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PRELIMINARY RESULTS ON THE SPIDER (ARANEAE) FAUNA OF NP KORNATI (CROATIA)

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As is the case for the whole of Croatia, most of the data on the spider fauna of Dalmatia dates back to the early 20th century. However, some recent works on the spider fauna of Dalmatia have been published by Rucner & Rucner (1995), Dobroruka (2004) and Majer et al. (2008). Recently, a considerable contribution to the knowledge on spider fauna of Dalmatia was made by the Association for Biological Research – BIOM through their research into central Dalmatian nature-protected areas. In order to increase the knowledge on the spider fauna of Dalmatia, the Spider Section of the Biology Students Association BIUS, conducted research into the spider fauna of Kornati National Park in 2009. The research was performed as part of the biology research camp "Kornati 2009", organized by BIUS. The Spider Section spent a total of 12 days in the field, from 14th to 21st of May and from 26th of September to 1st of October 2009. The research covered Kornat Island and several neighbouring islands, which are a part of the National Park: Gustac, Piškera, Lavsa, Levernaka, Mana and Velika Smokvica. Sampling sites were selected according to habitat types, i.e. olive groves, rocky pastures, dry meadows and pine forests. The aim was to include as many different habitats as possible, in order to collect the maximum possible spider taxa. Forty-two different taxa were identified: 31 to the species level and 11 to the genus, divided into 19 families. The remaining 6 taxa were represented with juvenile specimens, which could not be identified to the species level, but probably belong to the identified species. The families Araneidae, Lycosidae, Salticidae, Theridiidae were represented with the highest number of species. We found 2 new species for the Croatia araneofauna.

Spider fauna, Araneae, Croatia, Dalmatia, NP Kornati

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Kao i za cijelu Hrvatsku, većina podataka o fauni pauka srednje Dalmacije potječe s početka 20. stoljeća, dok u novije vrijeme radove o fauni pauka

Dalmacije objavljuju Rucner & Rucner (1995.), Dobroruka (2004.), Majer i sur. (2008.). Doprinos poznavanju pauka Dalmacije daje i Udruga za biološka istraživanja BIOM istraživanjem zaštićenih prirodnih područja središnje Dalmacije. Radi daljnjeg prikupljanja podataka o raznolikosti faune pauka Dalmacije, Sekcija za pauke Udruge studenata biologije BIUS provela je 2009. godine inventarizaciju pauka Nacionalnog parka Kornati.

Istraživanje je provedeno 2009. godine u sklopu biološkog kampa Kornati u organizaciji Udruge studenata biologije - BIUS. Sekcija za pauke provela je na terenu 12 dana, i to u razdoblju od 14. do 21. svibnja te od 26. rujna do 1. listopada 2009. godine. Istraživanje je obuhvatilo otok Kornat i nekoliko susjednih otoka unutar Nacionalnog parka, a to su: Gustac, Piškera, Lavša, Levernaka, Mana i Velika Smokvica. Lokaliteti na kojima je provedeno uzorkovanje pauka odabrani su prema tipu staništa, odnosno cilj je bio obuhvatiti što više različitih staništa kako bi se uzorkovala i što raznolikija fauna pauka. Staništa obuhvaćena istraživanjem bili su maslinici, kamenjarski pašnjaci, suhe livade te borove šume. Uzorkovanje se provodilo metodom sakupljanja rukom te pomoću ekshaustora (engl. pooter). Do sada su uspješno određene 42 takse raspoređene u 19 porodica.Od toga je 31 taksa određena do vrste, a 11 do roda.Njih 6 predstavljene su s juvenilnim oblicima, ali najvjerojatnije pripadaju već određenim vrstama. Porodice *Araneidae, Lycosidae Salticidae, Theridiidae* zastupljene s najviše vrsta. Pronađene su 2 nove vrste za Hrvatsku araneofaunu.

