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Research Article

New country records and further data to the stonefly (Plecoptera) fauna of southeast Macedonia

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Abstract
The stoneflies *Leuctra graeca* Zwick, 1978, *Zwicknia acuta* Murányi & Orci, 2014 and *Isoperla pesici* Murányi, 2011 are reported for the first time from the (FY) Republic of Macedonia. An apparently new species of *Zwicknia* Murányi, 2014 is referred but not named. The hitherto unknown larva of *Rhabdiopteryx doiranensis* Ikonomov, 1983 is described from both sexes. Further stonefly occurrences are also enumerated from the Anska Reka and Dojran Lake drainage basins, including the first early spring records of the autumnal *Leuctra bronislawi* Sowa, 1970 and *L. graeca*.

Key words: Plecoptera, FYROM, Macedonia, larval description, phenology, *Rhabdiopteryx*, *Zwicknia*, *Leuctra fusca* species-group

Introduction

Due to extensive collecting activity of Petar Ikonomov during the sixties to eighties of the last century, the Plecoptera fauna of Macedonia is the comparatively wellknown among Balkan countries. He published his results in over 15 faunistical, and three taxonomical papers that were summarized in a faunistic synopsis, where he counted 93 species to occur in the country (Ikonomov 1986). This species list covers nearly all of the taxa that can be expected in the region, indeed, only a single, recently described species was added since then (*Nemoura anas* Murányi, 2007). However, Ikonomov (1986) missed the Macedonian record of *Marthamea vitripennis* (Burmeister, 1839) published by Zwick (1984b), and also left one species described by himself, *Capnioneura valandovi* Ikonomov, 1978.

The southeastern, low elevation hills of Macedonia provide rather different stonefly habitats than the mountain systems in rest of the country. This area is considerably warmer and rather dry, covered mostly by macchia vegetation. Four stonefly taxa were originally described from this area (Ikonomov 1978, 1983), two of them (*Brachyptera macedonica* Ikonomov, 1983 and *Capnioneura valandovi*) not yet reported elsewhere. During March 2008, October 2013, February 2014 and May 2014, we visited the area to collect water insects in permanent and temporary waters of the Anska Reka and Dojran Lake watersheds (Fig. 1). Our trips resulted in fiding of new localities of endemic species, description of the hitherto unknown larva of *Rhabdiopteryx doiranensis* Ikonomov, 1983, three new species for the Macedonian fauna and interesting data of the phenology of some species.

Material and methods

Specimens were collected by singling, beating sheet or with waternet. They are stored in both 70 and 96% ethanol, and deposited in the Collection of Smaller Insect Orders, Department of Zoology, Hungarian Natural History Museum (HNHM), and in the Invertebrate Collection of the Mátra Museum of Hungarian Natural History Museum (MM). Living specimens for drumming signal recording were transferred to the laboratory in plastic boxes. After recording their vibrational signals, these specimens were also stored in 70 or 96% ethanol.

Drumming signals were recorded using a small, dynamic speaker (SAL YD78) as a vibration transducer. The examined specimen was placed on the diaphragm of the speaker, which was covered by a sheet of hobby glass to prevent the specimen from escaping from the surface of the speaker's diaphragm. The speaker was directly connected to the microphone input socket of a solid state, digital recorder (Zoom H4n). During the recordings ambient air temperature was measured using a P 300W thermometer. Vibration recordings were analysed and oscillograms produced using the software Adobe Audition. Drumming signal terminology follows Murányi et al. (2014).

If otherwise not stated in the text, phenology and distribution data refer to the regional European monographies (Fochetti & Tierno de Figueroa 2008, Graf et al. 2009, Kis 1974, Lubini et al. 2012, Tierno de Figueroa et al. 2003, Zhiltzova 2003) and online databases (DeWalt et al. 2014, Fochetti 2004). Terminology of larval description follows Murányi (2007).

