Acta entomologica serbica, 1996, 1(1/2): 63-80 UDC 595.733:591.9+57.087.1(497.11)

THE SUMMER ODONATA SPECIES IN THE LOWER TISA VALLEY, BANAT

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Records are provided for 17 Odonata species from the lower Tisa valley, Banat, and their habitat distribution is briefly noticed. This is the first record of *Calopteryx splendens splendens* (Harris) in Serbia, and the nominate subspecies is morphometrically examined.

KEY WORDS: Odonata, *Calopteryx splendens splendens*, Serbia.

INTRODUCTION

The present paper treats an Odonata collection taken by the authors in the country surrounding the town of Novi Bečej (20°09'E 45°36'N), which is situated in the lower Tisa valley, Banat. The river Tisa flowing from Hungary divides the southern, Serbian, part of the Pannonian Lowland into the plain of Banat extending eastward, and the plain of Bačka stretching westward (Fig. 1).

The 17 species found at Novi Bečej are not new records for these two plains. Odonata were surveyed in Hungary at the end of the 19th century and, among other records, 20 species tabulated for the area consisting of both plains, Banat and Bačka (KOHAUT, 1896). The majority, precisely 11 out of 17 species found at Novi Bečej during the present examination were generally ascribed to Banat and Bačka by KOHAUT (1896). Six other species were formerly recorded in W Bačka (PONGRACZ, 1944), and/or S Banat (ADAMOVIĆ, 1949, 1956). "Very little work has been done on the Odonata fauna of the Tisza valley" [in Hungary] wrote, surprisingly enough, TÓTH (1974), and presented, in the same paper, the valuable results of his 8-year examinations of Odonata "in the inundation area of the Tisza between Tiszabábolna and Kisköre", in Hungary.

Anyway, no records of the Odonata species from the central part of the lower Tisa valley were so far avilable. Therefore, results of a survey of the habi-

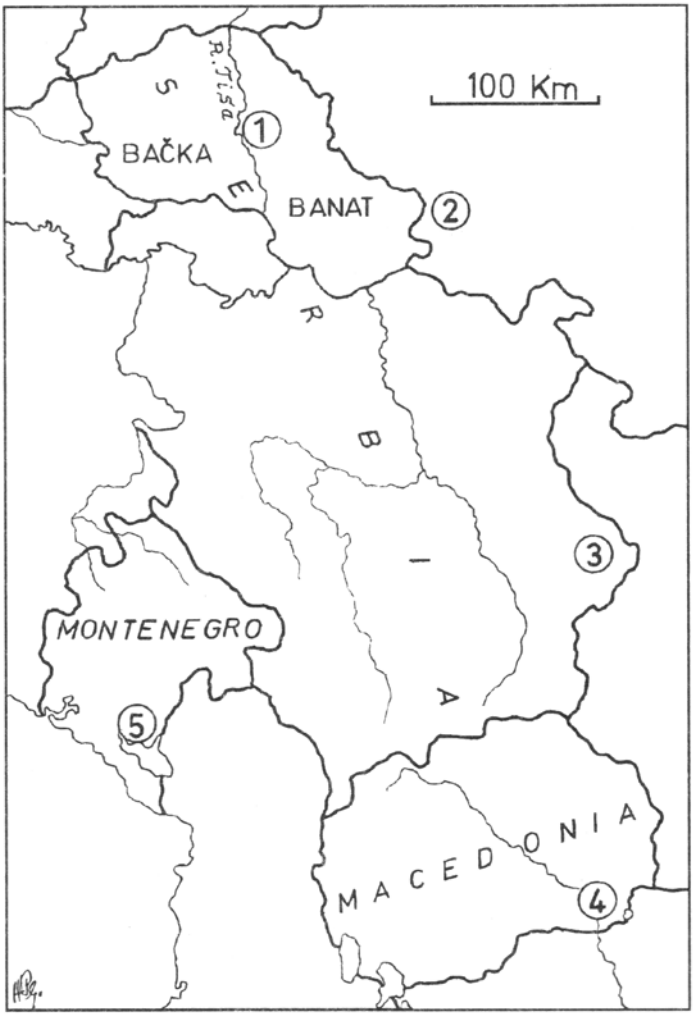

Fig. 1. A sketch map showing the position of sites where the samples of *Calopteryx* spp. have been taken. A site is marked with figure in a circle namely: 1 – Novi Bečej on the Tisa, Banat, where *Calopteryx splendens splendens* (Harris) was found and examined; 2 – Cacova, Roumanian Banat, where two males of the nominate subspecies were recorded by DUMONT (1977); 3 – Temska, E Serbia, and 4 – Djevdjelija, SE Macedonia, where *C. splendens ancilla* Sélys were taken and examined by ADAMOVIĆ & VIJATOV (1996); and, 5 – the NW end of Skadar Lake, S Montenegro, where *C. balcanica* Fudakowski was repetedly found (DUMONT, 1977; ADAMOVIĆ, unpublished data). – [Original]

tat distribution of species and particularly, a mophometric examination of a *Calopteryx splendens* series were considered worth-while to be described and discussed.

AREA EXAMINED

Most of the Pannonian Lowland is a flat, low-lying plain which slopes gently towards S and SE. Its landscape is dominated by the Danube and its great tributaries the Drava, the Sava and the Tisa (MEČKIĆ, 1989).

