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Contents

PAUL-MICHELLE BRUNELLE Status of <i>Somatochlora brevicincta</i> (Odonata: Corduliidae), the Quebec Emerald, in North America	1-8
MILEN MARINOV <i>Somatochlora borisi</i> spec. nov., a new European dragonfly species from Bulgaria (Anisoptera: Corduliidae)	9-16
MILEN MARINOV Commented bibliography of the Bulgarian fauna of the Odonata	17-45
MILEN MARINOV The genus <i>Somatochlora</i> Selys in Bulgaria	46-53
Protokoll der Jahresmitgliederversammlung des IDF in Schwäbisch Hall am 19. März 2000	54-56

Status of *Somatochlora brevicincta* (Odonata: Corduliidae), the Quebec Emerald, in North America

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INTRODUCTION

Somatochlora brevicincta Robert 1954 is one of the rarest odonates in Canada, and one of the most recently described. It is known only from North America, the type locale being in the Lake Mistassini region of the province of Quebec at ca. 50.5°N, 74°W (Fig. 1:1).

The species is of the cingulata group of the genus, in which the male cerci converge apically from a distinct joint, rather than in a smooth curve as in species of the *forcipata* group. *S. brevicincta* is very similar in size and appearance to *S. albicincta* (Ringed Emerald) from which it can be discriminated only by close inspection. Unlike *S. albicincta*, the pale abdominal annuli of *brevicincta* are interrupted dorsally, the male cerci approach at a more acute angle, and the vulvar lamina is not notched apically. At up to 50 mm in length it is much smaller than *S. cingulata* (Lake Emerald) which is up to 63 mm, and it has no dark basal markings outside the membranule of the wings, as have *S. franklini* (Delicate Emerald), *S. septentrionalis* (Muskeg Emerald) and *S. whitehousei* (Whitehouse's Emerald). *S. sahlbergi* (Treeline Emerald) lacks abdominal annuli posterior to segment 2.

The Quebec Emerald is listed as VU D2 (vulnerable, with a very small or restricted population) in the 1996 IUCN Red List of Threatened Animals (Baillie and Groombridge 1996) the only odonate listed solely for Canada. It currently holds the global status G3 (vulnerable) with The Nature Conservancy (Association for Biodiversity Information (ABI)), and the national statuses N2N3 (imperilled/vulnerable) for Canada and N1 (critically imperilled) for the United States (October 2000 data, M. Morrison, in litt.).

Interest in *S. brevicincta* was sufficient to cause the World Wildlife Fund to fund study in Quebec during 1997, during which work the larvae were taken for the first time. A description by R. Hutchinson is in final review for the journal *Faberies*.

In 1998, due to several unexpected range extensions east of Quebec, the Nova Scotia Museum (NSM) and the International Dragonfly Fund (IDF) supported

research and survey by myself on the species in Nova Scotia, the results published in Brunelle (1998, 1999, 2000).

Publication of these various range extensions has also led to reexamination of material already in collections, resulting in an eastern range extension to the island of Newfoundland, and a further site in New Brunswick.

Subsequently there have been yet more substantial range extensions west to British Columbia and south to Maine, which demonstrate that the species is cross-continental in distribution, though generally rare even when present.

METHODS

Specimens from the northeast in public collections in Canada and New England had been catalogued during the research leading to various preceding papers. Collections catalogued were; A.D. Pickett Entomological Museum, Truro, Nova Scotia (ADP); Canadian National Collection of Insects, Ottawa, Ontario (CNCI); International Odonate Research Institute, Gainesville, Florida (IORI); Maine Department of Forestry, Augusta (MDF); Maine Department of Inland Fisheries and Wildlife, Bangor (MDIFW); New Brunswick Museum, Saint John (NBM); Nova Scotia Department of Natural Resources Insectary, Shubenacadie (NSDNRI); Nova Scotia Museum, Halifax (NSM); Royal Ontario Museum, Toronto, Ontario (ROM); University College of Cape Breton, Sydney, Nova Scotia (UCCB); University of Maine, Orono (UMO); University of Massachusetts, Amherst (UMA); University of New Hampshire, Durham (UNH); and University of Prince Edward Island, Charlottetown (UPEI).

A collection taken in the early 1980s by the Biosystematics Research Center (BRC), housed separately at CNCI and apparently the basis for the odonate section of Martin and Allyson (1987), was confirmed and catalogued for me by Raymond Hutchinson in 1997 in conjunction with research on the odonates of the Greater Highlands Ecosystem for Cape Breton Highlands National Park (CBHNP) (Brunelle 2000).

In addition, members of the Atlantic Dragonfly Inventory Program (ADIP) and the Dragonfly Society of the Americas (DSA) provided data on specimens from the region.

During the 1998 season, 12 field days were spent in survey of peatlands throughout Nova Scotia, including those in the Cape Breton Highlands in which *S. brevicincta* had been sampled earlier.

RESULTS

Distribution

The 1998 survey resulted in the addition of *S. brevicincta* to the Nova Scotian Mainland list. Details on this, and on our overall knowledge of distribution of the species, are given below by province and state in order of discovery. Figure 1 shows the approximate locations of the various sites referred to in the text:

- 1 1954; Quebec; description, type locale (Robert 1954).
- 2 1954-98; Quebec; further sites (Pilon and Lagace 1998).
- 3 1983; Nova Scotia, Cape Breton Island (Brunelle 1998, 2000).
- 4 1990; Newfoundland; O.S. Flint, unpublished.
- 5 1997; New Brunswick; J. Edsall (Brunelle 1999).
- 6 1998; New Brunswick; S. Tingley (Tingley 1998).
- 7 1998; Nova Scotia, Mainland (Brunelle 1998, 1999).
- 8 1999; Maine (Nikula 1999).
- 9 2000; British Columbia (Cannings and Cannings 2000).



Fig. 1: Distribution of *Somatochlora brevicincta* as known in 2000.
Cartography: Ralph Koch, Trier, Germany.

Province of Quebec

In addition to the type locale (Fig. 1:1), *S. brevicincta* has been recorded from a number of other locales in the boreal and subarctic zones of that province (Fig. 1:2) as summarized in Pilon and Lagace (1998).

Province of New Brunswick

Our first indication that the species was to be found outside Quebec was the collection in 1997 of a single male by J. Edsall near a large concentric bog just north of Moncton. The site was a small bog in the boreal forest, less than 50 m in diameter, comprised of pools choked with *Sphagnum* sp. It has apparently been greatly increased, if not caused, by the logging road bisecting it. While the late date and low abundance suggests a wandering individual, the habitat is not inappropriate for the species.

In 1998, S. Tingley discovered the species in considerable abundance at a small roadside fen in northern New Brunswick, now referred to as Stuart's Bog. This fen is almost certainly the result of logging road construction earlier in the century, and is formed of a quaking *Sphagnum* mat, with intermittent grassy pools and a margin of thick grasses growing from dense saturated *Sphagnum*. Only males have been observed at this site to date.

In 1999, T.W. Donnelly discovered two female *brevicincta* labeled as *albicincta* at the Smithsonian Institution, collected by O.S. Flint at small man-made ponds adjacent to Half Way Inn ca. 6 km east of Stuart's Bog. It is likely that these females were on foraging flights, as these ponds are inappropriate for the species.

Data:

Westmorland County: 46°22'N, 64°97'W, New Scotland Bog, New Scotland Road off Highway 126 (Fig. 1:5): September 16, 1997, J. Edsall, 1 male; not subsequently taken (Brunelle 1998, 1999).

York County: 46°85'N, 66°70'W, Stuart's Bog, Highway 108, ca. 59 km east of junction of Highways 380 and 108 (Fig. 1:6): June 25, 1998, S. Tingley, 2 males, ca. 20 males seen (Tingley 1998); July 7, 1998, P.M. Brunelle, J.M. Cormier, S. Tingley, >4 males, ca. 10 males seen; August 8 1998, J-M. Cormier, 1 male, the only seen (Brunelle 1999).

Northumberland County: 46°83'N, 66°63'W, ponds at Half Way Inn, Highway 108 just east of Dungarvon River (Fig. 1:6): July 17, 1996, O.S. Flint, 2 females, Smithsonian Institution, Washington, DC.

Province of Nova Scotia - Cape Breton Island

In September 1997, R. Hutchinson discovered four previously undetermined male *S. brevicincta* from Cape Breton Island in the CNCI, and I subsequently

confirmed three of them. Collection locales were bogs on North Mountain on the Highlands Plateau. These locales were re-surveyed in 1998, but *S. brevicincta* was not found, possibly due to competition with the surprisingly abundant *S. septentrionalis*, itself a rare species in the province. Several of the bogs contained fen-like grassy ponds which would appear to be appropriate for *S. brevicincta*.

Data:

Inverness County: 46°82'N, 60°67'W, bog 1.1 km southwest of radio tower, Cabot Trail, North Mountain, Cape Breton Highlands National Park (Fig. 1:3): July 8, 1983, R.A. Layberry, 2 males, CNCI; August 15, 1983, J.E.H. Martin, R.J. Martin, 1 male; August 9, 1984, 1 male, CNCI (Brunelle 1998, 1999, 2000).

Province of Nova Scotia - Nova Scotian Mainland

During 1998 I encountered a single female foraging over a dirt road several kilometers from Long Lake Bog. She had apparently emerged not more than two weeks before, judging by the hardness of the exoskeleton (T. Vogt, in litt.), but could have travelled far from the larval habitat in that time.

Data:

Cumberland County: 45°67'N, 64°33'W, logging road to Long Lake Bog, south of River Hebert East (Fig. 1:7): July 30, 1998, P.M. Brunelle, 1 female (Brunelle 1998, 1999).

Province of Newfoundland

In 1999, T.W. Donnelly discovered a male *brevicincta* labeled as *albicincta* at the Smithsonian Institution, collected by O.S. Flint from a feeding swarm in a forest clearing.

Data: Outport Trail, Terra Nova National Park, ca. 48.5dN, 54dW (Fig. 1:4): July 16 1990, O.S. Flint, 1m, Smithsonian Institution, Washington, DC.

State of Maine, United States

The current most southerly record, and the only one for the United States, was taken in 1999 by J. Trimble in eastern Maine. A male was taken sheltering from the wind behind a tree on the heath, and a female foraging over the nearby logging road. That both genders were taken is suggestive of a breeding presence.

Data:

Penobscot County: T3R1NBPP Township, 45°25'N, 68°21'W, Thousand Acre Heath and adjacent logging road (Fig. 1:8): June 26, 1999, J. Trimble, 1 male, 1 female (Nikula 1999).

Province of British Columbia

S. brevicincta has been taken at four sites in British Columbia in the vicinity of McBride and Prince George (Fig. 1:9), ca. 54°N, 120°W, by S. Dunkle, S. Cannings and R. Cannings in August 2000 (Cannings and Cannings 2000, R. Cannings in litt.). Habitat appears to have been shallow ponds in peatlands.

Range

S. brevicincta is now known cross-continentially over ca. 66 degrees of longitude (54°W in Newfoundland to 120°W in British Columbia), and the known latitude range is 8°75' (54°N in British Columbia to 45°25'N in Maine). The species is certainly present across the Canadian north, and is a distinct possibility for the extreme north of the contiguous United States, though not likely in the Plains States. It seems unlikely that the extreme of northern distribution is yet known.

Phenology

The flight period of *S. brevicincta* is long, June 19 to September 4 in Quebec (Pilon and Lagace 1998), June 25 to September 16 in New Brunswick. The peak abundance in Atlantic Canada is in the last week of June, falling off markedly by the second week of July (Stuart's Bog).

Habitat

S. brevicincta inhabits acidic fens, usually but not always associated with bogs, but is rarely found at the secondary ponds (those ponds which do not receive mineralized ground or surface water) of the entirely ombrotrophic bog environment. Stuart's Bog, the site of greatest abundance known in Atlantic Canada, is probably indicative of its general habitat - a fen of inundated *Sphagnum* moss with intermittent shallow pools of standing water containing grassy emergents. Although this particular peatland appears to have been formed by highway construction, natural habitats resembling it would probably be associated with beaver dams, or other causes of backup of water into peatland environments. A good habitat indicator is standing deadwood in *Sphagnum* - indicative of a recently-formed fen. Fen habitats such as these are individually ephemeral, but frequently formed, and they are not rare in Canada.

In Atlantic Canada three of the five locales at which the Quebec Emerald is known are currently protected, two under the National Parks system (Terra Nova National Park, and Cape Breton Highlands National Park), and one through the Unique Areas Program managed by J.D. Irving Limited, Woodlands Division (New Scotland Bog). The Unique Areas Program is currently considering Stuart's Bog for this status as well.

Conclusions

The current listing of *S. brevicincta* at the highest statuses of rarity was principally due to its small known range. The considerable expansion of this range, coupled with the commonness of its larval habitat in North America, suggests that the species is secure, though evidently less abundant than congeners. The list statuses should now be reconsidered. Nevertheless, the species is known from only a few locales and remains very rare. Further survey is warranted to determine its true abundance, and to increase our knowledge of its habitat requirements and behaviour.

ACKNOWLEDGEMENTS

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***Somatochlora borisi* spec. nov., a new European dragonfly species
from Bulgaria (Anisoptera: Corduliidae)**

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ABSTRACT

A new dragonfly species is described and depicted. Short ecological and behavioural notes from the type locality are given. The holotype male and its male paratypes from the Deimin dere river in the Eastern Rhodopes mountains, Bulgaria, are deposited at the National Museum of Natural History, Sofia Bulgaria.

INTRODUCTION

There are six European species presently placed in the genus *Somatochlora* Selys, 1871: *metallica* (Vander Linden, 1825), *arctica* (Zetterstedt, 1840), *flavomaculata* (Vander Linden, 1825), *alpestris* (Selys, 1840), *sahlbergi* Trybom, 1889 and *meridionalis*, Nielsen 1935. *S. metallica*, *S. arctica*, *S. flavomaculata* fly mainly in the summer and *S. alpestris* until the end of September (e.g. Bos & Wasscher 1998). Their distribution is largely restricted either to the northern region of Europe or to higher mountain regions. The larvae of some species have some tendency to develop in running waters with *S. meridionalis* appearing to be an obligate rheophilic species (Marinov 1999).

Three *Somatochlora* species are so far known from Bulgaria (Marinov 2000). *S. meridionalis* inhabits mainly southern regions. It flies over small rivers in shady places (Marinov 1999). *S. metallica* is restricted to the high mountain bogs up to 2100 m altitude (Marinov 1995). The records of *S. flavomaculata* (Petrov 1973, Popov 1961) need confirmation. In the Eastern Rhodopes mountains I found a population of *Somatochlora* specimens that differ clearly from all European species listed above and from all other taxa by its morphological features. Several specialists have shared this opinion. The new species is here described.

DESCRIPTION

SOMATOCHLORA BORISI spec. nov.

1. Material

Holotype: 1 male, Deimin dere river ($41^{\circ}26'N$ $25^{\circ}54'E$) near the village of Byal Gradetz, Eastern Rhodopes mountain, S Bulgaria (fig. 1), 20 May 2000.

Paratypes: 3 males, same locality, one 20 May 1999, one 20 May 2000 and one 22 June 2000. Holotype and paratypes are deposited in the National Museum of Natural History in Sofia. One paratype is deposited in the collection of Dr. H. Wildermuth, Rüti, Switzerland.

More than 20 other individuals were caught and released at the same place. All of them possessed the same main morphological features as the rest of the material.

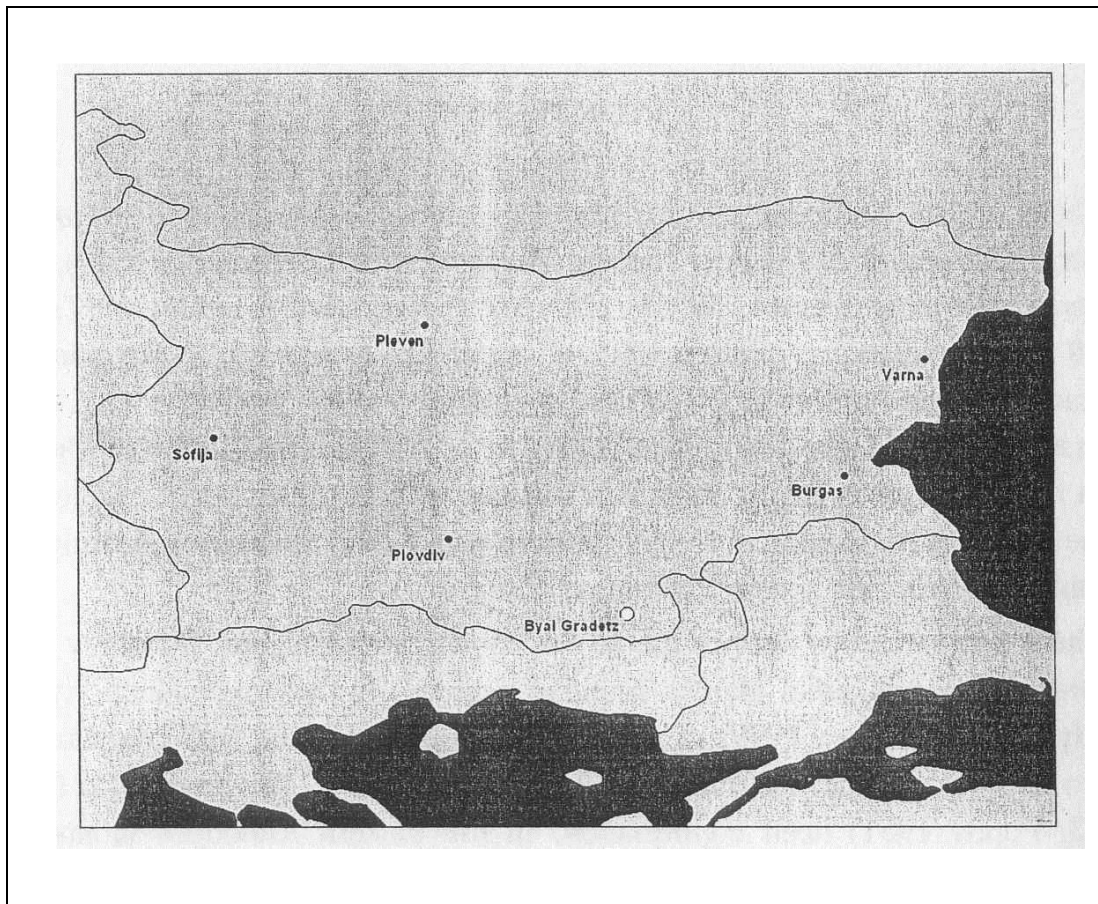


Fig 1.: Type locality of *Somatochlora borisi* spec. nov. in Bulgaria. Cartography by Ralph Koch, Trier, Germany

Holotype

Head: Top of vertex and compound eyes shining metallic green; frons metallic green in the middle and yellow on both sides with inner lower edges closing towards each other; postclypeus shining black in the middle and yellow on both sides; labrum black; labium yellow (Fig. 2).