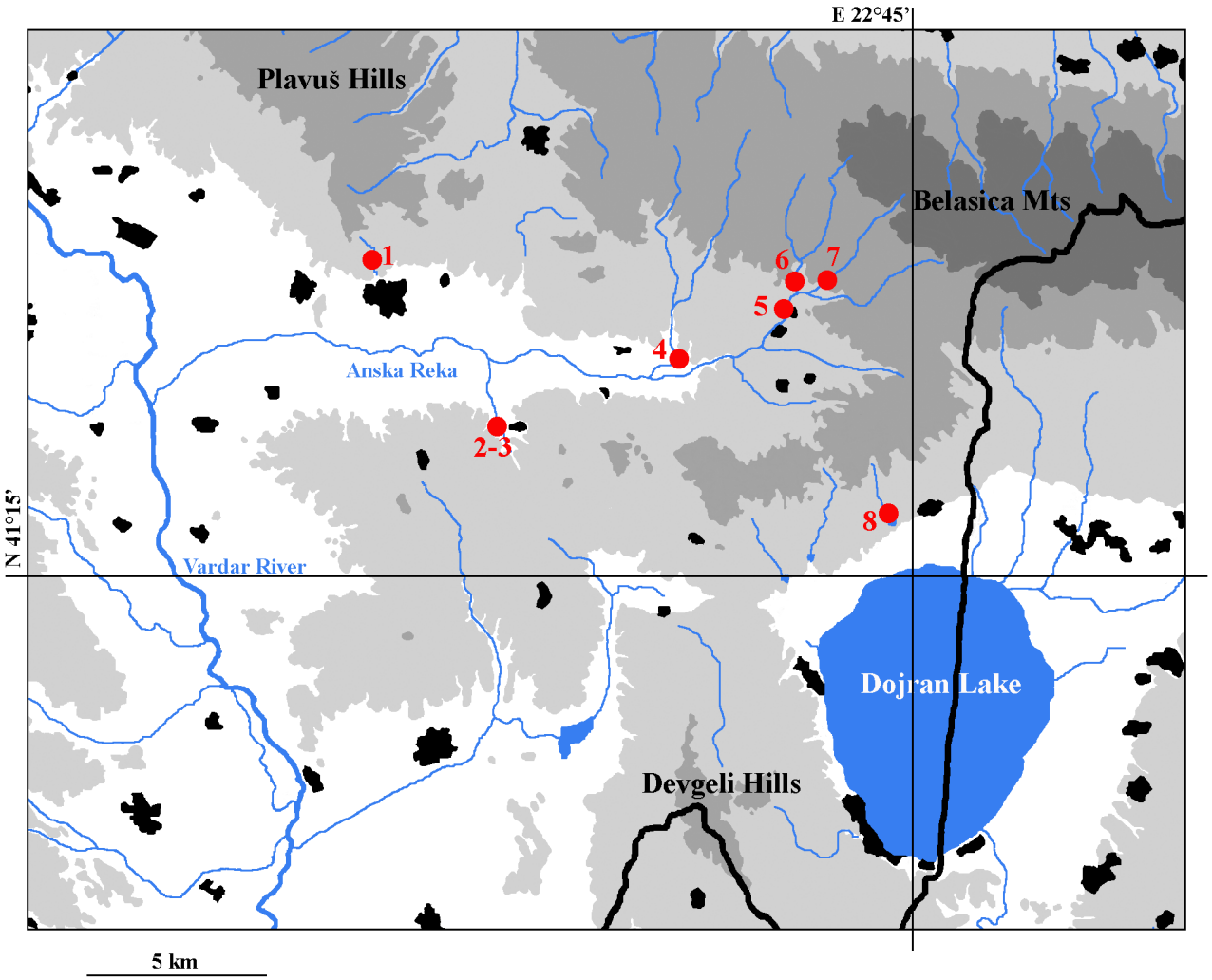

Figure 1. Collecting sites in the Anska Reka and Dojran Lake watersheds (altitudes above 200, 500 and 1000 meters are shaded in different grey). 1: Vodenic Stream at Motel Izvor; 2–3: macchia brook and creek at Dedeli; 4: Anska Reka tributary E of Čalakli; 5: Anska Reka at Kočuli settlement; 6: Činarli Stream above Bašibos; 7: Karani Stream above Bašibos; 8: macchia brook W of Nikolić.

Abbreviations of collectors: DA = Dorottya Angyal, SC = Szilvia Czigány, LD = László Dányi, TK = Tibor Kovács, DM = Dávid Murányi.

Results

Brachyptera risi (Morton, 1896)

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 3♂, 6♂ 7♀ larvae, 3♂ exuviae (HNHM: PLP4585), 1♂, 1♂ larva, 1♂ exuviae (MM: 2014-30); same locality, 05.05.2014, leg. TK, DM: 1♀ (MM: 2014-46); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (HNHM: PLP4589), 1♂ 3♀ larvae (MM: 2014-31).

This widespread European species reaches its southern limit of its Balkan distribution in Macedonia. In Central Europe and even in the Iberian Peninsula imagoes appear in April, data from February are known only from the Apennine Peninsula and Macedonia.

Brachyptera beali beali (Navás, 1924)

Macedonia: Valandovo municipality, Valandovsko Polje, Čalakli, tributary stream of Anska Reka, E of the village, 170 m, N41°18.071' E22°39.217', 20.02.2014, leg. DA, LD, TK, DM: 2♀ larvae (HNHM: PLP4581); Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 1♂ larva (MM: 2014-30); Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 15.03.2008, leg. SC, DM: 6♂ 7♀ larvae, 1♂ 4♀ exuviae (HNHM: PLP2553); same locality, 21.02.2014, leg. DA, LD, TK, DM: 1♀, 9♂ 13♀ larvae (HNHM: PLP4601), 3♂ 4♀ larvae (MM: 2014-34); same locality, 06.05.2014, leg. TK, DM: 1♀ (HNHM: PLP4699).

Populations consisted of both fully coloured adult and immatured larvae in February, suggesting an extended emergence period, similarly as observed at the Peloponnes (Murányi 2011a).

Brachyptera seticornis (Klapálek, 1902)

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 05.05.2014, leg. TK, DM: 1♂ (MM: 2014-46).

This late spring emerging Central European species reaches southern limit of its distribution in Macedonia. Our specimen has abnormal paraprocts, the left paraproct is being similar but shadow of the right paraproct.

Brachyptera macedonia Ikonomov, 1983

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Činarli Stream N of the village, 355 m, N41°19.050' E22°41.983', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (HNHM: PLP4594); Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 21.02.2014, leg. DA, LD, TK, DM: 1♀ (HNHM: PLP4602), 1♀ (MM: 2014-34).

The lack of associable larvae even in February suggests a rather early emergence period for this little-known SE Macedonian endemic.

***Rhabdiopteryx doiranensis* Ikonomov, 1983**
(Fig. 2A–E)

Macedonia: Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 15.03.2008, leg. SC, DM: 2♂ 1♀ larvae (HNHM: PLP2552); same locality, 21.02.2014, leg. DA, LD, TK, DM: 1♂, 3♂ 1♀ larvae (HNHM: PLP4600), 2♂ 2♀, 1♂ larva (MM: 2014-34).