The actual relief of the Pannonian Lowland originated, roughly, in the Upper Pliocene and the Lower Pleistocene epochs. A strait connecting two brackish water basins, Pannonian and Dacian, existed far back in the Lower Pliocene (STEVANOVIĆ, 1951). Levantinian Lake still remained in the lowest part of the plain until the Middle Pleistocene (LASKAREV, 1951). Lake was drained off by the Danube as it cut its gorge through the Karpathian mountains.

Large swamps, and streams flowing through marshy plains remained in S Pannonian Lowland till 18th century. Huge, long-lasting public works of digging canals for drainage, irrigation and navigation, as well as building embankments started in the Lowland at the end of 18th century. Nowadays, a large network of canals, called the Hydrosistem Danube - Tisa - Danube, extends throughout the whole area of Bačka and Banat (MILOVANOV, 1972; DOMONJI, 1983).

Drainage and other activities reclaimed for agriculture a vast part of swamps. In this manner, aquatic and marshy vegetation have been restricted to ox-bow lakes, swamps remained, and artificial channels. Consequently, aquatic insects, fish, birds and animals lost an enormous part of their habitats. An extreme decrease in number of wading birds nesting colonies has been recorded in the plain, for example (MARČETIĆ, 1955).

The river Tisa is navigable; its average width is 216 m, and avearge depth 11 m. However, the meandering Tisa was, and still is a sluggish stream. The altitude of the lower Tisa alluvial plain ranges from 82 m at Segedin to 76 m at the river mouth. The river was regulated in 19th century. Many meanders were cut off, the length of the channel reduced and the slope increased from 19.4 mm per kilometre before, to 28.1 mm per km after regulation (BUKUROV, 1948).

Two main landforms are found in the central part of the lower Tisa valley, namely: the loess terrace made of aeolian as well as fluviatile redeposited loess, and alluvial plain consisting of sand, silt and clay. The loess terrace and largest part of the alluvial plain are covered with featureless cropfields.

The moderate continental climate of the S Pannonina Lowland was labelled Cfwaw" (DUKIĆ, 1967). The mean annual temperature is 11.1°C in the central part of the Tisa valley. The lowest average temperature is in January (–1.2°C) and the highest in July (22.8°C). The mean annual rainfall is 603 mm, with the maximum in May (70.3 mm), and the minimum in February (28.8 mm).

Two types of forest grow on recent alluvial deposit in the Tisa flood plain (SLAVNIĆ, 1952). The first one, consisting of *Salix alba*, *S. amygdalina*, *S. purpurea*, *Amorpha fruticosa*, and some other plant species grows along flowing water. The next one consists of *Populus alba*, *P. nigra*, *Alnus glutinosa* and many other species. However, *Populetum nigro-albae* forests are usually "replaced by the cultures of Euramerican poplares" in the plain of the lower Tisa (PARABUĆSKI *et al.*, 1989).

Aquatic and marshy vegetation of ox-bow lakes, small streams and man-made canals has been repeatedly examined in Banat and Bačka (SLAVNIĆ, 1956; ČANAK & DOKIĆ, 1969; STOJANOVIĆ *et al.*, 1994). VUKOJE (1987) listed, among other things, plants of the canal situated S and SE of Novi Bečej.

During the present examination, Odonata have been collected and observed in the following seven sites and habitats at Novi Bečej.

(1) Ljutovo — the rather steep, left bank of the Tisa about 4 m high, situated SW of Novi Bečej. The bank is covered with shrubs and small trees of *Salix amygdalina*, *S. alba*, *Amorpha fruticosa*, and some other plants. Small stands of submergent and floating plants, namely: *Myriophyllum spicatum*, *Potamogeton pectinatus*, *P. perfoliatus*, *Lema minor*, are scattered in slow flowing, clean water along the sandy and silty bank of the river.

(2) Pumpa — the steep bank of the Tisa near a big pump, south of Novi Bečej. Actually, the Tisa flows here by an artificial channel dug to cut off a long, curved meander "Stara Tisa". All other features of this and preceding habitat are very much alike.

(3) DTD Canal — a part of the Danube-Tisa-Danube Canal, stretching from the sluice - gate to the railway bridge across the canal S of Novi Bečej. The canal is 50 m wide and 3 m deep. Submergent plants *Ceratophyllum demersum*, *C. submersum*, *Potamogeton perfoliatus*, *P. pectinatus* are found in the deepest water. A narrow belt of plants with floating leaves comprises *Nymphoides peltata*, *Potamogeton fluitans*, *Lemna minor*, and *Myriophyllum spicatum*. An even more narrow belt of emergent plants consists of *Phragmites orientalis*, *Typha latifolia*, *T. angustifolia*, *Glyceria maxima*, and some other plant species.

(4) Channel — one of many man-made channels, cut through the Tisa plain for drainage and/or irrigation. The channel examined is straight, about 5 m

wide and almost 2 m deep. *Ceratophyllum demersum* and *Lemna minor* grow in sluggish and moderatly clean water. Emergent plants, *Typha latifolia* and *T. angustifolia* grow sporadically along the channel banks.

