).

The present study adds a new locality to the distributional range of *S. borisi*. The male specimen from this new locality in Turkish Thrace is compared with those from the previous localities in terms of morphological features such as; wing venation, colour

and the shape of caudal appendages. Some relationships are discussed between the palaeogeography of the Balkans and the restricted range and endemicity of the species.

MATERIAL AND METHODS

In the collection of the Biology Department of Trakya University, Edirne, Turkey (TU) there are deposited two male specimens, still unrecorded, which were collected by the author in Turkish Thrace in 1992 and 1998. Information about the localities where those specimens collected is given below.

Collecting sites: The locations of all previously published (see references above) and new localities for *S. borisi* in the Balkans are shown in Figure 1.

New localities are: (1) Kırklareli-Vize, Kıyıköy, Pabuç dere (=Pabuç river), 41°38'N 28°05'E, near sea level, 05 July 1992, Papuç dere, is a river which originates from the southern parts of the Istranca Mountains, and flows into the Black Sea. This locality was already known for the species, as a female had been previously described from this river at the same place (Boudot *et al*., 2004). (2) İstanbul-Çatalca, İnceğiz village, 41°11'N 28°24'E, 70 m, 24 June 1998, a brook in the entrance of İnceğiz on the Çatalca-İnceğiz road. This locality is a new for the species.

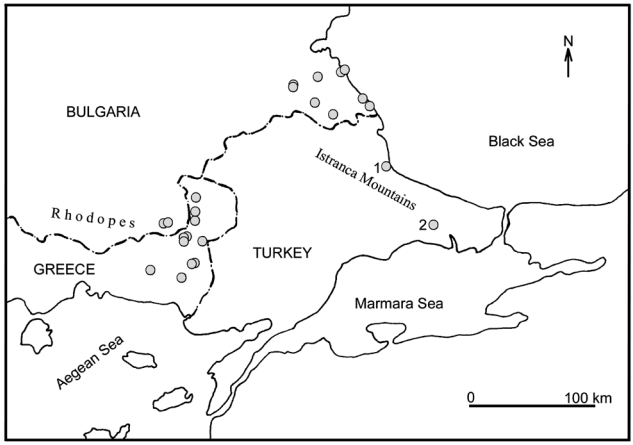

Fig.1 Records of *Somatochlora borisi* in the Balkans.

RESULTS

Material Examined: Loc.1: 1 male; Loc.2: 1 male.

Morphology and intraspecific variability

The abdominal appendages of the males from Kıyıköy and İnceğiz (Fig. 2a, b) match the descriptions given by Marinov (2001) and Marinov & Seidenbusch (2007) for *S. borisi*. The superior appendages are blunt and curved downward. Their proximal parts have two teeth. The tip of the inferior appendages is bilobed. Wings venation is also similar to that of *S. borisi.* Venation is usually black. Membranula is whitish basally

and brownish downwards. Discoidal cells in the fore- and hindwings are crossed by one vein. Forewing with one cubito-anal crossvein, hindwing with two cubito-anal crossveins. The shape of the genital lobe on S2 in the "Kıyıköy" specimen is similar to that of the type specimen given by Marinov (2001) (Fig. 3a). However, the outer edge of the genital lobe on S2 in the "İnceğiz" specimen is almost flat (Fig. 3b) instead of swollen. This difference in genital structure may be considered as a variation among individuals of the population. The thorax's colour of İnceğiz specimen is darker green than that of Kıyıköy. Marinov (2001) indicated that the lower distal yellow spot on the backsides of S2 in paratype specimens is in varying shapes. The shapes of these spots in our two males are more or less similar to each other, but they differ slightly from that of the type specimen given by Marinov (2001) (Fig. 3a, b).

