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FIRST OVERVIEW OF ORTHOPTERA AND MANTODEA OF THE SNIJEŽNICA KONAVOSKA MOUNTAIN

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During a study conducted in 2018 on Mt Sniježnica,the faunistically understudied southernmost karst mountain in Croatia, altogether 42 orthopteran and three mantid species were recorded at 18 localities at different altitudes. Two *Poecilimon* taxa new to Croatian fauna were found, one of them an undescribed species from the *elegans* group. Three bush-cricket species, namely *Leptophyes intermedia, Platycleis albopunctata grisea* and *Pholidoptera fallax*, were recorded for the first time in the Dubrovnik region. A curious variability of male cerci length, shape and position was observed within the *Pachytrachis gracilis* populations in the study area. The presence of several orthopteran species of importance for nature conservation was confirmed on Mt Sniježnica.

Key words: bush-crickets, *Poecilimon*, *Pachytrachis*, grasshoppers, mantids, Eastern Adriatic coast

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Tijekom istraživanja provedenog 2018. godine na Sniježnici, faunistički slabo istraženoj najjužnijoj krškoj planini u Hrvatskoj, na 18 lokaliteta na različitim nadmorskim visinama zabilježene su ukupno 42 vrste ravnokrilaca i tri vrste bogomoljki. Pronađene su dvije svojte roda *Poecilimon* nove za Hrvatsku, a jedna je od njih još neopisana vrsta iz *elegans* grupe. Tri vrste konjica, *Leptophyes intermedia*, *Platycleis albopunctata grisea* i *Pholidoptera fallax*, zabilježene su po prvi put na području Dubrovnika. U populacijama vrste *Pachytrachis gracilis* u istraživanom području primijećena je neobična varijabilnost dužine, oblika i položaja začanih nastavaka mužjaka. Potvrđena je prisutnost nekoliko vrsta ravnokrilaca od važnosti za propisivanje mjera očuvanja prirode na planini Sniježnici.

Ključne riječi: konjici, *Poecilimon*, *Pachytrachis*, skakavci, bogomoljke, istočna jadranska obala

INTRODUCTION

Sniježnica Konavoska Mountain, with the highest peak Sv. Ilija [St Elias], 1234 m a.s.l., is the southernmost Croatian karst mountain. The first faunistic research of the terrestrial fauna on the mountain started relatively late, in September 1984 (Croatian Natural History Museum, Branko Jalžić and N. Tvrtković) with the finding of a relict vole *Dinaromys bogdanovi* and an endangered snake *Elaphe quatuorlineata*. Italian orthopterist Filippo Maria Buzzetti was the first to note 20 grasshopper and bush-cricket species from Kuna Konavoska village and along the trail to Sv. Ilija in 2005 (Buzzetti, 2006); however, he published only the data for *Arcyptera brevipennis brevipennis*, *Prionotropis hystrix hystrix*, *Barbitistes yersini*, *Saga pedo* and *Pachytrachis bosniacus*. After a review of important faunistic data (Tvrtković & Veen, 2006), Mt Sniježnica and Konavosko polje (karst field)

were included in the Croatian Ecological Network in 2007 by the State Institute of Nature Protection (www.min.kulture/priroda/prilog1.2.novo/pdf), and were recently marked under the number HR2000964 (www.bioportal.hr). The snakes *Elaphe quatuorlineata* and *Zamenis situla*, and the relict vole *Dinaromys bogdanovi,* are the only terrestrial species from Mt Sniježnica included in the list of species important for protection. When it comes to orthopterans, Karaman *et al*. (2011) identified *Troglophilus cavicola* collected in 1995 by Marijana Franičević in Špilja Jezero cave and in 2006 by Roman Ozimec in Glogova jama pit (both situated on the slopes of Mt Sniježnica), as well as *T. ovuliformis* collected by Roman Ozimec in Špilja Jezero cave in 2002. After an examination of the Buzzetti Collection in Arzignano, Italy, J. Skejo and F. Rebrina redetermined a *Pachytrachis* specimen (previously identified as *P. bosniacus*) from Kuna Konavoska as *P. gracilis* (Skejo *et al*., 2018), a continental species never found this close to the Adriatic coast before.

The present orthopterological survey in the vicinity of Dubrovnik, undertaken by the authors in 2018 with a particular focus on Sniježnica Konavoska Mt., was encouraged by several factors. Firstly, the faunistic knowledge of orthopteran insects in the south-easternmost part of Croatia is generally insufficient. More specifically, an old note existed about the finding of a specimen belonging to *Poecilimon elegans* Brunner von Wattenwyl, 1878 group in the Lovćen pass in Montenegro, with more than 70 smaller teeth in the apical part of the stridulatory file, differing from typical *P. elegans* specimens from Slovenia (Heller, 1988). Later, Ingrisch & Pavićević (2010) discussed the existence of a probably new taxon with more than 100 stridulatory teeth from Montenegro (Lovćen pass) and from Mt Orjen, SE Grab, 1000 m a.s.l., in Bosnia and Hercegovina. Skejo *et al.* (2018) presumed the presence of *P. albolineatus* from Montenegro and Bosnia and Hercegovina or another undescribed species (close to *P. albolineatus*) in the Dubrovnik region.

Accordingly, the main aims of the current study were: 1) to gain knowledge of the Orthoptera and Mantodea inhabiting Mt Sniježnica, both by reviewing the published data and performing a systematic orthopterological survey of the mountain, focusing on rare and/or previously unrecorded species; 2) to conduct preliminary research into the vertical distribution of Orthoptera and Mantodea on Mt Sniježnica.

