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

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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 (Kenyer 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 (Mikiš 1966, 1970, 1977, 1979; Ingrisch & Pavčević 2012), or, at least, their species are listed (Mikiš 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 (Tvrković & 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

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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 Butičnica 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 watercourses; 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 Szővényi, 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.2013| 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 Rubus 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                         | 390          | 44°8’53”N 16°9’23”E  | 24.VII.2013 | GP, JS, GS |
| 16 | Plavno, Vodro polje, dry grasslands and forest edge                      | 420          | 44°9’48”N 16°9’49”E  | 24.VII.2013 | GP, JS, GS |
| 17 | Plavno, Opaciča brdo hill, rocky grassland patches                        | 760          | 44°10’59”N 16°11’2”E | 24.VII.2013 | GP, JS, GS |
| 18 | Kninisko 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°5’8”E  | 25.VII.2013 | GP, JS, GS |
| 20 | Open Quercus pubescens 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 ultrasonic 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), Ingrisch and Pavičević (2010), Ingrisch (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) [PMSl], in the G. Szővényi 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**

_Acrimetopa servillea macropoda_ (Burmeister, 1838): Komčić: 19 [1♂ HNHM (OrP 1437)]; Malovan: 1; Nadvrelo: 2a; Otrič: 4 [1♂ HNHM (OrP 1371)]; 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: Komčić: 19: Malovan: 1 [3♂ 2♂ 2♀ HNHM (OrP 1348)]; Otrič: 5b [1♂ FRecoll; 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♂ 2♀ SGcoll]; 21; Vunduci: 15. Widely distributed in grasslands, bushy habitats, forest edges and open forests up to the highest peaks.

_Leptophyes bosci_ Fieber, 1853: Malovan: 1; Otrič: 5b [1♂ 1♀ FRecoll; 1♂ 1♀ SGcoll; 1♂ 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]; Otrič: 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: Otrič: 5b [1♂ 1♀ FRecoll; 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): Komčić: 19 [1♂ HNHM (OrP 1438)]; Malovan: 1 [3♂ HNHM (OrP 1354); 8♂ 4♀ SGcoll]; Nadvrelo: 2a [1♂ 1♀ HNHM (OrP 1365)]; Otrič: 3 [2♂ 1♂ HNHM (OrP 1369)]; 5b [1♂ FRecoll; 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], 11 [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 & Pavičević, 2010, and its morphology fits _Poecilimon sp._ (near _elegans_ type “a”), as described in Ingrisch and Pavičević (2010). The calling songs of the Poštak specimens differ considerably both from _P. albolineatus_ and _P. elegans_ songs, as suggested by Ingrisch and Pavičević (2010). A comprehensive revision of this species group in its entire range is in progress.

_Poecilimon ornatus_ (Schmidt, 1850): Otrič: 5b [2♂ 1♀ FRecoll; 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): Otrič: 5a [4 PMSt (00274–75, 01265, 01267)]; 5b [1♂ SGcoll; 1♂ PMSt (00185)], 9, 10, 11, 13 [1♂ HNHM (OrP 1462)].

_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: Otrič: 14; Plavno: 16; Vunduci: 15. Lives in tall grasslands or bushy habitats, and even in gardens and orchards, probably widespread in the area.

_Tylospila lilifolia_ (Fabricius, 1793): Nadvrelo: 2a, 2b; Otrič: 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): Nadvrelo: 2a; Plavno: 16; Vunduci: 15. In dry grasslands or bushy habitats with a Mediterranean influence.

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

_Gampsocleis abbreviata abbreviata_ Herman, 1874: Otrič: 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 of the region.

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

_Pholodoptera aptera_ (Fabricius, 1793): Komčić: 19 [1♂ HNHM (OrP 1433)]; Otrič: 5b [1♂ FRecoll], 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.

_Pholodoptera dalmatica_ (Krauss, 1879): Nadvrelo: 2a [1♂ HNHM (OrP 1361); 1♂ SGcoll]; Otrič: 5b [3♂ 2♀ SGcoll], 6, 7 [1♂ 2♂ HNHM (OrP 1388); 5♂ 1♀ SGcoll], 8 [1♂ 1♀ FRecoll; 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 2010).
Pholidoptera fallax (Fischer, 1853): Komić: 19; Otrić: 5b [1♂ HNHM (OrP 1361)]; 2♂ SGcoll; 7♂ HNHM (OrP 1389); 2♂ SGcoll; 8♂ 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): Nadvrelo: 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 (Mikhaiilenko & Polomudrovin 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 Poštak Mt. delineates the south-westernmost border of the distribution of P. frivaldszkyi, the closest known population being the one from the Sator Mountain, 40 km eastwards in Western Bosnia (Mikić 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 Poštak 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 Poštak 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 griseoaptera (De Geer, 1773): Komić: 19; Malovan: 1; Otrić: 6 [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 litoralis litoralis (Fieber, 1853): Komić: 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): Komić: 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.