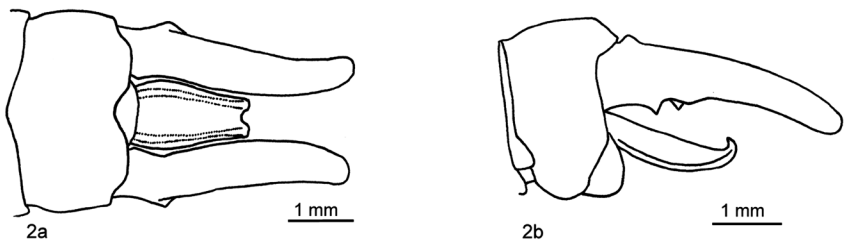

Fig.2. *Somatochlora borisi* (Kıyıköy) : male anal appendages, (a) dorsal view, (b) lateral view.

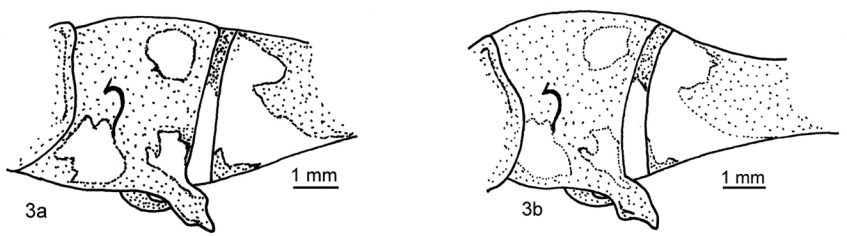

Fig.3. *Somatochlora borisi* : lateral views of abdominal segments (S1 and S2) of male specimens from Kıyıköy (a) and İnceğiz (b).

Habitat preference and associated species

Until now there was only one record of a single female of *S. borisi* from Turkish Thrace in Turkey (Loc.1) (Boudot *et al*., 2004). The two new records added in this paper refer to the two males collected in 1992 and 1998 from Turkish Thrace. One of these males originated from previously known locality (Kıyıköy). In this locality *Aeshna isoceles* (Müller, 1767)*, Libellula depressa* Linnaeus, 1758 and *Libellula fulva* Müller, 1764 were recorded in a small marshy area near the bank of the river, while *Orthetrum brunneum* (Fonscolombe, 1837) and *Sympetrum sanguineum* (Müller, 1764) were found on the river bank itself.

The second discussed specimen was found in the village of İnceğiz (Çatalca peninsula-İstanbul province), which is a new location for this species. This locality is situated at the south-eastern foot of the Istranca Mountains. The specimen was

caught around a slow flowing brook, surrounded mainly by *Salix* sp. and *Alnus* sp. trees positioned just at the entrance of İnceğiz on the main road to Çatalca. Dragonfly species sharing the same habitat with *S. borisi* in that locality are *Ischnura elegans* (Vander Linden, 1820), *Platycnemis pennipes* (Pallas, 1771), *Gomphus vulgatissimus* (Linnaeus, 1758), *Onychogomphus forcipatus* (Linnaeus, 1758), *L. depressa*, *L. fulva* and *O. brunneum*. Up to now the records of *S. borisi* have been only from rivers and streams (Marinov, 2001; Boudot *et al*., 2004; Marinov & Seidenbusch, 2007). At the described location there is a larger river passing near the edge of the village, which seems to fit at best the habitat requirement of the species (the Karasu deresi) and it most probably originated from there. The locality is about 26.5 km east to the longitude of the Kıyıköy site and constitutes now the easternmost boundary of *S. borisi* in Eurasia.

DISCUSSION

Somatochlora borisi inhabits mainly large and running rivers in southeastern Balkans, its distributional area. Although such suitable habitats present in a much larger area in the Balkans and *S. borisi* has sufficient ability to disperse, this species has been known in a limited area of the region so far. The distributional range of this species may have been restricted either by ecological requirements of this species that are not yet known, or by competitive interaction with other species which prevented its spreading. The latest data shows that the Global warming threatens the presence of *S. borisi*. The water amount of the rivers where this species breeds decreased as early as late July and the rivers themselves dried in September (Boudot *et al*., 2009). Localities of this species in Turkish Thrace were not visited in August and September. According to the author's own observations in the last decade, the water levels of rivers and brooks in the Istranca Mountains have decreased significantly or they dry out during the late summer.