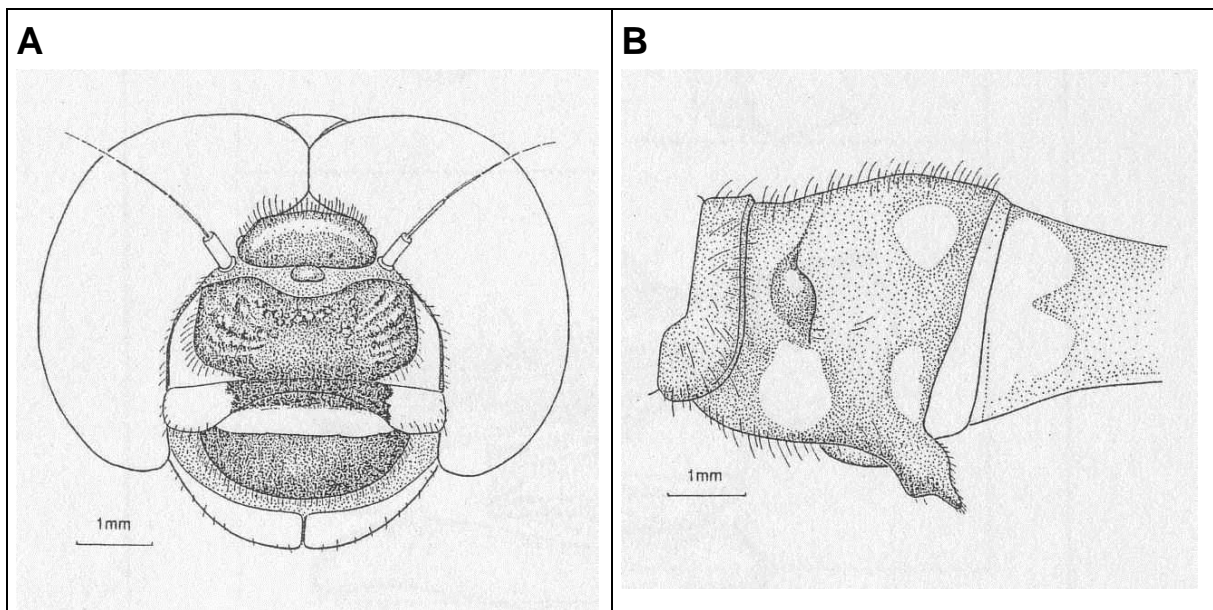


Fig. 2: *Somatochlora borisi* spec. nov. Head (A) and lateral view of abdominal segments 1 and 2 (S1 and S2) (B) of a paratype. Drawing by H. Wildermuth.

Thorax: Prothorax black, dorsal end and distal ring's edge yellow; synthorax shining metallic green with very dense whitish hair. Legs black, single yellow margins on the proximal backside of the foreleg femurs; external surface of the foreleg coxae yellow.

Wings: Venation predominantly black with slightly lightening along the costa and the first 3-5 antenodal cross veins; pterostigma black; base of the wings yellowish covering anal triangle in the hind wings; wing's membranula whitish on the upper part and brownish on the down one. Anal and wing triangles are crossed by one vein, one cubito-anal cross-vein in the fore and two in the hind wings, nodal index in the fore wing 6.8/8.8, in the hind wing 7.5/5.7.

Abdomen: Dark with metallic shine. S1, S2 and S10 black; yellow spots on S2, S3 (Fig. 2); S3- S9 shiny greenish as distal part of S7, S8 and S9 more dark brownish. Anal appendages are black and shaped as shown in Fig. 3. The superior appendages are almost as long as S9+S10, the apical ends are rounded and curved both downwards and outwards (Fig. 3). Two teeth are projecting from the distal part of the app. Superior. The appendages inferiores are bilobed at their apical end and curved up and slightly backwards (Fig. 3).

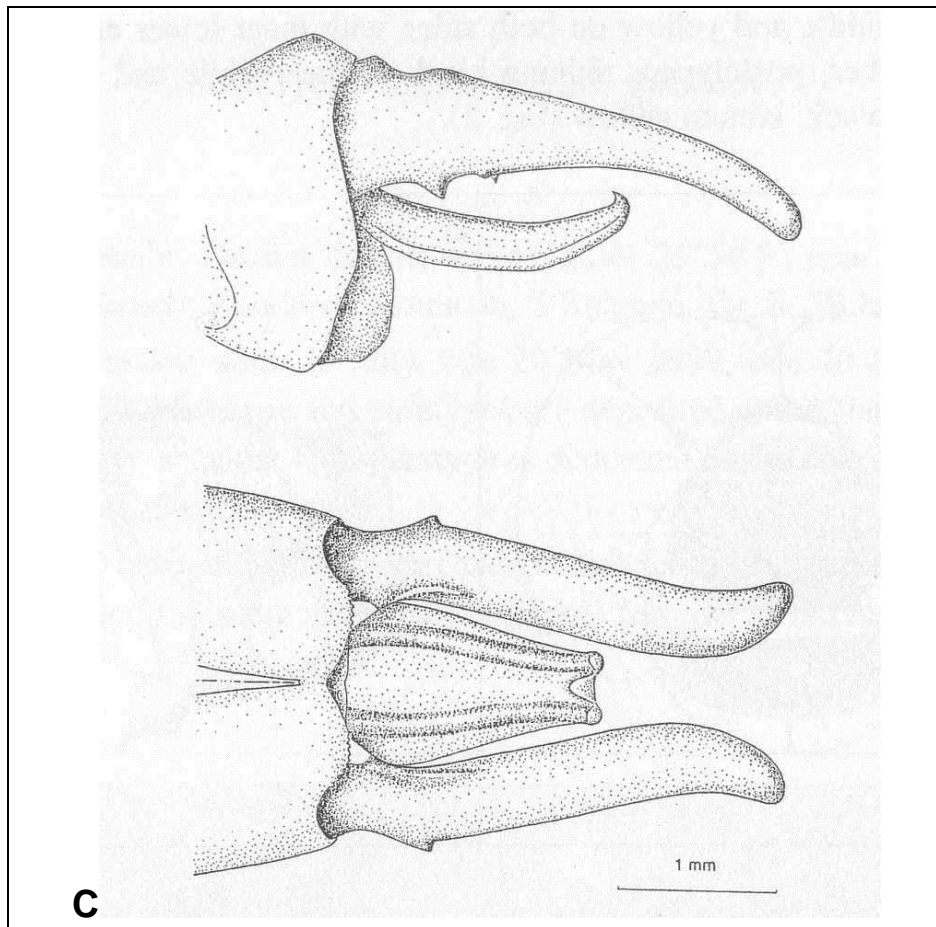


Figure 3. Anal appendages of a paratype (C) of *Somatochlora borisi* spec. nov. Drawing by H. Wildermuth.

Genitalia. The hamulus, lateral and ventral views of the penis are shown in Fig. 4 and 5.

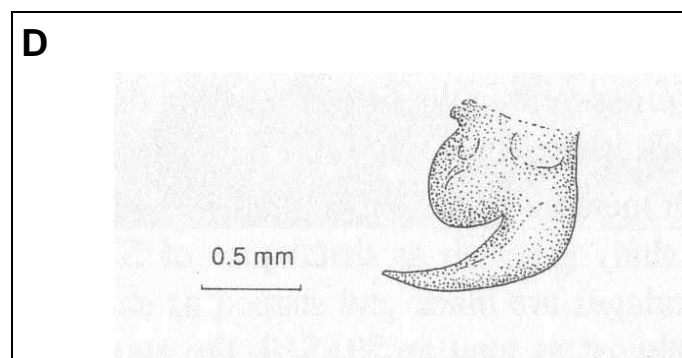


Fig. 4. The hamulus (D) of a paratype of *Somatochlora borisi* spec. nov. Drawing by H. Wildermuth.

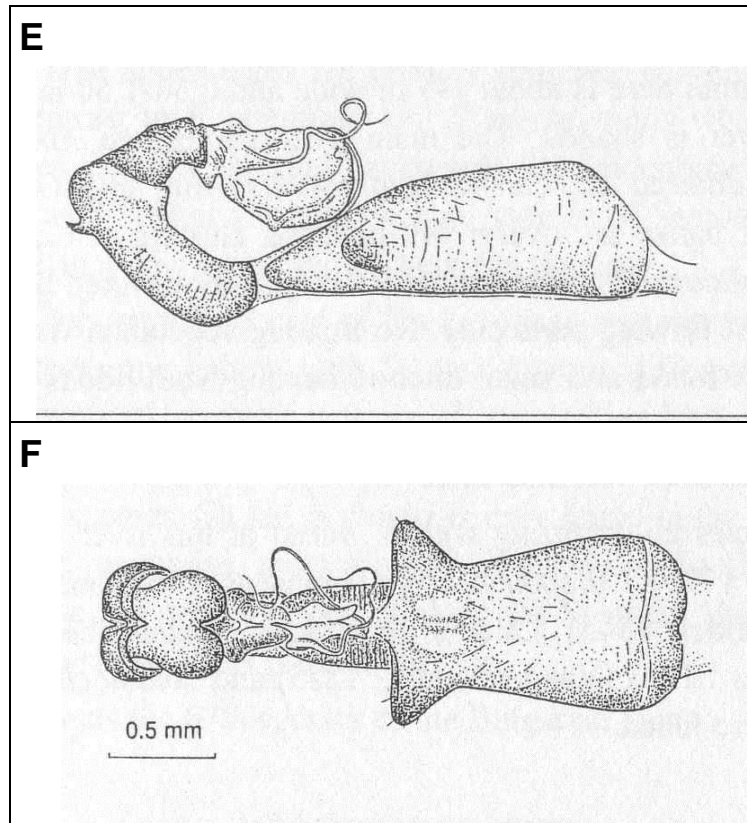


Figure 5. Lateral (E) and ventral view (F) of the penis of a paratype of *Somatochlora borisi* spec. nov. Drawing by H. Wildermuth.

Measurements. The total length of the individual, including appendages is 49 mm, the length of the abdomen including appendages 35 mm. The length of the hind wing is 31 mm.

Paratypes

The lower distal yellow spot on the backsides of S2 are of variable shape. The nodal indexes vary in the antenodal cross veins of the fore wing from 6 to 8. There are 5 cross veins in the hind wing constant 5. The postnodal cross veins in the fore wings vary from 6 to 7, in the hind wings from 7 to 8. An apparently old specimen (caught on 22 June, 2000) has an abdomen which is darker along its whole length.

Etymology

The new species is named after the author's son Boris.

HABITAT

The river Deimin dere is about 1-5 m wide and 0.50-1.50 m deep. At the type locality, the river is shaded. The main tree species are *Alnus glutinosa* (L.) Gaertn., *Salix cinerea* L., *Carpinus orientalis* Mill. and *Ostrya carpinifolia* Scop. The river banks are overgrown by great clusters of *Carex gracilis* Curt. and *Lythrum salicaria* L.. The ground is completely covered by mud. Big stones are visible at fast flowing parts only. No floating vegetation was present. A similar situation was found at a small ditch remaining from floods of the Byala river near the village of Gougoutka (about 2 km N of the *S. borisi* type locality) where one flying *S. borisi* male was also seen.

Dragonfly species co-occurring with *S. borisi* at this river were *Platycnemis pennipes* (Pallas, 1771), *Calopteryx virgo* (Linnaeus, 1758) and *Caliaeschna microstigma* (Schneider, 1845). Later in the season, around the end of June and July, *Chalcolestes viridis* (Vander Linden, 1825) and *Somatochlora meridionalis* Nielsen, 1935 were found.

ECOLOGICAL AND BEHAVIOURAL NOTES

S. borisi seems to be a spring species. It was found from mid-May (earliest date 20 May, 1999) to the end of June (latest date 22 June, 2000), only. No aggressive interactions between *S. borisi* and *S. meridionalis* were seen when they were observed at the same time on 22 June, 2000. Both species are similar in their behaviour. Males do not establish permanent territories. They fly low over the water surface, keep close to the river banks and move slowly up- and downstream with frequent hovering stops. In that way they probably search for females. Male *S. borisi* were not seen perching. Most probably, individuals use the upper tree branches for resting and roosting. One copulation wheel flew in the tree canopy.

Because of the structure of the river bottom (see above) *S. borisi* larvae are probably inhabitants of the pelorheophilic coenosis sensu Neizvestinova-Jadina (1937).

DISCUSSION

Males of *Somatochlora borisi* have well defined morphological features. Yet, the species appears to be morphologically most closely related to the *S. meridionalis-metallica* group. However, *S. borisi* does not have yellow transverse

frons bars as *S. metallica* and *S. meridionalis*. The two yellow spots do not merge. The thorax of *S. borisi* is covered with dense hair, lacking yellow spots as *S. metallica*. The anal appendages are broadly rounded, curved down and they are external, in contrast to *S. metallica* and *S. meridionalis* which have sharply pointed appendages showing up- and backwards. R. Seidenbusch (pers. comm.) refers to *S. borisi* as “...either a totally unusual species of *Somatochlora* or *Cordulia*, or it belongs to a new genus settled between the both...”

S. borisi is the only spring species of the European representatives of this genus. Because it shares the habitat with *S. meridionalis* differences in the flight season may have evolved in response to avoid competition between the imagines of the two species. Nothing is known about a possible habitat separation of the larvae of the two species. So far, *S. borisi* is only found in the Bulgarian part of Eastern Rhodopes mountains, most probably it occurs in the Greek part, too. *S. borisi* may be expected at similar places along the Southern Bulgarian Black Sea coast, where *S. meridionalis* is present, too.

S. borisi represents the 67th species of the Bulgarian fauna.

ACKNOWLEDGEMENTS

The new species was discovered thanks to the enthusiasm of Milena Christosova who was very insistent to show me this part of the Rhodops. My special thank are also to the two main sponsors of my expeditions to the type locality – the Foundation Bulgarian-Swiss Biodiversity Conservation Programme and the International Dragonfly Fund - and to Dr. Burkhard Grebe, who supported me in my investigations, too. There are several other friends of mine who helped me during the preparation of the publication and I want to mention them here with gratitude Richard Seidenbusch, Paul-Michel Brunelle, Marcel Wasscher, Dr. Stoyan Beshkov and Dr. Dimitar Dimitrov. The author specifically wishes to thank Dr. Hansruedi Wildermuth who realised the drawings.

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Commented Bibliography of the Bulgarian fauna of the Odonata

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INTRODUCTION

There are 108 years of history for Bulgarian Odonatology. The first material was published by Hristovitch in 1892. Many scientists have since contributed to our understanding of the Bulgarian dragonfly fauna. Among the Bulgarian names with greatest importance are Beshovski who published a series of papers in the sixties and the nineties, Petkov and Nedelkov who worked at the beginning of the twentieth century and Marinov in more recent years. There are also several foreign experts whose material has had a leading role. It is Urbanski who provided the only information on the Bulgarian odonate fauna for a very long and difficult period of time. He collected material during the political crisis on the Balkan and the Second World War. Scheffler's paper is one of the first attempts to review Bulgarian Odonata records. In the eighties, Beutler and Donath published very valuable articles from sites of great faunistic importance which were previously largely neglected: the Black Sea coast and the Struma river valley. Mauersberger provided several contributions around the 1990's. As a result of these activities, records of sixty-six dragonfly species are so far published for Bulgaria. The present study lists and comments on all papers on the Bulgarian odonate fauna so far known.