Moderana modesta (Fieber, 1853): Komić: 19 [1♂ 1♀ HNHM (OrP 1436)]; Malovan: 1 [1♂ 1♀ HNHM (OrP 1435)]; 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♂ 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): Nadvrelo: 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.

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

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

Platyceles affinis Fieber, 1853: Komić: 19; Nadvrelo: 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.

Platyceles grisea (Fabricius, 1781): Nadvrelo: 2a [1♂ HNHM (OrP 1453)]; Otrić: 4 [1♂ FRcoll], 8 [1♂ FRcoll], 11, 13, 14;
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 [♂ 3 juv. 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; Nadvrelo: 2a, 2b; Otrić: 3 [1 juv. 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 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. *Tessellana tessellata* (Charpentier, 1825): Nadvrelo: 2a, 2b; Otrić: 3 [1♂ HNHM (OrP 1367)]; Plavno: 16 [1♂ 1♀ HNHM (OrP 1425); 1♀ SGcoll; 1 PMSt (01606)]; 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 [♂ 3 juv. 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; Nadvrelo: 2a, 2b; Otrić: 3 [1 juv. 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 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. *Tessellana tessellata* (Charpentier, 1825): Nadvrelo: 2a, 2b; Otrić: 3 [1♂ HNHM (OrP 1367)]; Plavno: 16 [1♂ 1♀ HNHM (OrP 1425); 1♀ SGcoll; 1 PMSt (01606)]; 16 [1♂ 1♀ HNHM (OrP 1425); 1♀ SGcoll; 1 PMSt (01606)]; Vunduci: 15. A common
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; Nadvrelo: 2a; Otrići: 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; 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): Nadvrelo: 2a, 2b. Restricted to humid microhabitats, close to the water.

**Raphidophoridae**

**Raphidophorinae**

*Prionotropis hystrix* (Germar, 1817) Komići: 19; Malovan: 1; Nadvrelo: 2a, 2b; Otrići: 3, 4, 13, 14; Plavno: 16. It 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.

**Pamphagidae**

**Thrinchinae**

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

**Acrididae**

**Calliptaminae**

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

**Prionotropis hystrix** (Germar, 1817) Komići: 19; Nadvrelo: 2a, 2b; Otrići: 3, 4, 13, 14; Plavno: 16, 17, 20. Widespread in the dry grasslands of the study area.

**Paracaloptenus cristatus** (Willemse, 1973): Komići: 19; Nadvrelo: 2a, 2b; Otrići: 3, 4, 13, 14; Plavno: 16, 17, 20. Widespread in the dry grasslands of the study area.

**Gryllidae**

**Gryllinae**

*Gryllus campestris* Linnaeus, 1758: Komići: 5b; Plavno: 15; Vunduci: 15. A grassland inhabiting species, occurring often in extensively cultivated (mowed or grazed) habitats.

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

*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).

*Oecanthus pellucens* (Scopoli, 1763): Momici: 18 (song recording on 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.

**CAELIFERA**

**Tetrigidae**

**Tetriginae**

*Prionotropis hystrix* (Germar, 1817) Komići: 19; Nadvrelo: 2a, 2b. Restricted to humid microhabitats, close to the water.

*Paracaloptenus cristatus* (Willemse, 1973): Komići: 19; Nadvrelo: 2a, 2b; Otrići: 3, 4, 13, 14; Plavno: 16, 17, 20. Widespread in the dry grasslands of the study area.

**Pamphagidae**

**Thrinchinae**

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

**Acrididae**

**Calliptaminae**

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

**Paracaloptenus cristatus** (Willemse, 1973): Komići: 19; Nadvrelo: 2a, 2b; Otrići: 3, 4, 13, 14; Plavno: 16, 17, 20. Widespread in the dry grasslands of the study area.
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): Otrići: 5b [2♂ 1♀ HNHM (OrP 1483)]; 3♂ 1♀ SGcoll; 3♂ 1♀ PMSt (00190)]. 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 [♂ 2♀ HNHM (OrP 1440)]; Malovan: 1 [♂ 3♀ HNHM (OrP 1349)]; Otrići: 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)]; Otrići: 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): Otrići: 5b [1♂ FRcoll; 6♂ 2♀ HNHM (OrP 1382); 13♂ 3♀ SGcoll; 3 juv. PMSt (00187)], 5c [3 PMSt (00932, 00937-38)]. Restricted to mountain meadows in the central part of the Poštak Mt.