MATERIAL AND METHODS

Study area

Mt Sniježnica is situated north of Konavosko polje, between the pass to Stravča/Duba Konavoska and the Jablan Dol pass between Dubravka and Grab in Bosnia and Herzegovina. It is very close to the border with Montenegro, which is situated to the east (Fig. 1). The Zubci fault (geological fault, Marković, 1971) stretches linearly in the N - S direction (Grab – Jablan Dol pass – Dubravka – Molunat peninsula), separating Mt Sniježnica Konavoska from the western slopes of Bjelotina ridge, the westernmost part of the large Orjen Mountain (1894 m a.s.l.) massif (https://en.wikipedia.org/wiki/Orjen). The entire region has a Mediterranean climate but the Mt Orjen massif has abundant precipitation, with an annual average of

about 5000 l per m². In the winter, the higher part of Sniježnica is often covered with snow (= *snijeg* in Croatian). The southern coast-oriented slopes and the central part of Mt Sniježnica Konavoska are located in Croatia, whereas the lower part of the northern slopes, in the direction of Popovo polje, is in Bosnia and Herzegovina. According to Marković (1971), the bedrock of the lower part of the southern slopes consists of Palaeogene formations, mostly flysch, sandstones and breccia. Above the flysch there is a layer of Triassic dolomite, while the bedrock in the higher portions of the southern slopes, from Kuna Konavoska to Sv. Ilija peak, is of Jurassic limestones. It forms a geomorphologically heterogeneous high karst plateau with sinkholes, hollows, pits, caves and several isolated peaks. The outback of Sv. Ilija peak area consists of Cretaceous limestones.

Vukelić (2012) designated all forests in the south-eastern part of Croatia as Mediterranean deciduous forests and thickets with pubescent oak (Ordo *Quercetalia pubescentis* Klika 1933). In lower, warmer altitudes below 700 m a.s.l., sub-Mediterranean forests of the pubescent oak and Oriental hornbeam (*Querco pubescentis – Carpinetum orientalis* Horvatić 1939) grow on Mt Sniježnica, but on the higher, colder slopes above 700 (– 1000) m a.s.l. and throughout the northern slopes, sub-Mediterranean montane forests of pubescent oak and hop hornbeam with yellow birthwort (*Aristolochio luteae – Quercerum pubescentis* (Horvat 1959) Poldini 2008) are found. Grasslands on deeper soils are rare, occurring only in

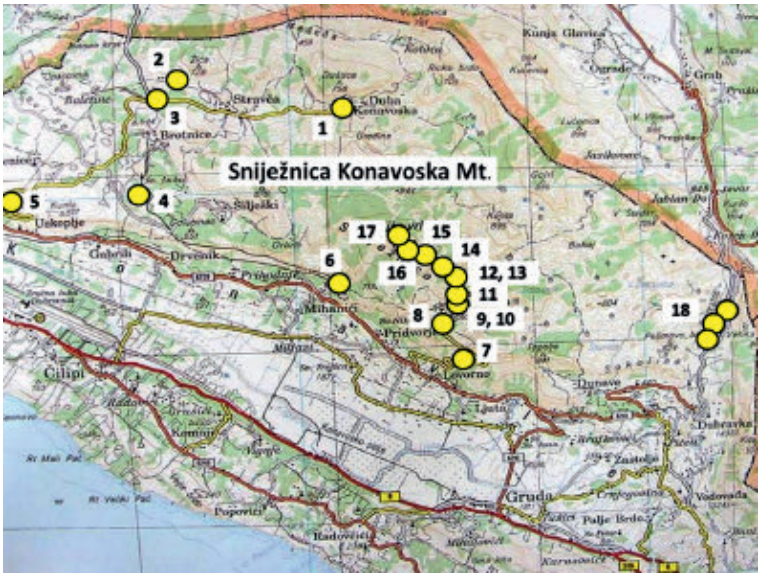

Fig. 1. Examined localities on Mt Sniježnica Konavoska, south of Dubrovnik City (Croatia): (1) Duba Konavoska, (2) Njivice, (3) fork Stravča - Njivice, (4) Sv. Luka, (5) Pass Konavle – Duba Konavoska, (6) Mihanići, tunel, (7) below pass to Kuna Konavoska, (8) Kuna Konavoska, before village, (9) Kuna Konavoska, start point to mountain trail, (10) trail Kuna Konavoska – Kupljenik, (11) Kupljenik, (12) trail Kupljenik – Ljeskovac, (13) Ljeskovac, (14) trail Ljeskovac – fork to Glogovac, (15) Glogovac, (16) trail fork to Glogovac – Sv. Ilija, (17) Sv. Ilija peak, (18) Prapratno transect.

small karst depressions (sinkholes and hollows) like Kupljenik, Ljeskovac and Glogovac (Fig 1). However, on steep southern slopes, e.g. between Ljeskovac and Sv. Ilija peak, dry rocky pastures with bushes are common, today mostly in different successional stages due to the decline in the number of cattle, goats and sheep in villages (information obtained from local villagers). Around Sv. Ilija peak, there is a relatively small area of epi-Mediterranean dry rocky grassland.

Sampling localities

The study area was visited by the authors on two occasions in 2018, in July (21., 23.07.) and August (18., 20., 21.08.), during which most of the localities were investigated (Tab. 1). Caves and an abandoned tunnel were visited early in 2018 (16.05.) and again in 2019 (14.4.) by the second author and biospeleologist Branko Jalžić; however these visits were focused primarily on underground sites, which were investigated for cave crickets. In total, 18 localities at different altitudes on Mt Sniježnica were visited (Fig. 1, Tab. 1).

Tab. 1. Localities investigated during the study of Orthoptera and Mantodea of Mt Sniježnica (Croatia) in 2018 and 2019, with corresponding altitudes, geographic coordinates and visiting dates.

