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First data on the Orthoptera diversity of Poštak Mountain and its surroundings (Croatia)

Gergely Szövényi ^{a*}, Josip Skejo ^b, Fran Rebrina^b, Nikola Tvrtković^c & Gellért Puskás ^d

^aDepartment of Systematic Zoology and Ecology, Eötvös Loránd University (ELTE), Pázmány Péter sétány 1/C, H-1117 Budapest, Hungary; ^bDivision of Zoology, Department of Biology, Faculty of Science, University of Zagreb, Rooseveltov trg 6, HR-10000 Zagreb, Croatia; ^cNatura – Society for Nature Protection of Croatia, Zagreb, Croatia; ^dDepartment of Zoology, Hungarian Natural History Museum, Baross utca 13, H-1088 Budapest, Hungary

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Summary. The insect fauna of the Dinarides is not widely studied. In 2013 and 2014, an orthopterological survey was conducted on the Poštak Mountain and its surroundings in the Lika region (Croatia), in order to sample the orthopteran communities of the prominent habitat types of the area. From 24 sampling sites, 80 Orthoptera species (44 Ensifera and 36 Caelifera) were collected, which amounts to almost half the known species in Croatia. One species, *Pholidoptera frivaldszkyi*, is recorded for the first time in the country.

Résumé. Premières données sur la faune des Orthoptères du mont Poštak et de ses environs (Croatie). La faune des insectes des Alpes Dinariques est à peine connue. En 2013 et 2014, une étude orthoptérologique a été menée sur le mont Poštak et ses environs, dans la région de Lika (Croatie), échantillonnant les Orthoptères dans les principaux types d'habitats de la région. Sur 24 sites d'échantillonnage, au total 80 espèces d'Orthoptera (44 Ensifera et 36 Caelifera) ont été détectées, ce qui correspond à près de la moitié des espèces connues habitant la Croatie. Une espèce, *Pholidoptera frivaldszkyi*, a été recensée pour la première fois dans le pays.

Keywords: Orthoptera; faunistics; Croatia; Poštak Mountain; *Pholidoptera frivaldszkyi*

The Dinaric Alps are considered a hotspot of endemisms regarding the European Orthoptera fauna (Kenyeres et al. 2009). In terms of Orthoptera diversity, this area is among the richest in Europe (Hochkirch et al. 2016b). Despite the remarkable biodiversity, however, our knowledge on the Orthoptera fauna of the different parts of this mountain range is highly variable. Several sites in the Dinaric Mountains in Bosnia and Herzegovina and Montenegro are well studied (Mikšić 1966, 1970, 1977, 1979; Ingrisich & Pavićević 2012), or, at least, their species are listed (Mikšić 1978, 1981). On the other hand, most of the Dinaric Alps of Croatia, excepting only some parts of the range near the Kvarner region (Učka Mt., S part of Velika Kapela Mt., N Velebit Mt.), are comparatively understudied. From the Croatian side of the Dinaric Alps, only two recent orthopterological surveys have been published, a comprehensive work about the Dinara Mountain and its surroundings (Rebrina et al. 2015), and a short survey of the Žumberak and Samoborsko gorje Mountains (Nagy 2006). Due to their transitional position between the continental and the Mediterranean climate (Bertović 1975), the Dinaric Alps display an outstanding degree of biodiversity, representing a mixture of Euro-Siberian and Mediterranean elements, and harbouring several endemic taxa (Tvrtković & Veen 2006).

The entomofauna of the Poštak Mountain in the Lika region (on the border area between Velebit Mt. and Dinara Mt.) is still largely unexplored, except for its butterflies (Koren et al. 2015). Prior to our study, no data were available on the Orthoptera inhabiting this mountain. Thus, the main aim of our study was to investigate orthopteran insects in the most important habitat types of the Poštak Mt. and its surroundings, in order to gain insight into the Orthoptera fauna of this area. We expected to find a rich fauna, composed of continental, Mediterranean, and Dinaric elements.

Materials and methods

Study area

The Poštak Mt. (Croatian: planina Poštak) is the southernmost, somewhat isolated part of the nearly 100 km long Lička Plješivica Mountain massif in the Lika region of Croatia, north of the town of Knin, in NW Dalmatia. The mountain massif runs from north to south, contrarily to most of the other Dinaric Mountains. The mountain gets its name from its 1421 m high, grassland covered peak, Poštak, surrounded by several other peaks. North-west of the Poštak Mt. lies the Velikopopinsko polje, separating it from the Lisac Mt., in the south-western part of the Lička Plješivica mountain chain. From the west, the Poštak Mt. is surrounded by the Malopopinsko polje, a small karst field (uvala) which, with the gorge of the Zrmanja River, separates it from the neighbouring

*Corresponding author. Email: gergely.szovenyi@ttk.elte.hu

Velebit Mt. On the north, the Poštak Mt. is bordered by the headwaters of the Una River, while in the east, by the deep valley of the Butižnica River. The bedrock of the mountain consists predominantly of limestone and dolomite, while its foothills and river valleys are partially covered in alluvial sediments. Acidophilic bedrock is hardly present. The area harbours a great variety of natural and semi-natural habitats. The southern and south-western slopes, often steep, are mostly covered by more or less rocky submediterranean dry grasslands and scrubs, or pubescent oak forests. Mediterranean elements, especially on the grasslands, are distributed from the foothills to the highest peaks, particularly in the central and southern parts of the mountain. On the other hand, the northern and north-eastern parts are often forested. Depending on the prevailing environmental conditions (elevation, depth of ground water level, exposition, etc.) and human activities in the past, they are dominated by continental sessile oak groves, or beech or pine forests. On some plateaus, extensive mountain hay meadows can be found, whereas the lowland variety of this habitat type covers large areas at the foothills, at the bottom of stream and river valleys, and in the plain polje. A small central part (2739 ha) of the range forms a site of community importance in the Natura 2000 network of the European Union (name: Poštak SCI; code: HR2001253).

Sampling sites

During the fieldwork in the summer of 2013 and 2014, 22 sampling sites in the Poštak Mt. area, and two further sites in

the neighbouring border area to the Velebit and Lisac Mt. were investigated, near the settlements Malovan, Komići, Momići, Nadvrelo, Otrić, Plavno and Vunduci, between 250 and 1350 m asl. Sampling sites covered: Ljubina poljana (1050–1090 m asl), a four-kilometre mountain valley (orientation W–E) covered by grasslands, situated on the northern side of the peak; other localities around the Poštak peak area (670–1350 m asl); Begovac pond (600 m asl), near the mountain pass to the Velebit Mt.; several sites in Plavno polje (and the surrounding slopes, 320–420 m asl), a southern valley with periodical water-courses; and sites on the slopes near the south-eastern Razvršje peak (1070–1140 m asl). Sites were chosen in order to best represent the variety of habitat types occurring in the study area, at different elevations (Figure 1). Two sampling sites are situated in the border area of the Poštak Mt. (3 – Malopopinsko polje, 18 – Momići). Data from two additional sampling sites (1 – Malovan, 19 – Komići) are not representative of the Orthopteran fauna of the Poštak Mt., but they are situated close to it, in the surrounding hills between the Lisac Mt. and the Velebit Mt.

Sampling sites and events are listed in Table 1. Site numbers correspond to the map of Figure 1.

Methods

All fieldwork was carried out in 2013 and 2014. The study area was shortly visited for the first time in June 2013. This visit was followed by the main study period in the second half of July

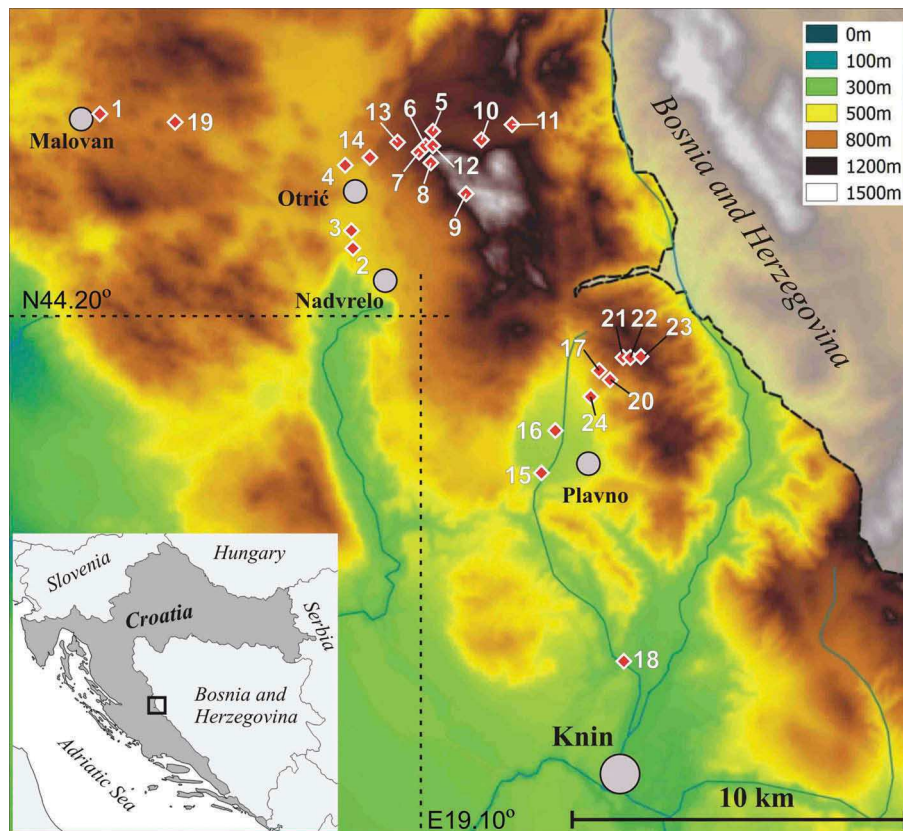


Figure 1. Map of the study area showing the sampling sites (sites are listed in the Materials and methods).