Fauna pauka, Araneae, Hrvatska, Dalmacija, NP Kornati

Introduction

Kornati National Park encompasses the homonymous archipelago situated in the centre of the Croatian part of the Adriatic Sea, between the Šibenik and Zadar archipelagos. Due to frequent burning of forests during the history in order to create new pastures, most of the islands in the archipelago have very scarce vegetation cover accompanied with, more or less, decreased plant species diversity. Influenced by the rainfall and strong winds, the remaining soil slowly eroded, which withheld the development of more complex plant communities (NP Kornati, 2011). Today, chasmophytic and halophytic vegetation is prevalent on the islands, with dry, stony pastures and rare olive groves as the dominating habitat type. Consequently, the accompanying fauna is less diverse and consists mainly of xerophylic and halophylic species.

Because of its unique flora and fauna with a large number of endemics, the Dalmatian coast has been a central point of interest to many researchers during

history. This is also the case with both foreign and Croatian arachnologists, who frequently did research in this part of Croatia. As with the rest of Croatia, most of the data on the spider fauna of Dalmatia originate from the 19th (Germar, 1817; Carrara, 1846; Gasperini, 1891; Gasperini, 1892; Damin, 1896) and the beginning of the 20th century (Damin, 1900; Girometta, 1914; Kulczynski, 1914; Kolosváry, 1939; Reimoser, 1920). Only recently, with the founding of the Croatian Biospeleological Society and the Spider Section of the Biology Student Association - BIUS, has new research into spiders of Dalmatia begun. (Kemfelja et al, 2005; Meštrović et al, 2005; Majer et al, 2008; Ozimec, 2002; Pavlek & Ozimec, 2009), followed by the research of the Association for Biological Research – BIOM, mainly focused on the nature-protected areas of Dalmatia. Despite the large interest in Dalmatian spider fauna, spiders of the Kornati archipelago remained fairly unknown. Records of spiders from Kornati islands are scarce, and derive mostly from the Austrian arachnologist Eduard Reimoser (1929).

With the purpose of increasing knowledge about spiders of the Kornati archipelago, and generally of Croatia, in 2009 the Spider Section of the Biology Students Association BIUS conducted research into the spider fauna of the Kornati National Park. As part of the material is still being analysed, this article shows onlysome of the results of this research.

Material and Methods

The greater part of the Kornati maritime zone was declared a national park in the year 1980. Today Kornati NP covers a surface area of some 217 km^2 and has a total of 89 islands, smaller islands and rocks with roughly 238 km of coastline. In spite of this relatively large number of islands, the terrestrial part of the park makes up only about ¼ of the total surface area, while everything else is a marine ecosystem. Kornat, with a surface area of 32.44 km², is the largest island in this group and takes up two thirds of the National Park. The island is 25.2 km long and up to 2.5 km wide (NP Kornati, 2011).

Inventarisation of spiders was carried out during two periods in the year 2009: from May 14th until May 21st and from September 26th until October 1st. Field research covered Kornat island and several neighbouring islands in the National Park: Gustac, Piškera, Lavša, Levernaka, Mana and Velika Smokvica (Figure 1).