No.	Locality	Altitude (m a.s.l.)	N	E	Date
1	Duba Konavoska	458	42°35′56,00′′	18°19′6,79′′	18.08.2018
2	Njivice: Jametina u dolinicah	470	42°36′22,67′′	18°18′3,68′′	14.04.2019
3	Fork Stravča – Njivice	490	42°36′10,72′′	18°17′48,77′	18.08.2018
4	Sv. Luka	450	42°35′0,52′′	18°17′28,16′′	21.08.2018
5	Pass to Duba Konavoska	500	42°35′2,97′′	18°15′31,40′′	18.08.2018
6	Mihanići (near the tunnel)	330	42°33′43,04′′	18°20′25,1′′	16.05.2018
7	Pridvorje - Kuna Konavoska	570	42°33′53,66′′	18°22′10,83′′	28.06.2006
8	Kuna Konavoska, below the village	670	42°33′21,64′′	18°21′48,61′′	21.07.2018 21.08.2018
9	Kuna Konavoska, starting point of the trail to Sv. Ilija peak	700	42°33′35,61′′	18°21′43,19′′	21.07.2018
10	Trail Kuna Konavoska – Kupljenik	710 -800			21.07.2018 20.08.2018
11	Kupljenik	800	42°33′48,81′′	18°21′33,21′′	21.07.2018
12	Trail Kupljenik – Ljeskovac	800 - 930			21.07.2018 20.08.2018
13	Ljeskovac	940	42°34′0,96′′	18°21′39,53′′	21.07.2018 20.08.2018
14	Trail Ljeskovac – fork to Glogovac	940 - 1040			21.07.2018 20.08.2018
15	Glogovac	990 -1000	42°34′5,04′′	18°21′41,30′′	20.08.2018
16	Trail fork to Glogovac – Sv. Ilija peak	1040 - 1180			21.07.2018 20.08.2018
17	Sv. Ilija peak	1230	42°34′26,39′′	18°21′6,26′′	21.07.2018 20.08.2018
18	Prapratno valley transect (start and end point noted)	550	42°32′55,5′′ 42°33′29,08′′	18°25′36,32′ 18°25′57,42′′	23.07.2018 19.08.2018

Methods

Animals were observed visually and/or auditively and collected by hand or sampled using a sweep net. Most species were identified in the field, but a male and a female voucher specimen of all species except for the most common ones were preserved in 75% ethanol. When a species of particular taxonomic interest (e.g. *Poecilimon* sp. from the *elegans* group) or unusual morphology (e.g. *Pachytrachis gracilis*) was concerned, a larger series was collected and preserved in 75% ethanol for further morphological analyses, and/or in 96% ethanol for molecular analyses. Material was deposited in the N. Tvrtković and F. Rebrina private collections in Zagreb. Orthoptera were identified using Harz (1969, 1975), Massa *et al.* (2012), Chobanov & Heller (2010), Ingrisch & Pavićević (2010) and Willemse *et al*. (2018), whereas Mantodea were identified using Harz & Kaltenbach (1976) and Battiston *et al*. (2010). Skejo *et al*. (2018) and Mantodea Species File Online (Otte *et al*., 2019) were used as references for relevant nomenclature.

RESULTS

Altogether 45 species of Orthoptera and Mantodea were found in the study area:

Orthoptera

Ensifera

Tettigoniidae

1. *Ephippiger discoidalis* Fieber,1853, crvenoglava sedlarka

Material examined: **Prapratno**, 550 m a.s.l., 1♂, 24.07.2018, leg. NT; **Kuna Konavoska**, 670 m a.s.l., photo Dubravko Dender; **Mihanići**, 330 m a.s.l., 1 nymph ♀, 16.05.2018, basking on the trail table near the tunnel, photo & leg. NT; near the road **Pridvorje – Kuna Konavoska**, 570 m, 1 nymph, 06.2006, photo NT;

2. *Cyrtaspis scutata* (Charpentier,1825), beskrilni staklasti konjic

Material examined: **Prapratno**, 550 m a.s.l., 1 subad. ♂, 23.07.2018, leg. NT; 2 ad. ♂♂ + 2 ad. ♀ ♀, 19.08.2018, leg. NT; trail **Ljeskovac** – fork to **Glogovac**, 1010 m a.s.l., 20.08.2018, leg. FR; **Glogovac**, 1000 m a.s.l., 20.08.2018, leg. & photo FR; Observed specimens: **Sv. Luka**, 450 m a.s.l., obs. FR;

3. *Acrometopa servillea macropoda* (Burmeister,1838), dugonogi listokrili konjic

Observed specimens: **Kuna Konavoska,** 700 m a.s.l., obs. FR; **Kupljenik,** 800 m a.s.l., **Ljeskovac,** 940 m a.s.l., obs. FR; **Prapratno,** 550 m a.s.l., obs. NT & FR;

4. *Barbitistes ocskayi* Charpentier in Ocskay et al., 1850, Ocskayjev ljuskokrili konjic

Material examined: **Prapratno**, 550 m a.s.l., 1♀, 23.07.2018, leg. FR;

5. *Barbitistes yersini* Brunner von Wattenwyl, 1878, Yersinov ljuskokrili konjic

Material examined: trail **Ljeskovac –** fork to **Glogovac**, 970 m a.s.l., 1♂, 21.07.2018, leg. FR; **Prapratn**o, 550 m a.s.l., 1♀, 23.07.2018, leg. NT;

Observed specimens: **Kuna Konavoska,** 700 m a.s.l., obs. FR;

6. *Leptophyes intermedia* Ingrisch & Pavićević, 2010, dinarski ljuskokrili konjic
Material examined: **Ljeskovac –** fork to **Glogovac**, 1020 m a.s.l., 1♂, 21.07.2018, leg. FR; **Sv. Ilija peak**, 1230 m a.s.l., 1♀, leg. FR;

7. *Leptophyes laticauda* (Frivaldszky,1868), riđonogi ljuskokrili konjic
Material examined: **Prapratno,** 550 m a.s.l., 1♂, 23.07.2018, leg. FR; **Ljeskovac** – fork to **Glogovac,** 960 m a.s.l., 23.07.2018, 1♂, leg. FR; 1010 m a.s.l., 20.08.2018, 1♀, listening to male calling song from bushes and leg. FR;

8. *Poecilimon* sp. (undescribed species from *elegans* group), ljuskokrili konjic
Material examined: **Ljeskovac** – fork to **Glogovac**, 1050 m a.s.l., 1♀, 21.07.2018, leg. FR; fork to **Glogovac – Sv. Ilija**, 1200 m a.s.l., 2♀ ♀, 21.07.2018, leg. FR; **Sv. Ilija**, 1230 m, 1♂+1♀, 20.08.2018, leg. FR;

9. *Poecilimon* sp. (from *ornatus* group), ljuskokrili konjic
Material examined: **Prapratno**, 550 m a.s.l., 1♂, 23.07.2018, leg. NT;