Besides the type locality, hitherto this species was reported only from SW Anatolia (Kazanci 2000). It seems to be a species of temporary streams in lowlands. Herein we describe the hitherto unknow larva.

Description of the matured larva (Fig 2A): Body length 8.0–10.0 mm. General colour light brown with dark dorsal pattern. Setation generally short, but distinct on the genital plates, and long swimming hairs present on tibiae and femora; cercus lacks swimming hairs. Head with a complex dark pattern in front of ecdysial suture, tentorial callosities distinct; occipital rugosities numerous, distributed on the whole occiput. Antenna pale, scape and apical third darker; antennal segments over 50 in number, only those in the apical half are longer than wide. Mouthparts pale but labrum with dark edges. Pronotum with few rugosities, forming a C-shaped pattern on both sides. Meso– and metanotum with cloudy pattern not reaching the wing pad bases, wing pads of length usual for the genus. Femora and tibiae uniformly light brown, tarsi darker. Ventral surface of thorax and abdomen whitish besides the genital plates. Transverse row of dark spots distinct on all tergites, anterior margin of tergites I–VII with medially interrupted transverse line; transverse anterior line is usually entire on tergite VIII, a posterior line also present on this tergite. Tergites IX–X with complex dark pattern; cercus light brown, apical segments darker; cercal segments over 40 in number, longer than wide around the 10th segment, apical ones more than three times longer than wide.

Male terminalia (Figs. 2B–C): Subgenital plate elongate, one and a half longer than wide; widest in its midlength, then conspiciously tapering but ending in a blunt, widely rounded apex. Posterior two thirds of the plate covered with setae, apical third with long, thin hairs. Base of the paraproct wide, apical projection short and slightly curved outwards, tip blunt. Epiproct triangular, pointed.

Female terminalia (Figs 2D–E): Pregenital plate, vulvar lobes and gonopore well visible through sternite VIII. Postgenital plate short and oval, its length is six fifth of the width; widest in midlength, posterior edge widely rounded. Posterior two thirds of the plate covered with setae, apical fourth with long, thin hairs. Paraproct wide and short, apex subrectangular. Epiproct simple, rounded.

Affinities: Habitus of the larva is typical for the genus, and can be identified only by the terminalia. Both the male and female larvae are easily distinguishable from members of the *Rhabdiopteryx neglecta* species group by their much smaller subgenital (male) or postgenital (female) plates (compare with e.g. Lubini et al. 2012: Figs. 151–154). The female larva differs from other known *Rhabdiopteryx* species by the wider and not pointed postgenital plate (compare with Kittel 1981: Fig. 4b for *R. acuminata* Klapálek, 1905; Kovács & Weinzierl 2003: Fig. 5 for *R. hamulata* (Klapálek, 1902); and Theischinger 1975b: Fig. 11 for *R. christinae* Theischinger, 1975). The male larva differs with the blunt apex of the subgenital plate from *R. acuminata* (see Fig. 4d in Kittel 1981), *R. antoninoi* Vinçon & Ravizza, 1999 (see Fig. 11 in Vinçon &Ravizza 1999) and *R. christinae* (see Fig. 9 in Theischinger 1975b), while with the complex dark pattern on tergites IX–X from *R. hamulata* (see Fig. 4 in Kovács & Weinzierl 2003).

***Leuctra fusca fusca* (Linnaeus, 1758)**
(Fig. 3A–B)

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Činarli Stream N of the village, 355 m, N41°19.050' E22°41.983', 20.02.2014, leg. DA, LD, TK, DM: 1♂ (HNHM: PLP4597).

This widespread Eurosiberian species is known as an autumnal, hyporhitral-potamal species in most of its range. Early spring imagoes were reported only from the Iberian Peninsula in Europe, the present data from February is the first non-autumnal report from the Balkans. The single male found above Bašibos shows no notable morphological difference from autumnal specimens previously collected in Macedonia.