RESULTS

A total of 135 articles dealing with the dragonfly fauna of Bulgaria were found during the literature survey. Two papers with no special information about Bulgaria were also included: Kovachev & Uzunov (1979a – no. 53) and Russev (1991a - no. 98). They were published in Bulgaria and probably do not have large popularity among odonatologists. Other papers in the list may not necessarily be confined to the Bulgarian Odonata fauna, but treat dragonfly species in the context of hydrobiological, ichthyological or ornithological investigations. The remaining papers list Bulgarian dragonflies in reviews or revisions of neighbouring countries or Europe as a whole. An additional body of information came from management plans prepared for different Bulgarian wetlands: the Srebarna Biosphere Reserve, the Durankulashko ezero Nature Monument, the Shablenssko ezero Protected Area, the Kamtchiya Biosphere Reserve, the Atanassovssko ezero Nature Reserve, the Poda Protected Area and

the Ropotamo Nature Reserve. As these documents were still not officially approved by the Bulgarian Ministry of Environment and Waters they were not included in the present paper. The list of the articles is alphabetically arranged by author. The Latin transcription is given for every originally published title's name.

Check list of odonatologically works published for or in Bulgaria

1. Angelov, P. 1960. – Proutchvania varchu entomofaunata na parka “Otdich i kultura” (mestnostta “Ostrova”) kraia Plovdiv s niakoi drugi faunistichni belejki. (Investigation on the entomofauna of the park “Otdich i kultura” (“Ostrova” area) near the town of Plovdiv with some other faunistical notes). – Ann. Mus. Plovdiv 3: 7-40. (in Bulgarian with Russian and French summaries)

Ten dragonfly species are given with brief information on measurements in three species; on sampling period in four species and basic morphological features for most of them.

2. Arnold, A. 1984. - Zur Libellenfauna des Iskar-Gebietes (VR Bulgarien) (Odonata). – Entomol. Nachr. und Ber. 28: 71-72. (in German with English and Russian summaries)
17 dragonfly species were collected from three sites between 3 and 27 August 1982. Three of them are given by genus or family names only.

3. Askew, R. 1988. – The dragonflies of Europe. – Harley Books, Martins, Great Horkesley: 294 pp.

Bulgaria is treated among other countries in the species distribution maps.

4. Beltcheva, R. 1959. – Proutchvania varchu yasovir “V. Kolarov” s ogleđ na ribostopanskoto mu izpolzvanie. (Investigation on “V.Kolarov” reservoir in terms of its fish-economical use). – Ann. Sofia University, Biol. geol. geogr. Faculty 51: 301-338. (in Bulgarian with Russian and German summaries).

This is a detailed investigation on the hydrology of the reservoir and reports on fish species composition as well as on the fish diet. Larvae of *Libellula quadrimaculata* were reported from a depth of 1.20 m.

5. Beshovski, V. 1960a. – Prinosa kam razred Odonata ot visokoplaninskite ezera i motchuri v Bulgaria. (A contribution to the order Odonata from the high mountain lakes and bogs in Bulgaria). – Bull. Inst. Zool. Mus. Sofia 9: 451-453. (in Bulgarian with Russian and English summaries).

This paper is based on the material collected by Prof. Valkanov from the Rila mountains and the author's specimens caught during an expedition in the Pirin mountains. Five species are given for the high mountain zone between 2000 – 2200 m, *Aeshna subarctica* is reported for the first time for the country. For each species sampling date and site, altitude, and previous Bulgarian information is given. Measurements of the abdomen, appendage and hind wings length are given for *Somatochlora metallica*. Regarding the restricted distribution of *A. subarctica* to N Europe its occurrence in Bulgaria is interesting and unusual,

although being found at high altitude. No other specimen has been reported since and there is a need to confirm this record.

6. Beshovski, V., 1960b. – Leteneto pri nasekomite (Insects' flight). – Magazine "Priroda i znanie" ("Nature and knowledge") 8 (8): 7-9. (in Bulgarian)

Information about the flight of dragonflies are provided such as gliding for up to 3-4 minutes in aeshnids, hovering and backwards flight .

7. Beshovski, V. 1964a. – Vodni kontcheta (Odonata) ot balgarskoto tchernomorsko kraibrejje (Dragonflies (Odonata) from the Bulgarian Black Sea coast). – Bull. Inst. Zool. Mus. Sofia 15: 115-129. (in Bulgarian with Russian and English summaries)

This detailed paper covers the whole Bulgarian part of the Black Sea coast. The climatic zones of Bulgaria are related to a proposed zoogeographical origin of the Bulgarian Odonata fauna including the grouping of the species found along the coast. 33 species are reported, *Caliaeschna microstigma* is new for the country. For each species location, date, no. and stage of individuals as well as basic measurements for abdomen and hind wing length are given. This paper contains the only published Bulgarian information on a dragonfly larva found in a lithotelm with a high salinity level – 13 ‰.

8. Beshovski, V. 1964b. – Vodni kontcheta (Odonata) ot Yujna Bulgaria (Dragonflies (Odonata) from South Bulgaria). - Bull. Inst. Zool. Mus. Sofia 17: 109-124. (in Bulgarian with Russian and English summaries)

Based on the author's investigations over a period from 1953 to 1963, 47 species are presented by site and date. The number of individuals, their stage (imago, larvae) and measurements of abdomen and hind wing length are given along with zoogeographical notes. Five species, *Epallage fatime*, *Coenagrion scitulum*, *Aeshna cyanea*, *Aeshna grandis*, and *Somatochlora alpestris* are reported as new for the country. Later, Beshovski (1965, 1991, 1993) excluded *Aeshna grandis* from the Bulgarian check list because of misidentification and *Somatochlora alpestris* because of its uncertainty.

9. Beshovski, V., 1964c. – Vodni koncheta – Odonata (Dragonflies – Odonata). – Magazine "Priroda i znanie" ("Nature and knowledge"), 17 (2): 11-13. (in Bulgarian)

A popular contribution on morphology, biology and evolution of dragonflies. A dragonfly accompanying a plane with a mean velocity of more than 144 km/h is also recorded.

10. Beshovski, V. 1965. – Odonata (vodni kontcheta) ot balgarskoto kraibrejje na reka Dunav i nyakoi vodoemi v severna Bulgaria (Odonata (dragonflies) from the Bulgarian riverside of the Danube and from certain wetlands in Northern Bulgaria. - Bull. Inst. Zool. Mus. Sofia 18: 159-168. (in Bulgarian with Russian and English summaries)

Odonata species collected during two expeditions in N Bulgaria: 15-30 June 1961, and 27-30 May 1962 with additional material collected by B. Russev in the period 1957-1959. Site and date, number and stage of individuals and abdomen and hind wing lengths are reported for thirty-six species, including the

first Bulgarian records for *Erythromma najas* and *Cordulia aenea*. Eighty mites were found on the abdomen of *Coenagrion pulchellum* and shown in a figure.

11. Beshovski, V. 1966. – Mediteranski vodni kontcheta v Bulgaria (Mediterranean dragonflies in Bulgaria). – Magazine “Priroda” 3: 66-68. (in Bulgarian)

The climate is related to the occurrence of Mediterranean species in Bulgaria. Seven of them, *Lestes virens*, *Coenagrion scitulum*, *Cercion lindeni*, *Aeshna affinis*, *Anax imperator*, *Libellula depressa* and *Sympetrum meridionale* are mentioned as examples of Mediterranean species that expand their range to N Europe. The distribution of *Epallage fatime*, *Caliaeschna microstigma* and *Cordulegaster insignis* is restricted to zones with European-Mediterranean climate. Notes on the morphology and the ecology of larvae are given.

12. Beshovski, V. 1967a. – Ekologitshen pregled na larvite na Odonata ot balgarskite reki (Ecological survey of the larvae of Odonata in the Bulgarian rivers). – Bull. Inst. Zool. Mus. Sofia 24: 5-20. (in Bulgarian with Russian and English summaries)

One of the most important ecological studies on the Bulgarian Odonata larvae. Larvae belonging to 16 dragonfly species were collected from 48 sites in 46 Bulgarian rivers and springs. They were divided into two ecological subgroups – rheophilic epiphytic and rheophilic benthonic. The author bases his investigation on the morphological structure of the larvae, which are related to the body adaptation to the running waters. The thorax height/width ratio is used as evidence for increased dorso-ventral flatness of the body in rheophilic species, which supports the adhesion to the substrate. Other adaptations are increased hardness of the caudal lamellae in the Zygoptera, a decrease in the mobility, an elongation of the first (*Calopteryx*) or third (*Caliaeschna microstigma*, Gomphidae, Cordulegastridae) antennal segments and a decreasing number of the antennal segments from six to seven (typical for Aeshnidae) to five (*C. microstigma*).

13. Beshovski, V. 1967b. – Hranata na sharana i byalata riba ot Burgaskoto, Mandrenskoto i Blatnishkoto ezero (Carp and perch-pike feed in the Bourgasko, Mandrensko and Blatnishko lakes along the Bulgarian Black Sea coast). – Proceedings of the Research Institute of Fisheries and Oceanography – Varna, State Publishing House, Varna: 195-209. (in Bulgarian with Russian and English summaries)

Between 1965-1966, 308 perch-pike and 787 carp specimens were investigated. Two dragonfly species were reported in the food of perch-pike: *Ischnura elegans* from Bourgas lake and *Anax imperator* from Mandra lake, S of the city of Bourgas, now being a reservoir.

14. Beshovski, V. 1968. – Larvi na Odonata ot baseinite sas stoyashti vodi v Bulgaria (Odonata) larvae from the stagnant water basins in Bulgaria). - Bull. Inst. Zool. Mus. Sofia 26: 5-27. (in Bulgarian with Russian and German summaries)

This very valuable work on the ecology of Bulgarian limnophilic dragonfly larvae lists 38 species from 100 localities. Species are divided into two ecological subgroups: limnophilic epiphytic and limnophilic benthonic. The author

describes different coenoses according to their dragonfly fauna. The thoracic ratio (see Beshovski 1967) is used to explain larval adaptation stagnant waters. A comparison with rheophilic larvae shows that limnophilic ones have a larger index – 0.77-1.13, in contrast to 0.58-0.80 in rheophilic larvae. This is because limnophilic larvae do not have the pressure from the stream in running waters. This index also varies within the limnophilic larvae - being bigger in epiphitic (up to 1.13) than in the benthonic (0.77-0.93). Dragonfly larvae from the two ecological groups are compared on the basis of their masks. They are divided in two groups: flat masks (Aeshnidae, Gomphidae, *Epallage*) and concave masks. The latter are further subdivided into two groups: concave masks of the lestid type (*Calopteryx*, Lestidae, Coenagrionidae) and concave masks of the libellulid type (Libellulidae and Cordulegastridae). The legs of the larvae show that rheophilic benthonic larvae that burrow in the sand have special digging spikes on their tibiae. They are missing in *G. flavipes*, which inhabits a pelorheophilic coenosis. All rheophilic benthonic larvae have a reduced number of foreleg tarsus segments used for digging. Such a reduction is also observed in *E. fatime* on the hind legs. They are used as a support against the stream. The spikes for digging are not developed in limnophilic larvae.

15. Beshovski, V. 1989. – Predstavitelite na semeistvata Epallagidae i Calopterygidae (Odonata) v Bulgaria (Specimens of the families Epallagidae and Calopterygidae in Bulgaria). – Acta zool. Bulg. 38: 3-10. (in Bulgarian with Russian and English summaries)

The author clarifies the up to date situation of the Bulgarian representatives of these two families. Of special interest is the record of a female *Calopteryx haemorrhoidalis*, though it is stated as an uncertain element of the Bulgarian fauna. All records list site and date and measurements. The distribution of *Epallage fatime fatime*, *Calopteryx haemorrhoidalis* and *C. virgo meridionalis* is mapped. The wings of *Calopteryx virgo festiva/meridionalis* and *C. splendens balcanica* are depicted.

16. Beshovski, V. 1991. – Pregled na vidovete Odonata saobshteni za Bulgaria (Review of the Odonata species reported for Bulgaria). – Proc. First National Conf. Entomol. 1991: 34-39. (in Bulgarian with English)

Very important step towards a Bulgarian dragonfly fauna. A total of 71 species is listed, 64 of them are reported as proven elements of the Bulgarian fauna, 13 subspecies are added. For all species the name of the author who first published it for the country is mentioned. (Remark: *Lestes macrostigma* was first recorded for Bulgaria by Scheffler (1973) not by Donath (1987)).

17. Beshovski, V. 1993. A critical note on some Odonata species (Insecta, Odonata), reported by Bulgarian authors for the territories of Bulgaria, Greece and Macedonia. – Acta zool. Bulg. 46: 39-43. (in English with Bulgarian summary)

The author justifies the omission of *Calopteryx splendens xanthostoma*, *Platycnemis hyalinata*, *Coenagrion lunulatum*, *Nehalennia speciosa*, *Aeshna grandis*, *Onychogomphus uncatius*, *Cordulegaster annulatus (=boltoni)* and *Somatochlo-*

ra alpestris from the Bulgarian check list. A special discussion is made on the genus *Cordulegaster* in Bulgaria. Its representatives are mapped according to its up to date distribution.

18. Beshovski, V. 1994a. – Fauna na Bulgaria. T. 23. Insecta, Odonata. (Fauna of Bulgaria, Vol. 23. Insecta, Odonata). – Publ. Bulg. Acad. Science: 372 pp (in Bulgarian)

This most outstanding work on the Bulgarian dragonfly species summarizes the present knowledge of the Bulgarian Odonata. The book consists of Table of contents, Foreword, Introduction, General part, Special part, References, and an Index. In the general part different aspects of the dragonfly morphology, biology and ecology are treated. Both imago and larvae are described. A special chapter about the role and importance of dragonflies identifies 22 species and subspecies which should be protected by law being the first attempt in this field. The special part gives keys for identifying 100 species and subspecies. Six of them had been earlier reported for Bulgaria, but either wrongly identified or found outside the present Bulgarian borders. The discovery of 7 species, *Ceriagrion tenellum*, *Coenagrion armatum*, *Coenagrion lunulatum*, *Somatochlora arctica*, *Epithea bimaculata*, *Selysiotthemis nigra* and *Leucorrhinia dubia* in Bulgaria is possible, although fairly doubtful for the latter species. For five species given in the keys, *Aeshna viridis*, *Paragomphus genei*, *Gomphus schneiderii*, *Trithemis annulata*, and *Sympetrum danae* information is provided about their closest records to Bulgaria. The taxonomic list follows Beshovski (1991). Each species is presented by individual drawings on the most significant features of both males and females, and possible colour forms. Measurements of total length, wing span, length of the abdomen and anal appendages, length of the hind wings and length of the pterostigma are reported for almost every species. The description of each species ends with small information of its zoogeographical position and distribution on the Balkan peninsula. Distribution maps for Bulgaria are provided. There is, furthermore, a key for the identification of 75 dragonflies larvae including *Ceriagrion tenellum*, *Nehalennia speciosa*, *Coenagrion armatum*, *Aeshna viridis*, *Aeshna grandis*, *Paragomphus genei*, *Lindenia tetraphylla*, *Onychogomphus uncatus*, *Cordulegaster boltoni*, *Epithea bimaculata*, *Somatochlora alpestris*, *Somatochlora arctica*, and *Sympetrum danae* which do not belong to the Bulgarian species list. Two Bulgarian species, *Hemianax ephippiger* and *Orthetrum anceps* are not keyed. The larval identification key shows drawings of the most significant features and gives total length, length of the caudal lamellae in the Zygoptera, short information on their Bulgarian habitats and their distribution in Bulgaria or on the Balkan Peninsula.

19. Beshovski, V. 1994b. - Comparative zoogeographical review of Odonata fauna of Bulgaria (Insecta, Odonata). – Acta zool. Bulg. 47: 3-15. (in English with Bulgarian summary)

The only special zoogeographic paper on Bulgarian dragonflies. The Bulgarian, Greek and Romanian Odonata faunas are compared. Thirty-four genera are placed in six groups according to their origin: boreal (25 genera) and meridional

(9 genera). Species and subspecies are separately classified. The 81 species are grouped in boreal (78 species) and meridional (3 species) and into three faunistic types: Euro-Siberian (49 species in six groups), Mediterranean (29 species in six groups) and Palaeotropic (3 species in one group). 21 subspecies are placed in four groups: East Mediterranean (9 subspecies), Balkan-Mediterranean (6 subspecies), West Mediterranean (3 subspecies) and Ponto-Sarmatic (2 subspecies).

20. Beshovski, V. 1996. – Odonatology in Bulgaria, with special consideration to the rheophilous Bulgarian Odonata. – *Selysia* 24: 6-8 (in English)

The author names two researchers recently involved in odonatological investigations in Bulgaria – himself (Prof. Dr. Venelin Beschovski) and Dipl. Biol. Milen Marinov. A short overview on the main threats for the Odonata species living in running waters (so called “rheophilous”) is given and 14 are tabulated according to five rheophilic types of biocoenosis. (Remark: The list did not mention *Somatochlora meridionalis*, which is also associated with running waters).

21. Beshovski, V. & M. Marinov 1993. – Vodnite kontcheta (Odonata) ot biosphernia rezervat Srebarna (The Dragonflies (Odonata) from the biosphere reserve Srebarna). - Proc. Second National Conf. Entomol. 1993: 9-13. (in Bulgarian with English summary)

This is the first detailed regional odonatological research for Bulgaria. Results from a four years investigation (1989-1992) are presented. 35 species are reported, 22 of them are new for the reserve. The authors could not prove the existence of *Brachytron pratense*, *Orthetrum coerulescens*, *Sympetrum flaveolum* and *Leucorrhinia pectoralis* previously given for Lake Srebarna (Beshovski 1965 1968). According to Mauersberger (1994) *Orthetrum anceps* should be included under the subspecies name *O. coerulescens anceps*. The presence of two other species given for the reserve *S. flaveolum* and *L. pectoralis* is doubtful. In Bulgaria *S. flaveolum* is predominantly a mountain species usually found at an altitude of above 600 m (but see Beshovski 1964a). For the Srebarna reserve it is reported by one exuviae collected in May (Beshovski 1965) which would be a very early emergence date for this species. In a personal conversation, Prof. Beshovski told me that although he had published *L. pectoralis* for Lake Srebarna its existence within the reserve’s borders needs confirmation.