(5) Provala — a long, moderately broad swamp with permanent, clean water, situated WSW of Novi Bečej. It was formerly an old branch stream parallel to the Tisa. A greater part of swamp is overgrown with *Typha angustifolia, T. latifolia, Phragmites australis* and *Glyceria maxima. Nymphoides peltata, Lemna minor* and *Salvinia natans* make patches of floating vegetation. *Marsilia quadrifolia* mats are scattered in the belt of emergent plants *Sparganium erectum, Butomus umbellatus, Alisma plantago.*

(6) Marsh at Vranjevo — a narrow, roughly straight marsh, lined with some old willow-trees of *Salix alba*, is situated S of Vranjevo. It may become a series of pools during the dry season (like in July 1995). An emergent vegetation, consisting of *Typha angustifolia, T. latifolia, Sium latifolium, Glyceria aquatica, Sparganium erectum, Butomus ambellatus, Bolboschoenus maritimus, Lythrum salicaria, Alopecurus geniculatus* grows in the unclean water and/or on the muddy banks of the pools.

(7) Clearings and paths — *Carex riparia, Alisma plantago, Agrostis alba, Euphorbia palustris, Lysimachia vulgaris, Calystegia sepium, Rubus caesium* grow on clearings and along paths in the willow and poplar forests on the Tisa banks.

MATERIAL AND METHODS

A total of 283 Odonata specimens (190♂ and 93♀) pertaining to 16 species was collected and one more species, namely *Stylurus flavipes,* was noticed by the authors in the surrounding country of Novi Bečej, from 24th till 28th of July 1995.

The field work was carried out in the way described in a previous paper (ADAMOVIĆ, 1993). Nomenclature of the wing veins follows ASKEW (1988). Measurements were taken after MAIBACH (1987).

The one – way analysis of variance, and the multiple comparison tests, TUKEY-test and SNK-test, were carried out by well known statistical procedures (ZAR, 1984).

RESULTS

In order to abridge and clarify the following annotated list, the dates of specimens collecting are omitted, and the sites are marked with the bracketed figures which have been used in the list of the seven sites examined. The morphometric data: range, mean value ± standard error, or range and mean value, are added for species taken in sizable series of specimens.

Calopterygidae. – *Calopteryx splendens splendens* (Harris, 1782): (1) 5♂ 3♀; (2) 21♂ 18♀; (3) 1♂.

MALE. — Measurements (in mm), N=27. — Abdomen: (app. incl.) 37.0 - 43.2 (39.76 ± 0.310); — superior appendage: 1.3 - 1.7 (1.49 ± 0.021); — forewing: 29.0 - 35.4 (30.48 ± 0.239); — width of forewing: 8.5 - 11.1 (9.21 ± 0.102); — the relative width of forewing (100w/FW): 28.14 - 34.14 (30.20 ± 0.261); — hindwing: 28.3 - 34.0 (29.60 ± 0.219); — width of hingwing: 8.3 - 10.6 (8.89 ± 0.098); — the relative width of hindwing (100w/HW): 27.85 - 32.42 (30.02 ± 0.199). Other details. — Width of hyaline apex of forewing: 1.7 - 3.7 (2.69 ± 0.089); — antenodal crossveins in forewing: 26 - 38 (31.26 ± 0.559); — the same in hindwing: 25 - 34 (28.52 ± 0.502); — number of crossveins in discoidal cell of forewing: 6 - 10 (7.44 ± 0.805); — number of cubito-anal crossveins in forewing: 11 - 14 (12.33 ± 0.193); — number cells in anal-loop of forewing: 35 - 57 (44.11 ± 1.174); — the same of hindwing: 43 - 72 (56.33 ± 1.281).

FEMALE. — Measurements (in mm), N=21. — Abdomen: (ovipos. incl.) 36.9 - 40.3 (38.89 ± 0.207); — forewing: 31.7 - 38.3 (33.74 ± 0.309); — width of forewing: 8.9 - 10.2 (9.52 ± 0.093); — the relative width of forewing (100w/FW): 24.80 - 30.33 (28.24 ± 0.303); — hindwing: 30.8 - 34.4 (32.46 ± 0.168); — width of hindwing: 8.6 - 9.5 (9.02 ± 0.051); — the relative width of hindwing (100w/HW): 25.58 - 30.00 (27.81 ± 0.238); — pseudopterostigma costal length of hindwing: 1.0 - 1.7 (1.38 ± 0.034); — number of cells in pseudopterostigma of hindwing: 2 - 5 (3.81 ± 0.191); — ratio of Nodus-pterostigma / pterostigma-Apex of forewing: 6.50 - 11.33 (7.88 ± 0.256). Other details. — Antenodal crossveins in forewing: 23 - 29 (26.38 ± 0.394); — the same in hindwing: 20 - 27 (24.57 ± 0.357); — number of crossveins in discoidal cell of forewing: 5 - 9 (7.29 ± 0.197); — number of cubito-anal crossveins in forewing: 10 - 15 (12.33 ± 0.304); — number of cells in anal-loop of forewing: 29 - 47 (36.73 ± 0.218); — the same in hindwing: 38 - 59 (46.29 ± 1.234).

Lestidae. – *Sympecma fusca* (Vander Linden,1820): (5) 2♂ teneral 2♀ teneral. — *Lestes barbarus* (Fabricius, 1798): (5) 7♂; (6) 5♂; (7) 1♂. — *Lestes sponsa* (Hansemann, 1823): (6) 1♂; (7) 3♂; — *Lestes virens vestalis* Rambur, 1842: (5) 20♂ 6♀ one of them teneral; (6) 2♀; (7) 14♂ 10♀.