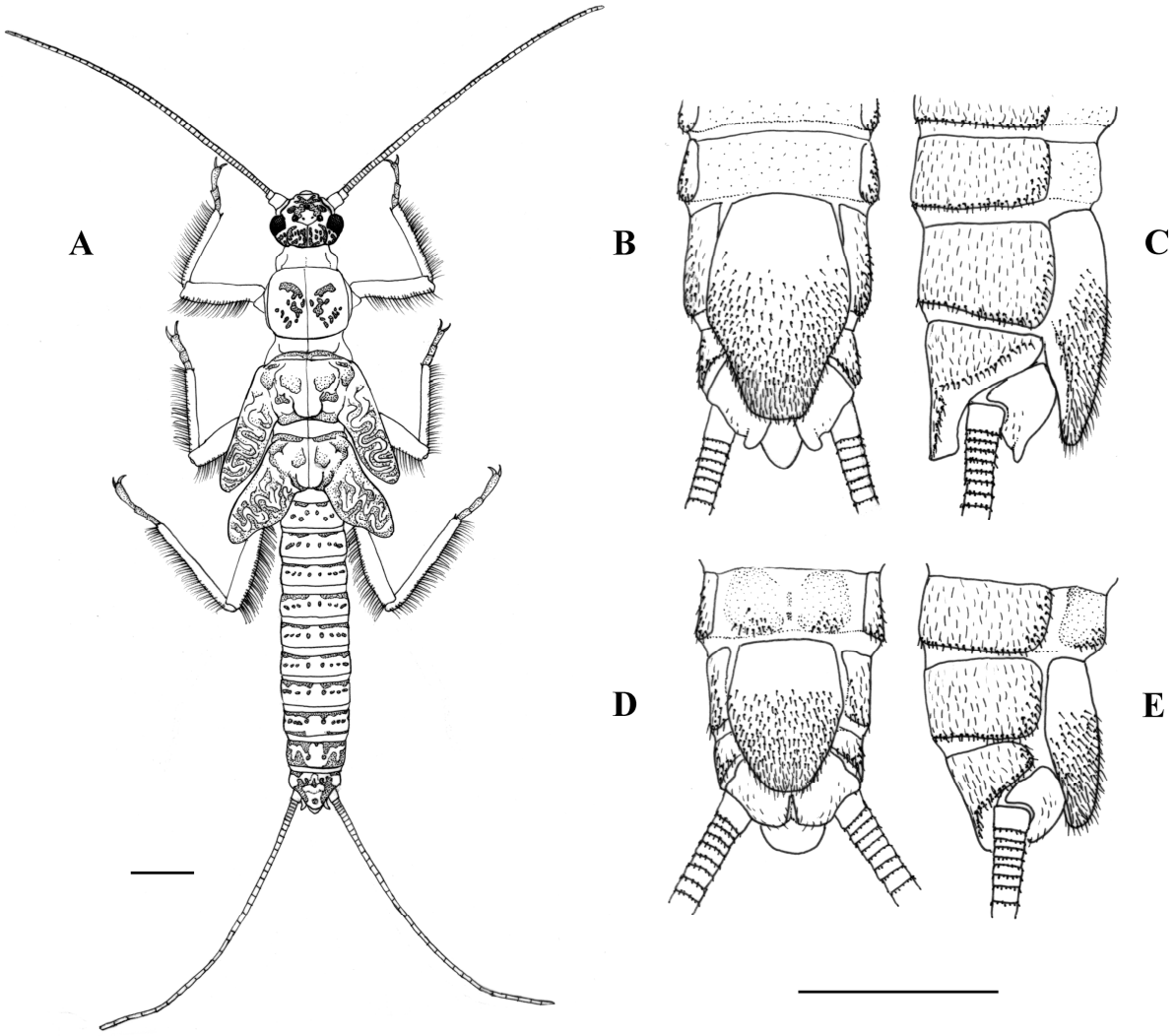

Figure 2. Larva of *Rhabdiopteryx doiranensis* Ikonomov, 1983: **A –** male habitus, dorsal; **B –**male terminalia, ventral; **C –** male terminalia, lateral; **D –** female terminalia, ventral; **E –** female terminalia, lateral. Scale bars 1 mm.

***Leuctra graeca* Zwick, 1978**
(Fig. 3C–D)

Macedonia: Valandovo municipality, Plavuš Hills, Valandovo, Vodenic Stream at Motel Izvor, N (above) of the city, 260 m, N41°19.636' E22°33.327', 04.10.2013, leg. TK, DM: 6♂ 1♀ (HNHM: PLP4518), 1♂ (MM: 2013-93); same locality, 20-22.02.2014, leg. DA, LD, TK, DM: 1♂ 1♀ (HNHM: PLP4578; found dead in garden lamps), 1♀ (MM: 2014-29).

This species was hitherto reported from Montenegro and Western Greece, caught in October only (Pardo & Zwick 1993, Zwick 1978). The population at Motel Izvor were most probably swarming during the whole winter, as we found several adults both in October and February, together with dried specimens in garden lamps. New for the fauna of Macedonia.

***Leuctra bronislawi* Sowa, 1970**
(Fig. 3E–F)

Macedonia: Valandovo municipality, Plavuš Hills, Valandovo, Vodenic Stream at Motel Izvor, N (above) of the city, 260 m, N41°19.636' E22°33.327', 04.10.2013, leg. TK, DM: 1♂ 2♀ (HNHM: PLP4517), 11♂ 6♀