22. Beshovski, V. & V. Gashtarov 1997. – *Selysiothemis nigra* (Vander Linden, 1825) a new genus and species for the Bulgarian fauna (Odonata: Anisoptera: Libellulidae). – *Entomol. Z.* 107: 309-310. (in English with German summary)

The first Bulgarian record of *Selysiothemis nigra* increased the number of species to 65 belonging to 39 genera.

23. Beshovski, V, & M. Marinov 1998. – Order Odonata. – In: Michev, T.; B. Georgiev; A. Petrova & M. Stoyneva 1998. – Biodiversity of the Srebarna Biosphere reserve. – Ministry of Environment and Waters, Pensoft: 73. (in English)

This is a short information based on Beshovski (1965, 1968) and Beshovski & Marinov (1993). A species check list containing 36 species is presented, not 35 as it is stated at the beginning of the article due to a technical mistake.

24. Beutler, H. 1987a. – Ein Fund von *Cordulegaster heros* Theischinger, 1979 im Pirin-Gebirge in Bulgarisch-Mazedonien (Insecta, Odonata, Cordulegastriidae). – Faun. Abhandlungen Staatl. Mus. Tierkunde Dresden, 15: 11-14. (in German with English summary)

The first record for *Cordulegaster heros* in Bulgaria. The collected specimens were measured and described. The lateral thorax view and the dorsal view of the end of the abdomen of the male are illustrated. Photographs of the exuviae were compared to exuviae of *Cordulegaster boltoni*.

25. Beutler, H. 1987b. – Libellen aus dem Einzugsgebiet der Struma in Bulgarisch-Macedonien (Odonata). – Opusc. zool. Flumin. 16: 1-8. (in German with English abstract)

This investigation carried out in a very interesting region yielded 23 species collected from eight localities on two expeditions in 1986 and 1987. The first record of *Cordulegaster heros* (which is given in a separate publication Beutler 1987a) is especially emphasized. Taxonomic and ecological notes are given for *Coenagrion scitulum*, *Ischnura elegans*, *Calopteryx virgo* and *Caliaeschna microstigma*.

26. Bilek, A., 1966. – Ergebnisse der Albanien-Expedition 1961 des Deutschen Entomologischen Institutes. – Beitr. Entomol. 16: 327-346 (in German with English and Russian summaries)

The species collected during the expedition to Albania are compared to the Odonata fauna of Yugoslavia, Greece and Bulgaria. Forty-eight species are reported for Bulgaria (Remark: This list is misleading in apparently *C. hastulatum*, *O. cecilia*, *A. juncea*, *A. cyanea*, *A. grandis*, *C. aenea* and *S. alpestris* from Beshovski's (1964b) paper but mentioning *E. fatime*, *C. scitulum*, *E. najas* and *S. metallica*. *E. cyathigerum* and *H. ephippiger* were also previously reported by Nedelkov (1923) for Bulgaria but were not mentioned here whereas the records of *L. tetraphylla* and *O. anceps* were based on material collected from sites outside present Bulgaria).

27. Bos, F. & M. Wasscher 1998. - Veldgids, Libellen. – Stichting Uitgeverij KNNV, Utrecht: 256 pp. (in Dutch)

Bulgaria is mentioned in a separate chapter where some South European species are given with short information.

28. Boudot, J. P., G. Jacquemin & H. Dumont 1990. Revision of the subspecies of *Onychogomphus forcipatus* (Linnaeus, 1758) in Europe and Asia Minor, and the true distribution of *Onychogomphus forcipatus unguiculatus* (Vander Linden, 1823) (Odonata, Gomphidae). – Bull. Anns Soc. R. Belge Entomol. 126: 95-111.

This paper is the base for the current taxonomic status of the species. Specimens from Bulgaria also had been analyzed and included in the results.

29. Buchholz, K. F. 1967. – Odonata. – In: Illies (Hrsg.) Limnofauna Europea. – Jena. pp.: 230-235. (in German)

Check list of the European Odonata. The information for Bulgaria is included under the name “Balkan”. A total of 70 species are given for the Balkan peninsula. By that time 60 species were known as inhabitants of Bulgarian wetlands (Beshovski 1965).

30. Buijs, L. Y. Uzunov & K. Tzankov 1992. – Water quality profile of the Danube River along the Bulgarian-Romanian stretch (June 1991). – International Centre of water studies – Report, Amsterdam: 70 pp. (in English)

Very detailed hydrological, meteorological and faunistic investigation of the Danube. *Gomphus flavipes* is reported from km 430 and 381.

31. Dimitrov, M. 1962. – Bentos na ribovadnite stopanstva v Plovdivski okrag. (The benthos of piscicultural farms in the Plovdiv region). – Proceedings of the freshwater fishery research station, Plovdiv 1: 21-57. (in Bulgarian with Russian and English summaries)

The author had investigated four fish farms in the region of Plovdiv for a three-year period (1957-1959). The only Odonata taxon is *Pyrrhosoma sp.* being found in submerged bank vegetation in the State Piscicultural Farm.

32. Dimitrov, M. 1970. – Varchu bentosa (hironomidi i oligoheti) na r. Yantra i pritotzite i. (On the benthos (chironomids and oligochaets) of the Yantra river and its tributaries). – Proceedings of the freshwater fishery research station, Plovdiv 7: 139-147. (in Bulgarian with Russian and German summaries)

This investigation is based on four field trips carried out in 1963, 1966, 1968 and 1969. In the latter year, odonata larvae are reported from mud.

33. Dimitrov, M. 1974. – Vliyanie na mineralnoto torene na baseinite varchu razvitiето na bentosa pri polikulturno otglejdane na sharan. (Effect of the pond mineral fertilization on the benthos development in polyculture carp rearing). – Proceedings of the freshwater fishery research station, Plovdiv 10: 47-68. (in Bulgarian with Russian and English summaries)

From two years of investigation (1971-1972), Odonata larvae are given as accidental elements in the samples.

34. Donath, H. 1987. – Odonaten von der südbulgarischen Schwarzmeereküste. – Notul. Odonatol. 10: 157-168. (in German with English abstract)

This is the third investigation of the Bulgarian Black sea coast after Beshovski (1964a) and Mauersberger (1985), listing 34 species collected from 14 localities. Of particular interest are the first Bulgarian record of *Cordulegaster picta*, the records of *Somatochlora metallica meridionalis* (first cited under this subspecies name), *Lestes macrostigma* (second information from the same locality as given in Scheffler (1973), and *Chalcolestes viridis*. This article does not give the subspecies name of the latter species. It would have been interesting as the reported sampling places Mitschurin (now Tzarevo) and the Campground Nestinarka are situated only about 11 km N of Achtopol where both *C. parvidens* and *C. viridis* occur (Marinov 1999).

35. Drenski, P., 1930. – Znachenieto na nasekomite za ribite i ribovadstvoto. (The importance of the insects for the fish and fisheries). – Magazine “Ribarski pregled” (“Fishermen’s review”) 1 (6): 94-96. (in Bulgarian)

Odonata (larvae and imago) are stated as “useful” insects. *Libellula depressa* and a coenagrionid are depicted. This short article has historical value. It appears to be one of the firsts in the Bulgarian literature where dragonfly illustrations are shown. The earliest dragonfly illustration I could find is published by Hristovich & Genev 1908 who as editors of the Magazine “Priroda” (“Nature”) depicted it on the back cover of issue 14 (7) but did not relate it to any article.

36. Drenski, P. 1942. – Varchu nasekomnata fauna na kraibrejnite oblasti severno ot Varna (On the insects fauna of the coastal area North from the town of Varna). – Bull. Bulg. Entomol. Society 12: 15-44. (in Bulgarian with German summary)

A detailed investigation of climate, plant and animal species composition of the Varna region. Two dragonfly species are reported among the insect species whose adults are predators.

37. Dumont, H., 1976. - *Aeschna charpentieri* Kolenati, 1846, a synonym of *Cordulegaster insignis* Schneideri, 1845, and on the correct status of *Cordulegaster charpentieri* auctorum (Anisoptera: Cordulegastridae). – Odonatologica 5: 313-321. (in English)

In his taxonomic investigation the author refers to the Bulgarian literature (Beshovski, 1964a). Some occurring confusion is explained in Beshovski (1993): “Dr. Dumont (1976) has made a mistake in his interpretation. My paper was in Bulgarian, with an insufficiently clear summary in English. The paper reports *C. insignis insignis* from the Black Sea coast. Along with this, however, emphasis is laid on the fact that, up to now the species has been found also along the valley of the river Struma in Southwest Bulgaria ... This made Dumont (1976) conclude that the specimen presented in the figures of my paper (Beshovski, 1964a) was found in Southwest Bulgaria. This led to an unprecise determination of that subspecies’ areal and later on, in Askew’s monograph (1988, p. 142, map No 70): the *C. i. charpentieri* range around the Black Sea was interrupted along the Bulgarian Black Sea coast. [...] subspecies is to be found in the northern and southern regions of East Bulgaria [...] as a natural sequence of its spreading in Asia Minor, through the eastern coasts of the Balkan Peninsula up to Northern Black Sea Coast.” Another species treated in Dumont (1976) is *Cordulegaster pictus*. The Bulgarian Black Sea area is included within the overall species distribution. (Notes: The status of the subspecies of *Cordulegaster insignis* in Bulgaria is still an open question. Beshovski (1994a) gives a key to identify the subspecies. The main feature is a transverse black bar along the labrum. Material sent to Gert Jan van Pelt for further determination is expected to contribute to a clarification of this situation).

38. Dumont, H. 1977. – Sur une collection d’Odonates de Yougoslavie, avec notes sur la faune des territoires adjacents de Roumanie et de Bulgarie. – Bull. Annls Soc. R. Belge Entomol. 113: 187-209. (in French with English summary)

Thirty-nine odonate species are reported mainly for the territory of Yugoslavia. Dragonflies found in Bulgaria are used in the discussion of the subspecies of *Calopteryx virgo*, *Platycnemis pennipes* and *Onychogomphus forcipatus*, and the status of *Orthetrum ramburi*.

39. Guerguiev, V. 1957. – Za nashite vodni nasekomi (About our water insects). – Magazine “Priroda i znanie” (“Nature and knowledge”) 10 (4): 8-10. (in Bulgarian)

Gives popular facts on the dragonfly life (larvae and imago). Three Odonata species are depicted, *Libellula depressa* is identifiable.

40. Guerguiev, V. 1963. – Dishane pri vodnite nasekomi (Respiration in aquatic insects). – Magazine “Priroda i znanie” (“Nature and knowledge”) 16 (3): 16-19. (in Bulgarian)

Short explanation of the respiratory mechanism of dragonfly larvae (Anisoptera) is given. The tracheal system is depicted.

41. Gueorgiev, V. V. Beshovski, B. Russev, K. Kumanski, M. Josifov & V. Sakalian 1998. – Insects of Bulgaria, Part 1: Odonata, Ephemeroptera, Plecoptera, Homoptera (Auchenorrhyncha), Heteroptera, Coleoptera. – In: Bulgaria’s Biological diversity: Conservation Status and Needs Assessment, vol. I and II: 163-209. (in English)

Unique summary of the knowledge for the country: brief historical review; major gaps in the current knowledge; assessment of the current knowledge; historic, current and potential threats; recommendations. Seventeen rare and one relict species (*Calopteryx virgo meridionalis*) are reported. All are given with known sites.

42. Heymer, A. 1967. – *Hemianax ephippiger* en Europe [Odon. Anisoptera]. – Annl. Soc. Entomol. France 3: 787-795 (in French with German summary)

Bulgaria is included in the up to date species distribution in Europe. Reference is made to the first ever record for the country (Nedelkov, 1923) with its original published information, but with latin transcription (Note: The translation of Nedelkov’s text follows: “Bourgas. V⁴”; and the text in the superscript: “¹ Collection of Mr. D. Vajev, a teacher”).

43. Houbenov, Z. 1996. – Faunistitchno raznoobrazie na Bulgaria – bezgrabnatchni jivotni (Faunistic diversity of Bulgaria – Invertebrates). – Historia Naturalis Bulgarica 6: 11-16. (in Bulgarian with English summary)

An overview on the faunistic literature ever published for Bulgaria. The species are given in a table. For the Odonata it is stated that the species number recorded so far for Bulgaria (64) can probably be increased to 75.

44. Hristova, T., 1956. – Vragove na ribite (Fishes’ enemies). – Magazine “Ribno stopanstvo” (Fish industry”) 2 (4): 28-31. (in Bulgarian)

Dragonflies are mentioned as important predators in fish rearing ponds.

45. Hubenov, Z. V. Beshovski, M. Josifov, A. Popov, K. Kumanski, V. Sakalian, S. Abadjiev, Y. Vididnova & T. Lyubomirov 2000a. – Entomofaunistic diversity of the Central Balkan National Park. – In: “Biological diversity of the Central Balkan National Park”, Pensoft Publishing House, Sofia: 616 pp. (in Bulgarian and English version)

Detailed investigation carried out by a team of Bulgarian leading entomologists. No Odonata species have been previously reported for the Central Balkan National Park. The ten dragonfly species reported within the current Park's borders now rise the level of exploration to 20-30%. The upper river courses remain poorly explored. *Cordulegaster bidentatus* is mentioned as a comparatively rare species.

46. Hubenov, Z. V. Beshovski, M. Josifov, A. Popov, K. Kumanski, V. Sakalian, S. Abadjiev, Y. Vididnova, & T. Lyubomirov 2000b. – Entomofaunistic diversity of the Central Balkan National Park. – In: “Biological diversity of the Rila National Park”, Pensoft Publishing House: 649 pp. (in Bulgarian and English version)

Short overview on the previously reported dragonfly species. Fifteen species are mentioned from the high mountain zones of Rila National Park. The level of exploration in the Park is estimated as 50-55%. The dragonfly fauna of this region is still insufficiently known. *Aeshna subarctica* is pointed as a rare species which existence within the Park's borders (and Bulgaria as well) needs to be confirmed.

47. Hristovitch, G. 1892. – Materiali za izutchavane na balgarskata fauna (Materials for studying Bulgarian fauna). – Collection of Folklore 8: 337-349. (in Bulgarian)

The first ever published odonatological record on Bulgarian dragonfly fauna. For *Libellula depressa* morphological and biological notes mainly for the larvae are given.

48. Islam, S. Y. Ouzounov & St. Kovatchev 1986. – Sastav i pazpledelenie na makrozoobentosa ot reka Struma (Composition and distribution of the macrozoobenthos from the Struma river). – Hidrobiologiya (Sofia) 28: 15-35. (in Bulgarian with Russian and English summaries)

127 samples collected from 17 stations during the period 1980-1984 yielded eight dragonfly species from 10 stations. The dominance structure based on De Vries (1937) is analyzed.

49. Klapalek, Fr. 1894a. Zpráva o cesté entomologické Bulharskem a Vých Rumelií r. 1893. – Věstník České Akademie Císaře Františka Josefa pro vědy, slovesnost a vmení, III: 308-310. (in Czech)

Small notes about the Bulgarian Neuroptera fauna (the Odonata then being part of that order) collected from two main regions – around Sofia (4 localities) and around Sadovo – 15 km E from Plovdiv - (7 localities). Odonata are mentioned from six of them, some with genus or order only. Three new species for the country (*Ischnura elegans*, *I. pumilio* and *Calopteryx splendens xanthostoma*) are reported.

50. Klapalek, F. 1894b. – Kam izutchavaneto na mrezokrilite i pravokrilite nasekomi v Bulgaria (To the studying of the neuropterian and orthopterian insects in Bulgaria). – Collection of Folklore 9: 458-471. (in Bulgarian)

Six of the nine species reported viz *Sympetrum vulgatum*, *S. sanguineum*, *Orthetrum coerulescens*, *Sympecma fusca*, *Lestes barbarus* and *Platycnemis*

pennipes were new for the Bulgarian Odonata check list. The wing colouration of "*Calopteryx splendens xanthostoma*" is briefly described.

51. Klapalek, F. 1913. – Ad Neuropteroidorum faunae bulgaricae cognitionem additamentum. – Časopis České společnosti Entomologické, Ročník 10: 15-29. (in Czech)

Based on insects collected by Dr. F. Rambousk from Bulgaria. Four species were recorded, *Lestes viridis* is listed as new for the country.

52. Kovatchev, V. 1904. – Prinos kam izutchavane na entomologitcheskata fauna na Bulgaria (A contribution to the studying of the entomological fauna of Bulgaria). – Report of the State Secondary school for boys “Knyaz Boris” for 1903/1904 school year: 3-12. (in Bulgarian)

Contains a short dragonfly list of 6 species found around the town of Rousse, NE Bulgaria. New for the country were *Aeshna mixta*, *Calopteryx virgo*, *Coenagrion ornatum*.

53. Kovachev, St. & Y. Uzunov 1979a. – To the saprobiological characteristic of the Hungarian Danube stretch. – Hidrobiologiya (Sofia) 9: 44-49. (in English with Russian summary)

This paper contains results obtained during the youth scientific expedition in July 1977. *Gomphus flavipes* was the only dragonfly in the samples taken from Veranka island.