10. *Tylopsis lilifolia* (Fabricius,1793), primorski listokrili konjic
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., **W Stravča**, 500 m a.s.l., **Prapratno**, 550 m a.s.l., **Kuna Konavoska**, 700 m a.s.l., **Kupljenik,** 800 m a.s.l., **Ljeskovac**, 940 m a.s.l., **Glogovac**, 1000 m a.s.l., 20.08.2018, all obs. FR & NT;

11. *Saga pedo* (Pallas, 1771), konjic vrač
Observed specimens: **Sv. Ilija**, 1230 m a.s.l., 1♀, 20.08.2018, photo FR; in June 2006, 1 nymph photo NT in **Kuna Konavoska**, 700 m a.s.l. (Buzzetti 2006);

12. *Decticus albifrons* (Fabricius, 1775), veliki primorski konjic
Observed specimens: **Sv Luka,** 450 m a.s.l., **Prapratno,** 550 m a.s.l., **Kuna Konavoska,** 670 m a.s.l., all obs. FR & NT;

13. *Modestana modesta* (Fieber, 1853), skromni livadni konjic
Material examined: **Prapratno**, 550 m a.s.l., 1♂ + 1♀, 23.07.2018; **Ljeskovac**, 940 m a.s.l., 2 ♀ ♀, 21.07.2018; **Sv. Ilija peak**, 1230 m a.s.l., 21.07.2018;
Observed specimens: **W Stravča,** 500 m a.sl., **Sv. Luka,** 450 m a.s.l., **Glogovac**, 1000 m a.s.l, all obs. FR & NT;

14. *Pachytrachis frater* (Brunner von Wattenwyl, 1882), južni skroviti konjic
Material examined: **Prapratno**, 550 m a.s.l., 1♂ 23.07.2018, leg. FR; **Kuna Konavoska**, 670 m a.s.l., 1♀, 21.07.2018, leg. FR; trail **Kuna Konavoska – Kupljenik – Ljeskovac,** 750 – 850 m a.s.l., 2♂♂ + 1♀, 21.07.2018, leg. FR; trail **Ljeskovac –** fork to **Glogovac**, 950 m a.s.l., 1♂, 21.07.2018, leg. FR;

15. *Pachytrachis gracilis* (Brunner von Wattenwyl, 1861), sjeverni skroviti konjic
Reported as *Pachytrachis bosniacus* (Buzzetti, 2006: Kuna)

Material examined: **Prapratno**, 550 m a.s.l., 5♂♂ 23.07.2018, leg. FR & NT; 1♂ 19.08.2018, leg. FR; **Kuna Konavoska**, 670 m a.s.l., 1♂, 21.07.2018, leg. FR; 9♂♂ + 2♀♀**,** 21.08.2018, leg. FR & NT;

16. *Pachytrachis striolatus* (Fieber,1853), primorski skroviti konjic
Material examined: **Ljeskovac**, 900 m a.s.l., 1♂, 21.07.2018, leg. FR; **Sv. Ilija peak**, 1230 m a.s.l., 2♂♂, 21.07.2018, leg. FR;
Observed specimens: **Prapratno**, 550 m a.s.l., nymphs + ad., 19.08.2018, obs. FR; **Ljeskovac – Glogovac**, 950 – 1040 m a.s.l., nymphs + ad. 21.07.2018, obs. FR; **Glogovac – Sv. Ilija**, 1040 – 1230 m a.s.l., nymphs + ad., 21.07.2018, obs. FR;

17. *Eupholidoptera schmidti* (Fieber,1861), crno-zeleni kožokrili konjic
Material examined: **Prapratno**, 550 m a.s.l., 23.07.2018, 2 ♂♂, leg. NT; recorded in Kuna Konavoska by Buzzetti;

18. *Pholidoptera dalmatica* (Krauss, 1879), dinarski kožokrili konjic
Material examined: **Mihanići**, near the tunnel, 330 m a.s.l., 1 nymph, 16.05.2018, leg. NT; **Prapratno**, 550 m a.s.l., 3 ♂♂ + 1♀**,** 23.07.2018**;** 2 ♂♂, 19.08.2018; **Ljeskovac,** 940 m a.s.l., 1♀, 21.07.2018; **Sv. Ilija peak**, 1230 m a.s.l., 1♂ + 2♀♀, 21.07.2018; all leg. FR & NT;

19. *Pholidoptera fallax* (Fischer, 1854), bjelorubi kožokrili konjic
Material examined: **Kuna Konavoska**, 670 m a.s.l., 1♂, leg. FR; **Prapratno**, 550 m a.s.l., 3 ♂♂, 23.07.2018, leg. FR & NT**; Prapratno**, 550 m a.s.l., 1♀**,** 19.08.2018, leg. FR;
Observed specimens: **Sv. Ilija peak**, 1230 m a.s.l., obs. FR;

20. *Platycleis albopunctata grisea* (Fabricius, 1781), bezgrbi šikarski konjic
Material examined: **Glogovac**, 1000 m a.s.l., 1 ♂, 20.08.2018, leg. FR; **Sv. Ilija peak**, 1230 m a.s.l., 1♀, 21.07.2018, leg. FR;

21. *Platycleis affinis* Fieber, 1853, jednogrbi šikarski konjic
Material examined: **Ljeskovac**, 940 m a.s.l., 1♂ + 1♀**,** 21.07.2018, leg. FR; Observed specimens: **Sv. Luka**, 450 m a.s.l., obs. FR; **Prapratno**, 550 m a.s.l., obs. FR;

22. *Rhacocleis germanica* (Herrich-Schäffer, 1840), konjic grmušar
Material examined: **Prapratno**, 550 m a.s.l., 2 ♂♂, 23.07.2018 and 19.08.2018, leg. FR & NT; Observed specimens: **Kuna Konavoska**, 670 m a.s.l., obs. FR & NT; **Sv. Ilija peak**, 1230 m a.s.l., obs. FR & NT;

23. *Sepiana sepium* (Yersin, 1854), riđoglavi konjic
Material examined: **Prapratno**, 550 m a.s.l., 1 ♂, 23.07.2018, leg. NT; Observed specimens: **Sv. Luka**, obs. FR & NT; **Kuna Konavoska**, obs. 670 m.a.s.l., obs. FR & NT; **Ljeskovac**, obs. FR & NT; **Glogovac**, obs. FR & NT;