MALE. — Measurements (in mm), N=34. — Abdomen: (app. incl.) 26.0 - 31.3 (28.30 ± 0.250); — hindwing: 17.0 - 19.8 (18.22 ± 0.109); — pterostigma costal length of hindwing 1.3 - 1.6 (1.43 ± 0.016). Other details. — Postnodal crossveins in forewing: 9 - 12 (10.59 ± 0.161); — the same in hindwing: 8 - 12 (10.12 ± 0.145): — number of cells between subnodal crossvein and the separation of R_3 in forewing: 2.0 - 4.0 (3.12 ± 0.070); — the same in hindwing: 2.0 - 3.0 (2.56 ± 0.041); — number of cells between the beginning of IR_2 and the begin-

ning of pterostigma in forewing: 2 - 6 (3.82 ± 0.171); — the same in hindwing: 3 - 6 (4.03 ± 0.143).

FEMALE. — Measurements (in mm), N=18. — Abdomen: (ovipos. incl.) 22.5 - 29.5 (26.05 ± 0.386); — hindwing: 18.2 - 20.5 (19.56 ± 0.161); — pterostigma costal length of hindwing: 1.4 - 1.8 (1.61 ± 0.024). Other details. — Postnodal crossveins in forewing: 9 - 12 (10.72 ± 0.273); — the same in hindwing: 8 - 11 (9.89 ± 0.233); — number of cells between subnodal crossvein and the separation of R_3 in forewing: 2.5 - 3.5 (3.03 ± 0.085); — the same in hindwing: 2.0 - 3.5 (2.58 ± 0.093); — number of cells between the beginnig of IR_2 and the beginning of pterostima in forewing: 3 - 6 (4.11 ± 0.179); — the same in hindwing: 3.0 - 5.5 (4.08 ± 0.168).

Platycnemididae. – *Platycnemis pennipes pennipes* (Pallas, 1771): (1) 8♂ 4♀; (2) 12♂ 2♀; (3) 3♂ 1♀; (4) 1♂ 1♀; (5) 1♂; (6) 2♀; (7) 8♂ 3♀.

MALE. — Measurements (in mm), N=33. — Abdomen: (app.incl.) 27.0 - 31.4 (29.81 ± 0.206); — hindwing: 18.8 - 21.7 (20.18 ± 0.121); — pterostigma costal length of hindwing 0.7 - 1.0 (0.83 ± 0.017). Other details. — Postnodal crossveins in forewing: 11 - 14 (11.73 ± 0.146); — the same in hindwing: 9 - 12 (10.03 ± 0.141); — number of cells between subnodal crossvein and separation of R_3 in forewing: 4.5 - 6.0 (5.17 ± 0.061); — the same in hindwing: 3.0 - 4.5 (4.00 ± 0.062); — number of cells between the beginning of IR_2 and the beginning of pterostigma in forewing: 2.0 - 5.0 (3.27 ± 0.131); — the same in hindwing: 1.0 - 4.5 (2.26 ± 0.121).

FEMALE. — Measurements (in mm), N=13. — Abdomen: (ovipos. incl.) 28.5 - 33.8 (30.35 ± 0.383); — hindwing: 19.6 - 23.0 (21.12 ± 0.330); — pterostigma costal length of hindwing: 0.7 - 1.2 (0.92 ± 0.039). Other details. — Postnodal crossveins in forewing: 11 - 13 (12.00 ± 0.226); — the same in hindwing: 9 - 11 (10.46 ± 0.187); — number of cells between subnodal crossvein and the separation of R_3 in forewing: 4.5 - 6.0 (5.15 ± 0.105); — the same in hindwing: 3.0 - 4.0 (3.77 ± 0.094); — number of cells between the beginning of IR_2 and the beginning of pterostigma in forewing: 2.5 - 4.5 (3.27 ± 0.167); — the same in hindwing: 1.5 - 3.5 (2.38 ± 0.172).

Coenagrionidae. – *Erythromma viridulum viridulum* (Charpentier, 1840): (1) 1♂; (2) 1♂; (3) 5♂ 2♀; (4) 3♂; (5) 1♂ 1♀. — *Ischnura elegans* (Vander Linden, 1820): (1) 2♂ 1♀ teneral; (2) 2♂; (3) 15♂ 10♀ one of them teneral; (4) 8♂ 4♀; (5) 2♂; (6) 5♂ 4♀.

MALE. — Measurements (in mm), N=34. — Abdomen: (app. incl.) 24.0 - 29.1 (26.61 ± 0.248); — hindwing: 15.2 - 18.4 (16.37 ± 0.121); — pterostigma colstal length of hindwing: 0.5 - 0.8 (0.64 ± 0.013). Other details. — Postn-

odal crossveins in forewing: 6 - 10 (8.38 ± 0.126); — the same in hindwing: 6 - 8 (6.91 ± 0.107).

FEMALE. — Measurements (in mm), N=19. — Abdomen: (ovipos. incl.) 24.8 - 27.4 (26.36 ± 0.163); — hindwing 16.2 - 19.4 (17.78 ± 0.139); — pterostigma costal length of hindwing: 0.5 - 0.9 (0.73 ± 0.021). Other details. — Postnodal crossveins in forewing: 8 - 10 (9.05 ± 0.143); — the same in the hindwing: 7 - 9 (7.63 ± 0.138).

Aeshnidae. – *Anax imperator* Leach, 1815: (3) 1♂. — *Aeschna affinis* (Vander Linden, 1820): (5) 1♂; (6) 5♂; (7) 2♂.