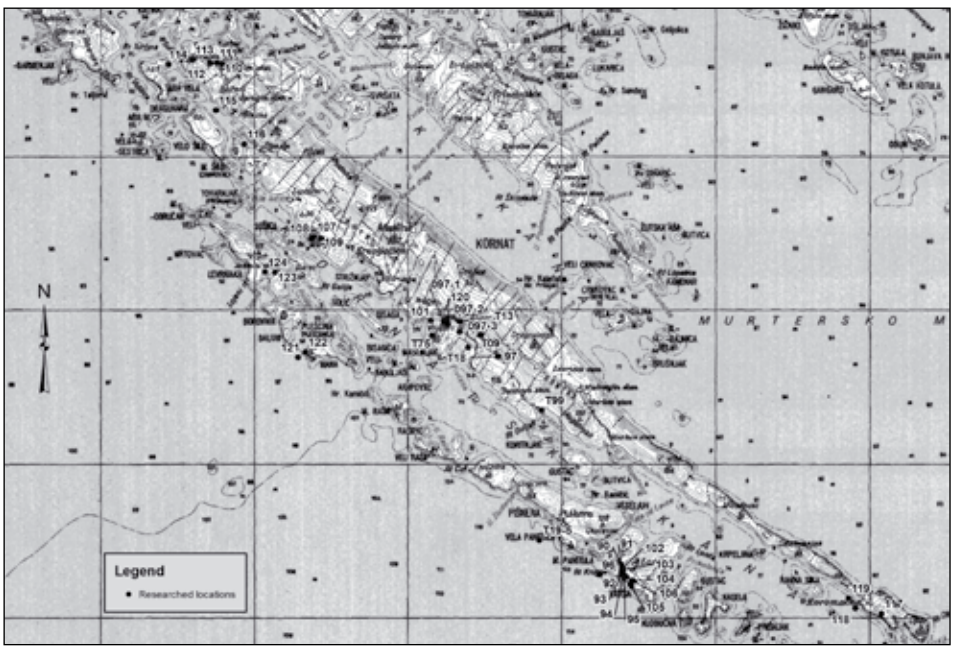

Figure 1. Researched locations in NP Kornati

Sampling locations were chosen according to the dominating habitat type, with the purpose of covering as many different habitat types as possible, in order to collect a more diverse spider fauna. The dominant habitat types were primarily olive groves, dry meadows and dry karstic pastures. The most represented habitat on the islands of NP Kornati is dry, stony karstic pasture. It is characterized by bare karstic rocks, with very scarce vegetation cover, dominated mostly by different grass species. The pastures are still used for grazing livestock, primarily sheep, but with very low intensity. Dry meadows on the islands are very similar to karstic pastures, but they are characterized with deeper soil and more diverse vegetation, again with dominating grasses. They are also used for livestock pasture. Olive groves are the only crops that are now grown at NP Kornati and represent the only areas now actively managed by inhabitants from the nearby coastal settlements.

Altogether, spider specimens were collected at 37 different locations in the National Park (Table 1)

Table 1. Sampling locations in NP Kornati

Site designation	Location	Coordinates	Dominant habitat type
090	Lavsa island	N43 45.135 E15 22.010	olive groves
091	Lavsa island	N43 45.068 E15 22.019	olive groves
092	Lavsa island	N43 45.034 E15 22.011	olive groves
T75	Vrulje hill	N43 48.359 E15 18.358	dry meadows
T13	Trtuša field	N43 48.560 E15 18.876	dry meadows
T09	Trtuša field	N43 48.360 E15 19.299	olive groves
097	south part of Trtuša field	N43 48.067 E15 19.639	olive groves
097-1	Trtuša field	N43 48.545 E15 18.592	olive groves
097-2	Trtuša field	N43 48.518 E15 18.665	olive groves
T18	Trtuša field	N43 48.190 E15 19.057	olive groves
T99	Knežak field	N43 47.305 E15 20.477	olive groves
T19-5	Piškera island	N43 45.484 E15 20.419	olive groves
109-5	Tarac field	N43 49.732 E15 16.034	olive groves
101	Vrulje	N43 48.572 E15 18.336	olive groves
102	Lavsa island	N43 45.072 E15 22.020	olive groves
103	Lavsa island	N43 45.070 E15 22.019	olive groves
104	Lavsa island	N43 44.909 E15 22.215	olive groves
105	Lavsa island	N43 44.859 E15 22.186	olive groves
106	Lavsa island	N43 44.982 E15 22.073	dry meadows
107	near Sv. Marija church	N43 49.752 E15 16.077	dry karstic pastures
108	Toreta hill	N43 49.732 E15 16.034	dry karstic pastures
109	Tarac field	N43 49.731 E15 16.214	olive groves
110	near Maslinje field	N43 52.186 E15 14.291	olive groves
111	near Kurbar hill	N43 52.200 E15 14.201	olive groves
112	near Pudarica hill	N43 52.196 E15 14.080	dry karstic pastures
113	Špraljin stan field	N43 52.240 E15 13.726	dry meadows
114	near Suhi vrh	N43 52.178 E15 13.257	dry meadows
115	near Divojački vrh	N43 51.532 E15 14.179	dry karstic pastures
116	Šipnate	N43 51.056 E15 14.728	olive groves
117	cape Opat	N43 44.437 E15 27.046	dry karstic pastures
118	Opat hill	N43 44.513 E15 26.536	dry karstic pastures
119	Koromačna	N43 44.649 E15 26.409	dry karstic pastures
120	Trtuša field	N43 48.536 E15 18.657	olive groves
121	Mana island	N43 48.063 E15 15.761	dry karstic pastures
122	Mana island	N43 48.134 E15 15.900	dry karstic pastures
123	Levernaka island	N43 49.258 E15 15.316	olive groves
124	Levernaka island, Ježnov stan field	N43 49.260 E15 15.124	dry meadows