Table 1. Investigated localities with corresponding habitat descriptions, coordinates, collecting date and collectors (FR – Fran Rebrina, GP – Gellért Puskás, MM – Marta Malenica, JS – Josip Skejo, GS – Gergely Szövényi, NT – Nikola Tvrtković).

No	Locality	Altitude (m)	Y and X coordinates		Date	Collectors
1	Roadside scrub and dry grassland at Malovan	770	44°16'14"N	15°56'48"E	21.VII.2013	GP, FR, JS, GS
2a	Dry rocky grasslands and pond shore at pond Begovac	600	44°13'28"N	16°4'1"E	21.VII.2013	GP, FR, JS, GS
2b	Dry rocky grasslands and pond shore at pond Begovac	600	44°13'28"N	16°4'1"E	10.VIII.2014	GP, GS
3	Malopopinsko polje, xero-mesic grassland on the plain	600	44°13'52"N	16°3'57"E	21.VII.2013	GP, FR, JS, GS
4	Southern slope of peak Brijegovi, rocky dry grassland	670	44°15'12"N	16°3'46"E	21.VII.2013	GP, FR, JS, GS
5a	Ljubina poljana, diverse (mixed dry, mesophilous and wet) grasslands	1080	44°15'47"N	16°6'18"E	16.VI.2013	NT, JS
5b	Ljubina poljana, mosaic of dry and mesic grasslands	1090	44°15'48"N	16°6'17"E	22.VII.2013	GP, FR, JS, GS
5c	Ljubina poljana, mesophilous grasslands near the southern forest edge	1050	44°15'48"N	16°6'17"E	17.VIII.2013	NT, MM
6	Ljubina poljana, forest edge with <i>Rubus</i> bushes in the south-western corner	1090	44°15'39"N	16°6'8"E	22.VII.2013	GP, FR, JS, GS
7	Rocky grasslands on the western slope of Poštak peak	1120	44°15'29"N	16°5'59"E	22.VII.2013	GP, FR, JS, GS
8	Rocky grasslands on the southern slope of Poštak peak	1220	44°15'15"N	16°6'16"E	22.VII.2013	GP, FR, JS, GS
9	Meso-hygrophilous grassland in a sinkhole north-east of Mali Poštak peak	1350	44°14'38"N	16°7'15"E	22.VII.2013	GP, FR, JS, GS
10	Ljubina poljana, xerophilous grasslands	1050	44°15'43"N	16°7'41"E	23.VII.2013	GP, FR, JS, GS
11	Ljubina poljana, grasslands, scrub and forest edge of the eastern part of polje	1070	44°15'57"N	16°8'27"E	23.VII.2013	GP, GS
12	Beech forest surrounding Ljubina poljana	1080	44°15'44"N	16°6'21"E	24.VII.2013	GP, JS, GS
13	Rocky grasslands at Kamenita glava	980	44°15'41"N	16°5'19"E	24.VII.2013	GP, JS, GS
14	Dry grasslands and forest edge above Budimiri	790	44°15'21"N	16°4'30"E	24.VII.2013	GP, JS, GS
15	Hygrophilous hay meadows and scrub around stream Radljevac at Vunduci	390	44°8'53"N	16°9'23"E	24.VII.2013	GP, JS, GS
16	Plavno, Vedro polje, dry grasslands and forest edge	420	44°9'48"N	16°9'49"E	24.VII.2013	GP, JS, GS
17	Plavno, Opačića brdo hill, rocky grassland patches	760	44°10'59"N	16°11'2"E	24.VII.2013	GP, JS, GS
18	Kninsko polje, near stream Radljevac at Momići	250	44°5'1"N	16°11'47"E	24.VII.2013	GP, JS, GS
19	Komići, dry grasslands and forest edge east of Malovan	780	44°16'4"N	15°58'58"E	25.VII.2013	GP, JS, GS
20	Open <i>Quercus pubescens</i> forest above Plavno	820	44°10'48"N	16°11'23"E	10.VIII.2014	GP, GS
21	Rocky grasslands west of Razvršje peak	1070	44°11'16"N	16°11'47"E	10.VIII.2014	GP, GS
22	Bushy slope in rocky grasslands west of Razvršje peak	1100	44°11'16"N	16°12'0"E	10.VIII.2014	GP, GS
23	Rocky grasslands on Razvršje peak	1140	44°11'16"N	16°12'15"E	10.VIII.2014	GP, GS
24	Ruderal vegetation in the village Plavno	520	44°10'28"N	16°10'47"E	10.VIII.2014	GP, GS

2013, and another short collecting trip in mid-August 2014. Most of the collecting in grassland habitats was performed by sweep netting, usually completed by visual and acoustic observations, while in bushy and forested habitats, visual and acoustic detection was chiefly applied, and the insects were collected by hand. To maximize the efficiency of the acoustic detection, an ultrasound detector (Mini-3 Bat Detector, NHBS, Totnes, UK – frequency range modified for orthopterological purposes) was used. The calling songs of several species were recorded directly by a ZOOM H1 digital handy sound recorder (Zoom Corporation, San Francisco, CA, USA) and by an Olympus VN-8400PC digital voice recorder (Olympus, Center Valley, PA, USA), using a Shure BG 4.0 condenser microphone (frequency response: 40–18,000 Hz). Specimens were identified using the taxonomic keys by Harz (1969, 1975), Ingrisich and Pavičević (2010), Ingrisich (2012), and Massa et al. (2012). The Orthoptera Species File Online (OSF; Cigliano et al. 2018) was consulted for valid taxonomy.

Most of the collected specimens were preserved in 70 or 96% ethanol solution, while some were captured alive and prepared, pinned and dried in the laboratory. Voucher specimens are deposited in the F. Rebrina private Orthoptera collection (Zagreb, Croatia) [FRcoll], the Orthoptera collection of the Split Natural

History Museum (Prirodoslovni Muzej – Split, J. Skejo collection) (Split, Croatia) [PMSt], in the G. Szövényi private Orthoptera collection [SGcoll], and in the Orthoptera collection of the Hungarian Natural History Museum (Budapest, Hungary) [HNHM].

Results

Altogether 80 Orthoptera species (44 Ensifera and 36 Caelifera) were detected in the study area, 78 of which were found within the natural boundaries of the Poštak Mountain. The remaining two (*Phaneroptera falcata* and *Pholidoptera littoralis littoralis*) were only found in the surrounding hills. The species are listed below in systematic order. Sampling site identifiers (numbers from 1 to 24), grouped by settlement, are indicated for every species in the list. The identifier number denotes site and sampling date. The geographical names, brief habitat descriptions, altitudes, collecting dates, and the names of collectors for all sampling sites are listed in Table 1. Published data (only

two species) in the list are marked by a corresponding reference. Voucher specimens are listed in brackets after each corresponding sampling site identifier. For the abbreviations of the collections comprising the voucher specimens, see *Materials and methods*. Catalogue numbers are added for each collection unit of the Hungarian and Split Natural History Museums' Orthoptera collection. Short notes on the local habitat requirements, distribution, and frequency of occurrence of each species, and in the case of endangered species, also the IUCN European Red List status (Hochkirch et al. 2016b). Further taxonomical notes are also provided in the list.

ENSIFERA

Tettigoniidae

Phaneropterinae

Acrometopa servillea macropoda (Burmeister, 1838): Komići: **19** [1♂ HNHM (OrP 1437)]; Malovan: **1**; Nadvreló: **2a**; Otrić: **4** [1♀ HNHM (OrP 1371)], **14**; Plavno: **17** [1♂ 2♀ SGcoll], **22**; Vunduci: **15** [1♀ HNHM (OrP 1415)]. Widely distributed in grasslands, bushy habitats and forest edges with a Mediterranean influence.

Barbitistes yersini Brunner von Wattenwyl, 1878: Komići: **19**; Malovan: **1** [3♂ 2♀ HNHM (OrP 1348)]; Otrić: **5b** [1♂ FRcoll; 2♂ 3♀ HNHM (OrP 1378); 3♂ 1♀ SGcoll; 3♂ 3♀ PMSt (00106)], **6**, **7** [2♂ HNHM (OrP 1391); 1♂ SGcoll; 2♂ PMSt (00188)], **8**, **11**, **13**, **14** [1♂ SGcoll]; Plavno: **17** [1♂ 1♀ SGcoll]; **21**; **22**; Vunduci: **15**. Widely distributed in grasslands, bushy habitats, forest edges and open forests up to the highest peaks.