24. *Tettigonia viridissima* (Linnaeus, 1758), veliki zeleni konjic
Observed specimens: **Sv. Luka**, 450 m a.s.l., obs. FR & NT; **Prapratno**, 550 m a.s.l., obs. NT; **Kuna Konavoska**, 700 m a.s.l., obs. FR & NT;

25. *Yersinella raymondii* (Yersin, 1860), krhka jersinela
Observed specimens: **Prapratno**, 550 m a.s.l., obs. FR;

Rhaphidophoridae
26. *Dolichopoda araneiformis* (Germar in Burmeister,1838), paukoliki spiljski konjic
Material examined: **Njivice: Jametina u dolinicah**, 470 m a.s.l., 14.03.2019, a juv. specimen leg. Branko Jalžić;
Observed specimens: **Mihanići (tunnel)**, 330 m a.s.l., several ad. + subad. specimens 16.05.2018, obs. NT under the bat colony of *Myotis myotis/oxygnathus* and *Rhinolophus ferrumequinum*;

**Troglophilus cavicola* (Kollar, 1833), obični spiljski konjic
Karaman *et al*., 2011: **Špilja Jezero** cave, entrance at 880 m a.s.l. (N slopes of Mt Sniježnica), 1 nymph ♂, 30.07.1995, leg. M. Franičević; **Glogova jama** pit, entrance at 1000 m a.s.l., 1 nymph ♀, 28.06.2000, leg. R. Ozimec;

**Troglophilus ovuliformis* Karny,1907, primorski spiljski konjic
Karaman *et al*., 2011: **Špilja Jezero** cave, entrance at 880 m a.s.l. (N slopes of Mt Sniježnica), 4 nymphs ♂♂, 16.03.2002, leg. R. Ozimec;

Mogoplistidae
27. *Arachnocephalus vestitus* Costa,1855, ljuskavi šturak grmušar
Observed specimens: **Sv. Luka**, 450 m a.s.l., 21.08.2018, obs. FR;

Gryllidae
28. *Melanogryllus desertus* (Pallas, 1771), tamni šturak
Observed specimens: **Prapratno**, 550 m a.s.l., listening to male calling song from underneath the *Rubus* sp. bushes, obs. NT & FR; identification FR;

29. *Gryllomorpha dalmatina* (Ocskay, 1833), primorska šturkolika
Observed specimens: **Ljeskovac**, 940 m a.s.l., obs. and photo FR;

30. *Oecanthus pellucens* (Scopoli, 1763), vinogradski prozirni šturak
Observed specimens: **W Stravča**, 500 m a.s.l.,18.08.2018, obs. NT & FR; **Sv. Luka**, 450 m a.s.l., 21.08.2018, obs. NT & FR; **Prapratno**, 550 m a.s.l., obs. FR & NT;

Caelifera

Acrididae
31. *Calliptamus italicus* (Linnaeus, 1758), talijanski krupnozadi skakavac
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., 18.08.2018, **W Stravča**, 500 m a.s.l., 18.08.2019, **Sv. Luka**, 450 m a.s.l., 21.08.2018, **Prapratno**, 550 m a.sl., **Kuna Konavoska**, 700 m a.s.l., all obs. FR & NT;

32. *Pezotettix giornae* (Rossi, 1794), mali smeđi skakavac

Observed specimens: **Sv. Luka**, 450 m a.sl., 21.08.2018, **Prapratno**, 550 m a.s.l., **Kuna Konavoska**, **Ljeskovac**, 940 m a.s.l., trail **Ljeskovac –** fork to **Glogovac**, 940 – 1040 m a.s.l., **Glogovac**, 1000 m a.s.l., trail fork to **Glogovac – Sv, Ilija**, 1040 – 1200 m a.sl., **Sv. Ilija peak**, 1230 m a.s.l., all obs. FR & NT;

33. *Anacridium aegyptium* (Linnaeus, 1764), egipatska šaška

Observed specimens: **Prapratno**, 550 m a.s.l., obs. FR & NT;

34. *Arcyptera brevipennis brevipennis* (Brunner von Wattenwyl, 1861), dinarski žarki skakavac

Buzzetti (2006) was the first to note this taxon for Mt Sniježnica

Observed specimens: **Prapratno**, 550 m a.s.l., trail before **Ljeskovac**, 930 m a.s.l., trail **Ljeskovac –** fork to **Glogovac – Sv. Ilija**, 1000 – 1150 a.s.l., **Sv. Ilija peak**, 1230 m a.s.l., all obs. FR & NT;

**Chorthippus bornhalmi* Harz, 1971, primorski livadni skakavac

Observed specimens: trail **Kuna Konavoska – Sv. Ilija**, 700 – 1230 m a.s.l., July 2005 leg. M. Buzzetti, in field notes as *C. brunneus* (Buzzetti in litt., 2006);

35. *Chorthippus mollis lesinensis* (Krauss, 1888), glavati livadni skakavac

Material examined: **Pass to Duba Konavoska**, 490 m a.s.l., 3 ♂♂, 18.08.2018, leg. FR; **Sv. Luka**, 1 ♂, 21.08.2018, leg. FR; trail **Kupljenik – Ljeskovac**, 850 m a.s.l., 1 ♂, 21.07.2018, leg. FR; 1♂, 20.08.2018, leg. FR; trail **Ljeskovac –** fork to **Glogovac**, 1000 m a.s.l., 2♂♂, 21.07.2018, leg. FR; 1 ♂, 20.08.2018, leg. FR; trail fork to **Glogovac – Sv. Ilija**, 1100 m a.s.l., 3♂♂, 21.07.2018, leg. FR; 2♂♂ + 2♀♀, 20.08.2018, leg. FR; **Sv. Ilija peak**, 1230 m a.s.l., 2♂♂, 21.07.2018, leg. FR, 2♂♂, 20.08.2018, leg. FR;

Observed specimens: **Prapratno,** 550 m a.s.l., obs. FR;

36. *Omocestus rufipes* (Zetterstedt, 1821), crvenozadi travnjački skakavac

Material examined: **Mihanići (near the tunnel)**, 330 m a.s.l., 16.05.2018, leg. NT;