The fundamental geological structure of the Balkans is closely related to the formation of the Alps about 65-70 million years ago in Europe (Demirsoy, 1996). The Rhodopes and Istranca Mountains, where *S. borisi* occurs, form a part of these mountain ranges. Topographic (high mountain areas and lowlands) and climatic diversity of Balkans allows the existence of diverse flora and fauna in the region (Krystufek & Reed, 2004). The Balkan Peninsula is one of the areas which includes high numbers of endemic taxa in the Circum-Mediterranean region (Polunin, 1987; Oosterbroek & Arntzen, 1992). Consequently, it is natural that *S. borisi* has an endemic distribution in the Balkans. Oosterbroek & Arntzen (1992) evaluated the correlation between Mediterranean palaeogeography and area-cladograms of different taxa found in the Circum-Mediterranean region to explain diversifications and distributions of the species in the region. They defined a basic pattern of area relationships in the Circum-Mediterranean region, which is likely to be also valid for other taxa in the region. The correlation between the taxon-area-cladogram and palaeogeographic reconstructions suggests an Early and Middle Miocene divergence (about 20 until about 15 million years ago) within the taxa in the Balkans. The results of the study of Oosterbroek & Arntzen (1992) showed that species and subspecies in the Balkans belong to Northwest Africa and Transmediterranean lineages. Therefore, the ancestral lineage of *S. borisi* in the Balkans may be associated with this period and probably

related with Transmediterranean or European lineage. According to Oosterbroek & Arntzen (1992), some divergences within Transmediterranean lineages might depend on refugial isolation during the glacial and interglacials of the Pleistocene epoch. So far, it has been thought that the recent disjunctive ranges of species are the remnants of preglacial ranges (Krystufek & Reed, 2004).

Recently, Dubatolov & Kosterin (2000) and Kosterin (2005) have defended the hypothesis that the recent disjunct distributions of species associated with the broad-leaved forests do not date back to preglacial period (about 1.8 million years ago). Palaeopalinological reconstructions, which were based on data obtained from rich material in Siberia, show that the continuous broad-leaved forests were re-established in Eurasia during interglacial periods and the Atlantic period of Holocene, when the climate was at an optimum. Consequently, the fauna throughout the region recolonized during these periods. In addition, climatic conditions in refugia in earlier glacial periods were insufficient for the survival of the animal and plant species (Kosterin, 2005). Refugia help to the survival of plants and animals in Siberia acted for only 5 to 8 thousand years after the Holocene climatic optimum, not for 1.8 million years (Dubatolov & Kosterin, 2000; Kosterin, 2005). According to palynological evidence, climatic optimum occurred much later (about 5 thousand years ago) in the west of Eurasia than that in the east (8 thousand years ago). The recent range disjunctions of refugial fauna in the Balkans may have also occurred in this putative duration proposed for the west of Eurasia. *S. borisi* is likely to be a member of such a refugial fauna, which was particularly unable to extent far North during the warmer Holocene due to lack of plasticity in its ecological requirement. Undoubtedly, new studies and data on the distributions of Odonata with well defined distribution will give some noteworthy information to explain the zoogeography of a region.

Somatochlora borisi has been repeatedly ascribed to the genus *Somatochlora* (Marinov, 2001; Boudot *et al*., 2004, 2009; Kalkman, 2006; Wildermuth, 2008). Marinov & Seidenbusch (2007) concluded that this taxon differs from other European species of *Cordulia* and *Somatochlora* in several characters. When *S. borisi* is compared to Nearctic Corduliidae (eight genera), it is apparent that it has a quite different combination of characters, and the authors ascribed it to a new monotypic genus, *Corduliochlora*. However none of these “special” features was undoubtedly significant *per se* to support indisputably a distinct genus rank, so that the question will remain open as far as a whole phylogenetic study of the Corduliidae group is not be undertaken (Wildermuth, 2008; Boudot *et al*., 2009).

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