Leptophyes boscii Fieber, 1853: Malovan: **1**; Otrić: **5b** [1♂ 1♀ FRcoll; 1♀ SGcoll; 1♀ PMSt (00195)], **6**, **7**, **9**, **10**, **11**; Plavno: **16**; Vunduci: **15** [1♂ HNHM (OrP 1417)]. Restricted to mesic and wet grassland plots rich in dicotyledons, and bushy habitats.

Leptophyes laticauda (Frivaldszky, 1868): Malovan: **1** [3♂ HNHM (OrP 1353); 7♂ 5♀ SGcoll]; Otrić: **10**, **14** [2♂ 1♀ SGcoll]. Widely distributed in the bushy habitats, forest edges and open forests of the study area. Often found in the canopy of maple trees.

Poecilimon ampliatus Brunner von Wattenwyl, 1878: Otrić: **5b** [1♂ 1♀ FRcoll; 3♂ 7♀ HNHM (OrP 1379); 7♂ 8♀ SGcoll; 1♂ 1♀ PMSt (00192)], **7**, **11**, **13** [1♂ SGcoll]. Inhabits various mountain grassland habitats, and in some cases, locally abundant.

Poecilimon sp. (*elegans* group): Komići: **19** [1♀ HNHM (OrP 1438)]; Malovan: **1** [3♂ HNHM (OrP 1354); 8♂ 4♀ SGcoll]; Nadvreló: **2a** [2♂ 1♀ HNHM (OrP 1365)]; Otrić: **3** [2♂ 1♀ HNHM (OrP 1369)], **5b** [1♂ FRcoll; 2♂ 2♀ HNHM (OrP 1380); 6♂ 1♀ SGcoll], **7** [1♂ HNHM (OrP 1392); 3♂ 4♀ SGcoll; 2♂ 2♀ PMSt (00186)], **8** [3♂ 1♀ HNHM (OrP 1394); 7♂ 4♀ SGcoll], **9** [2♂ HNHM (OrP 1400)], **10** [4♂ 5♀ SGcoll], **13** [1♂ HNHM (OrP 1463); 1♂ SGcoll], **14** [4♂ 2♀ HNHM (OrP 1413); 5♂ 5♀ SGcoll]; Plavno: **17** [2♂ 1♀ SGcoll], **21**, **22**, **23** [2♂ SGcoll]. This yet undescribed species from the *Poecilimon elegans* group is relatively widespread in the dry grasslands of the region between 600 and 1350 m asl. This taxon differs considerably both from *P. elegans* and *P. albolineatus* Ingrisch & Pavićević, 2010, and its morphology fits *Poecilimon* sp.

(near *elegans*) type "a", as described in Ingrisch and Pavićević (2010). The calling songs of the Poštak specimens differ considerably both from *P. albolineatus* and *P. elegans* songs, as suggested by Ingrisch and Pavićević (2010). A comprehensive revision of this species group in its entire range is in progress.

Poecilimon ornatus (Schmidt, 1850): Otrić: **5b** [2♂ 1♀ FRcoll; 1♂ SGcoll; 1♂ 1♀ PMSt (00191)], **6** [2♂ SGcoll], **7**, **9**, **11**, **13** [1♂ HNHM (OrP 1457)]. Inhabits various mountain grassland and bushy habitats, and forest edges, where in some cases locally abundant.

Polysarcus denticauda (Charpentier, 1825): Otrić: **5a** [4 PMSt (00274–75, 01265, 01267)] **5b** [1♂ SGcoll; 1♀ PMSt (00185)], **9**, **10**, **11**, **13** [1♂ HNHM (OrP 1462)], **14**.

Phaneroptera falcata (Poda, 1761): Malovan: **1**. It has only been found in the bushy roadside vegetation at one site, but probably widespread in similar habitats of the region.

Phaneroptera nana Fieber, 1853: Otrić: **14**; Plavno: **16**; Vunduci: **15**. Lives in tall grasslands or bushy habitats, and even in gardens and orchards, probably widespread in the area.

Tylopsis lilifolia (Fabricius, 1793): Nadvreló: **2a**, **2b**; Otrić: **3**; Plavno: **16**, **17**; Vunduci: **15** [4♂ 2♀ HNHM (OrP 1416)]. Inhabits tall grasslands or bushy habitats, and forest edges with a stronger Mediterranean influence, where found mostly on bushes.

Conocephalinae

Conocephalus fuscus (Fabricius, 1793): Vunduci: **15** [1♂ 1♀ HNHM (OrP 1418)]. Restricted to humid grassland habitats in the study area.

Ruspolia nitidula (Scopoli, 1786): Vunduci: **15**. In humid grasslands in the study area.

Tettigoniinae

Decticus albifrons (Fabricius, 1775): Nadvreló: **2a**; Plavno: **16**; Vunduci: **15**. In dry grasslands or bushy habitats with a Mediterranean influence.

Decticus verrucivorus (Linnaeus, 1758): Nadvreló: **2a**; Otrić: **3**, **4**, **5b** [1♂ SGcoll], **7**, **11**, **13** [2♂ HNHM (OrP 1459)]; Plavno: **23** [4♂ 2♀ HNHM (OrP 1475)]. In various, mostly mountain grassland habitats, up to the highest peaks in the region.

Gampsocleis abbreviata abbreviata Herman, 1874: Otrić: **5b**, **7** [2♀ HNHM (OrP 1390)], **8**, **13** [3♂ 2♀ SGcoll], **14**; Plavno: **21**, **23**. Inhabits submediterranean and mountain grasslands up to the highest peaks in the region.

Eupholidoptera schmidti (Fieber, 1861): Plavno: **16**, **17**; Vunduci: **15** [1♂ HNHM (OrP 1421)]. Prefers bushy habitats and forest edges with a Mediterranean influence.

Pholidoptera aptera (Fabricius, 1793): Komići: **19** [1♀ HNHM (OrP 1433)]; Otrić: **5b** [1♀ FRcoll], **6**, **7**, **9**, **11** [1♂ 1♀ HNHM (OrP 1407); 2♂ 2♀ SGcoll]. In open forests and forest edge habitats, and rarely in tallgrass meadows, also found at higher elevation in the region.

Pholidoptera dalmatica (Krauss, 1879): Nadvreló: **2a** [1♀ HNHM (OrP 1361); 1♂ SGcoll]; Otrić: **5b** [3♂ 2♀ SGcoll], **6**, **7** [1♂ 2♀ HNHM (OrP 1388)]; 5♂ 1♀ SGcoll], **8** [1♂ 1♀ FRcoll; 1♂ HNHM (OrP 1395)], **11** [2♂ 1♀ HNHM (OrP 1408)], **13** [1♂ HNHM (OrP 1458)]; 2♂ 1♀ SGcoll], **14** [1♂ SGcoll]; Plavno: **21** [1♂ 1♀ HNHM (OrP

1478)], **22**, **23** [1♂ HNHM (OrP 1474)]. In forest edge habitats and bushy meadows, often in rocky, dry places, up to the highest peaks is the region. Specimens collected during the fieldwork did not morphologically match any of the geographical races presently regarded as subspecies according to the OSF (Cigliano et al. 2018), as defined in the last comprehensive work on the infraspecific taxonomy of this species (Mařan 1952). The latter paper provides a detailed description and a morphological key to all the currently valid subspecies of *P. dalmatica*. However, based on the characters used in Mařan's (1952) paper, part of our specimens exhibited a combination of morphological characters of different subspecies. Several characters (i.e. length of pronotum, dentation of male titillator and the shape of male cerci) varied considerably, even between specimens collected at the same site. This raises questions about the validity of the subspecies and suggests that the subspecific taxonomy of *P. dalmatica* needs a thorough revision in the future.

Pholidoptera fallax (Fischer, 1853): Komići: **19**; Otrić: **5b** [1♀ HNHM (OrP 1381); 2♂ SGcoll], **7** [2♀ HNHM (OrP 1389); 2♂ SGcoll], **8** [1♂ HNHM (OrP 1396)], **10**, **11** [3♂ 1♀ 1juv. HNHM (OrP 1409)], **13** [1♀ SGcoll]; Plavno: **23** [1♂ 1♀ HNHM (OrP 1476)]. In various grassland habitats and forest edges, up to the highest peaks.

Pholidoptera femorata (Fieber, 1853): Nadvrela: **2a** [1♂ HNHM (OrP 1362)]; Otrić: **4** [1♂ FRcoll], **5b**, **13** [1♂ 2♀ SGcoll], **14** [1♂ 2♀ SGcoll]; Plavno: **16**, **17** [1♂ SGcoll]; Vunduci **15** [1♂ HNHM (OrP 1422)]. Prefers mesic or dry grasslands, mostly at lower elevations in the study area.

