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TEMPORAL AND SPATIAL PATTERN OF A DIPLOPOD POPULATION (MEGAPHYLLUM UNILINEATUM (C. L. KOCH)) IN A SANDY GRASSLAND

Z. VAJDA, and E. HORNUNG

Department of Ecology, József Attila University, H-6701 Szeged, P. O. B. 659. Hungary

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Abstract

The complex ecological studies (started in 1976) in a sandy grassland of Kiskunság National Park (Hungary) have given a good oppotunity to analyse the population characteristics of *Megaphyllum unilineatum* (C. L. KOCH), the only diplopod species living in that site.

Based on three years data sets of pitfall trapping (1983—85) the population's seasonal changes and spatial distribution were analysed on the basis of their surface activity. It can be concluded that

(1) the seasonal activity curve of the population has three peaks (spring, early summer and autumn). These peaks are related to climatic changes and reproductive periods.

(2) The spatial distribution is aggregated as a consequence of the heterogeneous habitat, macro-and microclimatic conditions. The places of aggregation are in so called shelter sites.

(3) The early larval stages appear at certain sites with most equalized microclimate („shelters").

Key words: Diplopoda, Iulidae, *Megaphyllum unilineatum*, sandy grassland, spatial heterogeneity, seasonal changes, population dynamics, clumped dispersion

Introduction

Most publications on diplopods deal with species of woody habitats. Studies on the fauna of different grassland types are very rare (HAACKER, 1968; COTTON and MILLER, 1974; BAKER, 1978a,b; BERCOVITZ and WARBURG, 1985; MEYER, 1985). The main reason for this fact may be due to the low species diversity of diplopods in such habitats. The studied *Megaphyllum unilineatum* is a drought resistent species of Mediterranean origin (GOLOVATCH, 1990), widely distributed in the Hungarian fauna. It is common in dry grasslands, in open acacia and poplar forests in Hungary. The species characteristics, environmental needs, areal distribution is given by HAACKER (1968).

Materials and methods

Description of site

Our ecological studies were carried out in a typical sandy grassland of the Great Plains, in central Hungary (Kiskunság National Park, Bugac region (MÓCZÁR et al., 1980). The investigated area is a part (2.4 ha, isolated of grazing by a fence) of a large pasture, the so called Puszta. The surface of the study site is heteromorph, dissected by wind-formed grooves and sand ridges, what means level differences of 2.5—3 m. The plant cover of the area stays mainly in three, mosaic-like plant assotiations (Fig. 1.), growing as a result of a secondary succession caused by the mentioned isolation (lack of grazing).

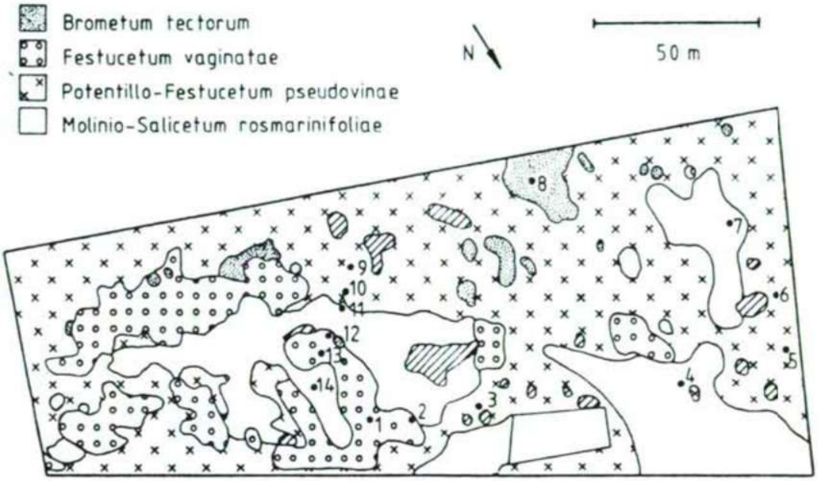

Fig. 1. Map of the investigated area with the different plant associations. The numbers (1—14) indicate the sites of trapgroups.

On higher levels (sand ridges) an open, perennial sandy-steppe grass assotiation (*Festucetum vaginatae* (FV)) can be found. The coverage of plants is low (40—60%), with large patches of bare sand surface. The soil here is coarse grained, having low humus (under 1.5%) and moisture content (between 2 and 7%). On deeper stands (wind grooves) appears a more dense association of *Molinio-Salicaetum rosmarinifoliae* (MSR), which consists of higher plants, means a closed grass association (total coverage 85—100%). The soil moisture here is 3—14% and the humus content is about 3.5% (KÖRMÖCZI, 1983).

