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Abundance and seasonal activity of millipedes in a dolomitic grassland community (Diplopoda)

by Z. KORSÓS, Budapest

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Abstract - Two millipede species (*Megaphyllum unilineatum* C. L. KOCH, 1838 and *Kryphioiulus occultus* (C. L. KOCH, 1847)) were collected by pitfall trapping in a dolomitic steppe meadow in 1988. Numbers of males, females and juveniles showed interesting changes, with respect to the characteristic seasonal activity of both species. Comments on the biology of these millipedes are given. With 1 table and 2 figures.

INTRODUCTION

Millipedes are considered to be an important component in the process of making humus and soil from leaf litter (BLOWER 1956). However, we know little about their life history, population biology, and ecology in spite of some serious and detailed investigations (e.g. BAKER 1979, DUNGER & STEINMETZGER 1981, GEOFFROY 1981, MEYER 1985, VOIGTLÄNDER 1987). This may partly be due to the large number of the still unsolved taxonomical and systematical problems of the group. In Hungary, too, there are only a few papers dealing with the ecology of millipedes. LOKSA (1966) gave a very thorough analysis of the soil-dwelling arthropod communities, including those of millipedes, of warm dwarf oak forests. POBOZSNY (1978) studied the role of millipedes in litter decomposition mainly from the production biology point of view. A field population study carried out by HORNUNG (1990) in a sandy grassland on a common species, *Megaphyllum unilineatum* is also relevant to the present study. All these investigations are mainly case studies making reference usually to a narrow field of the millipede ecology. The present study is not an exception, so for extensive summarizing theories we have to wait until a sufficient number of small, precise works based on taxonomically clear species-groups accumulates.

Material and methods

In connection with the "Succession Research Project" of the Hungarian Natural History Museum, a study area selected for population analysis of millipedes (and also for other soil-dwelling arthropods) was chosen on the Odvas Hill, a dolomitic part of the Buda Mts, at the western border of Budapest. Its description can be found in the paper by KISBENEDEK (1991).

108 pitfall traps were used on the northern slope of the Odvas Hill, in a closed dolomitic grassland plant association *(Festuco pallenti-Brometum pannonici)*. They were emptied 14 times from the middle of April until the end of October in 1988, i.e. during the active period of the soil-dwelling arthropods. The pitfall traps were plastic jars with a diameter of about 9 cm and were situated in three hierarchical groups, some hundred meters away from each other. Each group consisted of 3 x 3 x 4 traps, the quartet lying in a square meter.

The traps were filled with ethylene-glycol as a non-attractive preservative. The collected animals were identified to species and sex and are now deposited in the Myriapoda Collection of the Hungarian Natural History Museum.

RESULTS

Only two millipede species were found in the pitfall traps: *Megaphyllum unilineatum* C. L. KOCH, 1838 and *Kryphioiulus* (=*Cylindroiulus*, =*Allajulus*, see READ 1990) *occultus* (C. L. KOCH, 1847). Specimens of the first species were more abundant, which is not surprising considering its wide ecological tolerance and its general distribution, including somes xerophitic occurrences. The specimens collected were separated to males, females and juveniles, based on their genital features. In Table 1, the raw data of the pitfall traps are summarized.

Altogether 500 specimens of *Megaphyllum unilinatum* and 107 specimens of *Kryphioiulus occultus* were collected. It is already obvious at first sight that the number of females are usually higher in both species (Table 1). Mean sex ratio is 3.42 and 2.77 for females/males, in *M. unilineatum* and *K. occultus*, respectively.

Table 1. Number of specimens collected by pitfall traps checked fourteen times

Date of collection	*Megaphyllum unilineatum*			*Kryphioiulus occultus*		
	male	female	juv.	male	female	juv.
(1) 12. April	15	50	1	-	9	1
(2) 26. April	15	65	-	8	17	-
(3) 12. May	27	73	-	6	16	2
(4) 27. May	8	19	-	1	4	-
(5) 7. June	5	11	-	-	1	-
(6) 21. June	1	10	-	-	-	-
(7) 6. July	-	7	-	-	-	-
(8) 21. July	-	2	-	-	-	-
(9) 12. Aug.	-	1	-	-	-	-
(10) 24. Aug.	-	2	-	1	-	-
(11) 2. Sept.	-	3	-	2	4	-
(12) 14. Sept.	3	10	-	4	15	-
(13) 6. Oct.	17	29	4	5	1	1
(14) 19. Oct.	24	67	31	3	6	-
Total	115	349	36	30	73	4

It can be also seen from the data that the diplopods almost disappear in the summer months. Their seasonal activity dynamics are shown in Figs 1-2. Diagrams of males and females in both species run almost in parallel. However, there are certain differences in the start of the decline in activity. Specimens of *Kryphioiulus occultus* begin to disappear from the traps by the 5th-6th collecting dates, i.e. at the end of May, beginning of June; while in the other species, the males disappear in June, but the females only at the end of July. The beginning of the autumn activity period seems to be in the first half of September in both species. It is also worthwhile to mention, that juvenile specimens of *Megaphyllum unilineatum* appear in big numbers in autumn, while in the other species they were quite sporadic both in spring and at the end of the activity period.

