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DATA ON THE ORDER JULIDA, DIPLOPODA CLASS (MILLIPEDES) IN THE AREA OF LEVAN, FIER IN ALBANIA

SUMMARY

Julida order is part of the class Diplopoda, in the group Myriapoda. They belong to the subphylum Mandibulata, phylum Arthropoda. The order Julida is represented by species with significant distribution in our country and in the region. The data for the millipedes of Albania come mostly from partial studies, mainly done by foreign and local researchers. The object of this study is Julida order species collected in Levan, Fier. In this presentation are given the zoological and ecological data of the Order Julida. The study's objectives are: to identify the species of the order Julida in the study area; the ecological factors that limit or influence their spread; their zoogeographic spread compared to other areas of Albania or the region. About 80 species of this order have been identified in Albania. This is considered almost 50% of the expected species of Albania. The order Julida represents one of the richest orders of the class Diplopoda, including types of terrestrial environments, decomposers, and phytophagous. They are not of particular importance to the human economy, neither are known as pests of agricultural crops nor serve as vectors of human diseases. The collection of individuals was carried out from June 2019 to June 2021. The collection was done mainly by hand, but also with soil sieves. The gathering places were under stones, in tree barks, under the leaves, or in the upper layer of the soil. The collection stations were selected based on the habitat type. It was taken into consideration whether it is a forest area, a hilly area with cultivated plants, or a plane. In this study, systematic categories have been identified, including nine species represented in five genera and two families.

INTRODUCTION

Diplopod millipedes represent the richest species in the class of the Myriapoda group. This class includes types of terrestrial environments that are mainly decom-

posing and phytophagous. Diplopods are land creatures, widespread in different land environments and they are rich in species.

This study provides data on the population level of the Order Julida in the Levan-Fier area. The collection of individuals was carried out during the period 2019-2021. This area was chosen for the study due to the diversity of the environment. It is represented by genuine forest ecosystems, such as the Levan forest, hilly ecosystems with cultivated plants, agricultural land ecosystems, etc. Micro--environments of the urban area are also included in the study. During the collection period, changes were observed not only in the population density of the Order Julida, but also in the quality of the habitats. The number of individuals and the types determined in the collection stations are more a reflection of habitat changes and anthropogenic impact. Populations of the Order Julida are sensitive to changes in the physico-chemical and biological factors of the habitat (Kicaj, 2011; Kicaj, 2014).

MATERIAL AND METHODS

The material is collected during a timespan of two years. The collection of species was carried out in four seasons, in winter, spring, summer and autumn. Due to the influence of humidity, samples were collected more intensively in spring and autumn. The collection was done by hand, randomly in pre-defined environments. They are collected at any hour of the day. The collection environments were under stones, in the bark of trees, under the leaves of trees and in the upper layer of the soil.

Collected individuals are stored in test tubes with 80% alcohol to which a little ether is added. The samples are kept in places with no sunlight and are marked with a number or with the name of the station. Data of the collection station is also written on their labels. Other detailed data on the type of habitat, temperature, vegetation, number of individuals, etc., are recorded in the corresponding notebook. The four collection sites in the study area have been determined in advance.

The Levan forest is currently declared a managed nature reserve. It is located near the residential centre Levan, Fieri. This is a very intense area species-wide, and also in human activity. The vegetation is typical Mediterranean.

Frakull (plane area) is located in the South of the city of Levan. Individuals have piled up under stones, under trees, under rotting leaves, etc.

Frakull village (hilly area). In this station, the hilly part of the village of Frakull has been chosen, mainly with olive trees.

The urban areas for sampling were microhabitats inside the city of Levan, in walls, in tree leaves, etc., an area that has a increased human activity.

Processing of the material and definiton of the species

The definition of the species is done by direct observation of external morphological features and observation of some features in a stereomicroscope. In their determination, the following are taken into consideration: body size, body shape, number of segments and pairs of limbs, the presence of the gonopod on the seventh segment (to determine sex), body color, the shape of the cover and the way of placing the tergal plates etc. Further species identification is done by extracting and observing the gonopod according to identification keys (Mauries *et al*., 1997). The samples were determined with the help of a stereomicroscope and a determination key.