54. Kovachev, St. & Y. Uzunov 1979b. – Vazstanovitelni protzesi na macrozoobenthosnite saobshtestva v reka Struma sled odstranyavaneto na promishlenoto natovarvane sas suspendirani veshchestva (Restoration processes of the macrozoobenthos communities in Struma river after removing the industrial overloading with suspended materials). – Hidrobiologiya (Sofia) 9: 88-100. (in Bulgarian with Russian and English summaries)

A total of 21 sites had been sampled during six expeditions for the period 1975-1976. Five Odonata species are given with their frequency of occurrence. The observed tendency for recovery processes is based on finding zoobenthic indicators. In one of the methods the results show a decreasing level of the poly- and – alpha-mesosaprobic bionts (*Gomphus flavipes* is included) and an increase of the level of species known as everybionts which inhabit more clean waters (*Calopteryx splendens* and *Ophiogomphus cecilia* among the others). *Sympetrum striolatum* is given in separate chapter as example for increasing species diversity of a definite part of the river.

55. Kovachev, St. & Y. Uzunov 1981. – Vzaimno vliyanie na reka Tundja i yazovir “Zrebtchevo” varchu razvitiето na makrozoobentosnite saobshtestva (Mutual influence of the Tundja river and “Zrebtchevo” reservoir on the development of the macrozoobenthos communities). – Hidrobiologiya (Sofia) 15: 43-48. (in Bulgarian with Russian and English summaries)

Twelve field expeditions carried out 1976-1979 at six sample sites yielded three dragonfly species. They are not further specified.

56. Kovachev, S. & Y. Uzunov 1986. – Formation of macroinvertebrate communities in the course of the biological selfpurification of the Mesta River. – Arch. Hydrobiol., Suppl. 72(4): 427-526. (in English with German summary)

Very detailed study based on the samples taken from 17 stations. *Calopteryx splendens*, *Calopteryx virgo* and *Gomphus vulgatissimus* are reported from three stations with their frequency of occurrence.

57. Marinov, M. 1995. – New data on dragonflies (Odonata) of the Bulgarian high mountain lakes and marshlands in Rila and Pirin mountains. – Third national Scientific Conference Entomol. 1995: 15-17. (in English with Bulgarian summary)

Between 3 and 14 Aug 1994, six species were found at seven sample sites at altitudes from 2100 m to 2400 m a.s.l. Four species were not previously recorded for high altitudes of Bulgarian mountains. The highest Bulgarian odonate record is from 2400 m though suitable places (mainly dams) were found up to 2500 m.

58. Marinov, M. 1996. – Opazvaneto na vodnite kontcheta i technite mestoobitaniya. “Ape-lat ot Kushiro” (Protection of dragonflies and their biotopes. “Appeal from Kushiro”). – Maganize “Neophron”, Bulgarian Society for the Protection of Birds, 1: 5. (in Bulgarian)

A translated version of the appeal derived after the International Symposium for the protection of dragonflies - Kushiro' 1993 - is given.

59. Marinov, M. 1999. – *Chalcolestes parvidens* (Artobolevski) and *Somatochlora meridionalis* Nielsen in Bulgaria (Zygoptera: Lestidae; Anisoptera: Corduliidae). – Notul. Odonatol. 5: 31-33. (in English)

Chalcolestes parvidens and *Somatochlora meridionalis* are added to the Bulgarian fauna, bringing to 67 the dragonfly species number from the country. The former is reported for the first time for the country, while the latter was previously reported as *S. metallica meridionalis*. The up to date information is summarized in tables and species distribution in Bulgaria is mapped using UTM scale.

60. Marinov, M. 2000a. – Hello,Dragonfly!. – Sto Plus Publishing House, Kostinbrod: 32 pp. (in Bulgarian)

It is a booklet orientated to children mainly. The author uses an imaginary hero (named Odi – derived from Odonata) that describes its origin, morphology, life cycle and need for protection. The author's opinions on these different topics follow Odi's story.

61. Marinov, M. 2000b. – Pocket field guide to the dragonflies of Bulgaria. – Eventus Publishing House, Sofia: 104 pp. (in Bulgarian)

This is the first colour field guide for any invertebrate group of Bulgaria. Attention is paid to adults only. Twelve colour photos of different habitat types in Bulgaria and an identification key using colour computer graphics with arrows pointed to the exact morphological features are included. All then 66 species known for Bulgaria are illustrated and colour graphics in an identification key are added. Brief information are given on sexual and age dimorphism, closely

related species; subspecies in Bulgaria, ecological notes on larval preferences, flight period and measurements (total length and wing span). (Remark: The guide suffers from some mistakes the most significant of which is the colouration of the abdominal tip in female *Ischnura pumilio* (page 19 and 57), which is given male like).

62. Marinov, M. 2000c. – A contribute to the fauna of Srebarna biosphere reserve. – Acta Zool. Bulg. 52: 37-42 (in English with Bulgarian summary)

118 taxa are added to the Srebarna biosphere reserve checklist among them *Enallagma cyathigerum* and *Anax parthenope*, rising it to 2,866 taxa.

63. Mauersberger, R. 1985. – Libellen (Odonata) von der nordbulgarischen Schwarzmeerküste. – Entomol. Nachr. Ber. 29: 199-207. (in German with English and Russian summaries)

Twenty Odonata species are reported from the Bulgarian Black Sea coast in August 1983. One of the most important is *Orthetrum anceps* (the first record for Bulgaria in its current state borders). Special attention is also paid to *Hemianax ephippiger*, *Orthetrum brunneum*, *O. coerulescens*, *O. anceps* and *Symptetrum fonscolombii* and their visual cues for easy identification in the field.

64. Mauersberger, R. 1990. – Libellenbeobachtungen aus dem Bulgarischen Balkan-Gebirge (Stara Planina). – Libellula 9: 43-59. (in German with English summary)

This is a unique investigation of a very little explored region reporting 34 species from 12 sites sampled between 4 and 16 Aug 1988. Of special interest are the discussions on the status of Bulgarian *Cordulegaster* species and the *Orthetrum coerulescens/anceps* taxonomic problem.

65. Mauersberger, R. 1994. Zur wirklichen Verbreitung von *Orthetrum coerulescens* (Fabricius) und *O. ramburi* (Selys) = *O. anceps* (Schneider) in Europa und die Konsequenzen für deren taxonomischen Rang (Odonata, Libellulidae). - Dtsch. entomol. Z., N.F. 41: 235-256. (in German with English summary)

This paper deals with the *Orthetrum coerulescens/ramburi* (=anceps) taxonomic problem. Five phenotypes (enumerated 1-5) are established. Bulgarian specimens belong to phenotypes 4 and 5 only.

66. Mihailova-Neikova, M. 1959. – Prouchvane na Mandrenskoto ezero vav vrazka s ribostopanskoto mu izpolzvane (Investigations of the Mandra lake in connection with its fishery exploration). - Magazine "Ribno stopanstvo" (Fish industry) 5 (9): 28-31 (in Bulgarian)

Odonata larvae are mentioned as inhabitants of the lake.

67. Mihov, N., M. Marinov, T. Michev, P. Yankov, & M. Kurtev 1997. – Ezero Srebarna (Lake Srebarna). – In: Kostadinova, I., "Ornitologichno vajnite mesta v Balgaria" ("Important Bird Areas in Bulgaria"), Bulgarian Society for the Protection of Birds: 176 pp.

References to Beshovski (1965) and Beshovski & Marinov (1993) are given. Dragonflies are reported as a total number of 36 species including the second Bulgarian record of *Cordulia aenea*.

68. Nedelkov, N. 1909. – Nashata entomologitchna fauna (Our entomological fauna). – Archive Ministry National Education 1 - 3: 51-53. (in Bulgarian)

Sixteen species are reported with site and month of record. Eight species *Sympetrum pedemontanum*, *S. flaveolum*, *S. meridionale*, *Orthetrum brunneum*, *O. albistylum*, *Aeshna juncea*, *Onychogomphus forcipatus* and *Lestes sponsa* are new for the Bulgarian dragonfly fauna.

69. Nedelkov, N. 1923. – Osmi prinos kam entomologitchnata fauna na Bulgaria (Eight contribution to the entomological fauna of Bulgaria). – Magazine Bulg. Acad. Science, Nat. Sci. -Mathematical branch 25: 45-52. (in Bulgarian)

A considerable contribution based on the the author's investigations mainly on S and SW Bulgaria and places along the Black Sea coast, N Bulgaria and the Danube river banks. Eight out of 45 published taxa are given for the first time for Bulgaria (*Somatochlora metallica*, *Hemianax ephippiger*, *Cordulegaster insignis*, *Onychogomphus forcipatus unguiculatus*, *Ischnura pumilio* var. *aurantiaca*, *Enallagma cyathigerum*, *Platycnemis pennipes* var. *albidella*, var. *pecchioli*). *Brachytron pratense* is for the first time recorded from within current Bulgarian state borders.

70. Pechlivanov, L. 1998. – On the role of zooplankton in food of some numerous fish species in lake system Shabla-Ezerets. – Biodiversity of Shabla lake system, Ministry of Environment and Waters, Bulgarian Academy of Science, Institute of Zoology, "Prof. Marin Drinov" Academic Publishing House, Sofia: 107-113 (in English with Bulgarian summary)

The material collected in 1992 and 1994 yielded 97 fish specimens from eight species. The relative number, frequency and dominance of the taxa used as food spectrum are given. Odonata larvae are reported in the diet of the black-striped pipefish *Syngnathus nigrolineatus*.

71. Petkov, P. 1914. – Entomologitchni belejki (Entomological notes). – Works Bulg. Nature Research Society 6: 99-104. (in Bulgarian with French summary)

A list of seven Lepidoptera and nineteen Odonata species at that time deposited at the Royal Entomological Station in Sofia. All dragonfly species are presented either by the earlier and the new finding places. Eleven species (*Lestes virens*, *Coenagrion pulchellum*, *Coenagrion ornatum*, *Coenagrion mercuriale*, *Coenagrion puella*, *Gomphus vulgatissimus*, *Ophiogomphus cecilia*, *Aeshna mixta*, *Aeshna affinis*, *Anax imperator*, *Libellula fulva*) are stated as new for the country. (Remark: *C. ornatum* and *A. mixta* had been reported earlier: Kovatchev 1904; *Coenagrion mercuriale* is likely a misidentification).

72. Petkov, P. 1921. – Prinos kam izutchavane na balgarskite Odonata (A contribution to the studying of Bulgarian Odonata) – Ann. Sofia University, Phisico-Mathematical Faculty 1918-1920, 15-16: 1-39. (in Bulgarian with German summary)

The most fundamental Odonata work on the Bulgarian Odonata at that time. It is based on the author's excursions throughout the country and some of the territories outside the present Bulgarian state borders in Greece and Macedonia. The paper is divided in two parts: common notes and systematic list. The last pages contain the references and the summary. The first part gives much interesting information about dragonflies as an insect group. The stage of its exploration in the country for the time including a short overview of previous records is made on page 2. Detailed information about dragonfly biology with interesting observations (*Coenagrion puella* copulation pairs, egg laying in the Aeshnidae) are also provided. Some curious literature facts about dragonfly larvae predation on small fish and flight of the imago are given, too. The systematic list includes 59 species, subspecies and forms (last two are named "varieties" by the author), 26 are reported as new for the country (*Calopteryx virgo* var. *festiva*, *Lestes dryas*, *Platycnemis hyalinata* (*latipes*), *Nehalennia speciosa*, *Cercion lindeni*, *Coenagrion hastulatum*, *C. lunulatum*, *Erythromma viridulum*, *Pyrrhosoma nymphula*, *Lindenia tetraphylla*, *Gomphus flavipes*, *G. pulchellus*, *Onychogomphus uncatatus*, *Cordulegaster annulatus*, *C. bidentatus*, *Brachytron hafense*, *Anaciaeschna isosceles*, *Anax parthenope*, *Crocothemis erythrea*, *Orthetrum anceps*, *O. cancellatum*, *Libellula quadrimaculata* var. *praenubula*, *Sympetrum striolatum*, *S. fonscolombii*, *S. depressiusculum*, *Leucorrhinia pectoralis*). Later Beshovski (1965, 1991, 1993) excluded some of these (*P. hyalinata* (*latipes*), *N. speciosa*, *C. lunulatum*, *O. uncatatus*, *C. boltonii*, *L. tetraphylla*, *G. pulchellus*, *B. pratense*, *O. anceps*) from the Bulgarian check list due to either misidentification or because they were recorded from sites no longer belonging to Bulgaria. Each species in the systematic list is given with its overall distribution, previous information for Bulgaria, new finding places, flight season, important morphological identification features and species status on the Balkan peninsula. Special attention is paid to the *Libellula quadrimaculata* forms. The author provides a detailed description of the dark wing spots. He uses the variation in its shape and intensity as evidence that some of the recent *L. quadrimaculata* individuals show atavistic features typical for already extinct species. It does not support the Bartenev's opinion that *f. praenubila* is now in the process of extinction and therefore found less frequently.

73. Petrov, Tz. 1973. – Varchu biologiyata i ekologiyata na ptcheloyada (*Merops apiaster* L.) v Plovdivsko (On the biology and ecology of Bee-eater (*Merops apiaster* L.) in Plovdiv area. – Bull. Nat. Hist. Museum Plovdiv 1973: 65-87. (in Bulgarian with Russian and German summaries and short English abstract)

The results are based on the study carried out during the period 1970-1971 in 16 nests, which had been prepared for investigation using specific methodology. Totals of 18 Odonata taxa are reported, the most interesting are *Somatochlora flavomaculata* (second record for Bulgaria) and *Hemianax ephippiger*, the record being away from the main distribution centre in Bulgaria, the Black Sea coast and the Struma river valley.

74. Popov, A. 1961. – Edno vodno kontche nepoznato dosega za faunata na Bulgaria (Odonata) (One hitherto unknown record for the Bulgarian fauna of dragonflies (Odonata). – Magazine “Priroda” 6: 78-80. (in Bulgarian)

Contains the first record of *Somatochlora flavomaculata* for Bulgaria. The author gives its measurements and the overall species distribution. Some short overview of the odonatological research in Bulgaria is made, too. Of special interest is an explanation of the origin of the Bulgarian traditional name for dragonflies – “vodni kontcheta”. Its direct translation is “water foals” and is originated because of their flight over the water surface which reminds the fast running foals.

75. Prostov, A. 1960. – Izsledvaniya varchu sistematikata, biologiyata I stopanskoto znachenie na sinigerite v Bulgariya (Investigations on the systematic, biology and industrial significance of the tits in Bulgaria). – Bull. Inst. Zool. Mus. Sofia 9: 179-254. (in Bulgarian with Russian and German summaries)

Very detailed investigation of three tit species of the genus *Parus* in Bulgaria. Odonata remains are reported from one stomach of the Blue Tit (*Parus caeruleus*, L.) only.

76. Russev, B. 1959. – Beitrag zur Erforschung des Makrobenthos der Donau am Bulgarischen Ufer. – Comptes rendus l'Acad. bulg. Sci. 12: 345-348. (in German with Russian summary)

Hydrobiological investigations of the Bulgarian part of Danube river (between river km 845 and 375) were carried out at nine profiles from September 1956 – October 1958. Short ecological notes on *Gomphus vulgatissimus* and *Aeshna affinis* are reported.

77. Russev, B. 1962. – Nasekomnata fauna na reka Dunav pred balgarskiya bryag (The insects fauna of Danube river in front of Bulgarian shore). – Bull. Research freshwater-fisheries station - Plovdiv 1: 115-128. (in Bulgarian with Russian and German summaries)

Hydrobiological investigation of 20 profiles (totals of 720 sampling stations) along the Danube river (between km 845 and 375) at eleven times in different seasons covering both the Bulgarian and the Romanian parts. Five dragonfly species are reported. Air temperature, cloudiness, wind and humidity are pointed out as important abiotic conditions.

78. Russev, B. 1963a. – Hranata na tchigata (*Accipenser ruthenus*) v reka Dunav pred balgarskiya bryag (The food of sterlet (*Accipenser ruthenus*) in the Danube river off the Bulgarian shore). - Bull. Research freshwater-fisheries station – Plovdiv 2: 49-72. (in Bulgarian with Russian and German summaries)

Three hundred eighty-seven stomachs were collected from fish markets along the whole Bulgarian Danube river shore between 1953-1958. These were compared according to the quantitative relationships between food components using different methods. *Gomphus flavipes* and *G. vulgatissimus* represented 0.38 % of the total weight of the food components, 0.06 % of the total number

of the individuals in the food components, 1.59 % of the frequency of occurrence and 1.24 % of occurrence of the dominant food components.

79. Russev, B. 1963b. – Izchranvaneto na tchigata vzavisimost ot razpredelenieto na zoobentosa v balgarskiya sektor na reka Dunav (Feeding of the sterlet in order to the distribution of the zoobenthos in the Bulgarian part of Danube river). – Fish-breeding 2: 5-7. (in German with Russian summary)

A hydrobiological investigation carried out on the lithorheophilic coenosis along the Bulgarian Danube river banks from September 1956 to April 1961. The biomass of *Gomphus flavipes* reaches 119 mg/m² near the town of Nikopol (river km 597).

80. Russev, B. 1963c. - Anthropogene lithorheophile Biozönosen im Bulgarischen Donauabschnitt. - Comptes rendus l'Acad. bulg. Sci. 16: 545-547. (in German with Russian summary)

The biomass of *Gomphus flavipes* is given from near the town of Nikopol.