MALE. — Measurements (in mm), N=8. — Abdomen: (app. incl.) 44.9 - 50.4 (47.66); — superior appendage: 4.2 - 4.5 (4.34); — hindwing: 37.8 - 42.0 (39.78); — pterostigma costal length of hindwing: 3.3 - 4.0 (3.70). Other details. — Antenodal crossveins in forewing: 13 - 16 (14.63); — the same in hindwing: 7 - 11 (9.75); — postnodal crossveins in forewing: 7 - 10 (8.50); — the same in hindwing: 8 - 10 (9.25); — number of cells in anal-loop of hindwing: 6 - 8 (7.0).

Gomphidae. – *Stylurus flavipes* (Charpentier, 1825): (1) 1♂ teneral; (2) 1♂ teneral.

Libellulidae. – *Orthetrum coerulescens* (Fabricius, 1798): (3) 1♀. — *Orthetrum cancellatum* (Linnaeus, 1758): (3) 1♂; (4) 1♀. — *Orthetrum albistylum* (Sélys-Longchamps, 1848): (1) 1♀; (2) 1♂; (3) 1♀; (4) 1♂; (5) 1♀. — *Crocothemis erythraea* (Brullé, 1832): (3) 2♂; (4) 1♂. — *Sympetrum meridionale* (Sélys-Longchamps, 1841): (5) 1♀ teneral. — *Sympetrum sanguineum* (Müller, 1764): (4) 1♂; (5) 1♀; (6) 1♂; (7) 15♂ 10♀.

MALE. — Measurements (in mm), N=17. — Abdomen: (app. incl.) 20.2 - 26.1 (23.38); — superior appendage: 1.4 - 1.9 (1.68); — hindwing: 24.3 - 28.8 (26.65); — pterostigma costal length of hindwing: 2.4 - 2.8 (2.66). Other details. — Antenodal crossveins in forewing: 7 - 9 (7.53); — the same in hindwing: 5 - 6 (5.12); — postnodal crossveins in forewing: 6 - 8 (6.76); — the same in hindwing: 5 - 8 (6.65); — number of cells between Rspl and IR_3 in forewing: 5 - 7 (5.88); — the same in hindwing: 5 - 8 (5.94).

FEMALE. - Measurements (in mm), N=11. — Abdomen: (ovipos. incl.) 19.4 - 25.0 (23.51); — hindwing: 23.5 - 28.6 (26.87); — pterostigma costal length of hindwing: 2.2 - 3.0 (2.69). Other details. — Antenodal crossveins in forewing: 7 - 8 (7.36); — the same in hindwing: 5 - 6 (5.27); — postnodal crossveins in forewing: 6 - 7 (6.36); — the same in hindwing: 6 - 8 (7.00); — number of cells between Rspl and IR_3 in forewing: 5 - 7 (5.91); — the same in hindwing: 5 - 7 (6.09).

The present list decribes to some extent the actual Odonata fauna in the lower Tisa valley. It is far from beeing complete. The vernal and autumnal spe-

cies are lacking and further examination in the area is needed. The authors tried to present the habitat distribution of species, their relative abundance and reproductive behaviour in tabular form (Tab. I). It appears to be the most convenient, in spite of the mentioned lacking.

Groups of species found in the first two habitats: the Tisa left bank at Ljutovo (1), and the Tisa right bank at Pumpa (2) are very much alike. *Calopteryx splendens* and *Stylurus flavipes* are the characteristic species of the river Tisa.

A group of the Odonata species occupied the Danube - Tisa - Danube Canal (3) from the Tisa and the ox-bow lakes, which are the Tisa cut off meanders. The same is valid for the artificial channels cut through the plain (4).

Swamp at Provala (5) is an interesting habitat with a noticeable diversity of Odonata. *Lestes virens* is obviously one of the characteristic species of the habitat.

Table I

Distribution, relative abundance and reproductive behaviour of the species observed and taken in the seven habitats at Novi Bečej, Banat, during the second half of July 1995, namely: (1) Ljutovo, (2) Pumpa, (3) D T D Canal, (4) Channel, (5) Provala, (6) Marsh at Vranjevo, (7) Clearings and paths. [A - common species; M - moderately common; R - rare; E - extremely rare; — - presence of species not established; c - copulation noticed; o - oviposition observed; t - teneral specimens collected].

Species of dragonflies	Habitats (1)	(2)	(3)	(4)	(5)	(6)	(7)
S. flavipes	E t	E t	—	—	—	—	—
C. splendens	M	A	M	—	—	—	—
E. viridulum	M co	R co	A co	M co	R co	—	—
O. albistylum	R co	E o	A co	R c	R	—	—
I. elegans	E	E	A co	A co	E co	E c	—
P. pennipes	M co	R c	M co	M c	R c	R c	E c
A. imperator	E	E	E	—	—	—	—
O. cancellatum	—	—	R	R	—	—	—
C. erythraea	—	—	M co	R	M c	E	E
O. coerulescens	—	—	R	—	—	—	—
S. sanguineum	—	—	—	M co	M	R	M
S. fusca	—	—	—	—	R t	—	—
S. meridionale	—	—	—	—	R t	—	—
A. affinis	—	—	—	—	E	R	E
L. barbarus	—	—	—	—	E	E	E
L. virens	—	—	—	—	A co	R	E
L. sponsa	—	—	—	—	—	E	E