Morphological data

Order Julida, are more or less uniform in appearance. The length of the studied individuals is from 20 to 60 mm. Julida belong to the superorder Juliformia, characterized by fused body segments. The number of body rings is not the same on all individuals even on those of the same species, and all individuals have more than 30 segments. They are distinguished by the plate shape of the mouth, gnathochilarium. In Julida, the outer sclerites of the gnathochilarium border each other and the central sclerite (promentum) does not bear a setae (Enghoff, 2006). The basal segments of the mandibles are clearly divided into proximal and distal parts.

The collar is large and partially overlaps the head and the second ring of the body. Some species lack eyes or have only a single row of eyes (occelli). The last ring of the body (telson) and sometimes the anal part varies in a specific way in Julids, especially in the family Julidae. Often this part is extended. Telson elongation and anal vulvae also show taxon-specific differences. Vulvae serve to distinguish species or genera, but in some genera they are quite uniform. Male gonopods are difficult to examine because they are usually retracted inside the body. In Julida, both pairs of legs of the 7th body segment are transformed into gonopods. The front pair (anterior gonopods) usually serve as protective gonopods, while the rear pair (posterior gonopods) are sperm transfer organs. In contrast to other millipedes, non-gonopodial features are also important in the further classification of Julids. Such features are the structures of the first, second and seventh pair of male legs, the shape of the body, the structure of the mouthparts, etc., (Mikaljova, 2004).

RESULTS AND DISCUSSION

Definition of families

As in other orders of millipedes, the specific structure of the gonopods, the secondary organs in males, is one of the main criteria for dividing families. In Julida, the two pairs of legs of the 7th body segment are transformed into gonopods. The

front pair (anterior gonopods) usually form protective peltogonopods, while the rear pair (posterior gonopods) are sperm transfer organs. In contrast to other millipedes, non-gonopodial features are also important in the further classification of Julids, namely the structures of the first, second and seventh pairs of male legs, body shape, mouthparts structure (Enghoff, 1993).

Families can be easily separated by their gonopod confirmation and general shape. Members of the Blaniulidae family are slender, with a length-to-width ratio from about 20:1 to 30:1. The gonopods are completely outside the 7th body ring and directed posteriorly. Anterior gonopods laterally have rudiments with one telopodite segment, often with distal setae. The hind gonopods are long and slender. Julidae are stockier, with a length-to-width ratio of about 10:1 to 14:1, although some species of Blaniulidae and Julidae overlap in body size. The front part of the body ring, the prozone, is separated from the back part, the metazone, by a special suture (Mikhaljova, 2004).

Longitudinal striae surround the segments. In most species the gonopods are completely retracted inside the body, so their study requires great preparation and experience. The indicator of their presence is a leg gap on the 7th body ring combined with an abdominal cavity. In immature males, the ventral side of ring 7 is closed. Although it shows a high variability between species, the gonopods have a characteristic construction. The anterior gonopod, called the promerite, and a portion of the posterior gonopod, called the mesomerite, often form a pincer-like pair that helps the female avoid her vulvas during mating. The remaining posterior part of the gonopod is called the opisthomery. It is the only part directly involved in sperm transfer. A part of the opisthomere, the solenomere, carries a sperm duct, which opens apically. Parallel to the sperm duct is a groove leading to a flagellum, which is of anterior gonopodial origin. In some genera and families the flagellum is absent in the second pair (Stoev *et al*., 2005).

Taxonomic data

During the period of this study 145 individuals were observed, and were identified in the systematic categories described below (Engoff, 2006; Golovatch et al., 1990; Mauries et al., 1997; Mikaljova, 2004).

The order Julida (Meinent, 1868) is widespread in our study area. The size of the caught individuals reaches from 3-6 cm, except for the jeweled forms. Representative families of this order in our study area are:

Family Julidae (Meinent, 1868)

In our study they were found in all stations, and in almost all types of habitats. They were caught in garden soils under the bark of trees, in wooded areas, in microhabitats in populated areas, etc.

The following types are defined:

Genus *Pachyiulus* (Berlese,1883)
In the Balkans, 6 species of this genus are known so far, of which the following species were found within the scope of this study.

1- *Pachyiulus catarensis* (Latzel, 1884). Found at five collection stations. Referred to by Verhoeff (1901); Attems (1929); Manfred (1945);

2- *Pachyiulus dentiger* (Verhoeff, 1901). Found at four collection stations. Found before in our country. Referred by Attems (1929); Verhoeff (1901).

3- *Pachyiulus varius* (Fabricius, 1781). Found at four collection stations. Found before in our country. Referred to by Verhoeff (1901).

4- *Pachyiulius valonensis* (Verhoeff, 1901). Found in three collection stations. Found before in our country. Referred by Attems (1929); Verhoeff (1901).