81. Russev, B. 1963d. – Saprobiologichna pretzenka na balgarskiya sektor na reka Dunav (Saprobiological assessment of the Bulgarian stretch of the Danube river). – Bull. de l'Institut central de recherche scientifique de pisciculture et de pecherie Varna 3: 245-251. (in Bulgarian with Russian and German summaries)

Gomphus vulgatissimus is given as a frequently observed species and its saprobic valences (according to Zelinka & Marvan 1961) are stated.

82. Russev, B. 1964. – Hidrobiologitchi izsledvaniya na reka Arda i hyakoi heini pritotzi (Hydrobiological investigation on Arda river and some of its tributaries). - Bull. Inst. Zool. Mus. 17: 5-49. (in Bulgarian with Russian and German summaries)

Detailed physico-geographical and hydrological characteristics are given from 18 stations sampled between 1956-1957 and 1962-1963. Five dragonfly species are reported from three stations.

83. Russev, B. 1966a. - Hidrobiologitchi izsledvaniya na reka Maritza, I. (Hydrobiological investigation on Maritza river. I). - In "Fauna na Trakia (Fauna of Thrace)", т.3, Bulg. Acad. Science: 231-291. (in Bulgarian with Russian and German summaries)

Eleven stations had been established and sampled during different months in 1955, 1960, 1962-1963. Detailed physico-geographical and hydrological characteristics and 13 Odonata species are reported from 9 stations with their finding date, place and brief references.

84. Russev, B. 1966b. – Zoobentosat na reka Dunav mejdu 845 i 375 retchen kilometer. I. Sastav, razpredelenie i ekologiya (Zoobenthos of Danube river between 845 and 375 river kilometer. I. Composition, distribution and ecology). - Bull. Inst. Zool. Mus. 20: 55-131. (in Bulgarian with Russian and German summaries)

The article comprises the first part of a very detailed investigation of the river Danube river in Bulgaria over seven years (1953-1959) including detailed physico-geographical and hydrological characteristics. Nine Odonata taxa are reported with some short references. Detailed information on abiotic habitat parameters of *Gomphus flavipes* are given.

85. Russev, B. 1967a. – Zoobentosat na reka Dunav mejdu 845 i 375 retchen kilometer. II. Biotzenologiya i dinamika (Zoobenthos of Danube river between 845 and 375 river kilometer. II. Biocoenology and dynamic). - Bull. Inst. Zool. Mus. XXIII: 33-78. (in Bulgarian with Russian and German summaries)

Second part of the study reported in Russev 1966b. Here the attention is paid to the type and distribution of the different biocoenosis along the river. *Gomphus flavipes* is reported from all coenoses with its frequency of occurrence.

86. Russev, B. 1967b. - Hidrobiologitshi izsledvaniya na reka Maritza. II. Saprobiologitchn pretzenka za 1965 i 1966 (Hydrobiological investigation on Maritza river. II. Saprobological estimation for 1965 and 1966). - Bull. Inst. Zool. Mus. 25: 87-99. (in Bulgarian with Russian and German summaries)

During the period April 1965 – July 1966 hydrobiological samples had been taken at 19 points along the Bulgarian part of the Maritza river at the Bulgarian-Greek border. Ten odonate taxa are reported, *Platycnemis pennipes* and *Gomphus vulgatissimus* are associated with alpha-mesosaprobic situations.

87. Russev, B. 1968a. - Saprobiologische Übersicht über die Donau und ihrer Nebenflüsse zwischen dem 845. und 375. Flusskm. - Limnologische Berichte der X. Jubiläumstagung Donauforschung 1968: 481-489. (in German with Russian summary)

Saprobological investigations had been carried out in the Danube river and some of its tributaries both along the Bulgarian and Romanian parts. *Gomphus vulgatissimus* is a useful indicator for different saprobiological levels.

88. Russev, B. 1968b. - Saprobiologische Charakteristik des Donauzuflusses Iskar. 1-9. (in German). Published in Switzerland, no further details available.

Zelinka & Marvan's (1961) method is used in order to assess the saprobiological situation in the bigger Danube tribute in the Bulgarian part. A total of six odonata taxa (including unidentified Coenagrionidae) were found at twenty stations sampled during different months in 1964 and 1968.

89. Russev, B. 1969. - Der Grund als Hauptfaktor bei der Verteilung des Zoobenthos im Bulgarischen Donauabschnitt. - Zool. Inst. Bulg. Akad. Wissensch.: 286-290. (in German with Russian summary)

The dominance structure of the zoobenthos is given. *Gomphus flavipes* is mentioned as inhabitant of different coenosis types.

90. Russev, B. 1972. - Influence of some ecological factors on changes of the standing crop of Zoobenthos of the Danube in the Bulgarian stretch 814-822. - Proc. IBP-UNESCO Symp. Poland, Kazimierz Dolny 1970: 813-826. (in English)

A statistical analysis of several years of investigations of the zoobenthos biomass in the Bulgarian Danube. *Gomphus flavipes* is pointed out as “[...] relatively much more numerous”. Analyses of the distribution of the dragonfly larvae along the river are carried out with respect to the composition of the bottom, the depth, current velocity, water level and distance from shore.

91. Russev, B. 1977a. - Die Struktur der benthalen Zoozönosen im bulgarischen Donauabschnitt und ihre Wandlungen unter Einwirkung des Menschen. - *Hidrobiologiya* (Sofia) 5: 81-88. (in German with Russian summary)

Between 1956-1958, 1959-1961, 1964, and 1970-1973 a total of 1036 sites were sampled 18 times. In this generalizing article no species names are given. Their total biomasses in different coenoses are reported for various periods.

92. Russev, B. 1977b. – Zamarsyavane i samopretchistvane na reka Osam spored sastava na bentosnata i fauna (Pollution and self-purification of Osam river according to the change of its bentic fauna). – *Hidrobiologiya* (Sofia) 6: 3-22. (in Bulgarian with Russian and German summaries)

Five Odonata species are reported from five out of 138 stations sampled at different months in 1968, 1969 and 1971.

93. Russev, B. 1977c. – Bioindikatori – prechisvateli na vodite (Bio-indicators – purifiers of the waters). – Magazine “Priroda i znanie” (“Nature and knowledge”), 24 (4): 18-22. (in Bulgarian)

Explanation of the Kolkwitz & Marsson’s (1909) saprobiological system. The larva of *Onychogomphus forcipatus* is depicted and stated as typical for beta-mesosaprobic waters.

94. Russev, B. 1978. – Osobenosti i znatchenie na zoobentosa na reka Dunav mejdu 845-ya i 735-ya retchen kilometar (Special features and importance of the zoobenthos of the Danube river between 845 and 375 river’s kilometer). – In: *Limnologiya na balgarskiya sektor na reka Dunav* (Limnology of the Bulgarian part of Danube river), Sofia Bulgarian Academy of Science, Institute of Zoology: 145-200. (in Bulgarian with Russian and German summaries)

An overview is given on material collected from the Bulgarian Danube between 1952-1973. In 32 investigations *Gomphus flavipes* was reported among the dominant species. It is included in separate tables showing the dominance frequency in different coenoses, the number and biomass in the river sediments and the distribution according to water flow and depth.

95. Russev, B. 1979a. - Gegenwärtige Kenntnisse über die Artenzusammensetzung des Zoobenthos der Donau. - XIX Jubiläumstagung der Internationalen Arbeitsgemeinschaft Donauforschung; *Limnologische Berichte Bulg. Akad. der Wissensch.*: 306-339. (in German)

Twenty Odonata species are given from the whole Danube river. Of particular interest is the record of *Leucorrhinia pectoralis* from the former Czechoslovakia (river km 1880-1780) and Hungary (river km 1850-1433). The results are summarized in a separate table giving the total species number from each animal group for each country. Ten Odonata species are reported for the Bulgarian part of the river.

96. Russev, B. 1979b. - Änderungstendenzen im saprobiologischen Zustand des Bulgarischen Donauabschnittes. (Tendencies of directional changes of the saprobiological condition of the Bulgarian part of the river Danube) – 19. Jubiläumstagung der Inter-

nationalen Arbeitsgemeinschaft Donauforschung; Limnologische Berichte 1979: 457-461. (in German)

Odonata are mentioned among other orders in this overview of the results from different countries.

97. Russev, B. 1985. – Tendenzii v izmeneniyata na hidrobiologitchno i saprobiologitchno sastoyanie na reka Tundja. II. (Tendencies in the changes of the hydrobiological and saprobiological condition of Tundja river. II). – Hidrobiologiya (Sofia) 26: 15-36. (in Bulgarian with Russian and English summaries)

Thirty samples taken from 16 stations in 1981 yielded seven Odonata taxa from seven of these stations. Their frequency of occurrence, of dominance and the coefficient of dominance are reported.

98. Russev, B. 1991a. - Zoobenthos und saprobiologischer Zustand der Donau während der im März 1988 durchgeführten internationalen Expedition. (The zoobenthos and the saprobiological condition of the Danube during the international expedition carried out in 1988) - Hidrobiologiya (Sofia) 37: 34-41. (in German with Russian summary)

Twenty-three sites were sampled during that expedition. *Gomphus flavipes* is reported from Višegrad (river km 1694).

99. Russev, B. 1991b. – On the adaptation on reobionts to running waters. – Hidrobiologiya (Sofia) 37: 53-58. (in English with Russian summary)

Short summary of the ecological investigations given in Beshovski (1967, 1968).

100. Russev, B. & V. Kaneva-Abadjieva 1973. - Sur la faune du benthos des Marais de quelques îles Bulgares du Danube. – Hidrobiologia (Bucuresti) 14: 255-268. (in French with German summary)

Seventeen islands along the Bulgarian part of Danube river were investigated during different months of 1964-1967. Six dragonfly species are reported for ten of the islands.

101. Russev, B. & I. Yaneva 1975. – Hidrofaunistitchni proutchvaniya na nyakoi rodopski vodoemi (Hydrofaunistical investigations of some Rhodope wetlands). - In: "Fauna na Rodopite. Materiali (Fauna of the Rhodopes. Materials)". Bulg. Acad. Science: 11-39. (in Bulgarian with Russian and German summaries)

A very detailed investigation with material from 1962-1972 and additional material from 1931 and 1956. Ten Odonata taxa were recorded at 18 out of 85 sampling sites.

102. Russev, B. Y. Uzunov, St. Kovatchev, I. Yaneva & L. Ivanova, 1981. – Tendenzii v izmeneniyata na saprobiologitchno sastoyanie na reka Maritza (Tendencies in the changes of the saprobiological condition of the Maritza river). – Hidrobiologiya (Sofia) 14: 51-64. (in Bulgarian with Russian and English summaries)

Eighteen sites were sampled in 1976 and 1977. Three Odonata species are reported as evidence for restoration (selfcleaning) or increasing quality of the river in certain parts.

103. Russev, B., V. Cure, & V. Popescu-Marinescu 1983. – Die Veränderungen der Strömungsgeschwindigkeit und ihre Auswirkungen auf die Plankton- und Benthos-biozönosen der Donau. (Changes in the velocity of the Danube and its influence on the planktonic and benthic communities) – *Hidrobiologia (Bucuresti)* 17: 93-148. (in German)

This paper summarizes investigations on the Danube river carried out prior to 1970 and between 1971-1973. Eleven dragonfly species are reported from both periods.

104. Russev, B. M. Nikolova & M. Dimitrova 1984. – Tendenzii v izmeneniyata na hidrobiologitchnoto i saprobiologitchnoto sastoyanie na reka Tundja. I. 1955-1967 (Tendencies in the changes of the hydrobiological and saprobiological condition of Tundja river. I. 1955-1967). – *Hidrobiologiya (Sofia)* 22: 59-73. (in Bulgarian with Russian and English summary)

A total of 139 stations were established and sampled between 1955-1967 along the whole Bulgarian part of the Tundja river. Sixteen Odonata taxa (one unidentified) were reported from 56 sampling sites.

105. Russev, B. & I. Yaneva 1986. – Hidrobiologitchen pregled na desniya dunavki pritok Tzibrita (Hydrobiological review of the right Danube tributary Tzibritza). - *Hidrobiologiya (Sofia)* 28: 36-45. (in Bulgarian with Russian and English summaries)

Nine sites were sampled in different months of 1961, 1964, 1967 and 1978. Seven Odonata species and their frequency of occurrence, frequency of dominance and the dominance coefficient are reported from eight stations.

106. Russev, B. M. Nikolova & I. Yaneva 1987. – Tendenzii v izmeneniyata na hidrobiologitchnoto sastoyanie na poretcieto na reka Russenski Lom (Tendencies in the changes of the hydrobiological condition of the Russenski Lom river) - *Hidrobiologiya (Sofia)* 31: 65-82. (in Bulgarian with Russian and German summaries)

A total of 246 samples taken from 30 stations in different intervals within the period 1950-1984 are presented. Eight Odonata species are mentioned from 32 samples.

107. Russev, B., I. Yaneva & M. Nikolova, 1991. – Hidrobiologitchnoto sastoyanie na poretchieto na reka Lom (Hydrobiological condition of the Lom river). - *Hidrobiologiya (Sofia)* 36: 13-31. (in Bulgarian with Russian and English summaries)

The sampling of 22 sites yielded five Odonata species during the period 1961-1968. They are given by period but not by site.

108. Russev, B. Y. Ouzounov, 1991. - Der Zustand der benthalen Zoozönosen in bulgarisch-romanischen Donauabschnitt. (The situation of the benthic community in the Bulgarian - Romanian part of the Danube river). - *Hidrobiologiya (Sofia)* 37: 24-31. (in German with Russian summary)

Seven profiles from 56 stations were sampled in 1986. *Gomphus flavipes* is reported from three profiles.

109. Russev, B. et. al. 1994. – Limnologiya na balgarskite dunavski pritotzi (Limnology of the Bulgarian Danube's tributaries). - "Knijen tigar" Publ. House: 255 pp. (in Bulgarian with German summary)

The most valuable work on the Bulgarian Danube river's tributaries. It combines any kind of investigations ever carried out along the whole stretch of the river. The information from 11 tributaries is analyzed and a species check list is given. Odonata species are reported on page 152-153. In total, 32 taxa are given from all the tributaries.

110. Russev, B. A. Petrova, I. Yaneva & S. Andreev, 1998. – Diversity of Zooplankton and Zoobenthos in the Danube River, its tributaries and adjacent water bodies. - In: Bulgaria's Biological diversity: Conservation Status and Needs Assessment, vol. I and II: 261-292. (in English)

The dragonflies occur with a frequency of $pF = 7.14\%$. Short information for Odonata is given: "Thirty-one species have been found, mainly in the middle and lower stretches of the Danube tributaries". (Remark: In a personal detailed investigation throughout the literature and personal unpublished data I found 47 species found along the Danube river, its tributaries and oxbows).

111. Scheffler, W. 1973. – Libellen (Odonata) aus Bulgarien. – Dtsch. entomol. Z., N.F. 20 : 357-362. (in German)

Very important results from two expeditions throughout Bulgaria in 1969 and 1970. Nine sites are briefly described. Nineteen species were found. This list is of special interest as, although it is not pointed out, it contains the first information for *Lestes macrostigma* for Bulgaria. In the last part of the article the author presents a dragonfly species check list for Bulgaria. A special chapter is given for *Coenagrion hastulatum* with regard to its habitat requirements. (Remark: This list mentions 65 taxa, not 66 as stated. Some of them are not correct. *Lestes macrostigma* is in fact recorded for the first time for Bulgaria, *Lindenia tetraphylla* was already omitted by Beshovski (1965) from the Bulgarian list, *Onychogomphus costae* has never been reported for the country and *Selysiothemis nigra* was only later found by Beshovski & Gashtarov 1997. The list does not include *Lestes sponsa* found by Nedelkov (1909). Despite of these shortcomings this paper played a considerable role in Bulgarian dragonfly faunistics).

112. Schmidt, E. 1949. – Über Ausbildung von Steppenformen bei der Waldlibelle *Platycnemis pennipes* (Pall.) (Odonata, Zygoptera). (On the development of steppe forms in the forest damselfly *Platycnemis pennipes* (Pall.) (Odonata, Zygoptera). – Ber. Naturforsch. Ges. Augsburg 2: 55-106. (in German)

The alphabetical list of the *P. pennipes* records states: "Scopie, Bulgarien". This town is not within the current Bulgarian state borders.

113. Schmidt, E. 1978. – Odonata: In Illies, J. "Limnofauna Europea": 274-279. (in German) This paper mentions 71 species for the Balkan Peninsula, including Bulgaria, apparently not reporting *Lestes macrostigma* (Scheffler 1973).

114. Schorr, M., W. Schneider & H. Dumont 1998. – Ecology and distribution of *Lindenia tetraphylla* (Insecta, Odonata, Gomphidae): a review. – Int. J. Odonatol. 1: 65-88 (in English)

Bulgaria is included with a special remark in this review of the published distribution records of *L. tetraphylla*. The species was reported by Petkov (1921) but later excluded from the Bulgarian list by Beshovski (1965) as Petkov's sample site, the village of Mravintzi (district of Kavardartzi), is not within the current Bulgarian state borders.