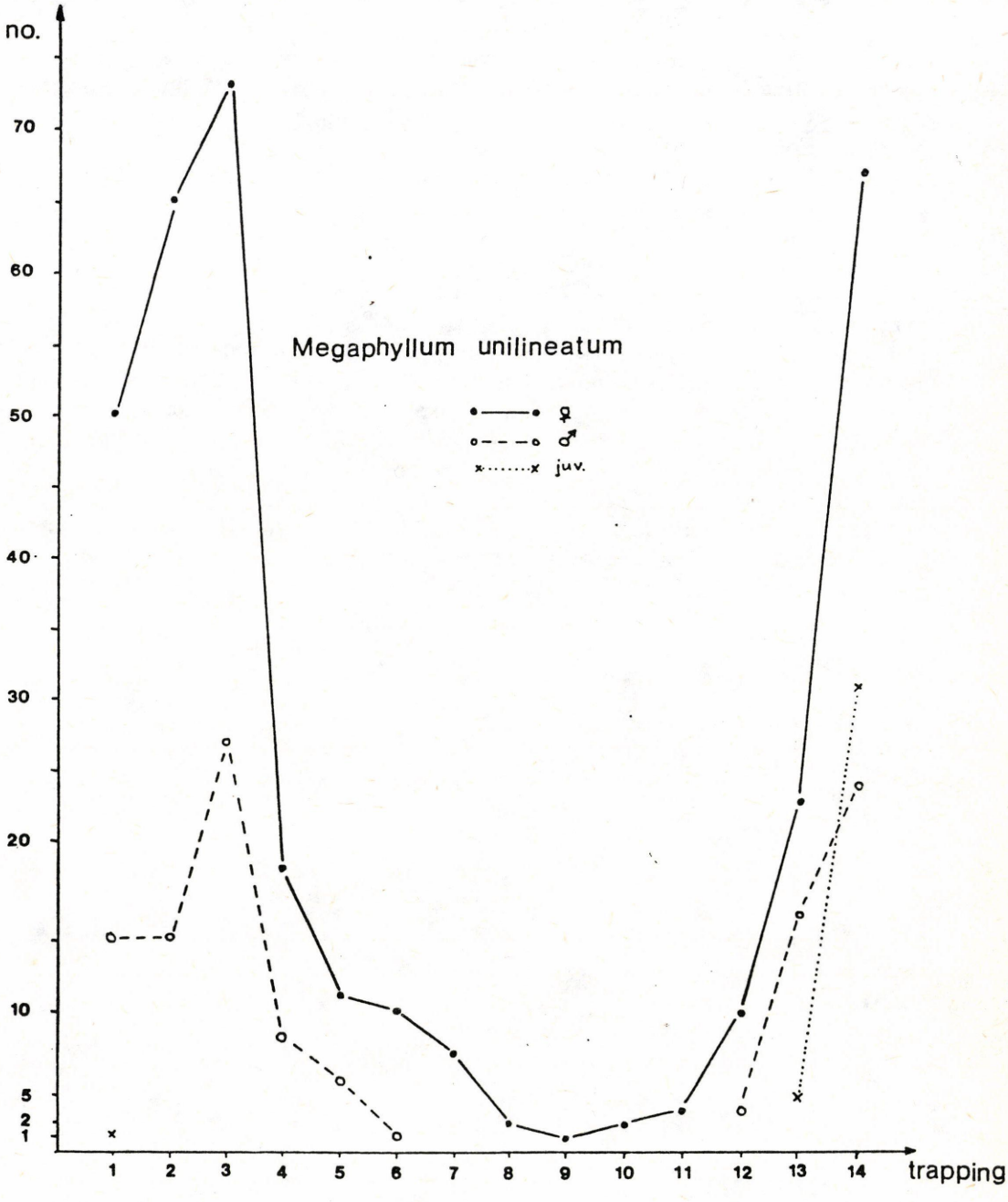

Fig. 1. Seasonal activity pattern of *Megaphyllum unilineatum*

DISCUSSION

The difference in abundance of the two species is probably due to the greater ecological tolerance of *Megaphyllum unilineatum*. Based on literature data (SCHUBART 1934), this species occurs in almost every kind of biotopes. Since millipedes usually prefer rather moist microhabitats, *Megaphyllum unilineatum* having a broad tolerance for environmental conditions often becomes dominant on drier places. In Hungary, it is a common inhabitant of sandy grasslands, disturbed, ruderal, and anthropogenic habitats. Being a relatively large-sized species with successful breeding strategy, it is obviously a serious competitor for other millipedes.