Pholidoptera frivaldszkyi (Herman, 1871): Otrić: **5b** [3♂ FRcoll; 3♂ 7♀ HNHM (OrP 1377); 7♂ 6♀ SGcoll]. The green dark bush-cricket has been recorded for the first time in Croatia in this study. An isolated population inhabits fresh mountain hay meadows of Ljubina poljana, at about 1050–1100 m asl. Distribution of this species encompasses the Carpathians and the Balkans, where it typically inhabits humid mountain grasslands. Taking into account its recent rediscovery in the Upper Don River basin, *P. frivaldszkyi* also occurs in the Eastern European part of Russia, in the remnants of lowland steppe (Mikhailenko & Polumordvinov 2015; Kaňuch et al. 2017). Considering the known distribution of this species, the Ljubina poljana population seems to be highly isolated. According to the present knowledge, the Pořtak Mt. delineates the south-westernmost border of the distribution of *P. frivaldszkyi*, the closest known population being the one from the Šator Mountain, 40 km eastwards in Western Bosnia (Mikšić 1978). Here, in the south-western border of its distribution, it is restricted to a few suitable plots, similarly to its north-westernmost occurrences in Slovakia (Fabriciusová et al. 2008). The morphology of *P. frivaldszkyi* from the Pořtak population generally fits the morphology of Transylvanian specimens, where this taxon has been described, but their coloration is unusual. Head, pronotum, legs, as well as dorsal and lateral parts of the abdomen were entirely brown in a considerable portion of the observed specimens, while in other specimens, the lateral parts of the abdomen were partly greenish (Figures 2, 3). This mixed coloration seems to be rather common in Dinaric populations (Figure 4), whereas completely brown (Figure 5) and predominantly green specimens are rarely found. However, green coloration is common in the Carpathian populations of this species (Figure 6). The specific coloration of the Croatian *P. frivaldszkyi* may be associated with the high level of isolation (Kaňuch et al. 2014),

but this should be confirmed by genetic analyses. The morphology of the male stridulatory file (Figure 7, 8), cerci (Figure 9) and titillators (Figure 10) in the Pořtak population is similar to the morphology of these traits in Transylvanian populations. However, male calling song exhibits some variability in syllable structure between the populations from different parts of its distribution in the Balkans and the Carpathians (Figures 11–13). In addition, our sound recordings show high temperature dependence of syllable repetition rate, already described in this species by Heller (1988). Due to its small size and possible long-term isolation, the Ljubina poljana population of *P. frivaldszkyi* may be threatened by extinction, and should therefore be considered a conservation priority.

Pholidoptera griseoptera (De Geer, 1773): Komići: **19**; Malovan: **1**; Otrić: **6** [1♂ 1♀ FRcoll], **7**, **9**, **11**; Plavno: **20**. In forests, forest edges and rarely in meadows close to forested areas. Widespread in the suitable habitats in the study area.

Pholidoptera littoralis littoralis (Fieber, 1853): Komići: **19** [6♂ 5♀ HNHM (OrP 1432)]; Malovan: **1** [2♂ HNHM (OrP 1455)]. In forest clearings and bushy or tallgrass meadows, but rather rare in the study area.

Bicolorana bicolor (Philippi, 1830): Komići: **19**; Malovan: **1** [1♂ HNHM (OrP 1456)]; Otrić: **5b** [1♂ FRcoll; 3♂ 1♀ SGcoll; 1♂ PMSt (00189)], **7** [1♂ FRcoll], **11**, **13** [1♂ HNHM (OrP 1461); 2♂ 1♀ SGcoll], **14**; Plavno: **21** [1♀ HNHM (OrP 1480)], **22**, **23**; Vunduci: **15** [1♀ HNHM (OrP 1419)]. Widespread in various grassland and bushy habitats in the whole study area, from lower elevations to the highest peaks.

Modestana modesta (Fieber, 1853): Komići: **19** [1♂ 3♀ HNHM (OrP 1436)]; Malovan: **1** [1♂ 1♀ HNHM (OrP 1355)]; Otrić: **4** [1♂ 1♀ FRcoll], **5b** [2♂ 2♀ SGcoll; 1♂ 2♀ (00251)], **7** [1♀ SGcoll], **8** [1♀ HNHM (OrP 1397)], **10** [1♂ HNHM (OrP 1401)], **11**, **13** [1♂ HNHM (OrP 1460); 2♂ 1♀ SGcoll], **14** [1♂ HNHM (OrP 1412); 1♂ 1♀ SGcoll]; Plavno: **21** [2♂ 1♀ HNHM OrP 1479)], **22**, **23**; Vunduci: **15**. In mesic and dry, often rocky grassland and bushy habitats, in the entire study area, from lower elevations to the highest peaks.

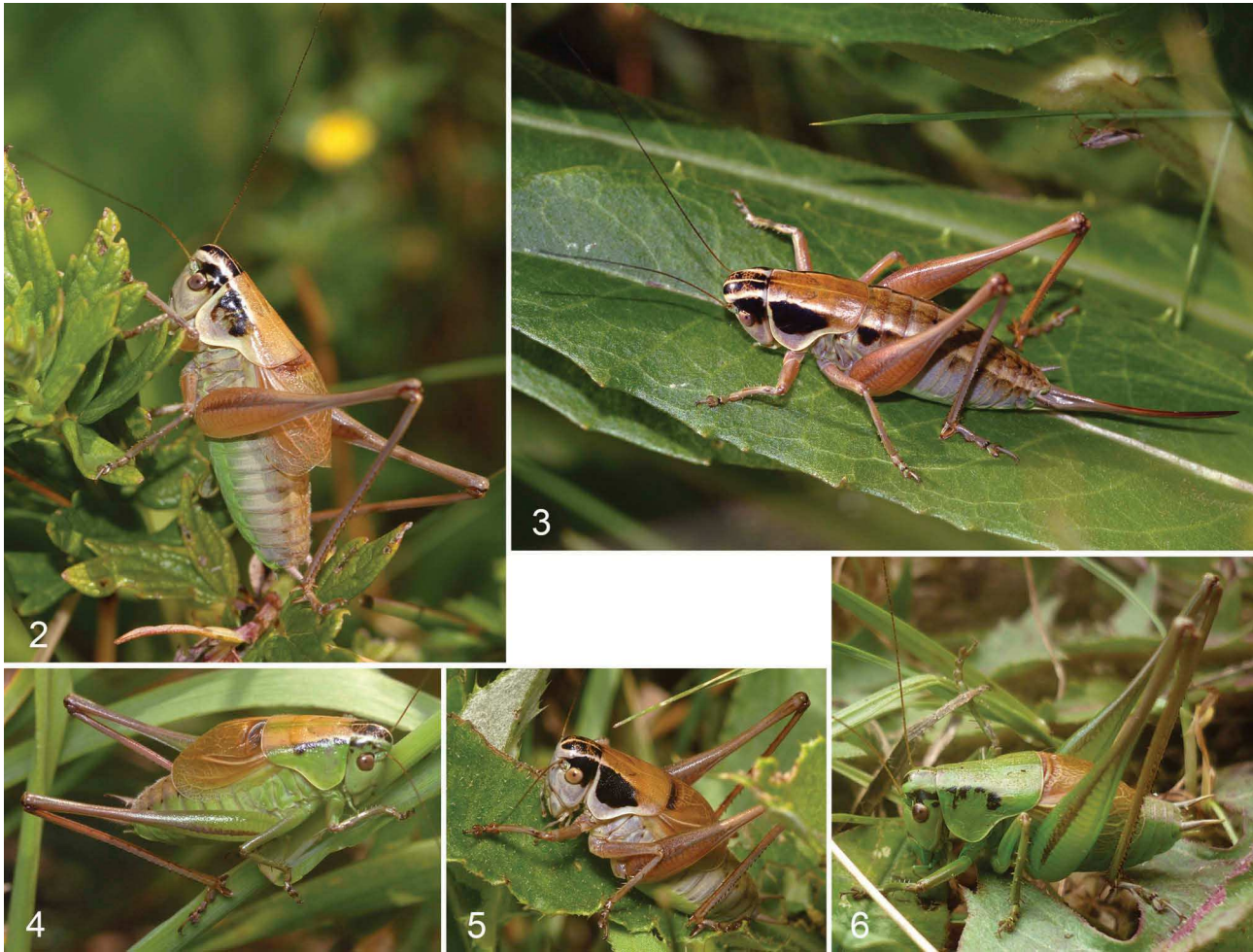
Montana stricta (Zeller, 1849): Nadvrela: **2a** [1♂ HNHM (OrP 1366)]; Otrić: **3** [3♀ HNHM (OrP 1368)], **11**; Plavno: **16** [6♂ 5♀ HNHM (OrP 1424); 3♂ 1♀ SGcoll; 4 PMSt (1269-73)]. In dry grasslands at lower elevations.

Pachytrachis gracilis (Brunner von Wattenwyl, 1861): Komići: **19** [1♂ 1♀ HNHM (OrP 1434)]; Malovan: **1**; Otrić: **11**, **14** [2♂ 1♀ SGcoll]; Plavno: **20**. In bushy grasslands and forest edges.