The macroclimate is semiarid with a summer precipitation under 200 mm and with a daily temperature fluctuation of 27—32 °C. (Detailed description of this area can be found in BODROGKÖZY and FARKAS, 1981; KÖRMÖCZI et al., 1981; KÖRMÖCZI, 1983; HORNUNG, 1984.)

Sample methods

Nearly 6000 specimens of *M. unilineatum* were collected by pitfall-trapping from 14 standard sites of the area (Fig. 1.) through three years, from 1983 to 1985. The traps were emptied bi-weekly during the whole activity period, from March till the end of November. (For detailed sampling technique see HORNUNG, 1984.) The continuous data sets give a good possibility to study the population both in time and space. Thus we gain information about the relative abundance and locomotion activity of individuals.

Evaluation

Population dynamics was followed on the basis of trapped individuals' mean numbers at the regular sampling periods.

To introduce spatial heterogeneity dispersion was analysed. The pitfall traps were placed at 14 standard sites of the three main plant associations: in *Festucetum vaginatae* (FV) on sand ridges (trap No. 1, 2, 10, 12, 13), *Potentillo-Festucetum pseudovinae* (PFP) (No. 3, 5, 6, 9) and *Molinio-Salicaetum rosmarinifoliae* (MSR) in wind grooves (No. 4, 7. 11, 14). Trap No. 8 — by its environmental characteristics — can be envolved in FV trapgroup.

Type of dispersion was analysed: Index of dispersion ($I_D = s^2/\bar{x}$, in sensu SOUTHWOOD, 1978) was calculated for every sampling period of each year (Fig. 2.).

Group average clustering of Chekanovski's similarity coefficient was used for comparision of habitat patches (see SOUTHWOOD, 1978).

Results and discussion

Population dynamics

The curves of population changes show the same seasonal tendency during the three years studied (Fig. 2.). They have three maxima: in April, in June and in October. Activity with three peaks was shown by David (1984). MEYER (1985) found julid species with one and two peaks of abundance, whereas PEITSALMI (1981), DUNGER and STEINMETZGER (1981) described two activity peaks. The differences may be due to either the great geographic distances, or to both the different species and their different environments within their habitats.

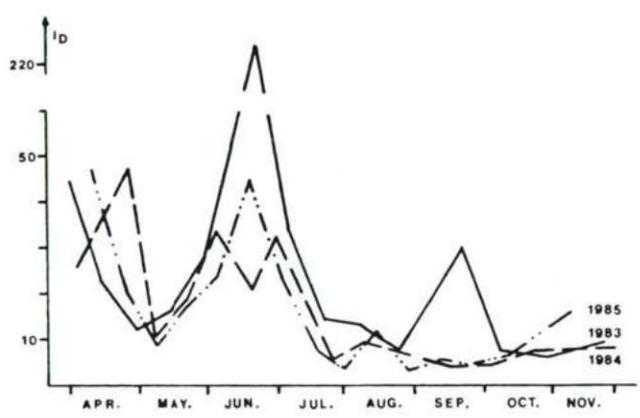

Fig. 2. The changes of dispersion indices (I_D) during the investigated time periods.

For standardization values of Fig. 3. (number of caught individuals) are corrected for trapdays. The first peak appears in spring, when climatic conditions are relatively favourable and individuals are surface active. During this time a large number of individuals can be observed moving on the bare sand, too.

The decreased number during May, after the first peak can be due to the partial inactivity of ovipositing females. The sex rate of adults is about or above 0.5 in this period (Fig. 3.). All the authors calculating sex rate found that number of females exceed that or males. (For further data see HALKKA (1958) and TRACZ (1984).)

In June (second peak) the females after having layed their eggs, may become active again and also the first moving larval stage (second developmental stage with one ocellus) appears.

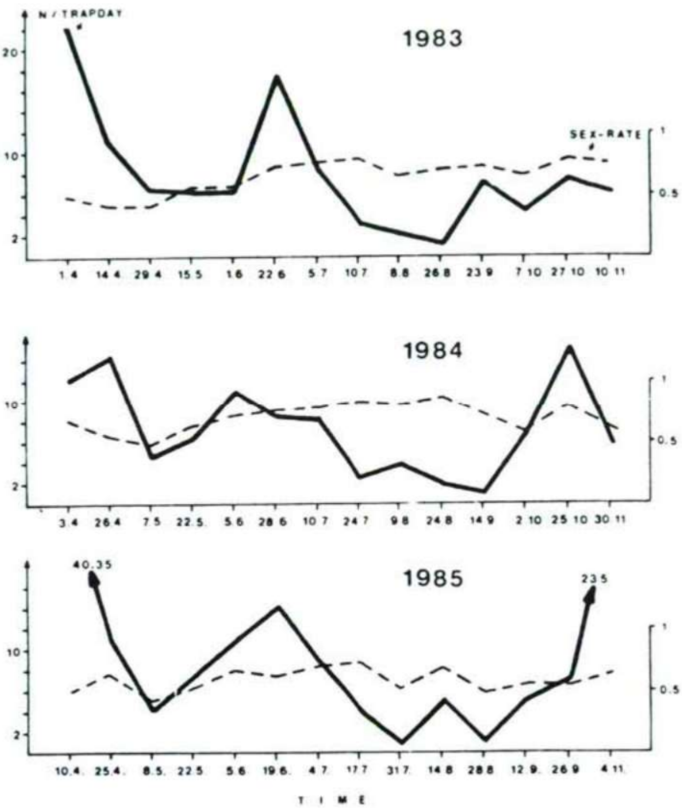

Fig. 3. The changes in the number of trapped individuals, corrected for trap-days.