Kryphioiulus occultus is a small species, preferring a warm climate and, at least in Hungary, seems to be confined to undisturbed, south-faced, rocky grassland associations.

The characteristic sex ratio observed in both species can be considered to be usual in millipede communities; females appear in larger numbers in the pitfall traps, because there are more females, and not because they are more active (BAKER 1985). This sex ratio may be connected with the otherwise poorly known life history and breeding strategy of the species. Similarly, the increasing number of juvenile specimens of *M. unilineatum* during autumn may show a prospering population, while the low juvenile number in the other species may be due to its declining population. Perhaps this latter process may be explained by the expansion of the city to the Buda Mts, and the narrow tolerance limits of *K. occultus*.

The seasonal activity diagrams (Figs 1-2) - which is the result of nocturnal feeding by millipedes (LÖSER 1980) - are typical for soil-dwelling arthropods living in warm

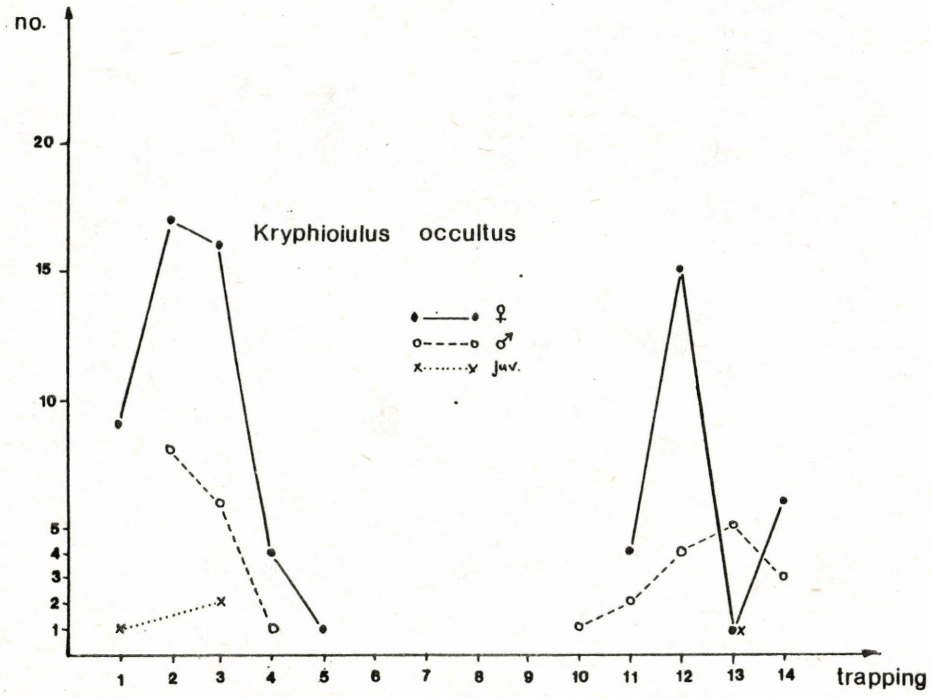

Fig. 2. Seasonal activity pattern of *Kryphioiulus occultus*

grassland communities. In the hot summer months, air temperature can reach 50 °C, and the thin, low vegetation provides little protection against drought. Millipedes, searching for moisture, hide down into the soil and among the dolomite rock fragments for summer aestivation. The situation has already been shown several times: diplopods of the temperate region usually have bimodal yearly activities (GEOFFROY 1981). Besides the spring and autumn activity peaks and the complete winter hibernation, there is usually a low summer activity period. Interestingly enough, in some cases, even winter activity has been proved for millipedes under the snow layer (MERRIAM, WEGNER & CALDWELL 1983). BARLOW (1958) found *Cylindroiulus latestriatus* (=*frisius*) to be active in March-May and September-November. VOIGTLÄNDER (1987) stated the same for *Enantiulus nanus* and *Kryphioiulus* (=*Allajulus*) *occultus*. HORNUNG (1990) during her long-term study of the Diplopoda and Isopoda communities in a sodic grassland in Hungary, also found a summer resting period in *Megaphyllum unilineatum*. As regards *Kryphioiulus occultus*, the early decline of activity at the beginning of June, found on the Odvas Hill, can be explained again by the narrow ecological tolerance of that species.

Pitfall trapping is not a satisfactory method for estimating population size. Despite that, the larger number of captured females and the appearance of the juvenile specimens must be due to a larger abundance. However, the lack of the specimens in the pitfall traps during summer is due to the low activity of the millipedes as soil-dwelling animals (BAKER 1979, 1985, HORNUNG 1990). One aim of the further studies could be a detailed investigation on the population dynamics and life history of both species. The relationship between the environmental factors and the millipedes can also be subject to subsequent examinations.

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Author's address: Dr. Zoltán Korsós
Zoological Department
Hungarian Natural History Museum
H-1088 Budapest, Baross u. 13
Hungary