Pachytrachis striolatus (Fieber, 1853): Komići: **19** [1♂ 1♀ HNHM (OrP 1435)]; Malovan: **1** [1♀ HNHM (OrP 1356)]; Nadvrela: **2a**; Otrić: **4** [1♂ 1♀ HNHM (OrP 1372)], **5b** [1♂ PMSt (00196)]; **13** [1♀ SGcoll], **14** [1♂ 1♀ HNHM (OrP 1411); 3♂ SGcoll]; Plavno: **17** [1♂ 2♀ HNHM (OrP 1427); 3♂ 2♀ SGcoll], **21**, **22**, **23** [1♀ HNHM (OrP 1477)]. Widespread in dry, often rocky grasslands, scrubs and forest edges in the whole study area, except the highest peaks.

Platycleis affinis Fieber, 1853: Komići: **19**; Nadvrela: **2a** [1♂ 1♀ FRcoll; 1♂ 1♀ HNHM (OrP 1357)], **2b**; Otrić: **3**; Plavno: **16** [1♂ 1♀ HNHM (OrP 1423); 1♂ 1♀ SGcoll]; Vunduci: **15**. In various, mostly dry grassland habitats and scrublands in the whole area.

Platycleis grisea (Fabricius, 1781): Nadvrela: **2a** [1♀ HNHM (OrP 1453)]; Otrić: **4** [1♀ FRcoll], **8** [1♀ FRcoll], **11**, **13**, **14**;



Figures 2–6. Colour variation of *Pholidoptera frivaldszkyi* from populations in the Western Balkans and Romania, the latter not far from the type locality of the species. **2, 3**, Croatia, Poštak Mt., Ljubina poljana; **4**, Bosnia and Herzegovina, Bjelašnica Mts., “Radava Šuma”, 1650 m, 43°42′33.5″N 18°16′12.7″E, 30.VII.2016, leg. G. Puskás & G. Szövényi; **5**, Bosnia and Herzegovina, Trnovo Municipality, Treskavica Mts., Rogoj Pass, 1170 m, 43°38′11.5″N 18°28′19.2″E, 19.VII.2015, leg. G. Puskás & G. Szövényi; **6**, Romania, Mureș valley, Ideciu de Jos, meadow, 390 m, 46°49′37.2″N 24°46′8.4″E, 14.VI.2015, leg. G. Puskás.

Plavno: **17, 20, 21, 22, 23**. Common species in the whole study area, inhabiting various dry grassland and bushy habitats.

Psorodonotus illyricus Ebner, 1923: Otrić: **5a** [2♂ 3juv. PMSt (01242, 01245–47, 01843)], **5b** [1♂ 2♀ FRcoll; 2♂ 2♀ HNHM (OrP 1376); 2♂ 2♀ SGcoll], **5c** (data published in Kaya et al. 2015); **6, 7, 8, 11, 13**. Restricted to some extensive mountain grasslands in the central part of the Poštak Mt. The species is Near Threatened in Europe and at EU28 level as well.

Rhacocleis germanica (Herrich-Schäffer, 1840): Komići: **19**; Nadvreló: **2a, 2b**; Otrić: **3**; 14 [1juv. SGcoll] Plavno: **17, 20, 22**; Vunduci: **15**. In dry bushy grasslands and forest edges in the whole study area.

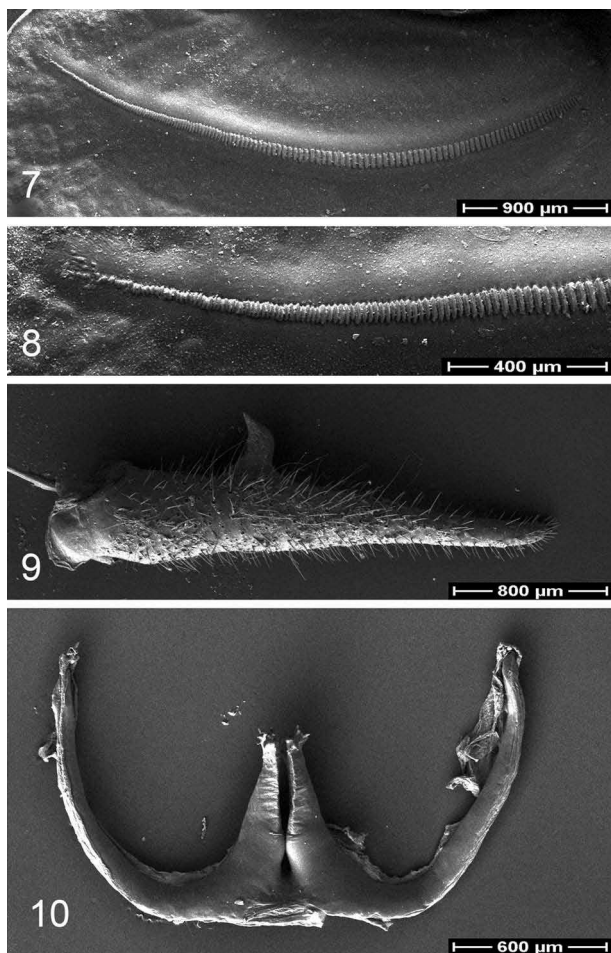
Roeseliana roeselii (Hagenbach, 1822): Otrić: **5b** [1♂ FRcoll; 2♂ SGcoll], **11, 13**; Vunduci: **15**. Prefers humid microhabitats, therefore occurs in mountain meadows and stream valleys in the study area.

Tessellana tessellata (Charpentier, 1825): Nadvreló: **2a, 2b**; Otrić: **3** [1♂ HNHM (OrP 1367)]; Plavno: **16** [1♂ 1♀ HNHM (OrP 1425); 1♀ SGcoll; 1 PMSt (01606)];

Vunduci: **15** [5♂ 8♀ HNHM (OrP 1420)]. In mesic and dry grassland habitats at lower elevations.

Tettigonia balcanica Chobanov & Lemonnier-Darcemont, 2014: Otrić: **11** [7♂ 2♀ HNHM (OrP 1406); 3♂ 2♀ SGcoll] (data published in Chobanov et al. 2014). The specimens of *Tettigonia balcanica* collected in the scrubs and forest edges in the eastern part of the Ljubina poljana in July 2013 were designated as paratypes of this species in its description paper (Chobanov et al. 2014). This species is widely distributed in the Balkans, and this is the first population found in Croatia. According to our present knowledge, the Poštak Mt. delineates the north-westernmost border of the species’ distribution, and the specimens collected in this area exhibit some slight morphological differences from its other known populations. Most likely widely distributed in mountain forest edges and humid bushy meadows of the study area.

Tettigonia viridissima (Linnaeus, 1758): Komići: **19**; Malovan: **1**; Momici: **18** (song recording on the field); Otrić: **5b, 6, 7, 9, 11, 13, 14**; Plavno: **16, 17, 23**; Vunduci: **15**. A common



Figures 7–10. Scanning electron microscopy photos of some important morphological characters of *Pholidoptera frivaldszkyi* from Ljubina poljana (Croatia, Poštak Mt.). 7, Stridulatory file; 8, detail of the apical part of the stridulatory file; 9, male left cercus; 10, titillators.

species easy to detect acoustically, inhabiting forested and bushy habitats or grasslands close to forested areas in the whole study area.

Bradyporinae

Ephippiger discoidalis Fieber, 1853: Komići: **19**; Nadvreló: **2a** [1♀ HNHM (OrP 1359)]; Otrić: **3, 4, 5b, 7, 8, 9, 11, 13**; Plavno: **16** [1♂ 1♀ SGcoll], **21, 22, 23**. Locally common grassland and scrub inhabiting species, occurring in the whole study area.

Gryllidae Gryllinae

Gryllus campestris Linnaeus, 1758: Komići **19**; Nadvreló: **2a**; Otrić: **5b**. A grassland inhabiting species, occurring often in extensively cultivated (mowed or grazed) habitats.

Melanogryllus desertus (Pallas, 1771): Vunduci: **15**. Grassland inhabiting species occurring also in arable lands, similarly to the previous species. Probably not rare but overlooked.

Eumodicogryllus bordigalensis (Latreille, 1804): Momici: **18** (song recording on the field). Grassland inhabiting species, most probably overlooked (similarly to the previous species).

Oecanthinae

Oecanthus pellucens (Scopoli, 1763): Momici: **18** (song recording in the field); Plavno: **16**; Vunduci: **15**. It occurs in tallgrass meadows, bushes and trees, even in cultivated lands and settlements, not rare in the study area.

Trigonidiidae

Nemobiinae

Pteronemobius heydenii (Fischer, 1853): Nadvreló: **2a, 2b**. Restricted to humid microhabitats, close to the water.

Raphidophoridae

Raphidophorinae

Troglophilus cavicola (Kollar, 1833): Otrić: **12** [8♂ 4♀ 1juv. HNHM (OrP 1410)]. In rocky forests and caves, probably not rare in the suitable habitats of the study area.

CAELIFERA

Tetrigidae

Tetriginae

Tetrix depressa Brisout de Barneville, 1848: Nadvreló: **2a**; Plavno: **17**. Restricted to special humid microhabitats, without or with only sparse vegetation.