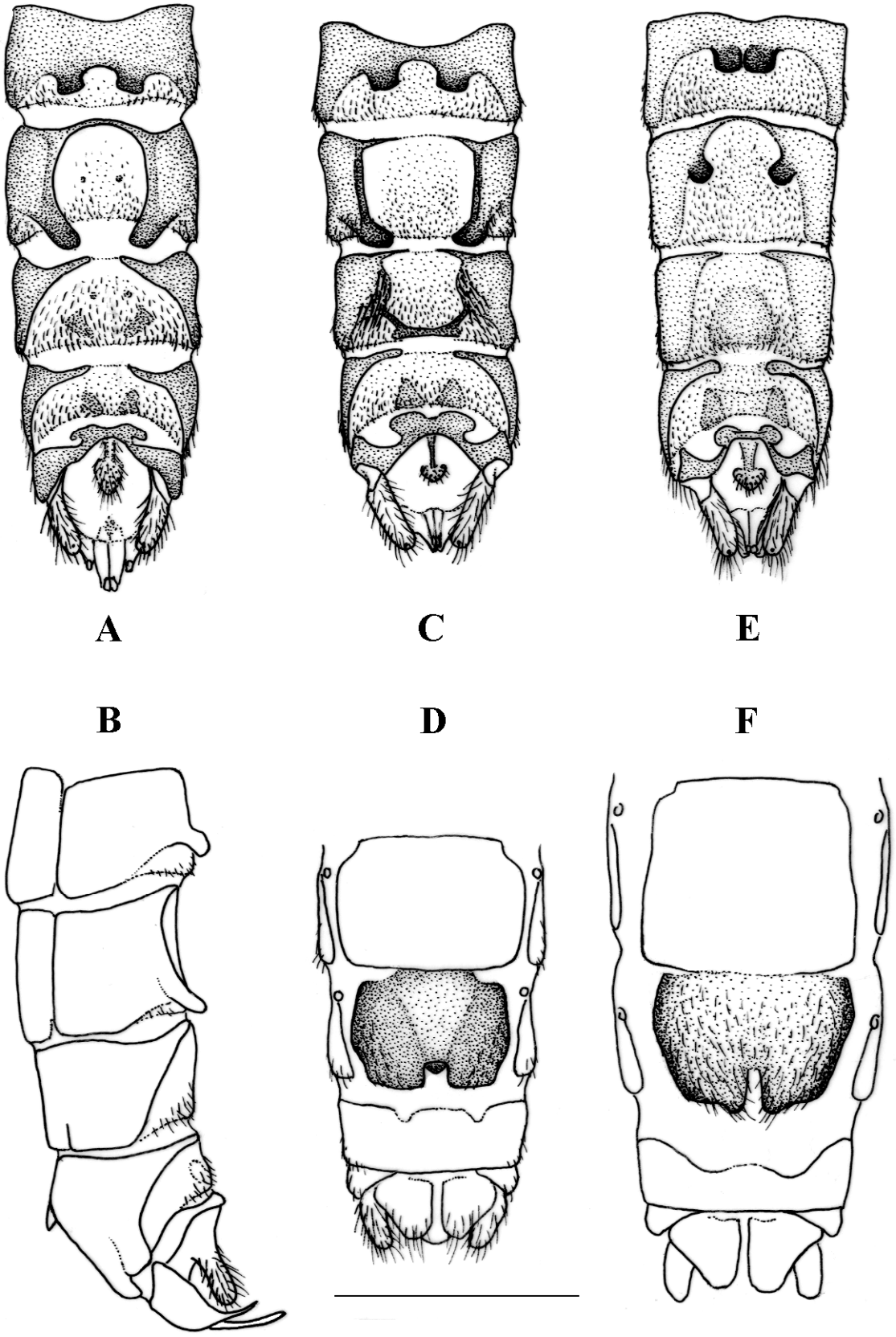

Figure 3. Terminalia of the spring emerging *Leuctra fusca* group specimens: **A –** *L. fusca fusca* (Linnaeus, 1758) male, dorsal view; **B –** *L. fusca fusca* male, lateral view; **C –** *L. graeca* Zwick, 1978 male, dorsal view; **D –** *L. graeca* female, ventral view; **E –** *L. bronislawi* Sowa, 1970 male, dorsal view; **F –** *L. bronislawi* female, ventral view. Scale bar 1 mm.

(MM: 2013-93); same locality, 20-22.02.2014, leg. DA, LD, TK, DM: 2♀ (HNHM: PLP4579; found dead in garden lamps), 1♂ 3♀ (MM: 2014-29).

A Carpatho-Balcanian autumnal species that is rather frequent in areas of Mediterranean climate all over the Balkans. However, it had never been found in early spring before. Its phenology at Motel Izvor was similar to *L. graeca*, adults were present probably during the whole cold season.

***Leuctra hippopus* Kempny, 1899**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 10♂ 8♀, 1♀ larva, 1 exuviae (HNHM: PLP4583), 6♂ 6♀ (MM: 2014-30); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 7♂ 4♀, 2♀ larvae (HNHM: PLP4592), 1♂ 4♀ (MM: 2014-31).

This widespread West Palaearctic species is a common spring emerger and covers the whole Balkans. Its emergence in February is rather unusual, thought already reported from Macedonia. Winter imago-data are known from the Iberian Peninsula and the Pyrenees.

***Leuctra olympia* Aubert, 1956**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (HNHM: PLP4584), 1♂ 1♀ (MM: 2014-30).

An early to mid-spring species that is endemic to western and southern parts of the Balkans.

***Capnopsis schilleri balcanica* Zwick, 1984a**

Macedonia: Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 21.02.2014, leg. DA, LD, TK, DM: 1♂ 4♀ (MM: 2014-34); Valandovo municipality, Valandovsko Polje, Dedeli, macchia creek W of the village, 160 m, N41°16.958' E22°35.916', 21.02.2014, leg. DA, LD, TK, DM: 1♂ (HNHM: PLP4603), 2♀ (MM: 2014-35).

The Balkanian subspecies of this insect is an early spring emergent, contrary to the northern populations of the species.

***Zwicknia acuta* Murányi & Orci, 2014** (in: Murányi et al. 2014)
(Fig. 4A–B)

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 2♂ (HNHM: PLP4586), 1♂ (HNHM: PLP4587; drumming recorded), 3♂ 1♀ (MM: 2014-30); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (MM: 2014-31).

This species was described very recently from Austria, Germany, Hungary, Serbia and Slovakia. It seems to be a species of larger and permanent streams. New to the fauna of Macedonia.

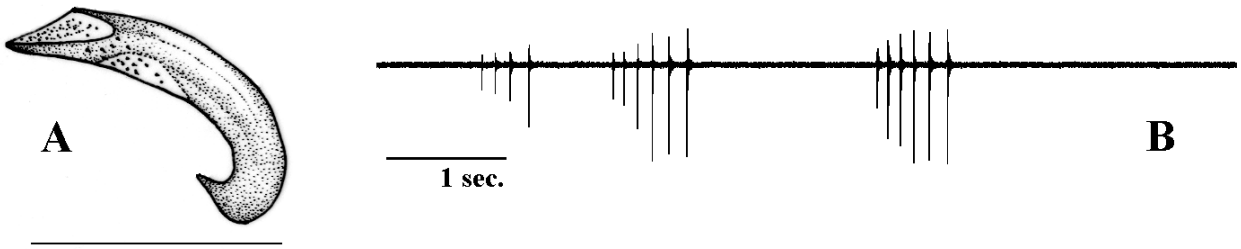

Figure 4. Macedonian specimen of *Zwicknia acuta* Murányi & Orci, 2014: **A –** male epiproct, lateral view, scale bar 0.5 mm; **B –** oscillogram showing a sequence of three calls, ambient air temperature was 18.2°C during the recording.