C. splendens is particularly interesting among the species recorded. Males of *C. splendens* taken at Novi Bečej had the hyaline wing apex wider than it was usually the case among males of the species inhabiting E Serbia and SE Macedonia. That was visible even in the field. Therefore, the series of *C. splendens* (27♂) collected at Novi Bečej, with the width of hyaline apex of forewing (w hy Ap FW) 1.7 - 3.7 (2.69 ± 0.089), are compared statistically with two series of male specimens of *C. s. ancilla*, which were previously taken at Temska, E Serbia (29♂) with "w hy Ap FW" 0.0 - 2.3 (0.98 ± 0.148), and Djevdjelija, S Macedonia (13♂) with "w hy Ap FW" 0.0 - 2.0 (0.65 ± 0.108). As shown in Table II, there are highly significant differeces among the means of the width of hyaline apex in forewing of males from Novi Bečej, Temska and Djevdjelija ($F=67.00$; $P< 0.001$).

Table II

Results of the one-way ANOVA of the five selected characters of *Calopteryx splendens splendens* and *C. s. ancilla*. A total of six samples (groups) are examined: males – Novi Bečej (N=27), Temska (N=29), Djevdjelija (N=13); and, females – Novi Bečej (N=21), Temska (N=17), Djevdjelija (N=24). Degrees of freedom – males: between groups 2, within groups 66; and – females: between groups 2, within groups 59.

Characters	Males			Females		
	Mean square			Mean square		
	Groups	/ Error	F	Groups	/ Error	F
w hy Ap FW	27.47	/ 0.41	67.00	–	–	–
100w/FW	20.85	/ 1.42	14.68	5.20	/ 0.81	6.42*
100w/HW	34.40	/ 1.26	27.30	8.35	/ 0.61	13.71
Anal L FW	557.50	/ 112.60	4.95*	174.00	/ 12.51	13.91
Anal L HW	2276.50	/ 138.38	16.45	584.70	/ 21.17	27.62

*F - value significant, P<0.01
All other F-values highly significant, P<0.001
w hy Ap FW = width of hyaline Apex in forewing,
100w/FW = the relative width of forewing (% of wing length),
100w/HW = the relative width of hindwing,
Anal L FW = number of cells in anal-loop of forewing,
Anal L HW = the same of hindwing.

The mean value of this character of males from Novi Bečej was significantly larger than those of males from Temska and Djevdjelija, according to TUKEY-test and SNK- test. On the contrary, the null hypothesis is accepted in comparison "w hy Ap FW" between the males from Temska and Djevdjelija (Tab. III). In addition, some males of the species from Temska (9♂ or 33.1%), and Djevdjelija (6♂ or 46.2%) had the apex of wings completely dark, while no one male among the speciments taken at Novi Bečej had an entirely dark wing apex.

Table III

The SNK multiple comparison test, with unequal sample sizes, applied on the mean values of the width of hyaline Apex in forewing (w hy Ap FW), of the following three samples of males: *C. s. splendens* from Novi Bečej (NB), and *C. s. ancilla* from Temska (T) and Djevdjelija (D). The probability = 0.05.

Samples ranked by means:	D	T	NB
Ranked sample means:	0.65	0.98	2.69
Sizes of samples:	13	29	27

Comparison	Difference of means	SE	q	p	Q	The null hypothesis
NB – D	2.04	0.15	13.60	3	3.40	Reject
NB – T	1.71	0.12	14.25	2	2.83	Reject
T – D	0.33	0.15	2.20	2	2.83	Accept

Overall conclusion: NB T D

There are significant difference among sample of *C. s. splendens* from Novi Bečej and both samples of *C. s. ancilla* from Temska and Djevdjelija.

There is no significant difference between samples of *C. s. ancilla* from Temska and Djevdjelija; therefore, they are underlined together.

Significant or highly significant differences are also found among mean values of four other characters examined separately for males and females (Tab. II). The overall results of the multiple comparison TUKEY-test and SNK-test applied on the means of these four characters confirmed that there are no significant differences between the samples of *C. s. ancilla* (males and females) from Temska and Djevdjelija, except in the relative width of forewing (100w/FW) of males from these two localities (Tab. IV). On the contrary, the samples of *C. splendens* (males and females) from Novi Bečej are significantly different in each of the four characters from those taken both in Temska and Djevdjelija (Tab. IV).

The males as well as females of *C. splendens* from Novi Bečej have significantly smaller relative width of forewing (mean value 30.20 in ♂, and 28.24 in ♀) than males and females from Temska (31.28 in ♂, and 28.67 in ♀), and Djevdjelija (32.31 in ♂ and 29.20 in ♀). The same is valid for hindwing, namely: Novi Bečej (30.02 in ♂ and 27.81 in ♀), Temska (32.05 in ♂ and 29.12 in ♀), and Djevdjelija (32.10 in ♂ and 28.59 in ♀). Both males and females of *C. splendens* from Novi Bečej have significantly smaller number of cells in anal-loop of forewing (44.11 in ♂ and 36.73 in ♀) than males and females of *C. s. ancilla* from Temska (52.41 in ♂ and 39.88 in ♀), and Djevdjelija (52.20 in ♂ and 42.30 in ♀). The same is valid for hindwing namely: Novi Bečej (56.33 in ♂ and 46.29 in ♀), Temska (74.10 in ♂ and 52.12 in ♀), and Djevdjelija (69.15 in ♂ and 56.50 in ♀).