Genus *Brachyiulus* (Berlese, 1884)

5- *Anoploiulus apfelbecki* (Verhoeff,,1898); Synonyms: *Brachyiulus apfelbecki* (Verhoeff,, 1898). Found at a collecting station, in the urban area, in moist places. Previously referred to in the Vlora district. Referred to by Attems (1929).

6- *Anoploiulus pusillus* (Leach, 1814) = *litoralis* (Verhoeff,1898). Synonyms: *Brachyiulus pusillus* (Leach, 1815); *Julus pusillus* (Leach, 1815); *Julus exiguus* (Brantd, 1841); *Julus virgatus* (Wood, 1864); *Julus stuxbergi* (Fanzago, 1875); *Brachyiulus littoralis* (Verhoeff, 1898); *Microbrachyiulus littoralis* (Jawlowski, 1939).

Found in all collection stations. Found before in our country. Referred by Attems (1929), Verhoeff, (1901).

Genus *ommatoiulus* (Latzel, 1984)

7- *Ommatoiulus sabulosus* (Linneus, 1758). Found at three collection stations. It is referred to from previous expeditions to Albania.

Genus *Cylindroiulus* (Verhoeff,, 1894)

8- *Leptoiulus trilineatus* (Koch 1847). Found in two collection stations. Referenced by Mauries, (1996); Golovatch, (1996); Stoev, (1996).

Family Blaniulidae (Koch, 1847)

Genus *Nopoiulus* (Menge,1851)

9- *Nopoiulus kochii* (Gervais1847). Found in two collection stations. Referenced by Mauries et al., (1997), Golovatch et al., (1997).

Zoogeographical data

This study presents the zoographical aspects of *Julida order* in Albania. The current level of information analyzes the distribution in Albania based in the studies and published works by foreign and Albanian researchers.

Focusing in the Southern Region of Albania, it has been assessed the biodiversity for the diplopods in the area. The collected data are compared with previous findings by Verhoeff (1901), Atems (1929), Manfredi (1945), Mauriès et al. (1997) etc. The distribution range of the occurred species is presented at national

or Balkan level. Based on the findings, different habitats of the Southern Region are compared among each other.

The geographic distribution of species in Albania

Based on data from our study zone and other areas of our country, we compared the zoogeographical spreading in this zone, with the spreading in other areas of Albania (Tab. 1).

Tab. 1- Comparison with other collecting station in the country

No	Species	Previous expeditions	References for Albania
1	*Pachyiulus catarensis* (Latzel, 1884)	Attems 1929	Shkodra District, Dibra District
		Manfredi 1932	Shkodra district, Korca District
		Manfredi 1945	Bureli District, Berati District
		Verhoeff 1932	Dibra, Pogradeci and Korca District
		Verhoeff 1901	Station not specified
		Kiçaj, Qirjo 2004	Vlora, Saranda (Butrinti)
2	*Pachyiulus dentiger* (Verhoeff, 1901)	Attems 1929	Vlora District
		Verhoeff 1901	Vlora District
		Kicaj, Qirjo 2009	Vlora (Radhima, Pashalimani)
3	*Pachyiulus varius* (Fabricius 1781)	Attems 1929	-
		Verhoeff 1901	Vlora, Pashalimani
		Manfredi 1945	Berati District
		Kicaj, Qirjo 2009	Vlora (Terbaci), Saranda (Fterra)
4	*Pachyiulus valonensis* (Verhoeff, 1901)	Attems 1929	Vlora District
		Verhoeff 1901	Vlora District
		Kiçaj, Qirjo 2009	Vlora (Radhima), Saranda (Borshi)
5	*Anoploiulus apfelbecki* (Verhoeff, 1898)	Attems 1929	Mirdita District
		Kiçaj, Qirjo 2009	Vlora, Saranda (Butrinti)
6	*Anoploiulus pusillus* (Leach, 1814) = *litoralis* (Verhoeff, 1898)	Attems 1929	Vlora District
		Verhoeff 1901	Vlora District
		Kiçaj, Qirjo 2009	Vlora & Saranda (in some collection stations)
7	*Ommatoiulus sabulosus (=Archiulus, = Schizophyllum* (Line, 1758)	Kiçaj, Qirjo 2009	Vlora (Llogara); Saranda (Butrinti)
8	*Leptoiulus trilineatus* (Koch, 1847)	Kicaj, Qirjo 2009	Vlora (Llogara); Saranda (Fterra)
9	*Nopoiulus kochii* (Gervais, 1847)	Kiçaj, Qirjo 2009	Vlora (Llogara, Smokthina))

From the comparison of julida order's collecting areas in previous expeditions it results that species of order Julida, found in this study zone, are refered in other collecting areas in Albania.