Pamphagidae

Thrinchinae

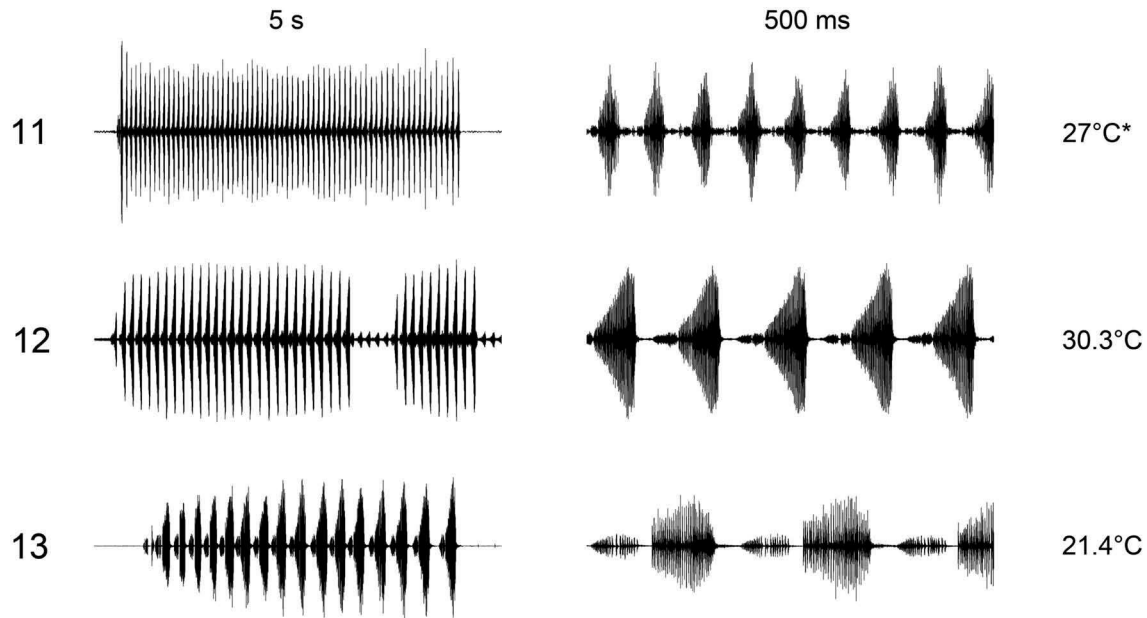
Prionotropis hystrix (Germar, 1817) Komići: **19** [1♂ HNHM (OrP 1454)]; Nadvreló: **2a** [1♂ 1♀ FRcoll; 1♂ HNHM (OrP 1358)]; Otrić: **4** [2♂ 1♀ SGcoll], **7** [1♂ 1♀ SGcoll], **13, 14** [1♀ SGcoll]; Plavno: **21** [1♂ 1♀ HNHM (OrP 1481)]. Occurs at low population density, in dry rocky grasslands with a Mediterranean influence in the study area. Assessed in the European Red List as Vulnerable both at European and EU28 level.

Acrididae

Calliptaminae

Calliptamus italicus (Linnaeus, 1758): Komići: **19**; Malovan: **1**; Nadvreló: **2a, 2b**; Otrić: **3, 4, 13, 14**; Plavno: **16, 17, 20**. Widespread in the dry grasslands of the study area.

Paracaloptenus cristatus Willemse, 1973: Komići: **19** [2♂ 1♀ HNHM (OrP 1439)]; Otrić: **8** [1♂ 5♀ SGcoll]; Plavno: **17** [5♂ 3♀ HNHM (OrP 1428); 3♂ 3♀ SGcoll; 8 PMSt



Figures 11–13. Oscillograms of male calling songs of *Pholidoptera frivaldszkyi* from three different populations. **11**, Croatia, Poštak Mt., Ljubina poljana. *: in this case, air temperature has been measured in the shadow, but body temperature of the calling specimen could be much higher in the sun; **12**, Romania, Feleacu 46°41'34.8"N 23°37'22"E 580 m Feleacu 30.VI.2009, leg. K.M. Orci & G. Szövényi; **13**, Slovakia, Slovenský raj 48°57'46.8"N 20°22'55.2"E Hrabušice, Podlesok Camp 23.VIII.1999, leg. G. Szövényi.

(01673-80)], **20**, **21** [2♂ 1♀ HNHM (OrP 1483)]. In rocky or stony dry open grassland plots or forest edges. Not common in the study area, but sometimes locally abundant. Assessed as Near Threatened at European and EU28 level in the European Red List.

Melanoplinae

Micropodisma salamandra (Fischer, 1853): Otrić: **5b** [9♂ 2♀ HNHM (OrP 1383); 3♂ 1♀ SGcoll; 3♂ 1♀ PMSt (00190)], **5c** [1 PMSt (01093)], **6**, **7**, **11**, **13**. Restricted to the mesic and humid parts of the mountain meadows in the central part of the Poštak Mt.

Miramella irena (Fruhstorfer, 1921): Komići: **19** [3♂ 2♀ HNHM (OrP 1440)]; Malovan: **1** [7♂ 3♀ HNHM (OrP 1349)]; Otrić: **5b** [2♂ 4♀ SGcoll], **6** [2♀ FRcoll; 4♂ 2♀ SGcoll]. Occurs in a few forest edges, bushy habitats and mountain grasslands in the study area.

Odontopodisma decipiens decipiens Ramme, 1951: Komići: **19** [1♀ HNHM (OrP 1441)]; Malovan: **1** [1♂ HNHM (OrP 1350)]; Otrić: **4**, **6** [3♂ 3♀ SGcoll], **14** [1♀ SGcoll], **17** [1♀ SGcoll]. In forest edges, bushy habitats and mesic or humid grasslands in the whole study area.

Pseudopodisma fieberi (Scudder, 1897): Otrić: **5b** [1♂ FRcoll; 6♂ 2♀ HNHM (OrP 1382); 13♂ 3♀ SGcoll; 3 juv. PMSt (00187)], **5c** [3 PMSt (00932, 00937-38)], **6**, **7**, **9**, **11**. Restricted to mountain meadows in the central part of the Poštak Mt.

Catantopinae

Pezotettix giornae (Rossi, 1794): Komići: **19**; Malovan: **1**; Nadvrela: **2a**, **2b**; Otrić: **3**, **4**, **14**; Plavno: **16**, **17**; Vunduci:

15. Common in the dry grasslands and scrubs in the study area, at lower elevations.

Cyrtacanthacridinae

Anacridium aegyptium (Linnaeus, 1764): Plavno: **16**. In places with stronger Mediterranean influence, often in cultivated lands or gardens. It seems to be localized in the study area.

Oedipodinae

Aiolopus strepens (Latreille, 1804): Nadvrela: **2a**. Probably common at lower elevations in the study area, but overlooked due to its peculiar phenological character (overwintering adults).

Mecostethus parapleurus (Hagenbach, 1822): Otrić: **13** [1♂ SGcoll]. Requires humid habitats, therefore its occurrence in a rocky grassland habitat is most probably incidental, and due to its good flying ability. Probably, it lives in some humid grasslands in the Ljubina poljana or in the Malopopinsko polje.

Oedipoda caerulescens (Linnaeus, 1758): Nadvrela: **2b**; Otrić: **4**; Plavno: **17**. In dry, open, often rocky habitats in the study area.

Oedipodasp. (*germanica* group): Malovan: **1**; Nadvrela: **2a**; Otrić: **5b**, **13**; Plavno: **17** [1♂ SGcoll], **21**. According to recent molecular genetic analyses [briefly reported in Hochkirch et al. (2016a)], populations formerly regarded as *Oedipoda germanica* in parts of Italy and the entire Balkan Peninsula may represent a distinct species. Thus we listed them under the name above. In dry, open, rocky grassland habitats.

Psophus stridulus (Linnaeus, 1758): Otrić: **5, 8** [1♂ SGcoll], **11** [1♂ FRcoll]. In open mountain grasslands, restricted to the higher parts of the Poštak Mt.

Gomphocerinae

Euchorthippus declivus (Brisout de Barneville, 1848): Nadvreló: **2a, 2b**; Otrić: **3, 4** [1♂ 1♀ PMSt (01809-10)], **11, 14** [1♂ HNHM (OrP 1414)]; Plavno: **16, 17** [1 PMSt (01799)], **23**. Common in the dry grasslands in the whole study area.

Euchorthippus pulvinatus (Fischer von Waldheim, 1846): Plavno: **17** [1♂ HNHM (OrP 1430); 1♂ 1♀ SGcoll; 1♂ 1♀ PMSt (01825-26)]. In dry steppic grasslands, and probably very rare in the study area. Assessed as Least Concern at European level, but Vulnerable in EU28.

Euthystira brachyptera (Ocskay, 1826): Komići: **19**; Malovan: **1**; Otrić: **4, 5b** [1♀ SGcoll; 1♂ 1♀ PMSt (0193)], **6, 7, 9, 11, 13, 14**; Plavno: **21, 22, 23**. In mesic and humid grasslands, forest edges and clearings in the whole study area.