Methods used to collect spider specimens were the exhauster or a pooter and pitfall traps. Pitfall traps were placed on 2 locations: one in the olive groves in

Trtuša field and second in Tarac field. On each location 5 cups were randomly placed, at the distance from 5 to 10 meters of each other. Due to the impossibility of digging holes for pitfall traps in the other habitats, and lack of deeper soil covering the bare karst, the traps were placed only in the olive groves. As a preservative, approximately 2 dl of ethylene-glycol water solution (1:1) was used, with one drop of dishwashing detergent. Samples were preserved in 70% ethanol. The species were identified according to Grimm, 1985; Roberts, 1995; Nentwig et al. 2011; Prószyński, 2011 and Metzner, 2012, while the taxonomy was adjusted according to Platnick, 2011.

Results

During the research 117 spider specimens were collected, 78 of which were adult specimens, which could be unambiguously identified up to the species level. Forty-two different taxa were identified: 31 to the species level and 11 to the genus. The remaining 6 taxa were represented with juvenile specimens, which could not be identified to the species level, but probably belong to the identified species. 19 families were identified (Table 2). Two species were recorded for the first time for Croatian spider fauna (van Helsdingen, 2011)

Table 2. The list of species with number of specimens collected on NP Kornati

Family	Species	Gender	Number of specimens	Sampling method	Locality	Date in the year 2009
Sparassidae	*Micrommata ligurina* (C. L. Koch, 1845)	♀	1	pooter	T99	18/05
Titanoecidea	*Titanoeca tristis* (L. Koch, 1872)	♂	1	pooter	T99	18/05
Scytodidae	*Scytodes sp.*	JUV	2	pooter	122	30/09
Pholcidae	*Holocnemus pluchei* (Scopoli, 1763)	♀	1	hand	110	27/09
		♀	1	hand	101	26/09
		♀	2	hand	T13	16/05
		♂	1	hand	T13	16/05
		♀	2	hand	090	14/05
		♀	2	hand	091	14/05
		♀	1	hand	T18	17/05

Table 2. - continued

Dysderidae	*Dysdera dubrovninni* (Deeleman-Reinhold, 1988)	♀	1	hand	122	30/09
Eresidae	*Eresus kollari* (Rossi, 1846)	♀	1	hand	108	26/09
Theridiidae	*Crustulina scabripes* (Simon, 1881)	♂	1	pooter	102	26/09
		♂	1	pooter	117	28/09
	Steatoda sp.	JUV	1	pooter	122	30/09
		JUV	1	pooter	107	26/09
		JUV	1	pooter	108	26/09
		JUV	1	pooter	109	26/09
	Steatoda paykulliana (Walckenaer, 1805)	♀	1	hand	T99	18/05
	Theridion sp.	JUV	2	pooter	T75	15/05
	Argyrodes argyrodes (Walckenaer, 1841)	♀	1	pooter	107	26/09
Tetragnathidae	*Zygiella X-notata* (Clerck, 1757)	♀	1	pooter	101	26/09
		♂	1	pooter	118	28/09
Araneidae	*Araneus sp.*	JUV	1	pooter	T75	15/09
		JUV	2	pooter	T19-5	19/05
	Araneus diadematus (Clerck, 1757)	♀	1	hand	102	26/09
		♀	1	hand	107	26/09
		♀	1	hand	112	27/09
		♂	1	hand	114	27/09
	Argiope lobata (Pallas, 1772)	♀	1	hand	104	26/09
		♀	1	hand	107	26/09
		♀	1	hand	117	28/09
	Agalenatea redii (Scopoli, 1763)	♀	1	pooter	107	26/09
		♀	1	pooter	108	26/09
		♀	1	pooter	109	26/09
		♀	2	pooter	T19-5	19/05
	Agelenatea sp.	JUV	2	pooter	107	26/09
		JUV	1	pooter	108	26/09
		JUV	1	pooter	109	26/09
	Argiope bruennichi (Scopoli, 1772)	♀	1	hand	107	26/09
		♀	1	hand	113	27/09
		♀	1	hand	117	28/09
	Araneus angulatus (Clerck, 1757)	♂	3	pooter	097	16/05
	Nuctenea sp.	JUV	1	pooter	110	27/09
	Mangora acalypha (Walckenaer, 1802)	♀	2	pooter	097	16/05
	Gibbaranea sp.	JUV	1	pooter	118	28/09