The spreading of species in Balkan peninsula

Based on data from Albania, and other countries in Balkan peninsula (Mauries et al, 1997; Enghoff, 2006), we compared the zoogeographical spreading in Albania, with the spreading in other countries (Tab. 2).

Tab. 2- Comparison of the species of diplopoda class met in our study area with those of the Balcan area.
AL: Albania, MA: North Macedonia, SMZ: Serbia and Montenegro, CR: Croatia, B&H: Bosnia and Herzegovina, GR: Greece, BU: Bulgaria.

No	Species	AL	MA	SMN	CR	B&H	BU	GR
1	*Pachyiulus catarensis* (Latzel, 1884)	+	+	-	+	-	+	-
2	*Pachyiulus dentiger* (Verhoeff, 1901)	+						
3	*Pachyiulus varius* (Fabricius, 1781)	+	+	-	+	+	+	+
4	*Pachyiulus valonensis* (Verhoeff, 1901)	+						
5	*Anoploiulus apfelbecki* (Verhoeff, 1898)	+	+	-	+	+	-	-
6	*Anoploiulus pusillus* (Leach, 1814) = *litoralis* (Verhoeff, 1898)	+	+	-	+	+	+	+
7	*Ommatoiulus sabulosus* (Line, 1758)	+	-	-	-	-	+	-
8	*Leptoiulus trilineatus* (Koch, 1847)	+	-	-	-	-	+	+
9	*Nopoiulus kochii* (Gervais, 1847)	+	+				+	-

References for Balkan peninsula show that the species below have a wide regional spreading: *Pachyiulus varius* (Fabricius, 1781)*; Anoploiulus apfelbecki* (Verhoeff, 1898) *Anoploiulus pusillus* (Leach, 1814) = *litoralis* (Verhoeff, 1898) This spreading is confirmed even in the european maps of zoogeographical spreading of these species.

*Pachyiulus dentige*r (Verhoeff, 1901)*, Pachyiulus valonensis* (Verhoeff, 1901), are not refered in other places of the Balkan peninsula.

CONCLUSIONS

The families of Julida order can be easily divided by the construction of the gonopods, the general shape: Members of the Blaniulidae family are slender, with a length-to-width ratio of about 20:1 to 30:1. The gonopods are completely outside

the 7th body ring and directed posteriorly. The anterior gonopods, in the lateral part, have rudiments with a segment of telopodites. The posterior gonopods are long and thin.

Julidae are stockier, with a length-to-width ratio of about 10:1 to 14:1, although some species of Blaniulidae and Julidae overlap in body size. Nine species belonging to five genera and two families are reported in this study. The family Julidae is the most represented in the study area, with four genera and eight species. The genus *Pachiulus* is the most widespread in this family. This is also related to the wide regional distribution of these taxa.

Based on the data found in our study area and those collected for Albania, a comparison of the zoogeographic distribution within our country for the species encountered during this study was made. The species *Pachyiulus dentiger* (Attems, 1929; Verhoeff, 1901), *Pachyiulus valonensis* (Attems, 1929: Verhoeff, 1901), *Anaploiulus pusillus* (Attems, 1929; Verhoeff, 1901) are referred by researchers in the Southern Region of Albania, but not in other locations.

From the distribution at the Balkan level, we note that the species: *Pachyiulus cattarensis* (Latz, 1884), *Pachyiulus varius* (*Fabricius,* 1781), *Anoploiulus apfelbecki* (Verhoeff, 1898), *Anoploiulus pusillus* (Leach,1814) = litoralis (Verhoeff, 1898), have a wide regional spread. This is also confirmed by the study of the zoogeographic distribution map, where these species are found all over the European continent.

Due to the sedentary life and slow movement, the endemism of Myriapod species as a whole is known. Furthermore, the Balkans is referred to as a source region for the migration of species to other areas of Europe through the northward passage.

Based on the time of finding the individuals, Julids are found in environments with normal humidity and temperature. The combination of these factors makes their spread possible. In very high and very low temperatures, as well as in severe drought, their spread is limited. In the months of January, July, August, their limited spread is observed.

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