Both the epiproct morphology (Fig. 4A) and drumming call characters (mean inter beat interval, number of beats per call, call duration, number of calls in a sequence, inter call interval) slightly differ from typical ones described from the Carpathian Basin, but still fit within the variability of the species (compare Figs. 80, 108–109, 121, 127–130, 166, 174–178 in Murányi et al. 2014).

All together 15 calls were recorded. Calls were produced in short call sequences containing 2-3 calls per sequence. Each call is series of 4-6 beats (mean number of beats per call is 5.1, n=14 calls; one aberrant call with only two beats were excluded from this and all other call parameter measurements). Within a call beats were repeated with gradually increasing inter beat intervals (mean values of individual inter beat intervals varied between102-161 ms, overall mean inter beat interval was 128.3, n=14). Inter call interval varied between 700-2500 ms (mean=1235.8, n=7).

Zwicknia sp.

Macedonia: Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 21.02.2014, leg. DA, LD, TK, DM: 1♀ (MM: 2014-34); Valandovo municipality, Valandovsko Polje, Dedeli, macchia creek W of the village, 160 m, N41°16.958' E22°35.916', 15.08.2008, leg. SC, DM: 2♀ (HNHM: PLP2549); same locality, 21.02.2014, leg. DA, LD, TK, DM: 2♂ 1♀ (HNHM: PLP4604-4605), 1♂ 2♀ (MM: 2014-35).

This apparently new species will be described later, together with further new taxa of the genus (Murányi et al. in prep.). A winter-end species of ephemeral creeks in macchia vegetation.

***Capnioneura balkanica macedonica* Ikonomov, 1978**

Macedonia: Valandovo municipality, Plavuš Hills, Valandovo, Vodenic Stream at Motel Izvor, N (above) of the city, 260 m, N41°19.636' E22°33.327', 20-22.02.2014, leg. DA, LD, TK, DM: 3♂ 1♀ (HNHM: PLP4580; found dead in garden lamps); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 2♀ (HNHM: PLP4593), 1♀ (MM: 2014-31); Dojran municipality, Dojran Basin, Nikoliќ, brook in macchia forest, W of the village, 250 m, N41°15.550' E22°43.960', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (HNHM: PLP4599), 2♂ 3♀ (MM: 2014-33).

The nominal species, *C. balkanica balkanica* Baumann & Kaćanski, 1975, was described from Montenegro, *C. balkanica macedonica* from SE Macedonia. The species was reported also from the Peloponnes, first without subspecific identification (Tierno de Figueroa & Fochetti 2007), then as *C. balkanica balkanica* (Murányi 2011a). Comparing the Peloponnes material with the present topotypes, those can be attributed to *C. balkanica macedonica* instead of *C. balkanica balkanica*.

In Montenegro, imagoes were found from November to March, Macedonian specimens are on the wings from February to April, while the Peloponnes specimens were caught in March and April. All known populations live in permanent streams and spring outlets.

***Capnioneura valandovi* Ikonomov, 1978**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (MM: 2014-31); Valandovo municipality, Belasica Mts, Bašibos, Činarli Stream N of the village, 355 m, N41°19.050' E22°41.983', 20.02.2014, leg. DA, LD, TK, DM: 1♂ 1♀ (HNHM: PLP4596); Dojran municipality, Dojran Basin, Nikolić, brook in macchia forest, W of the village, 250 m, N41°15.550' E22°43.960', 20.02.2014, leg. DA, LD, TK, DM: 1♀ (MM: 2014-33).

This species is known from SE Macedonia only, where it was found in permanent streams from February to March (Ikonomov 1978).

***Protonemura praecox praecox* (Morton, 1894)**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 1♂ (MM: 2014-30); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 1♀, 1♀ larva (HNHM: PLP4590), 1♂ 4♀, 1♂ 2♀ larvae (MM: 2014-31); Valandovo municipality, Belasica Mts, Bašibos, Činarli Stream N of the village, 355 m, N41°19.050' E22°41.983', 20.02.2014, leg. DA, LD, TK, DM: 1♂ (HNHM: PLP4595).

An European species that emerges from February to April. A southern Balkan subspecies, *Protonemura praecox graeca* Berthélemy, 1971 was described from Central Greece. Our specimens are clearly belong to the nominal subspecies.

***Amphinemura quadrangularis* Zwick, 1978**

Macedonia: Dojran municipality, Dojran Basin, Nikolić, brook in macchia forest, W of the village, 250 m, N41°15.550' E22°43.960', 06.05.2014, leg. TK, DM: 1♀ (MM: 2014-48).

A Balkanian species that is known from Greece, Albania, Macedonia and Kosovo. Our specimen was found at a permanent brook.

***Protonemura rauschi* Theischinger, 1975a**

Macedonia: Valandovo municipality, Plavuš Hills, Valandovo, Vodenic Stream at Motel Izvor, N (above) of the city, 260 m, N41°19.636' E22°33.327', 06.05.2014, leg. TK, DM: 1♂ (HNHM: PLP4697), 1♀ (MM: 2014-47); Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 05.05.2014, leg. TK, DM: 1♂ (HNHM: PLP4696); Valandovo municipality, Valandovsko Polje, Dedeli, macchia creek W of the village, 160 m, N41°16.958' E22°35.916', 06.05.2014, leg. TK, DM: 1♂ 5♀ (HNHM: PLP4701).