The great decline in mid-summer must be due to weather conditions as drought prevails during this period. As a result soil surface temperature reaches a maximum and soil moisture content is at a minimum. Under such extreme physical conditions individuals may become totally inactive. This is called „summer-sleep" by STOJALOWSKA (1961).

The third peak in activity appears in October. With improving climatic conditions the surface activity increases. Mating pairs can be regularly found during the fall.

Spatial heterogeneity

On the basis of dispersion indices the distribution of the population prooved to be aggregated during all periods (Fig. 2.). The highest aggregation was noticed in April and in June during all three years. Dispersion indices are significant in every case ($p < 0.001$) by the chi-square test. Fig. 4/a. shows the dendrograms of similarity of sites based on the the 14 trap-sites and the different sampling periods. It can be clearly seen that diplopods qualify their habitat to be „coarse grained". The traps are divided into two similarity groups. The „most favourable" sites are shown by the three-dimensional figure of trapped individuals (Fig. 4/b.) where the number of

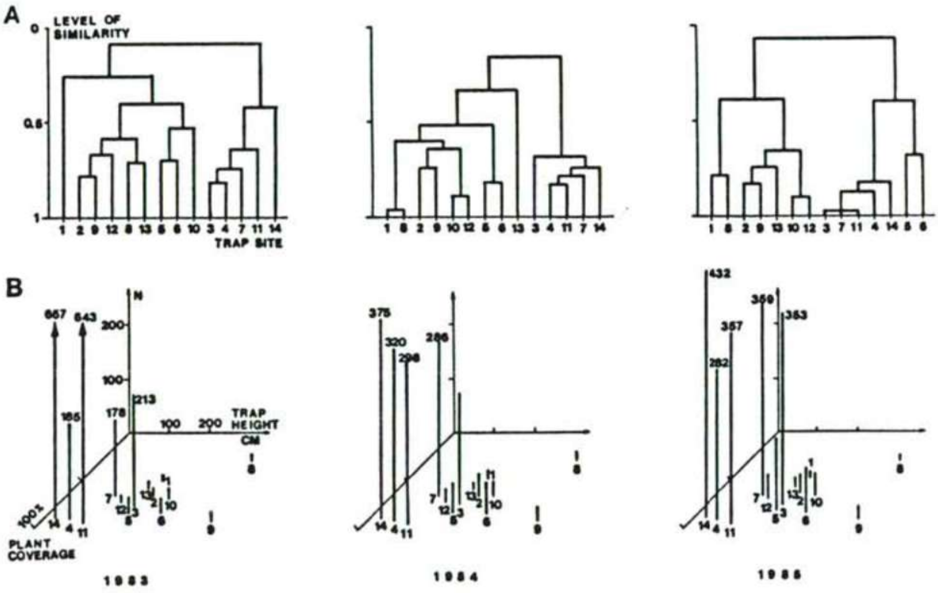

Fig. 4/a. Dendrograms of similarity of the 14 trap sites (Chekanowski's coefficient; group averaging). 4/b. Number of trapped animals during the different years in connection with plant coverage and the vertical position of traps.

diplopods is related to the vertical position of sampling sites („trap height") and to the percentage of plant coverage. The highest figures are the ones in „wind groove" traps. Diplopods seem to prefer living at deeper places, with high plant coverage (Trap No. 4, 7, 11, 14). These sites were located in the MSR association, where relative humidity was the highest within the study area (35—48% during summer mid-day). The daily temperature fluctuations were lower comparing to sand ridges. The soil surface temperature fluctuated less because of increased foliage heights (40—60 cm) and denser plant cover (85—100%). These were the sites most frequently used for egg laying. More than 90% of the early larval stages (mainly the second) appear in wind groove traps. They are the most sensitive to humidity. Early instars are known to assamble in the hatching site (STRIGANOVA and MAZANTSEVA, 1979). Egg clutches can be often found under these traps. Survival probability of larvae is the highest at these humid places (see also HALKKA, 1958; PEITSALMI, 1981). These microhabitats are the sites of adult aggregation aswell. About 70% of adults were trapped there.

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