Observed specimens: **Duba Konavoska,** 700 m a.s.l., **Sv. Luka**, 450 m a.s.l., **Glogovac**, 1000 m a.s.l., all obs. FR & NT;

37. *Pseudochorthippus parallelus* (Zetterstedt, 1821), obični livadni skakavac

Material examined: **Prapratno**, 550 m a.s.l., 1♂ + 1♀**,** 23.07.2018, leg. NT & FR; 1♂ + 1♀**,** 14.08.2018, leg. NT & FR; **Ljeskovac**, 940 m a.s.l., 3 ♂♂, 21.07.2018, leg. FR; **Sv. Ilija peak**, 1230 m a.s.l.,1 ♂, 21.07.2018, leg. FR; 1 ♂, 20.08.2018, leg. FR;

Observed specimens: fork to **Glogovac – Sv. Ilija**, 1040 - 1200 m a.s.l., obs. FR;

38. *Stenobothrus fischeri* (Eversmann, 1848), bjeloglavi tamnokrili skakavac

Material examined: **Ljeskovac –** fork to **Glogovac**, 1000 m a.s.l., 3 ♂♂, 21.07.2018, leg. FR; **Sv. Ilija peak**, 1200 m a.s.l., 1?, 21.07.2018, leg. FR; 1230 m a.s.l., 1 ♂, 20.08.2018, leg. FR;

Observed specimens: **Kupljenik,** 800 m a.s.l.; **Ljeskovac**, 940 m a.s.l.; fork to **Glogovac – Sv. Ilija**, 1100 m a.s.l., all obs. FR;

39. *Aiolopus strepens* (Latreille, 1804), debelonogi pjegavi skakavac
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., **Sv. Luka**, 450 m a.s.l., **Duba Konavoska**, 458 m a.s.l., all obs. FR & NT;

40. *Oedipoda caerulescens* (Linnaeus,1758), plavokrili kamenjarski skakavac
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., obs. FR & NT;

41. *Oedipoda meridionalis* Ramme, 1913, crvenokrili kamenjarski skakavac
Material examined: **Pass to Duba Konavoska**, 490 m a.s.l., 18.08.2018, leg. NT & FR; trail **Kuna Konavoska – Kupljenik**, 700 m a.s.l.; trail **Kupljenik – Ljeskovac**, 880 m a.s.l., leg. FR & NT;
Observed specimens: **Kuna Konavoska** 670 m a.s.l., **Kupljenik**, 800 m a.s.l., **Ljeskovac** - fork to **Glogovac**, 1040 m a.s.l., all obs. FR & NT;

Pamphagidae
42. *Prionotropis hystrix* (Germar 1817), krški žaboliki skakavac
Buzzetti (2006) was the first to note this taxon for Mt Sniježnica
Observed specimens: trail before **Ljeskovac** and **Ljeskovac**, 920 – 940 m a.s.l., obs. FR & NT;

Mantodea
Mantidae
1. *Ameles heldreichi* Brunner von Wattenwyl, 1882, istočna patuljasta bogomoljka
Material examined: **Pass to Duba Konavoska**, 490 m a.s.l., 18.08.2018, leg. FR; **Sv. Ilija**, 1230 m a.s.l., 18.08.2018, leg. FR;
Observed specimens: **W Stravča**, 500 m a.s.l., **Duba Konavoska**, 458 m a.s.l., **Sv. Luka**, 450 m a.s.l., **Prapratno**, 550 m a.s.l., all obs. FR;

2. *Mantis religiosa* (Linnaeus, 1758), obična bogomoljka
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., 18.060.2018; **Duba Konavoska**, 458 m a.s.l., 18.08.2018; **Sv. Luka**, 450 m a.s.l., 21.08.2018, obs. NT & FR; **Prapratno**, 550 m, **Ljeskovac**, 940 m a.s.l., **Ljeskovac** – fork to **Glogovac**, 950 – 1050 m a.s.l., fork to **Glogovac – Sv. Ilija**, 1050 – 1200 m.s.l., **Sv. Ilija peak**, 1230 m a.s.l., all obs. FR & NT;

Empusidae
3. *Empusa fasciata* (Brullé, 1832), krunasta bogomoljka
Observed specimens: **Pass to Duba Konavoska**, 490 m a.s.l., nymph 18.08.2018, photo FR; near the road **Pridvorje – Kuna Konavoska**, 570 m a.s.l., ad. ♀**,** June 2006, photo NT; **NW Mihanići**, 330 m a.s.l., obs. Dubravko Dender;

Of the 45 species observed on the southern slopes of Mt Sniježnica Konavoska, in total, on the foothills below 700 m a.s.l. we recorded 38 species. The following species occurred only in this, the most thermophilous belt: *Ephippiger discoidalis, Barbitistes ocskayi, Decticus albifrons, Eupholidoptera schmidti, Yersinella raymondi, Dolichopoda araneiformis, Arachnocephalus vestitus, Modicogryllus desertus, Oecanthus pellucens, Calliptamus italicus, Anacridium aegyptium, Aiolopus strepens, Oedipoda caerulescens, Empusa fasciata*. The findings of two continental species, *Pachytrachis gracilis* and *Pholidoptera fallax,* as well as the unexpected finding of *Poecilimon* sp. from the *ornatus* group, were restricted to a relatively narrow belt between 500 and 700 m a.s.l., i.e. Kuna Konavoska plateau with sinkholes and the narrow Prapratno valley before the pass.

On mostly steep, coast–oriented slopes between 700 and 1000 m a.s.l., we noted 22 species in all. Within this belt there was the uppermost limit of the distribution of several Mediterranean species: *Cyrtaspis scutata, Acrometopa servillea macropoda, Barbitistes yersini, Leptophyes laticauda, Tylopsis lilifolia, Pachytrachis frater, Platycleis affinis*, *Sepiana sepium* and *Gryllomorpha dalmatina.* Heretofore, *Prionotropis hystrix* was found only in this belt at 950 m a.s.l. near Ljeskovac, but the mountain trail crosses hot and dry eastern-submediterranean rocky grassland in the early stages of succession, a habitat typical for this species, only at this locality. Accordingly, much wider distribution of this species is expected on Mt Sniježnica.