A Balkanian species that is known from Greece, Macedonia and Serbia. Our specimens were found at both permanent and temporary streams.

***Nemoura subtilis* Klapálek, 1894**

Macedonia: Valandovo municipality, Plavuš Hills, Valandovo, temporary sidebrook of Vodenic Stream at Motel Izvor, N (above) of the city, 260 m, N41°19.636' E22°33.327', 06.05.2014, leg. TK, DM: 4♀ (HNHM: PLP4698), 1♀ (MM: 2014-47); Valandovo municipality, Valandovsko Polje, Dedeli, macchia

creek W of the village, 160 m, N41°16.958' E22°35.916', 06.05.2014, leg. TK, DM: 1♂ 1♀ (HNHM: PLP4702).

A Balkano-Anatolian species that is usually found in small streams and brooks. Our specimens were found at temporary waterflows.

***Isoperla pesici* Murányi, 2011b**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 05.05.2014, leg. TK, DM: 3♂ 2♀ (HNHM: PLP4695), 1♂ 2♀ (MM: 2014-46); Dojran municipality, Dojran Basin, Nikoliќ, brook in macchia forest, W of the village, 250 m, N41°15.550' E22°43.960', 15.03.2008, leg. SC, DM: 5 larvae (HNHM: PLP2548); same locality, 20.02.2014, leg. DA, LD, TK, DM: 1 larva (HNHM: PLP4598); same locality, 06.05.2014, leg. TK, DM: 1 larva (HNHM: PLP4703); Valandovo municipality, Valandovsko Polje, Dedeli, macchia brook W of the village, 150 m, N41°17.036' E22°35.905', 15.03.2008, leg. SC, DM: 1 larva (HNHM: PLP2550); same locality, 06.05.2014, leg. TK, DM: 1♀ (HNHM: PLP4700).

This species was described recently from Montenegro. Its Montenegrian habitats are cold spring outlets, in Macedonia we found it in both permanent and temporary streams. New to the fauna of Macedonia.

***Perla abdominalis* Burmeister, 1839**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 05.05.2014, leg. TK, DM: 1♀ exuviae (HNHM: PLP4694), 1♀, 2♀ exuviae (MM: 2014-46).

An European species that inhabits large streams and small rivers. Eggs of our specimens are similar to eggs of other Macedonian specimens as illustrated by Sivec & Stark (2002).

***Perla* cf. *pallida* Guérin-Méneville, 1838**

Macedonia: Valandovo municipality, Belasica Mts, Bašibos, Anska Reka at Kočuli settlement, 310 m, N41°18.658' E22°41.717', 20.02.2014, leg. DA, LD, TK, DM: 2♀ larvae (HNHM: PLP4582); same locality, 05.05.2014, leg. TK, DM: 2♂ (HNHM: PLP4692–4693), 1♂ 1♀ (MM: 2014-46); Valandovo municipality, Belasica Mts, Bašibos, Karani Stream NE of the village, 400 m, N41°19.076' E22°42.434', 20.02.2014, leg. DA, LD, TK, DM: 1♀ larva (HNHM: PLP4588).

The larvae agree with larvae that can be widely found in the Carpathian Basin and most parts of the Balkans, and having eggs described as *Perla pallida* Type 2 by Sivec & Stark (2002). However, the short winged males and the normal winged female considerably differ from the Carpathian Basin populations both in their colouration and terminalia characters.

Discussion

Ikonomov (1974, 1978, 1983, 1986) reported 28 species from the Anska Reka and Dojran Lake drainage basins. Among these, we did not find the following species: *Amphinemoura triangularis* (Ris, 1902), *Protonemura intricata* (Ris, 1902), *Nemoura cinerea* (Retzius, 1783), *N. uncinata* Despax, 1934, *N. flexuosa* Aubert, 1949, *Leuctra hirsuta* Bogoescu & Tabacaru, 1960, *L. metsovonica* Aubert, 1956, *Perlodes microcephalus* (Pictet, 1833), *Isoperla tripartita* Illies, 1954, *Perla marginata* (Panzer, 1799), *Chloroperla tripunctata* (Scopoli, 1763) and *Siphonoperla neglecta* (Rostock, 1881) but completed the species list with *Brachyptera beali*, *Leuctra graeca*, *L. hirsuta*, *Zwicknia acuta*, an undescribed *Zwicknia* species,