Table 2. - continued

Lycosidae	*Paradosa sp.*	JUV	1	hand	T18	17/05
	Alopecosa albofasciata (Brullé, 1832)	♀	1	pooter	T13	16/05
		♂	1	trap	109-5	20/05
		♀	1	pooter	107	26/09
		♂	1	pooter	108	26/09
		♂	1	pooter	109	26/09
	Hogna radiate (Latreille, 1817)	♀	1	hand	104	26/09
		♀	1	hand	107	26/09
		♀	1	hand	120	29/09
		♂	1	hand	121	30/09
		♂	1	hand	122	30/09
	Hogna sp.	JUV	1	pooter	T13	16/05
		JUV	2	pooter	T18	17/05
		JUV	1	pooter	T18	17/05
		JUV	1	pooter	T99	18/05
	Trohosa hispanica (Simon, 1870)	♂	2	trap	109-5	20/05
Pisauridae	*Pisaura sp.*	JUV	2	pooter	110	27/09
Agelenidae	*Textrix sp.*	JUV	1	pooter	101	26/09
Cybaeidae	*Cybaeus sp.*	JUV	2	pooter	102	26/09
Clubionidae	*Clubiona sp.*	JUV	2	pooter	T13	16/05
Gnaphosidae	*Zelotes femellus* (L. Koch, 1866)	♂	2	pooter	101	26/09
	Nomisia exomata (C. L. Koch, 1839)	♀	1	pooter	T99	18/05
	Haplodrassus dalmatensis (L. Koch, 1866)	♂	1	trap	109-5	20/05
Philodromidae	*Tibellus sp.*	JUV	1	pooter	112	27/09
		JUV	1	pooter	123	30/09
		JUV	1	pooter	124	30/09
Thomisidae	*Thomisus onustus* (Walckenaer, 1805)	♀	1	pooter	118	28/09
	Xysticus bufo (Dufour, 1802)	♀	1	pooter	110	27/09
		♀	1	pooter	112	27/09
		♂	1	pooter	114	27/09
	Ozyptila sanctuaria (O. P.-Cambridge, 1871)	♂	1	pooter	107	26/09
		♂	1	pooter	108	26/09
		♂	1	pooter	109	26/09
	Xysticus apricus* (C. L. Koch, 1876)	♂	1	pooter	T99	18/05
Segestriidae	*Segestria sp.*	JUV	2	hand	T75	15/05
		JUV	1	hand	T18	17/05

Table 2. - continued

Salticidae	*Philaeus chrysops* (Poda, 1761)	♂	2	pooter	097	16/05
		♀	1	pooter	T18	17/05
		♂	2	pooter	T09	16/05
		♂	2	pooter	092	14/05
	Euophrys rufibarbis (Simon, 1868)	♀	1	pooter	123	30/09
		♀	1	pooter	124	30/09
	Phelegra bresnieri (Lucas, 1846)	♀	1	pooter	114	27/09
		♀	1	pooter	122	30/09
	Sitticus sp.	JUV	1	pooter	T75	15/05
	Menemerus sp.	JUV	1	pooter	101	26/09
		JUV	1	pooter	102	26/09
	Pellenes nigrociliatus (Simon, 1875)	♀	1	pooter	T18	17/05
	Heliophanus kochii (Simon, 1868)	♂	1	pooter	092	14/05
	***Salticus mandibularis* * (Simon, 1868)**	♂	1	pooter	T99	18/05

* First record for Croatia

In the total sample, the families Araneidae, Lycosidae, Salticidae, Theridiidae were represented with the highest number of species (Fig. 2).