115. Seidenbusch, R. 1997. – Comparison of wing features in selected European and Mediterranean specimen of the species group *Calopteryx virgo* Linnaeus 1758. – Sulzbach – Rosenberger Libellenrundbriefe 4: 4-9. (in English)

C. virgo festiva specimens collected from Varna, N Bulgarian Black Sea coast were used in this study.

116. Simeonov, S. 1964. – Proutchvane varchu chraneneto na domashnoto vrabtshe (*Passer domesticus* L.) v Sofiisko (Investigation on the diet of the House Sparrow (*Passer domesticus* L.) in Sofia region). – Annals of Sofia University, Biol.-geol.-geograph. Faculty 1 Biology (Zoology) 61: 239-275. (in Bulgarian with Russian and German summaries)

The results of this studied carried out between 1959-1961 are arranged in tables. In one of the tables the food of nestling house sparrows is mentioned to contain 2 adult odonates and 1 larva. The same author (Simeonov 1963) has not found Odonata species during other investigations carried out in the related Eurasian Tree Sparrow (*Passer montanus* L.).

117. Simeonov, S. 1983. – Novi materiali varchu chranata ha kukumyavkata (*Athene noctua* (Scop.) v Bulgaria (New materials on the food of the Little Owl (*Athene noctua* (Scop.) in Bulgaria). – Ekologiya (Sofia) 11: 53-60. (in Bulgarian with Russian and English summaries)

In food pellets collected from 24 sites all around the country between 1968-1980 Odonata (no species names) are listed. Remains of 57 individuals were found in the spring-summer period and 23 in autumn-winter. It is interesting to note that no Odonata species are reported in the food of Short-eared Owl (Simeonov 1983, same magazine), although this species inhabits wetlands.

118. Simeonov, S. & Y. Sofroniev, 1981. – Proutchvaniya varchu poloviya dimorfisam i chraneneto na vodniya kos (*Cinclus cinclus*) v Bulgaria (Investigations on sex dimorphism and diet of the dipper (*Cinclus cinclus*) in Bulgaria). – Annals of Sofia University “St. Kl. Ochriski” 72/73: 80-87. (in Bulgarian with Russian and German summaries and short English abstract)

Over 12 years 118 stomachs of dippers from different Bulgarian regions were investigated. Zygoptera (2 individuals), Lestidae (3) and *Lestes virens* (1) were reported from one sample each, Anisoptera (7) from 5, Gomphidae (9) from 4 and Libellulidae (8) from six stomachs.

119. Tuleshkov, K. 1946. – Golemina na nasekomite (Sizes of insects). – Magazine “Prirodoznanie” (Nature-knowledge) 5 (1-2): 39-45. (in Bulgarian)

Meganeura monyi is mentioned as the ancestor of current dragonflies with wing span up to 70 cm long.

120. Tuleshkov, K. 1948. – Tzvetat na nasekomite. (The colour of insects). – Magazine “Priroda i znanie” (Nature and knowledge) 2 (2-3): 18-22. (in Bulgarian)

Dragonflies are mentioned as insects with a very strong cuticle.

121. Tzvetkov, L. 1955. – Izsledvane varchu chranata na ribite v Beloslavskoto ezero (Investigation on the food of the fishes in Beloslav lake). – Bull. Inst. Zool. Mus. Sofia 4/5: 329-347. (in Bulgarian with Russian and German summaries)

This investigation carried out mainly in 1951 mentions fifteen fish species. Three dragonfly taxa are inhabitants of the phytorheophilic coenosis.

122. Tzvetkov, L. 1957. – Zoobentosat na Beloslavskoto ezero (Zoobenthos of the Beloslavssko lake). - Bull. Inst. Zool. Mus. Sofia 6: 381-439. (in Bulgarian with Russian and German summaries)

Odonata larvae are mentioned as phytophilic species inhabiting the lake.

123. Urbanski, J. 1947. – Notatki odonatologizne z Bulgarii (Odonatological notes for Bulgaria). – Ann. Univ. Mariae Curie-Sklodowska (Lublin) 2, Sectio C: 241-268. (in Polish with French summary)

A paper of great value as it has been the only specific odonatological work on Bulgarian dragonflies for a considerable period of time (1923-1960). The results are based on the samples taken between 1936 and 1938 from 20 different places, which are mapped, mainly around Sofia (1), Plovdiv (4), Varna (9), Bourgas (1), Veliko Tarnovo (3), Sliven (100 km W from Bourgas) and Lakatnik (50 km N from Sofia along the Iskar river valley). A detailed description for each of them is given. For each of 21 species site and date, number of specimens caught and various measurements are mentioned.

124. Uzunov, Y. B. Russev, St. Kovachev & I. Yaneva, 1981. – Vidov sastav i razpredelemie na makrozoobentosa ot reka Maritza (Species composition and distribution of the macrozoobenthos of the Maritza river). - Hidrobiologiya (Sofia) 14: 3-15. (in Bulgarian with Russian and English summaries)

190 samples had been collected from 18 stations during 1976-1977. Totals of 9 dragonfly species are reported from 16 stations.

125. Uzunov, Y. & St. Kovachev, 1981. – Rolyata na grunta za izgrajdaneto na strukturata na makrozoobentosnite saobshtestva ot reka Maritza (The role of the ground for creating the macrozoobenthos communities structure from Maritza river). - Hidrobiologiya (Sofia) 14: 65-74. (in Bulgarian with Russian and English summaries)

The investigation is based on the collection summarized in Uzunov et al. (1981). Here, some of the species are grouped according to their habitats. The relative abundance and the frequency of occurrence are reported, too. *Gomphus flavipes* is mention to dwell mud and *Calopteryx splendens* between wooden branches and roots.

126. Uzunov, J. & Kovachev, St. 1985. - Macroinvertebrate communities structures in the Maritza River under human impact. - Hidrobiologiya (Sofia), 24: 33-47. (in English with Russian summary)

This paper is based on the investigation whose methodology had been described in Uzunov et al. (1981). It summarizes all available data. The proportion of “Odonata” in the macrozoobenthos along the river is given.

127. Uzunov, Y., St. Kovachev & K. Kumanski & J. Ludskanova-Nikolova, 1998. – Aquatic ecosystems of the Aegean and Black Sea basins. - In: Bulgaria's Biological diversity: Conservation Status and Needs Assessment, vol. I and II: 293-2318. (in English)

Overview of two catchment provinces of the Black Sea (seven river basins, river basins of the smaller Black Sea tributaries and basins of the coastal lakes lacking their own outflow) and the Aegean Sea (five river basins) mentioning 58 odonate species. Species numbers are detailed for each river basin. *Coenagrion mercuriale*, *Ophiogomphus cecilia*, *Gomphus flavipes*, *Brachytron pratense* and *Leucorrhinia pectoralis* are reported as species from the European Red Data List. *O. cecilia* and *G. flavipes* are stated as rare European species, but they are common in the basins studied.

128. Van Tol, J. & M. J. Verdonk, 1988. – The protection of dragonflies (Odonata) and their biotopes. – European Committee for the Conservation of Nature and Natural resources: 180 pp. (in English)

Information for Bulgaria is based mainly on the works of Beshovski (1964a) and Scheffler (1973). For the species status of *Cordulegaster heros* a single reference is given to Urbanski (1947) concerning a period when the Odonata of Bulgaria were insufficiently known. The precise Bulgarian distribution is given for: *Epallage fatime*, *Coenagrion ornatum*, *Coenagrion scitulum*, *Caliaeschna microstigma*, *Stylurus flavipes*, *Gomphus vulgatissimus*, *Onychogomphus forcipatus*, *Cordulegaster bidentata bidentata*, *Cordulegaster heros* and *Sympetrum depressiusculum*. The species list contains one very interesting information about *Gomphus schneideri* for Bulgaria (cit. as “Dumont, pers. comm.”). The presence of this species in Bulgaria is still not officially published. I have the following remarks: (1) *Aeshna subarctica* is reported only once for Bulgaria (Beshovski, 1960). (2) This paper contains no information about *Ophiogomphus cecilia* for Bulgaria though it has been collected mainly by larvae from the larger Bulgarian rivers – Maritza, Struma, Tundja, Ogosta and Iskar (near to the Danube river). (3) Until *Lindenia tetraphylla* has not been confirmed for present-day Bulgaria its northern distribution border should be shifted slightly southwards. (4) The status of *Cordulegaster insignis* is still under discussion. The here cited work contains information for both *Cordulegaster charpentieri* (based on unpublished pers. comm. from Prof. Dumont) and *Cordulegaster insignis* (the record from Kyustendil district, W Bulgaria, which originally comes from Nedelkov, 1923). In the literature concerning Bulgaria these taxa are cited several times with different subspecies names: *C. i. insignis* (Beshovski, 1964a) and *C.i.charpentieri* (Beshovski, 1991, 1993, 1994a, 1994b; Dumont, 1976). (5) There is a second Bulgarian record of *Somatochlora flavomaculata* (Petrov, 1973) as well as of *Leucorrhinia pectoralis* (Petkov, 1921).

129. Verschuren, D. 1989. – Revision of the larvae of West-Palaeartic *Cordulegaster* Leach, 1815 (Odonata, Cordulegastridae), with a key to the considered taxa and a discussion on their affinity. – Bull. Anns Soc. R. Belge Entomol. 125: 5-35. (in English)
C. pictus is mentioned from Bulgaria.

130. Verschuren, D. 1991. – Phylogenetic significance of antennal growth patterns at two levels of dragonfly taxonomy: the example of *Cordulegaster* (Anisoptera: Cordulegastridae). – Odonatologica 20: 321-331 (in English)

The paper is based on the part of the material collected for Verschuren (1989), where details on the finding places are given. The name of Bulgaria in the present paper is given as one of the countries where the material is collected.

131. Yaneva, I. 1987. – Zoobentosat na reka Vit. I. Sastav, structura i dinamika na zootzenozite (The zoobenthos of the Vit river. I. Composition, structure and dynamic of the zoocoenoses). - Hidrobiologiya (Sofia) 31: 37-64. (in Bulgarian with Russian and English summaries)

The results are based on the investigations carried out at 12 stations for the period 1973-1978. Five species are reported from two stations.

132. Yaneva, I. 1991. – Hidrobiologitchnoto sastoyanie na reka Ogosta prez razlitchni periodi (Hydrobiological status of Ogosta river during the different periods). – Hidrobiologiya (Sofia) 36: 32-48. (in Bulgarian with Russian and English summaries)

Twelve sites were sampled during different periods 1968-1969, 1977 and 1985. Five Odonata species are reported for seven of the sites.

133. Yaneva, I. & B. Russev 1989. – Saprobologitchnoto sastoyanie na reka Iskar v parvite godini sled vlisane v eksploataziya na Sofiiskata pretchisvatelna stantziya (The saprobological status of the Iskar river in the first years after the start of the Sofia purification plant). - Hidrobiologiya (Sofia) 34: 3-19. (in Bulgarian with Russian and English summaries)

Eleven sites were sampled during 1985 and 1986. Totals of 8 Odonata taxa are reported from 4 places.

134. Yaneva, I., B. Russev 1997. – Veränderungen der Artenzusammensetzung und Güteklasse des bulgarischen Donauzuflusses Jantra nach dem Makrozoobenthon. (Changes in the species composition of the makrozoobenthos community and water quality of the Bulgarian Danube tributary Jantra). – Lauterbornia 31: 1-16 (in German with English summary)

Seventeen odonate taxa were found in 181 samples at 22 between 1964-1967 and 1987-1988.

135. Yoakimov, D. 1899. – Prinosa kam faunata ot nasekomi na Rila planina (A contribution to the insects fauna of Rila mountain). – Bulgarian Literary Society “Sredetz” 60: 879-880. (in Bulgarian)

This is the first article where measurements are given for Bulgaria dragonflies. Four Odonata species are reported without any specification of the localities. New species for the country was *Libellula quadrimaculata*.

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The genus *Somatochlora* Selys in Bulgaria

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INTRODUCTION

Worldwide, 42 species of the genus *Somatochlora* Selys are described. It is a holarctic genus (Walker & Corbet 1975). In Europe it is represented by six species distributed mostly in the northern part of the continent. Only *Somatochlora meridionalis* is restricted to S Europe (Bos & Wasscher 1998). *Somatochlora metallica* was the first member of the genus to be reported for Bulgaria (Nedelkov 1923). Later, the species was mentioned also by other authors (Beshovski 1960, 1964, 1968, 1994; Marinov 1995, 1999, 2000a,b). Donath (1987) and Beshovski (1994) mentioned *S. meridionalis* as a subspecies of *S. metallica*. Here, I follow the investigation by Marinov (1999) who mapped their up to date distribution in Bulgaria and treat both as two separate species. Both species are rare in Bulgaria. *S. metallica* dwells high mountain lakes of the Rila, Pirin and Rhodopes mountains, whereas *S. meridionalis* seems to be limited to the south-eastern Bulgarian Black Sea coast. *S. flavomaculata* is reported for Bulgaria though only twice (Popov 1961, Petrov 1973). The Bulgarian record of *S. alpestris* (Beshovski 1964) has later been excluded from the Bulgarian Odonata checklist by Beshovski (1991) because it was found in an atypical habitat (Beshovski 1993).

Having in mind the importance of a more detailed inventory in the beginning of 1999 I submitted a project to the IDF with the main aim of increasing the knowledge about Bulgarian *Somatochlora* species. The following steps were envisaged:

- 1) Inventarization of the collections of the larger Bulgarian Museums of Natural History which still harbour specimens that have not been revised.
- 2) Inventarization of the material collected during student's field activities of the large Bulgarian Universities of Sofia and Plovdiv. The material of the Sofia University is largely from the northern and northwestern part of Bulgaria, that of the Plovdiv University mainly from the southern Black Sea coast.

- 3) Visiting the known *Somatochlora* localities in order to see if *Somatochlora* populations persisted over years.
- 4) Investigation of new localities primarily along the Bulgarian Black Sea coast. This area is of special importance for *S. meridionalis*. The Eastern Rhodopes mountains were included into the project as they are well known for their Mediterranean influence.
- 5) Collecting more biological and ecological notes for the *Somatochlora* species at their breeding sites.
- 6) Mapping the distribution according to the information gathered.

USE OF MONEY FROM THE IDF

The grant received from IDF was spent for travelling expenditures in search for possible *Somatochlora* breeding places. The project was additionally supported by The Bulgarian-Swiss Biodiversity Conservation Programme, and private funds by Dr. Burkhard Grebe and the author.

RESULTS

1. Description of the sample sites and dates

1) Otmanli river:

Stream flowing into Black Sea, passing near the hut "Strandja", about 15 km SE from the town of Bourgas; UTM-grid: NG49; 42°27'N, 27°35'E (visits: 28 May 1999; 22 June 1999; 24 June 2000) The stream is between 0.90 and 3.00 m. and 0.03-0.40 m deep. The place is situated at the bottom of a gully (up to 4 m. deep). The surrounding slopes are planted with exotic trees as for instance: *Fraxinus americana* L., *Fraxinus oxycarpa* Willd., *Ulmus campestris* L., and *Acer negundo* L. The stream's banks are overgrown by *Galium aparine* L., *Mercurialis perennis* L., *Galeopsis speciosa* Mill., *Heracleum sibiricum* L., *Mentha longifolia* (L.) Huds., *Chaerophyllum bulbosum* L., *Chaerophyllum byzantinum* Boiss., *Lapsana communis* L., and *Scutellaria gallericulata* L.

2) Stream bridged by the road Bourgas - Tzarevo

About 5 km N of the town of Tzarevo, UTM-grid: NG67, 42°13'N, 27°48'E (visits 5 August 1999; 24 June 2000). The width of the stream ranges from 1 to 3 m, the depth between 0.05 and 0.50 m. It is flowing on the bottom of a gully (up to 7 m deep). The vegetation consisted of *Fraxinus excelsior* L., *Prunus cerasifera* Ehrh., *Equisetum maximum* L., *Sparganium erectum* L., *Pycreus longus* (L.) Hayek, *Carex otrubae* Podp., and *Typha angustifolia* L. On some

quiet places with low currency the water surface is overgrown by *Callitriche platycarpa* Kütz. This site possibly coincides with the one figured by Donath (1987) as “N of Michurin” (Michurin is the former name of Tzarevo). A more precise estimation is, however, impossible as there are more than one stream north of the town.

3) Reka Deimin (Chambar) dere

Stream bridged by a road less than 1 km SW of the village of Byal Gradetz UTM-grid: MF08, coordinates 41°26'N, 25°54'E (visits: 20 May 1999; 28 July 1999; 20 May 2000; 22 June 2000). This small stream varies between 1-5 m in width and 0.50-1.50 m in depth. It is flowing through a shady area with the main tree species *Alnus glutinosa* (L.) Gaertn., *Salix cinerea* L., *Carpinus orientalis* Mill., and *Ostrya carpinifolia* Scop. The stream banks are overgrown by great clusters of *Carex gracilis* Curt. and *Lythrum salicaria* L.. No floating vegetation was present even in small overflows. Both sides of the river are ground with some boulders at fast flowing sites. The bottom is completely covered by mud.

4) Small stream E from the village of Topolovo

UTM-grid: LG91, coordinates 41°43'N, 25°40'E (visit: 22 June 2000). This small stream flows in a comparatively flat area with some big opening among the trees which form small clusters along the river.

5) Dam of the hut “Rilski ezera”, Rila mountains

Altitude 2 100 m, UTM-grid: FM97, coordinates: 42°13'N, 23°16'E

(visit: 20 July 1999). This small reservoir is formed in a flat area by damming streams from snow melts. The banks are open with no vegetation around. The closest bushes are at a distance of about 100 meters from the place.