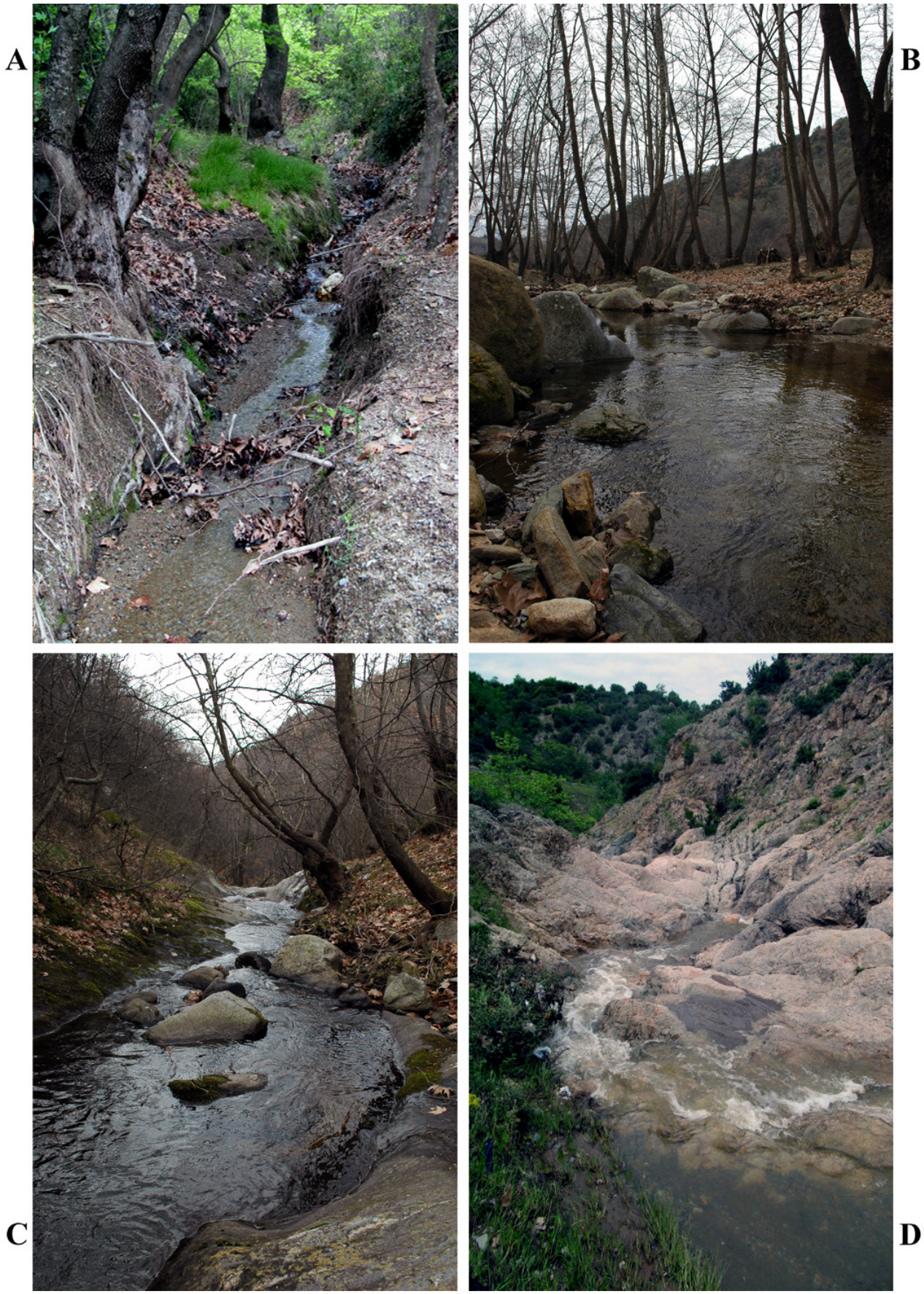

Figure 5. Habitats in the Anska Reka watersheds: **A –** Vodenic Stream at Motel Izvor; **B –** Anska Reka at Kočuli settlement; **C –** Karani Stream above Bašibos; **D –** macchia brook at Dedeli.

Amphinemura quadrangularis, *Isoperla pesici* and *Perla pallida*. Altogether, the stoneflies hitherto reported from (FY) Republic of Macedonia now equals 100, but occurrence or status of some taxa need to be confirmed. For example the European species of genus *Zwicknia* Murányi, 2014 (in: Murányi et al. 2014) were treated as one single species, *Capnia bifrons* (Newman, 1838), until recently. Now we confirmed the occurrence of two *Zwicknia* species in SE Macedonia, while *Z. bifrons* itself needs to be confirmed. Records of *Dictyogenus* Klapálek, 1904, a genus restricted to the Alps, most probably refer to the recently described *Besdolus illyricus* Kovács & Zwick, 2008. Similarly, Macedonian data of the Jura endemic *Perlodes jurassicus* Aubert, 1946 undoubtedly refer to an another species.

The species composition of the studied permanent and temporary streams differ distinctly. European species like *Brachyptera risi* or *Leuctra hippopus* were found only in permanent streams flowing in deciduous forest. The Balkanian endemics like *Leuctra bronislawi*, *L. graeca*, *L. hirsuta* and the *Capnioneura* species also were found only in permanent, while *Rhabdiopteryx doiranensis* and the new *Zwicknia* species occured in temporary waterflows in macchia vegetation. Some typical habitats are shown on Fig. 5A–D.

The autumnal species *Leuctra bronislawi* and *L. graeca* were found for the first time swarming in early spring, and our *L. fusca* imago is the first Balkanian spring occurence of this mostly autumnal species. Species having a long flight period during the whole cold season consists of only 4% of the European stoneflies (Graf et al. 2009). Aegean species of the *Leuctra fusca* group are tending to have this life strategy. Both autumnal and spring emerging adults were already reported for the Cretean *L. minoica* Pardo & Zwick, 1993, the Kykladen endemic *L. aegaeica* Pardo & Zwick, 1993 and *L. moreae* Zwick, 1978 from the Peloponnes (Pardo & Zwick 1993, Tierno de Figueroa & Fochetti 2001); other island species probably can be found in both seasons also. For mainland species whole cold season emergence was not yet reported, and possibly occurs only in warm winters like 2013/14. The widespread European *Brachyptera risi* and *Leuctra hippopus* emerged exceptionally early in comparision to populations in most of their area, but imagoes from February were already reported for both in Macedonia (Ikonomov 1986).

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