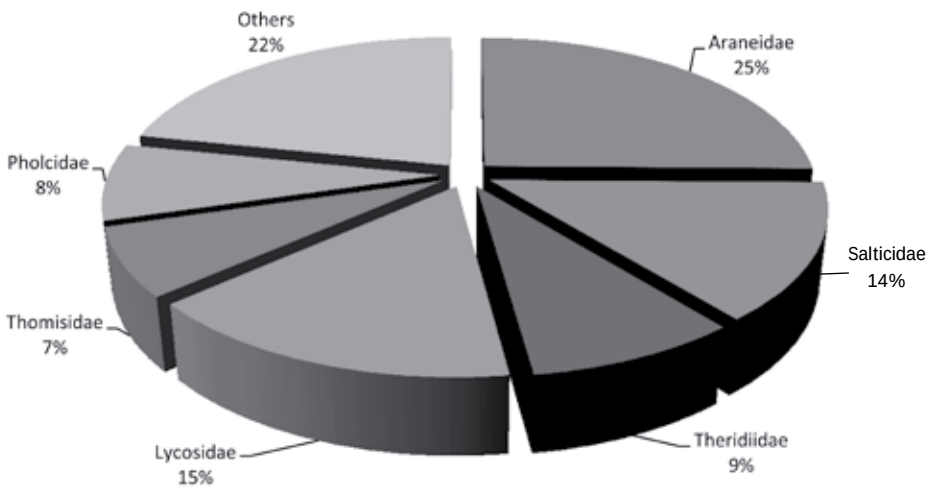

Figure 2. Share of specimens of the individual family in the total number of collected specimens

Discussion

Although the research period was very short, it had been expected that more spider specimens would be collected. The reasons for such a small number of specimens definitely comes from the chosen sampling methods but also from the extreme environmental conditions, including weather conditions and habitat structure. The dry, monotonous, low productive karstic stony grounds together with high temperatures and low precipitation shaped the floral and faunal communities, the species of which use different strategies to survive these extreme habitat conditions (Wise, 1993). In order to sample these species it is necessary to use adequate sampling methods, like detailed examination of ground level (e.g. undersides of stones, low vegetation), pitfall trapping and night hand collecting. The main method used in this research included a visual examination of the field zone layer of the vegetation, according to Duffey, 1966 (Foelix, 2011) with hand and pooter collecting, which strongly biased the sample towards large, easily detectable species, e.g. of the family Araneidae, which was dominant family in both species and specimen number. Although pitfall traps are a very efficient method for sampling both diurnal and nocturnal terrestrial arthropods in different kinds of Mediterranean habitats (Cardoso, et al, 2007), only few spider specimens were collected with the use of this method, the reason being insufficient exposition time (4 days) and also some potential errors in the pitfall placement. The material sampled with pitfall traps is still in the process of being determined. Due to field configuration and vegetation structure, a sweeping net, as a method of sampling, could not be used. Considering the small number of specimens, a relatively large number of species was collected, again mostly due to the selective sampling methods used. Majer et al. (2008) conducted similar research on the Dalmatian island of Vis, collecting 231 specimens, and identifying 31 species. As was the case with this research, due to they short exposition period of the pitfall traps, they also collected a negligible number of specimens using this method.

During this research, two species, *Salticus mandibularis* (Simon, 1868) and *Xysticus apricus* (C. L. Koch, 1876), were for the first time recorded for the Croatian spider fauna. *S. mandibularis* was so far recorded only in Italy and Greece, while *X.apricus* was considered an Italian endemic (van Helsdingen, 2011).

All of the species sampled were found in habitats that are identical or very similar to the characteristic habitats for the species described in the literature, that is, all the species are typical representatives of Mediterranean habitats with high

average annual temperatures and low precipitation (thermophilic and xerophyl species).

Conclusion

Although relatively few individuals were collected, considering the time spent in the field, a relatively large number of species was identified. The small number of individuals caught was due to inadequate sampling methods and to extreme environmental factors of the area researched. All identified species are typical representatives of warm and dry Mediterranean habitats. This was only a preliminary study of the araneofauna of the Kornati archipelago and the data are still in the process of analysis, so upon completion we can expect more species recorded for this area. We found two new species for the Croatia araneofauna. Concerning the poor knowledge about the spider fauna of Kornati and Croatia in general, despite the low number of specimens and species collected, this study still represents a significant contribution to the knowledge of Croatian spiders.

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