6) Izvorska river

Coordinates 41°26'N, 25°54'E. A stream flowing almost parallel to the Southern Black Sea coast in a distance of about 20 km. The stream enters the Mandra reservoir about 10 km S from the town of Bourgas. Parts of this reservoir were briefly surveyed on 26 May 1999 S of village of Izgrev, UTM-grid: NG38, coordinates: 42°20'N, 27°25'E)

7) 10 small streams flowing into the Black Sea between the towns of Ahtopol and Tzarevo

UTM-grid: NG76 (visit: 5 August 1999). All have similar appearances as streams 1 and 3 and most of them are temporary.

8) One unidentified *Somatochlora* like individual was seen on 25 June, 2000 at a small stream passing the road Tzarevo-Malko Tarnovo about 2 km E from the bridge over the Veleka river, UTM-grid: NG55, 42°02'N, 27°39'E. This site is a potential *S. meridionalis* breeding place.

2. Area covered and sampling periods

A total of 2500 km in 1999 and 1800 km in 2000 were travelled by private car. Most of the places were visited only once, others were sampled monthly (see “Description of the sample sites and dates”).

3. *Somatochlora* distribution

Three *Somatochlora* species were found. Here attention is paid to only two of them: *S. metallica* and *S. meridionalis*. The third species was new to science (Marinov 2000b). Unfortunately, the status of *S. flavomaculata* in Bulgaria still remains unclear. In the original publication the site is described as: “...around the floods of Vatcha river not far away from the Kritchim railway station in S Bulgaria” (Popov 1961). In a personal conversation Dr. Popov explained that he has found it by accident above the river while climbing downhill. I have visited this place and checked the river on 27 May 1994 without success. During the work on the current project Dr. B. Grebe and myself could visit the same place again (26 July 1999). However, due to insufficient information available and limiting time we could not gather more detailed information. Another record comes from the region around the village Izbegli in the Plovdiv region (Petrov 1973). It is about 50 km E of the one mentioned above. It seems that this region deserves special investigation for *S. flavomaculata*.

A flying *Somatochlora*-like individual was seen at site 2) on 03 August 1996. Although it could not be resighted during the present investigation, the occurrence of *S. meridionalis* at this place is possible. It is very similar to other *S. meridionalis* habitats and geographically close to one of them (site 1). Sample site 4) was chosen as the streams are situated closely to the Donath's (1987) *S. meridionalis* records. Most of the streams were completely dry during the August visit. Only one of them (crossing the road Tzarevo-Achtopol N of the town of Achtopol) appeared as a suitable breeding site of *S. meridionalis*. The other two representatives of this genus were found at five places: *S. meridionalis* at 1) to 4) and *S. metallica* at 5).

The current knowledge of the distribution of the *Somatochlora* species in Bulgaria is given in Table 1.

Table 1. *Somatochlora* records in Bulgaria. **Ad.** refers to records of adults, **L** to larvae.

Date	Site	UTM grid	Coordinates	remarks	Reference
<i>Somatochlora meridionalis</i>					
27.07.1944	Ugarchin	KH97	43°06'N, 24°25'E	1 ad	this paper
13-VII-1987	Achtopol	NG76	42°06'N, 27°56'E		Donath 1987
14-VII-1987	Nestinarka camping	NG76	42°11'N, 27°51'E		
15-VII-1987	Mitchurin	NG67	42°11'N, 27°50'E		
16-20-VII-1987	Kiten	NG67	42°14'N, 27°47'E		
17-VII-1987	Karaatchka River	NG67	42°13'N, 27°47'E		
18-VIII-1987	Achtopol	NG76	42°06'N, 27°56'E	2 ad	Marinov 1999
09-VIII-1990	Achtopol	NG76	42°06'N, 27°56'E	2 ad	Marinov 1999
June 1992	Botanical garden – Varna	NH78	43°14'N, 27°52'E	1 ad	this paper
05-VIII-1997	Hut “Strandga” - river	NG49	42°27'N, 27°35'E	2 ad	Marinov 1999
22-VI-1999	Otmanli			3 ad	this paper
24-VI-2000				6 ad	this paper
July 1999	Etropole	GN44	42°50'N, 24°00'E	1 ad	this paper
28-VII-1999	Deimin (Chambar) dere river	MF08	41°26'N, 25°54'E	7 ad	this paper
22-VI-2000				10 ad	this paper
05-VIII-1999	Stream passing under the road Bourgas- Tzarevo	NG67	42°02'N, 27°39'E	3 ad	this paper
24-VI-2000	about 5 km N of the town of Tzarevo			1 ad	this paper
22-VI-2000	Small stream E from the village of Topolovo	NG91	41°43'N, 25°40'E	2 ad	this paper
<i>Somatochlora metallica</i>					
June 1923	Vratza	GN09	43°13'N, 23°33'E	not re-vised	Nedelkov 1923
17-VIII-1954	Belitchkite motchuri	GM14	?		Beshovski 1960
04-VII-1950	Iakoruda - Ribnoto ezero	GM15	42°01'N, 23°41'E	1 L	Beshovski 1964
02-X-1957	Batak	KG64	41°57'N, 24°13'E	3 L	
05-IX-1956	I Smoliansko lake	LG01	41°36'N, 24°41'E	1 L	
19-V-1962				1 L	
	Assenovgrad	LG25	42°01'N, 24°53'E	L	Beshovski 1968
	II Smoliansko lake	LG01	41°36'N, 24°41'E	L	
	Mandrata - Rila	?	?	L	
10-VIII-1965	Malka Vata lake - Rila mountain	?	?	1 ad	Marinov 1999
14-VIII-1994	Hut “Sedemte ezera” -	FM97	42°13'N, 23°16'E	1 ad	Marinov 1999
18-VII-1999	Rila mountain			2 ad, 1 L	this paper
<i>Somatochlora flavomaculata</i>					
25-VI-1958	Vatcha river – Kritchim	KG95	42°03'N, 24°28'E	1 ad	Popov 1961

1970-1971	Village of Izbegli	LG35	?	1 ad	Petrov 1973
<i>Somatochlora borisi</i>					
20-V-1999	Deimin (Chambar) dere river	MF08	41°26'N, 25°54'E	1 ad	this paper
20-V-2000				3 ad	this paper
22-VI-2000				1 ad	this paper

The distribution of the *Somatochlora* species in Bulgaria is mapped in Figure 1.

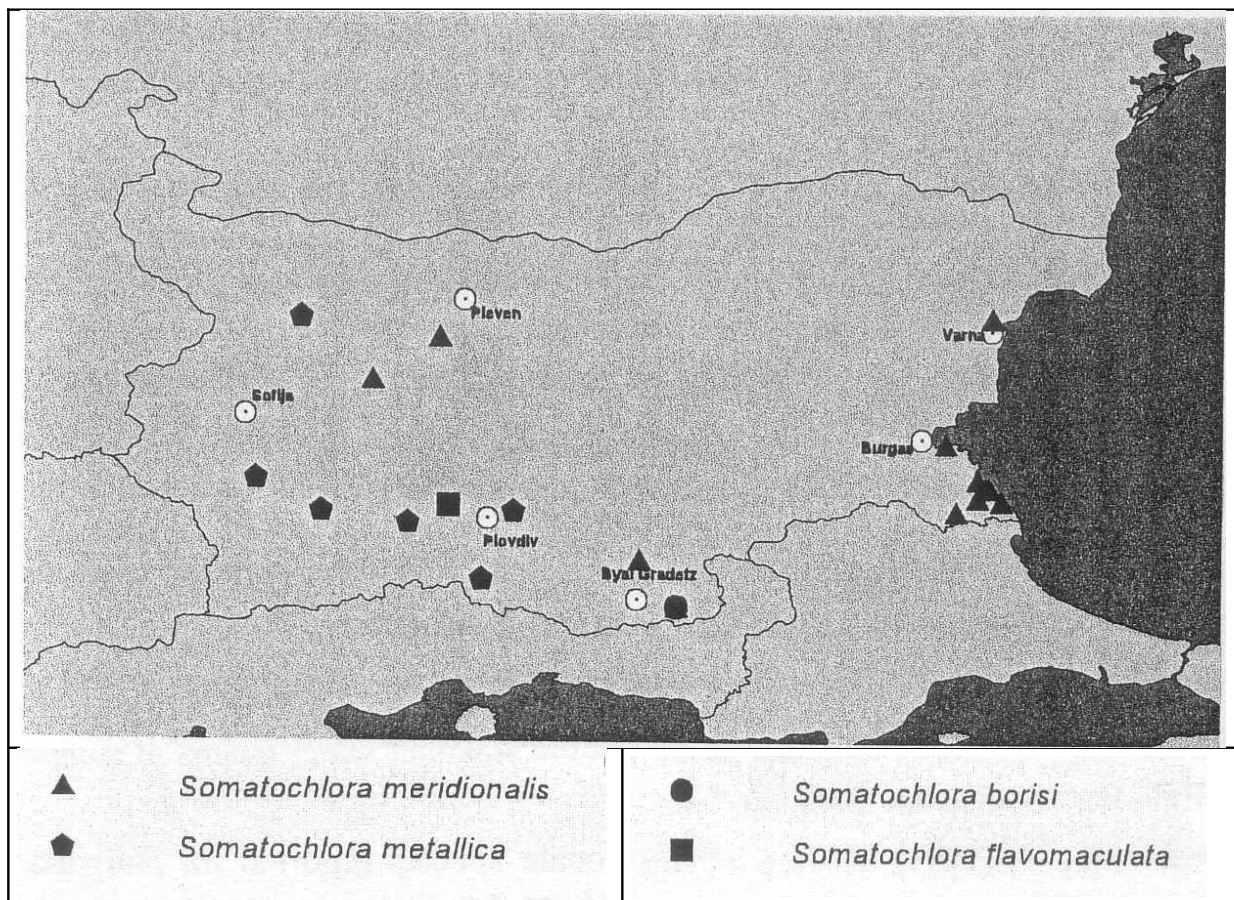


Fig. 1: Distribution of the *Somatochlora* species in Bulgaria (cartography: Ralph Koch, Trier).

4. Flight period

The earliest and latest dates when *S. meridionalis* was found were 22 June 1999 and 05 August 1997, respectively. Although site 1) was visited on 26 May 1999 there were no *Somatochlora* flying. It suggests that the average flight period of *S. meridionalis* lasts for about two months from the end (probably middle) of June to the middle (end) of August. Additional information based on detailed regional studies will further clarify this subject. The information for *S. metallica* is even scarcer due to a lower sampling frequency in the species main dis-

tribution centre – the higher parts of the Rila and perhaps Pirin and Rhodopes mountains. Imagines were found mainly in August (latest date 17 August 1954) but a new record dates from 18 July 1999 indicating a flight period of *S. metallica* of at least one month.

5. Short ecological description

In Bulgaria, *S. metallica* and *S. meridionalis* have completely different habitats. The latter appears to be strictly rheophilic and is found at small streams with comparatively fast flowing waters shaded by trees, or on the bottom of gullies. It flies closely over the water surface and very often hovers for some seconds, similar to the habit of *Caliaeschna microstigma*. Both species are found flying together in southern Bulgaria.

S. metallica inhabits high mountain lakes with an open water surface lacking vegetation. Due to this individuals emerged directly on the ground (one exuvia was found 1 m away from the water). *S. metallica* is flying very quickly over the water without hovering. It co-occurs with *Aeshna juncea*.

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Protokoll der Jahresmitgliederversammlung des IDF

Ort: Schwäbisch Hall

Datum: 19. März 2000

Zeit: 14:10 bis ca. 15:30

Anwesend sind 5 Mitglieder: Burkhard Grebe, Martin Lindeboom, Klaus Reinhardt, Wolfgang Röske, Martin Schorr.

Tagesordnung

1. Begrüßung, Annahme der Tagesordnung
2. Tätigkeitsbericht des Vorstandes (Förderprojekte)
3. CD-ROM
4. Odonatological Abstract Service
5. VG-Wort
6. Kassenbericht
7. Entlastung des Vorstandes
8. Verschiedenes

TOP 1: BEGRÜßUNG, ANNAHME DER TAGESORDNUNG

Begrüßung durch den Schatzmeister. Feststellung der ordnungsgemäßen Einladung. Bestimmung des Versammlungsleiters (Martin Schorr) und des Protokollanten (Martin Lindeboom). Annahme der Tagesordnung. Annahme des Protokolls (Münster 1999).

TOP 2: TÄTIGKEITSBERICHT DES VORSTANDES (FÖRDERPROJEKTE)

- Förderprojekt Kasachstan (K. Reinhardt): abschließende Erläuterungen von M. Schorr (Bericht: IDF-Report 2(2): 1-11).
- Förderprojekt Somatochlora/Bulgarien (Herr Milen Marinov): Martin Schorr berichtet über Probleme und Verbesserungsmöglichkeiten.
- Förderprojekt Bestimmungsschlüssel für die Libellen Mittelamerikas (Druckkostenzuschuß / Herr Steffen Förster): Martin Schorr berichtet, dass der IDF pro verkauftes Exemplar evtl. eine Spende vom Herausgeber in Höhe von etwa DM 2,- erhalten könnte.
- Förderprojekt: Verhaltenökologie von *Megaloprepus coerulatus*, (Arijen van't Hof, Groningen, Niederlande): Martin Schorr berichtet von einer etwas unklaren Projektsituation, bewertet das Projekt insgesamt jedoch positiv ("anspruchsvolle Studienarbeit").
- Förderprojekt: Ostafrika-Schlüssel (Reisekostenzuschuß / Viola Clausnitzer): Martin Schorr berichtet über die aktuelle Projektsituation (Frau Clausnitzer ist z.Z. in Äthiopien).
- Förderprojekt: Molecular systematics and the evolution of genitalia in libellid dragonflies (Thomas Artiss, USA): Martin Lindeboom hat noch keinen

Zwischen- oder Abschlußbericht erhalten. Er wird sich mit Thomas Artiss in Verbindung setzen; der Bericht soll im nächsten oder übernächsten Report erscheinen.

TOP 3: CD-ROM

Martin Lindeboom berichtet kurz über den Stand der Arbeit. Die Literatur-Datenbank ist fertig und der Verkauf der CD kann in Kürze beginnen (siehe TOP 8).

TOP 4: ODONATOLOGICAL ABSTRACT SERVICE

Martin Schorr berichtet über das Abkommen zwischen IDF und WDA. Der IDF erhält pro WDA-Mitglied und Ausgabe 1 englisches Pfund (d.h. bei zwei Ausgaben pro Jahr 2 Pfund pro WDA-Mitglied und Jahr).

TOP 5: VGWORT

Martin Schorr berichtet kurz über die kontroverse Diskussion mit der VG Wort bezüglich einer Beteiligung an der Ausschüttung für Verlage. Die VG Wort hat - nach mehreren Anschreiben des Schatzmeisters - die Zeitschrift OAS mit einer durchschnittlichen Inlandsauflage von 300 Exemplaren als eigenständige Zeitschrift anerkannt. Dementsprechend wird diese Zeitschrift bei der Ausschüttung berücksichtigt. Der IDF-Report wurde von der VG Wort nicht anerkannt. Die Verbreitung des IDF-Reports soll in der Zukunft, u.a. durch einen verstärkten Schriftentausch des Schatzmeisters, verbessert werden.

TOP 6: KASSENBERICHT, BERICHT DER KASSENPRÜFER

Martin Schorr stellt den Kassenbericht 1999 vor (Einnahmen: 5884,13 DM; Ausgaben: 7228,56 DM; Sparbuch: 3659,05 DM; Vermögen zum 31.12.1999: 4.516,90 DM).

Die Kasse wurde von Wolfgang Röske und Dr. Burkhard Grebe (letzterer in Vertretung der erkrankten Ingrid Kastrowski) geprüft. Bis auf einen leicht zu korrigierenden Rechenfehler gab es keine Beanstandungen.

TOP 7: ENTLASTUNG

Der Vorstand wurde - ohne Gegenstimmen und ohne Enthaltungen - entlastet.

TOP 8: VERSCHIEDENES

Angesprochen und kurz diskutiert (ohne abschließende Bewertungen) wurden diverse Projektideen bzw. Projektskizzen, u.a.

- der Vorschlag einer Bibliographie für Bulgarien (Idee Martin Schorr; Angebot an Herrn Marinov)
- Checklist für Botswana als IDF-Projekt (Jens Kipping)
- Studium der Libellen in der Region der Tuva Republik (Idee Oleg Kosterin)
- Angesprochen wird auch die Zukunft der Acta Hydroentomologica, Publikationsmöglichkeiten eines Ostafrikaschlüssels (IDF-Verlag?), und die Auf-

nahme von Artikeln in den IDF-Report.

Martin Lindeboom möchte die redaktionelle Arbeit am IDF-Report baldmöglichst abgeben und sich in Zukunft auf die CD-ROM (Koproduktion: Schorr u. Lindeboom), die OAS und die Internetseiten des IDF konzentrieren. Abschließende wird - auf Wunsch von Martin Lindeboom -kurz über die Erscheinungsweise der CD-ROM diskutiert; Martin Schorr und Martin Lindeboom fungieren als Herausgeber und Rechte-Inhaber (CD-ROM + heiligende Zeitschrift: Fundamentals of Odonatological Research); der IDF bekommt mindestens 30% des Gesamtgewinns als freiwillige Spende von den beiden Herausgebern.

Martin Lindeboom, Schriftführer

IDF-Report

Newsletter of the International Dragonfly Fund

The International Dragonfly Fund (IDF) is a scientific society founded in 1996 for the improvement of odonatological science and the protection of species.

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