Table IV

Results of the multiple comparison test applied on the means of four morphometric characters of *C. s. splendens* from Novi Bečej (NB), and *C. s. ancilla* from Temska (T), and Djevdjelija (D).

Character	Males			Females		
100w/FW	NB	T	D	NB	T	D
100w/HW	NB	T	D	NB	T	D
Anal L FW	NB	T	D	NB	T	D
Anal L HW	NB	T	D	NB	T	D

There is no significant difference between or among the samples which are underlined together.
100w/FW = the relative width of fortewing (% of wing length).
100w/HW = the relative width of hindwing.
Anal L FW = number of cells in anal-loop of forewing.
Anal L HW = the same of hindwing.

On the other hand, the yellow patterns on the metallic green thorax side, metasternum and head in frontal view of both subspecies females are very similar (Tab. V). In order to calculate χ^2, small numbers of "B", "a" and "n" patterns in Table V had to be added to the nearest frequency in the same row so as to avoid having a column in the contigency table with too small frequency. The chi-squared test confirmed a high similarity in yellow patterns between two subspecies (χ^2 3.03, df 8, P> 0.90).

Table V

Frequency of the yellow patterns on the females thorax side (A – C), metasternum (a – d), and head in frontal veiw (n – p). The yellow patterns in each of three sets are ranked from the smallest towards the largest one, according to a figure in a previous paper (ADAMOVIĆ & VIJATOV, 1996). All the females were heterochromic, namely: *C. s. splendens* from Novi Bečej (NB) 21♀, and *C. s. ancilla* from Temska (T) 17♀ and Djevdjelija (D) 24♀.

		Thorax			Metasternum				Head		
Subspecies	Loc.	A	B	C	a	b	c	d	n	o	p
C. s. splendens	NB	–	1	20	–	–	6	15	–	6	15
C. s. ancilla	T	–	1	16	1	–	8	8	3	3	11
	D	–	–	24	–	–	7	17	–	5	19

DISCUSSION

DUMONT (1977) made an interesting remark about *C. s. splendens*: "pas rencontre en territoire yougoslave, mais deux spécimens mâles pris à Cacova [a

site situated about 7 kilometre far from the Serbian frontier], Banat (Roumanie) et une photographie de la même sous-espàce prise dans la région de la porte de Fer sur le Danube y prouvent sa présence." The results of the present examination of the *C. splendens* population from Novi Bečej, Banat are in favour of DUMONT's statement.

The authors have recently carried out a morphometric examinations of two series of specimens pertaining to the subspecies *C. splendens ancilla* Sélys-Longchamps 1853, collected at the following sites: Temska, a village (43°16'N 22°33'E; 500 m altitude) by the rocky, cascading brook Temštica, E. Serbia, and Djevdjelija, a town (41°08'N 22°30'E; 50 m altitude) situated in the river Vardar valley (ADAMOVIĆ & VIJATOV, 1996). These two series are compared statistically in the present paper with a sereis of *C. splendens* males and females taken at Novi Bečej, Banat. The specimens from Novi Bečej are significantly distinct from *C. s. ancilla* and belong to *Calopteryx splendens splendens* (Harris, 1782). This is the first record of the nominate subspecies in Serbia.

While examining *C. splendens* in Romanian Banat near the Serbian frontier, BEUTLER (1988) mentioned: "Die Individuen unter scheiden sich auch in der Körper grösse nicht von mitteleuropäischen Stücken [...]".

The mean value ± standard error of five morphometric characteristics of *C. s. splendens* from England and W Europe, puplished by MAIBACH (1987), are brought into comparison with those of the nominate subspecies from Novi Bečej (Tab. VI) the mean values are obviously very much alike. No statistically significant differences were found by t-test, except for a single character of male, namely: the abdomen length, and another single character of female, namely: ratio of Nodus-pterostigma/pterostigma-apex of forewing (Tab. VI).

C. s. splendens is distributed in Hungary (UJHELYI, 1957; STEINMANN, 1960, 1962; TÓTH, 1974), and Austria (ST. QUENTIN, 1959), as well as in England, western and central Europe (MAIBACH, 1987). The records of it in Romanian and Serbian Banat lead to a conclusion that the nominate subspecies inhabits the whole Pannonian Lowland. The transitional formes from *C. s. splendens* to *C. s. ancilla* are to be expected in central Serbia.

Further examinations, and new collections of *C. splendens* in N Dalmatia and Quarner Islands are required. The nominate subspecies has been recorded from that area (FRAUENFELD, 1860; FUDAKOWSKI, 1932). ST. QUENTIN (1944) mentioned 8♀ from Island Rab, which have been deposited "in Museum" [of Vienna].

Both subspecies of *C. splendens* were found in Slovenia, namely: *C. s. splendens* in the Triglav National Park (KIAUTA, 1962), and *C. s. ancilla* (= *C. s. caprai*) in Inner Carniola and Slovene littoral (KIAUTA, 1969).

Table VI

Measurements (in mm) and some other details about *Calopteryx splendens splendens*, and the comparison by t-test of each corresponding pairs of mean-values, separately for males and females, from England and W Europe (E)[1], and Novi Bečej (NB); mean value ± standard error.