In the highest belt, just before and around the mountain's peak, Sv. Ilija (1000 – 1234 m a.s.l.), in dry rocky epi-Mediterranean grasslands, we found only 16 species: *Poecilimon* sp. from *elegans* group, *Leptophyes intermedia, Platycleis albopunctata grisea, Saga pedo, Modestana modesta, Pachytrachis striolatus, Pholidoptera dalmatica, Pholidoptera fallax, Rhachocleis germanica, Arcyptera brevipennis, Stenobothrus fischeri, Pezotettix giornae, Chorthippus mollis lesinensis, Pseudochorthippus parallelus, Ameles heldreichi* and *Mantis religiosa.* The first three species were restricted to this belt.

DISCUSSION

This study significantly improves the knowledge of the Orthoptera and Mantodea species richness of Mt Sniježnica Konavoska, raising the number of known species from 22 (Buzzetti, 2006 and his field notes, Karaman *et al*., 2011) to 48 species. Preliminary data on the vertical distribution of Orthoptera and Mantodea on the southern slopes of Mt Sniježnica Konavoska show the expected altitudinal pattern, a decline in species richness with increasing elevation (e.g. Kryštufek *et al*., 2008). However, our results also highlight the importance of geomorphological features like isolated peaks (e.g. Sv. Ilija), sinkholes, hollows (e.g. Ljeskovac, Glogovac) and narrow valleys (e.g. Prapratno), for the preservation of rare species. The most important results of the study are the findings of two taxa new to the Croatian fauna.

The first is an undescribed *Poecilimon* sp. from the *elegans* group (Fig. 2 a), found in Sv. Ilija peak area, which morphologically corresponds to specimens previously collected in Lovćen pass in Montenegro (Heller, 1988) and on Mt Orjen (SE Grab) in Bosnia and Herzegovina (Ingrisch & Pavićević, 2010). A male collected on Mt

Sniježnica has a subgenital plate rather similar to that of *P. albolineatus* Ingrisch & Pavićević, 2010 (Fig. 2 a), but, e.g., the white medial line is missing from the tergites and there are about 107 teeth in the stridulatory file.

The second taxon was a larger *Poecilimon* sp. from the *ornatus* group (Fig. 2 b), collected in Prapratno valley. It likely belongs to the morphologically very variable *P. affinis* (Frivaldszky, 1868), possibly the subspecies *P. a. komareki* Cejchan, 1953 (Chobanov & Heller, 2010), the only large *Poecilimon* known from the neighbouring coastal Mediterranean part of Albania and Montenegro. Both taxa require further research, particularly from the bioacoustic point of view, since their acoustic signals are of the utmost importance for accurate species identification.

On Mt Sniježnica, *Leptophyes intermedia* (Fig. 2 c) described from Mt Durmitor (Ingrisch & Pavićević, 2010) was found in July and August on herbs in dry epi-Mediterranean grasslands between 1020 and 1230 m a.s.l. According to Puskás *et al*. (2018) and Skejo *et al*. (2018), this species is endemic to the Dinaric Alps. It was found on the southern slopes of Mt Velebit, as well as on Mosor and Biokovo, at similar altitudes. We observed *L. laticauda*, a morphologically similar species, up to 960 m a.s.l., but mainly on bushes or in the crowns of deciduous trees. The findings of *L. intermedia* and the continental species *Platycleis albopunctata grisea* and *Pholidoptera fallax* are the first records of these species in Dubrovnik region.

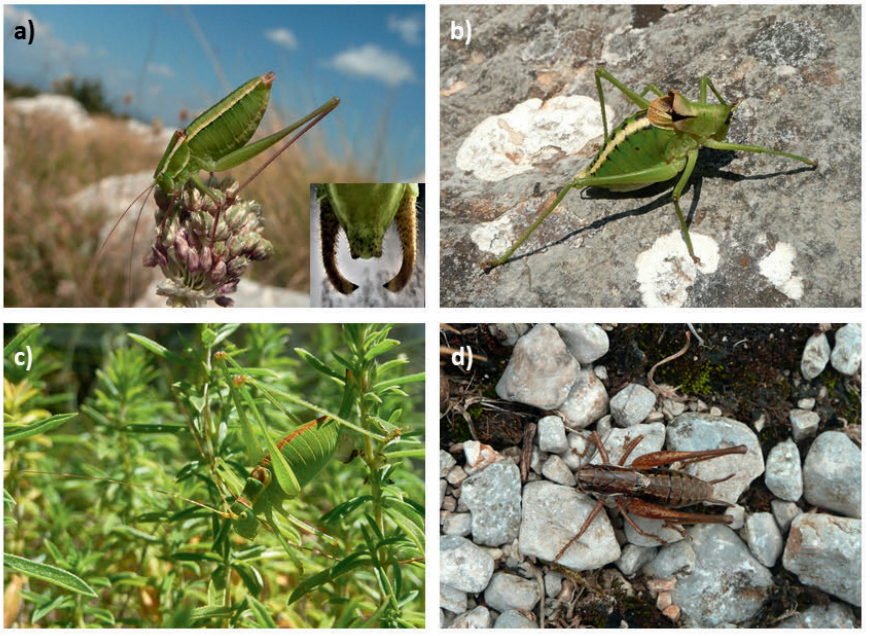

Fig. 2. Notable orthopterans of Mt Sniježnica (Croatia). a) *Poecilimon* sp. (*elegans* group) male, with an inserted photograph of the apical part of subgenital plate from below; b) *Poecilimon* sp. (*ornatus* group) male; c) *Leptophyes intermedia* female; d) *Pachytrachis gracilis* male (Prapratno near Dubravka population).