Arcyptera brevipennis brevipennis (Brunner von Wattenwyl, 1861): Nadvreló: **2a** [1♀ FRcoll; 1♂ 1♀ HNHM (OrP 1360)]; Otrić: **3, 4** [1♂ 1♀ SGcoll; 1 PMSt (01656)], **5b, 7** [1♂ 1♀ SGcoll] **8** [1♂ 1♀ HNHM (OrP 1398)], **11** [1♀ SGcoll], **13** [1♂ SGcoll], **14**; Plavno: **17** [1♂ HNHM (OrP 1429)], **21** [1♂ HNHM (OrP 1482)]. In rocky open grasslands, regularly with low abundance, in several places in the study area. Assessed in the European Red List as Vulnerable at European and EU28 level as well.

Chorthippus apricarius (Linnaeus, 1758): Otrić: **5b** [1♂ HNHM (OrP 1387); 1♂ 1♀ SGcoll], **6, 7, 8, 11**. In various mountain grasslands in the central part of the study area.

Chorthippus biguttulus (Linnaeus, 1758): Otrić: **10, 13**. Found in mountain grasslands, seems rare in the study area.

Chorthippus brunneus (Thunberg, 1815): Plavno: **24**. In open dry, often degraded habitats, but localized in the study area.

Chorthippus bornhalmi Harz, 1971: Komići: **19**; Malovan: **1** [1♂ 1♀ HNHM (OrP 1351)]; Otrić: **5a** [8 PMSt (01284, 01286, 01287, 01299, 01301-3, 01307)] **5b** [2♂ 1♀ SGcoll], **7, 8** [1♂ 1♀ HNHM (OrP 1399)], **9, 10, 11, 13, 14**; Plavno: **16** [1♀ SGcoll]; **17** [1♂ SGcoll]. Common in various dry open habitats in the whole study area, especially at higher elevations.

Chorthippus dorsatus (Zetterstedt, 1821): Komići: **19**; Otrić: **5b, 11, 13**; Vunduci: **15**. In mesic and humid grassland plots in the whole study area.

Chorthippus mollis mollis (Charpentier, 1825): Otrić: **11** [1♂ SGcoll]; Plavno: **20, 21, 22**. Found in dry mountain grasslands in the study area, sometimes abundant.

Pseudochorthippus parallelus (Zetterstedt 1821): Nadvreló: **2a**; Otrić: **5b** [1♂ PMSt (00194)], **6** [1♀ FRcoll], **9, 11**; Plavno: **16, 23**; Vunduci: **15**. In mesic and humid grassland habitats in the whole area.

Gomphocerippus rufus (Linnaeus, 1758): Komići: **19** [1♂ HNHM (OrP 1442)]; Otrić: **14** [1juv. SGcoll]; Plavno: **20, 22**. Shady grassland habitats, especially forest edges and clearings in the study area.

Myrmeleotettix maculatus (Thunberg, 1815): Otrić: **10** [1♂ FRcoll; 4♂ 3♀ HNHM (OrP 1404); 2♂ SGcoll]; **11**; Plavno: **16** [2♀ SGcoll]; **23**. Only in dry, open shortgrass habitats at various elevations in the study area.

Stauroderus scalaris (Fischer von Waldheim, 1846): Otrić: **5b** [1♂ 2♀ SGcoll], **7, 8, 11, 13, 14**; Plavno: **21** [1♂ HNHM (OrP 1486)], **23**. In open mountain grasslands in the study area, at higher elevations.

Omocestus haemorrhoidalis (Charpentier, 1825): Otrić: **4** [1 PMSt (1129)]; **5b** [1♂ HNHM (OrP 1386)], **10** [1♂ 1♀ HNHM (OrP 1405)], **11**. In a few dry grasslands in the study area.

Omocestus petraeus (Brisout de Barneville, 1855): Nadvreló: **2a** [3♂ 4♀ HNHM (OrP 1364)]; Otrić: **3, 4, 14**; Plavno: **16**. In shortgrass parts of dry, open, often rocky habitats in the study area.

Omocestus rufipes (Zetterstedt, 1821): Malovan: **1**; Nadvreló: **2b**; Otrić: **5b**. Prefers humid grassland microhabitats, occurrence localized in the study area.

Stenobothrus fischeri (Eversmann, 1848): Komići: **19**; Nadvreló: **2a** [5♂ 7♀ HNHM (OrP 1363)]; Otrić: **3** [1♀ HNHM (OrP 1370)], **4** [3♂ 2♀ HNHM (OrP 1373)]; Plavno: **16** [1♀ HNHM (OrP 1426)]; **5♂ 1♀ SGcoll**; **2 PMSt (00814-15)**, **17** [1♀ HNHM (OrP 1431); 1♂ SGcoll]. In open, stony or rocky grasslands at lower elevations.

Stenobothrus lineatus (Panzer, 1796): Komići: **19**; Malovan: **1** [1♀ HNHM (OrP 1352)]; Nadvreló: **2a**; Otrić: **4** [1♂ 1♀ HNHM (OrP 1375)], **5b** [1♂ HNHM (OrP 1384)]; 1♂ SGcoll, 1♂ 1♀ PMSt (00197)], **7, 9, 11, 13, 14**; Plavno: **16, 17, 21, 22, 23**. Common in dry and mesic grasslands in the whole study area.

Stenobothrus nigromaculatus (Herrich-Schäffer, 1840): Komići: **19**; Otrić: **4** [1♀ HNHM (OrP 1374)], **5b** [1♂ HNHM (OrP 1385)], **10** [1♀ HNHM (OrP 1403)]; 1♂ SGcoll]; **11**; Plavno: **17, 21** [2♂ 1♀ HNHM (OrP 1484)], **22, 23**. In dry, open, often shortgrass habitats in the whole study area.

Stenobothrus rubicundulus Kruseman & Jeekel, 1967: Otrić: **5b, 7** [3♂ 2♀ HNHM (OrP 1393); 1♀ SGcoll], **8, 10** [1♂ HNHM (OrP 1402)], **11, 13** [1♀ SGcoll], **14**; Plavno: **17, 20, 21** [1♂ 1♀ HNHM (OrP 1485)], **22, 23**. In dry, open, rocky grassland slopes at higher elevations in the study area.

Discussion

The present study provides the first comprehensive orthopterological dataset for the Poštak Mountain, notwithstanding two already published sets of data (Chobanov et al. 2014; Kaya et al. 2015). The outstandingly rich orthopteran fauna of the Poštak Mt. and its surroundings was dominated by species of wider Mediterranean, European or Palearctic distributions. Out of 16 Mediterranean taxa (*Acrometopa servillea macropoda*, *Barbitistes yersini*, *Leptophyes laticauda*, *Poecilimon* sp./*elegans* group/, *Tylopsis lilifolia*, *Decticus albifrons*, *Eupholidoptera schmidti*, *Pholidoptera dalmatica*, *P. femorata*, *Modestana modesta*, *Ephippiger discoidalis*, *Anacridium aegyptium*, *Prionotropis hystrix*, *Oedipodasp./germanica* group/, *Arcyptera brevipennis* and *Chorthippus bornhalmi*), three are distributed all the way from the foothills to the mountain peaks, namely *Poecilimon* sp./*elegans* group/, *E. discoidalis* and *C. bornhalmi*. Six species (*Poecilimon* sp./*elegans* group/, *Pholidoptera dalmatica*, *Modestana modesta*, *Psorodonotus illyricus*, *Prionotropis hystrix* and *Paracaloptenus cristatus*) and a subspecies (*Arcyptera*

brevipennis brevipennis) occurring in the study area are endemic to the Dinaric Alps. All of these Dinaric taxa are restricted to different types of dry or mesic, well-preserved natural and semi-natural submediterranean grassland habitats, which have recently been declining for various reasons in the entire range of the Dinaric Alps, especially in its northern parts (Kaligarić & Ivajnsić 2014). Four of these species are globally endangered to different degrees (*P. ill-yricus* – Near Threatened, *P. hystrix* – Vulnerable, *P. cristatus* – Near Threatened and *A. brevipennis* – Vulnerable), according to the IUCN Red List (Hochkirch et al. 2016b). Another widely distributed Eurasian steppic grasshopper species, *Euchorthippus pulvinatus*, considered Vulnerable in the European Union (Hochkirch et al. 2016b), also occurs here. Altogether five species fall into one of the endangered categories of the IUCN in the European Red List, which represents 6.3% of the species detected in the study area. *Psorodonotus illyricus* is restricted to a few large mountain grasslands (*Nardetum*) in the central part of the Poštak Mt. (parts of the Ljubina poljana and the Poštak peak area), *E. pulvinatus* has been detected only in a single south-facing dry grassland in the southern edge of the Poštak group, while *P. hystrix*, *P. cristatus* and *A. brevipennis* have been found in several sampling sites with open, rocky, submediterranean grasslands throughout the study area. The presence of these endangered taxa, and their locally wide distribution, underlines the high conservation value of the study area. This is especially true for the large grasslands of the Ljubina poljana, which are highly liable to succession, while harbouring altogether 44 orthopteran species, including some rare ones.