	Males		Females	
Character	E	NB	E	NB
Abd	36.4 ± 1.3	39.76 ± 0.31[2]	35.9 ± 4.6	38.89 ± 0.21
FW	30.1 ± 1.1	30.48 ± 0.24	32.6 ± 1.4	33.74 ± 0.31
w FW	9.9 ± 0.4	9.21 ± 0.10	9.6 ± 0.5	9.52 ± 0.09
w hy Ap FW	2.0 - 5.0[3]	2.69 ± 0.09	— —	— —
N-pt/pt-Ap	— —	— —	5.3 ± 0.8	7.88 ± 0.26[4]
Ans FW	30.2 ± 4.7	31.26 ± 0.56	26.9 ± 2.3	26.38 ± 0.39
Anal L FW	46.7 ± 7.8	44.11 ± 1.17	35.9 ± 4.6	36.73 ± 0.22

[1] data quoted from MAIBACH (1987),
[2] a significant difference was found between two means ($t=2.51$; $df>100$; $P<0.02$),
[3] only range has been available from MAIBACH (1987),
[4] a highly significant difference was found ($t=3.07$; $df>100$; $P<0.005$),
in all other pairs of means no significant difference was found,
Abd = abdomen length (app. or ovipos. incl.),
FW = forewing length,
w FW = width of forewing,
w hy Ap FW = width of hyaline apex in forewing,
N-pt/pt-Ap = ratio of Nodus-pterostigma/pterostigma-Apex of forewing,
Ans FW = number of antenodal crossveins in forewing,
Anal L FW = number of cells in anal-loop of forewing.

A few remarks about some other species will be added in brief.

The teneral specimens of *Sympecma fusca* announced a new serotinal generation of the species in the area.

Lestes virens vestalis was abundant, and had its peak at Provala (5), in second half of July 1995.

Eight males of *Aeshna affinis* are taken, and none of a closely related species *A. mixta*, in the area examined. TÓTH (1974) made the following remarks about these species in the Tisa valley in Hungary: [*A. affinis*] "occurs in this entire area of the Tisza", [while *A. mixta*] "can be collected sporadically in this area of the Tisza". In the surrounding country of Beograd "*A. affinis* is a vernal and aestival (early summer) species, while *A. mixta* is a serotinal (late summer) and autumnal species" (ADAMOVIĆ,1966).

Two males of *Stylurus flavipes* were observed on the Tisa bank. The species has been always collected on river banks in Serbia, of the Sava, the Danube and the Morava (ADAMOVIĆ, 1948, 1949). A female of *S. flavipes* was formerly taken

(D. ČUBRILOVIĆ *leg.*) in the Tisa valley at the town of Kanjiža (20°04'E 46°04'N), near the Hungarian frontier (ANDJUS,1992). "In Hungary strong populations [of *S. flavipes*] are known in the Tisza and Körös river systems" (AMBRUS *et al.*, 1992).

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ЛЕТЊЕ ВРСТЕ ODONATA У ДОЛИНИ ДОЊЕ ТИСЕ, БАНАТ

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Извод

Приказани су и коментарисани подаци о 17 врста Odonata што су их аутори посматрали и прикупили у другој половини јула 1995 године, у околини Новог Бечеја, Банат. До сада није било објављених налаза ових инсеката из средњег дела Тисине долине у Банату. Међутим, врсте нађене овог пута код Новог Бечеја биле су забележене на ширем подручју Баната и Бачке (KOHAUT, 1896; PONGRASZ, 1944; ADAMOVIĆ, 1949, 1956; ANDJUS, 992).

Нађене врсте дају, у одређеној мери, слику о летњој фауни Odonata у околини Новог Бечеја. Пролећне и јесење врсте недостају па би испитивања требало наставити. Дистрибуцију по стаништима, релативну бројност и репродуктивно понашање било је, ипак, најпогодније приказати табеларно и поред поменутих недостатака (Tab. I).

Посебна пажња посвећена је прикупљеној серији примерака *Calopteryx splendens* (27♂ 21♀). Мужјаци ове врсте из околине Новог Бечеја имају упадљиво шире хијалинске врхове крила но што је то случај код мужјака исте врсте из других делова Србије. Аутори су недавно испитали морфометријски неке популације рода *Calopteryx* са подручја некадашње Југославије (ADAMOVIĆ & VIJATOV, 1996). Том приликом је, између осталог, утврђено да популације из Темске у Србији, и Ђевђелије у Македонији, припадају подврсти *Calopteryx splendens ancilla* Sélys 1853. У овом садашњем раду серија *C. splendens* из Новог Бечеја упоређена је, анализом варијансе и применом TUKEY-теста и SNK-теста, са серијама из Темске (29♂ 17♀) и Ђевђелије (13♂ 24♀). Серија *C. splendens* из Новог Бечеја се у већини испитаних карактеристика сигнификантно разликовала од *C. s. ancilla* из Темске и Ђевђелије (Tab. II - IV), па је одређена као *Calopteryx splendens splendens* (HARRIS, 1782). Ово је први налаз номиналне подврсте у Србији. Типична форма је, иначе, описана у Енглеској. У овом раду су упоређене, t-тестом, средње вредности одређених карактеристика *C. s. splendens* из околине

Новог Бечеја са средњим вредностима што их је утврдио MAIBACH (1987) за серију из Енглеске. Од 12 изведених поређења у 10 (83.3%) случајева није нађена статистички сигнификантна разлика између серија из Новог Бечеја и Енглеске (Tab. VI).

Received November 30, 1995.
Accepted March 4, 1996.