Three sympatrically occurring *Pachytrachis* species were found in the study area – *P. frater*, *P. striolatus* and *P. gracilis*. The former two species inhabited dry, mostly rocky shrubland and forest edges. On the southern slopes of Mt Sniježnica, *P. frater* occurred between 600 and 1000 m a.s.l., whereas *P. striolatus* was found between 900 and 1200 m a.s.l., sometimes syntopically with *P. frater*. The southern exposure probably allows these thermophilous species (Ingrisch & Pavićević, 2012) to inhabit relatively high altitudes, *P. striolatus* reaching the very peak of Mt Sniježnica (Sv. Ilija). The two species also occurred syntopically in the Prapratno valley at 550 m a.s.l. The topography of this area possibly creates a microclimate similar to that found in the higher portions of the southern slopes, allowing *P. striolatus* to be present here at a lower altitude. On the other hand, *P. gracilis* (Fig. 2 d) was found in more sheltered, somewhat humid forest edges and clearings in the valleys and mountain passes between 500 and 700 m a.s.l. (i.e. Kuna Konavoska, Prapratno). According to our findings, *P. frater* had an earlier activity period in the study area than *P. gracilis* and *P. striolatus*; unlike *P. frater*, the latter two species were still found in August, although at this time *P. striolatus* was already absent from the altitudes below 1100 m a.s.l.

The shape of the male cerci is a major distinguishing character for *P. gracilis* (Harz, 1969; Ingrisch & Pavičević, 2010; Ingrisch, 2012; Massa *et al*., 2012; Willemse *et al*., 2018). Cercus length in our sample varied between 3.55 and 4.8 mm, according to measurements taken from 15 specimens from two populations (Kuna Konavoska, Prapratno). A peculiar variability of the length, shape and position of male cerci was observed within the populations in the study area. Longer cerci were typically more slender than the shorter ones, with a more prominent attenuation in the middle (Fig. 3 a, b, c). In most identification keys, *P. gracilis* cerci are defined as straight in dorsal view, narrowed in the middle (e.g. Ingrisch & Pavićević, 2010; Ingrisch, 2012) and almost parallel (Massa *et al*., 2012) or slightly diverging (Willemse *et al*., 2018). In 9 of 15 specimens from the study area, the gap between the apical parts of the diverging cerci was as wide as or wider than cercus length (Fig. 3 a, b). Such cerci were bent laterally in the middle (Fig. 3 a). Nevertheless, titillator shape was typical for the species (Harz, 1969) in all examined specimens, although the length of the apical part varied to some extent (Fig 3. d, e, f), without correlation to the variability of cerci. These findings emphasize the importance of considering the morphological variability of a species when defining its distinguishing characters at a local level.

The unusually high variability of morphological traits in *P. gracilis* population in the study area is probably of interest in uncovering the traces of former microrefugia in different parts of the Dinaric Alps, a part of one of major ice age refugia in the Balkan peninsula (Hewitt, 2008). It is possible that the area was a glacial microrefugium, harbouring the original diversity of *P. gracilis*, from which certain morphological variants later colonized other parts of the present distribution. Other potential microrefugia for orthopterans have been identified in the Dinaric Alps (Ivković *et al*., 2018). However, this matter can be resolved only with a comprehensive morphological and phylogenetic study, encompassing samples from different parts of the *P. gracilis* distribution.

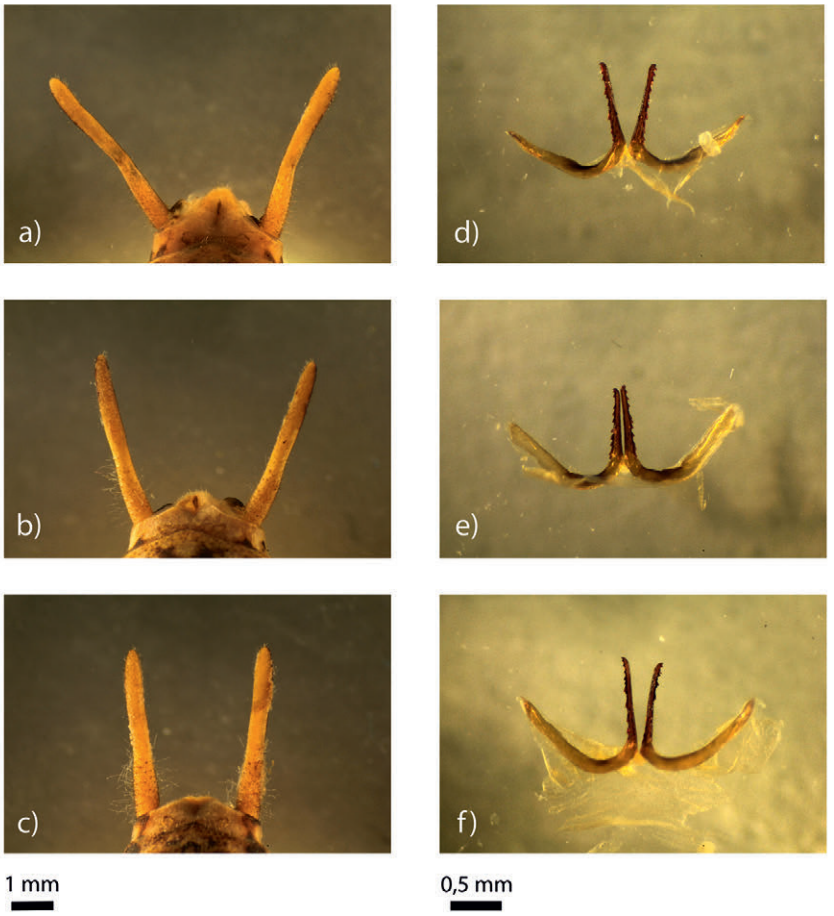

Fig. 3. Morphological variability of *Pachytrachis gracilis* in Kuna Konavoska population (Croatia): an example of three morphological variants (a-d, b-e, c-f), (a-c) male cerci from dorsal view; (d-f) titillators of the same specimens from dorsal view.

Grasshoppers *Arcyptera brevipennis* and *Prionotropis hystrix*, found on Mt Sniježnica, were assessed in the European Red List as Vulnerable (VU) species, while the bush-cricket *Pachytrachis frater* was listed as Endangered (EN) species, at the European and EU28 level (Hochkirch *et al*., 2016). The bush-cricket *Saga pedo* is a species included in the Annex of Habitats Directive. Confirmation of the presence of these species on Mt Sniježnica Konavoska is important for the Public Institution for the Protection of Nature and Environment in the Dubrovnik and Neretva County.

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