**Catantopinae**

*Pezotettix giornae* (Rossi, 1794): Komići: 19; Malovan: 1; Nadvrelo: 2a, 2b; Otrići: 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): Nadvrelo: 2a. Probably common at lower elevations in the study area, but overlooked due to its peculiar phenological character (overwintering adults).

*Mecostethus parapleurus* (Hagenbach, 1822): Otrići: 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): Nadvrelo: 2b; Otrići: 4; Plavno: 17. In dry, open, often rocky habitats in the study area.

*Oedipoda caerulea* (germanica group): Malovan: 1; Nadvrelo: 2a; Otrići: 5b, 13; Plavno: 17 [1♂ SGcoll]. 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 strialus (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): Nadvrelo: 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 steppe grasslands, and probably very rare in the study area. Assessed as Least Concern at European level, but Vulnerable in EU28.

Euthystrra 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): Nadvrelo: 2a [♂ 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 bruneus (Thunberg, 1815): Plavno: 24. In open dry, often degraded habitats, but localized in the study area.

Chorthippus bornhalmi Hara, 1971; Komići: 19; Malovan: 1 [1♂ 1♀ HNHM (OrP 1351)]; Otrić: 5a [8 PMSt (01284, 01286, 01287, 01299, 01301-3, 01307)], 5b [2♂ 2♀ 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): Nadvrelo: 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)]. 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)]. In a few dry grasslands in the study area.

Omocestus petraeus (Brissout de Barneville, 1855): Nadvrelo: 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; Nadvrelo: 2b; Otrić: 5b. Prefers humid grassland microhabitats, occurrence localized in the study area.

Stenobothrus fischeri (Eversmann, 1848): Komići: 19; Nadvrelo: 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)]; Nadvrelo: 2a; Otrić: 4 [1♂ 1♀ HNHM (OrP 1375)], 5b [1♂ 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 (Acrometop a servilea macroproda, Barbistites versini, Leptophasis laticauda, Poecilimon sp./elegans group/, Tylopsis litifolia, Decticus albifrons, Eupholidoptera schmidti, Pholidoptera dalmatica, P. femorata, Modestana modesta, Euphligger discoidalis, Anacridium aegyptium, Prionotropis hystrix, Oedipoda/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, Psoronomus 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 & Ivajnić 2014). Four of these species are globally endangered to different degrees (P. illyricus – Near Threatened, P. hystric – Vulnerable, P. crista tus – 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. hystric, P. crista tus 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 thallasinus (Fabricius, 1781), Chorthippus oscheli Helversen, 1986, Dociostaurus maroccanus (Thunberg, 1815), Mecenoma thallasinum (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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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, Tettigoniiidae). 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 frivaldskyi (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, Willemsen LP, Krištín A, Szővényi 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.2016-3.3RTS.
T16084601A74507300.en

Hochkirch A, Nieto A, Garcia Criado M, Cálix M, Braud Y, Buzzetti FM, Chobanov D, Odé D, Presa Asensio JJ, Willemse 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, Pavičević 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, Pavičević 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, Jaruška B, Krištín A. 2017. Isolated populations of the bush-cricket Pholidoptera frivaldskyi (Orthoptera, Tettigoniidae) in Russia suggest a disjunct area of the species distribution. Zookeys. 665:85–92.

Kaňuch P, Jaruška B, Irgou EI, Irgou IS, Krištín A. 2014. Geographic variation in relict populations: genetics and phenotype of bush-cricket Pholidoptera frivaldskyi (Orthoptera) in Carpathians. Journal of Insect Conservation. 18:257–266.

Kaya S, Chobanov DP, Skejo J, Heller KG, Çiplak 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, Crne M, Pavliha G, Trkov D. 2015. Mountain Poštak, a new hotspot for the Lepidoptera of Croatia (Lepidoptera: Rhopalocera). SHILAP Revista de Lepidopterologia. 43 (169):145–155.

Mačan 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 frivaldskyi (Herman, 1871) (Orthoptera: Tettigoniidae) in European Russia. Caucasian Entomological Bulletin. 11(2):271–278.

Mikšić S. 1966. Populacija skakavaca (Acridoidea) i zrikavaca (Tettigoniioidea) 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 pružača 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 Jugoslavia; p. 1583–1589.

Mikšić S. 1981. Mitteleuropäische und mediterrane Orthopteren in der Fauna der Herzegowinischen 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, Tvtrković N. 2015. First results of inventory 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.

Tvtrković 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.