A recent overview of the Orthoptera fauna from the Dinara Mt. (Rebrina et al. 2015) provides an opportunity for the faunistic comparison of these two neighbouring mountains. The Dinara is the highest mountain in Croatia (1831 m asl) and its 100 km long north-west–south-east ridge stretches along the Croatian–Bosnian border, east of the town of Knin. The two ranges are divided by the deep valleys of the Butižnica and Una rivers. Although the Dinara mountain chain is much higher and larger than Poštak, species richness here (78 species) proved to be only slightly lower than that of the Dinara Mt. (86 species). Furthermore, the overlap of the already explored Orthoptera fauna of the two mountains is only 62 of 102 species (61%). In the case of two adjoining mountains of similar bedrock and a rather similar range of habitat types, this suggests that most of the differences are merely apparent, since the detailed investigation of both areas has only just started. Several species, which have formerly been found in the Dinara Mt. [e.g. *Acrida ungarica* (Herbst, 1786), *Acheta domestica* (Linnaeus, 1758), *Aiolopus thalassinus* (Fabricius, 1781), *Chorthippus oschei* Helversen, 1986, *Doclostaurus maroccanus* (Thunberg, 1815), *Meconema thalassinum* (De Geer, 1773), *Saga pedo* (Pallas, 1771), *Sepiana sepium* (Yersin, 1854), *Tetrix subulata* (Linnaeus, 1758)], are

common in Southern or South-Eastern Europe. Their apparent absence from our study area is probably caused by the relatively low number of sampling plots, compared to the high habitat diversity of the region. Therefore, it is reasonable to suggest that, with further research, the actual orthopteran species richness in the Poštak Mountain could approach 100.

The surprisingly rich Orthoptera fauna of the Poštak mountain range, recorded in our preliminary survey, shows that even a geographically restricted area with a high variety of natural and semi-natural habitats may harbour high biodiversity and maintain considerable populations of several endangered species. Our results confirm the suggestion, based on the rich butterfly fauna found on the Poštak Mt. (Koren et al. 2015), that the area might be considered a hotspot of insect diversity in Croatia, which underlines the necessity of further research and conservation of its fauna.

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ORCID

Gergely Szövényi  <http://orcid.org/0000-0001-9632-4066>
 Josip Skejo  <http://orcid.org/0000-0002-2554-4499>
 Gellért Puskás  <http://orcid.org/0000-0001-8008-749X>

References

- Bertović S. 1975. Prilog poznavanju odnosa klime i vegetacije u Hrvatskoj, razdoblje 1948–1960. *Acta Biologica*. 7(2):89–216.
- Chobanov DP, Lemonnier-Darcemont M, Darcemont C, Puskás G, Heller KG. 2014. *Tettigonia balcanica*, a new species from the Balkan Peninsula (Orthoptera, Tettigoniidae). *Entomologia*. 2:95–106.
- Cigliano MM, Braun H, Eades DC, Otte D 2018. Orthoptera species file. Version 5.0/5.0. [cited 2018 Mar 26]. Available from: <http://Orthoptera.SpeciesFile.org>.
- Fabriciusová V, Kaňuch P, Krištín A. 2008. Body size patterns of *Pholidoptera frivaldszkyi* (Orthoptera) in very isolated populations. *Journal of Orthoptera Research*. 17(2):171–176.
- Harz K. 1969. The Orthoptera of Europe I. W. The Hague: Junk.
- Harz K. 1975. The Orthoptera of Europe II. W. The Hague: Junk.
- Heller K-G. 1988. Bioakustik der europäischen Laubheuschrecken. Weikersheim: J. Margraf.
- Hochkirch A, Kleukers R, Rutschmann F, Presa JJ, Willemsse LPM, Krištín A, Szövényi G, Chobanov DP 2016a.

- Oedipoda germanica*. The IUCN Red List of Threatened Species 2016: e.T16084601A74507300; [cited 2018 Apr 11]. doi:10.2305/IUCN.UK.2016-3.RLTS.T16084601A74507300.en
- Hochkirch A, Nieto A, García Criado M, Cáliz M, Braud Y, Buzzetti FM, Chobanov D, Odé B, Presa Asensio JJ, Willemsse L, et al. 2016b. European Red List of Grasshoppers, Crickets and Bush-crickets. Luxembourg: Publications Office of the European Union.
- Ingrisch S. 2012. Illustrated key to Orthopterous insects from Durmitor, Montenegro. Fauna Balkana. 1:121–149.
- Ingrisch S, Pavićević D. 2010. Seven new Tettigoniidae (Orthoptera) and a new Blattellidae (Blattodea) from the Durmitor area of Montenegro with notes on previously known taxa. Zootaxa. 2565:1–41.
- Ingrisch S, Pavićević D. 2012. Faunistics, distribution and stridulation of orthopteroid insects of the Durmitor plateau and the surrounding canyons. Fauna Balkana. 1:13–120.
- Kaligarić M, Ivajnić D. 2014. Vanishing landscape of the “classic” Karst: changed landscape identity and projections for the future. Landscape and Urban Planning. 132:148–158.
- Kaňuch P, Dorková M, Mikhailenko AP, Polumordvinov OA, Jarčuška B, Krištín A. 2017. Isolated populations of the bush-cricket *Pholidoptera frivaldszkyi* (Orthoptera, Tettigoniidae) in Russia suggest a disjunct area of the species distribution. Zookeys. 665:85–92.
- Kaňuch P, Jarčuška B, Iorgu EI, Iorgu IŞ, Krištín A. 2014. Geographic variation in relict populations: genetics and phenotype of bush-cricket *Pholidoptera frivaldszkyi* (Orthoptera) in Carpathians. Journal of Insect Conservation. 18:257–266.
- Kaya S, Chobanov DP, Skejo J, Heller KG, Çıplak B. 2015. The Balkan *Psorodonotus* (Orthoptera: Tettigoniidae): testing existing taxa confirmed presence of three distinct species. European Journal of Entomology. 112:525–541.
- Kenyeres Z, Rácz IA, Varga Z. 2009. Endemism hot spots, core areas and disjunctions in European Orthoptera. Acta Zoologica Cracoviensia - Series B: Invertebrata. 52(1–2):189–211.
- Koren T, Črne M, Pavliha G, Trkov D. 2015. Mountain Poštak, a new hotspot for the Lepidoptera of Croatia (Lepidoptera: Rhopalocera). SHILAP Revista de Lepidopterología. 43 (169):145–155.
- Mařan J. 1952. Contribution to the knowledge of the genus *Pholidoptera* Wesm. Acta Entomologica Musei Nationalis Pragae. 28:209–221.
- Massa B, Fontana P, Buzzetti FM, Kleukers R, Odé B. 2012. Orthoptera. Fauna d'Italia. 48. Bologna: Calderini; p. 563.
- Mikhailenko AP, Polumordvinov OA. 2015. Distribution and ecology of the bush-cricket *Pholidoptera frivaldszkyi* (Herman, 1871) (Orthoptera: Tettigoniidae) in European Russia. Caucasian Entomological Bulletin. 11(2):271–278.
- Mikšić S. 1966. Populacija skakavaca (Acridoidea) i zrikavaca (Tettigoniidae) na planinskim pašnjacima Bjelašnice. Glasnik Zemaljskog Muzeja - Prirodne nauke, Nova series. 5:123–162.
- Mikšić S. 1970. Fauna Orthoptera Planina Maglic, Volujak i Zelengora. Glasnik Zemaljskog Muzeja - Prirodne nauke, Nova series. 9:121–134.
- Mikšić S. 1977. Orthoptera planinskog masiva Jahorine. Glasnik Zemaljskog Muzeja - Prirodne nauke, Nova series. 16:141–158.
- Mikšić S. 1978. Neke karakteristike faune Orthoptera planinskog područja zapadne Bosne. Acta Entomologica Jugoslavica. 14:49–57.
- Mikšić S. 1979. Sastav populacija Orthoptera planine Vranice. Zagreb: Drugi Kongres Ekologa Jugoslavije, Association of Ecological Societies of Yugoslavia; p. 1583–1589.
- Mikšić S. 1981. Mitteleuropäische und mediterrane Orthopteren in der Fauna der Herzegowinisches Karstes. Acta Entomologica Jugoslavica. 17:65–70.
- Nagy A. 2006. Preliminary data on the Orthoptera-assemblages of the Žumberak and Samobor Mountains (Northwest Croatia). Articulata. 21:77–84.
- Rebrina F, Skejo J, Tvrtković N. 2015. First results of inventarisation of Blattodea, Mantodea and Orthoptera (Insecta: Polyneoptera) of the Dinara Mountain area. Annales de la Société entomologique de France (N.S.). 51(1):60–69.
- Tvrtković N, Veen P. 2006. The Dinaric Alps. Rare habitats and species. Conservation Project in Croatia. Part A. Zagreb: Hrvatski prirodoslovni Muzej, and Royal Dutch Society for Nature Conservation (KNNV); p. 1–67.