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Summary

It has been widely assumed that Collembola respond to light, but until now there has been very little experimental proof of this. Field observations allowed to distinguish soil-dwelling species that would escape from light from surface-dwelling species that would be attracted to light. However, the supposed effect of light could be due to other factors such as temperature or dryness. We demonstrated that individuals of the Collembolan species *Heteromurus nitidus* (Entomobryidae), when placed in a light gradient (temperature and moisture being homogeneous), clustered in the darker area. This effect occurred rapidly and changes in the distribution of animals persisted after illumination ceased. This shows light to act as a strong repellent for this soil-dwelling Collembolan species.

Keywords: *Heteromurus nitidus*/Light avoidance/Repellence/Collembola.

Réponses à la lumière d'une espèce de Collembole édaphique.

Résumé

L'idée que les Collemboles répondent à la lumière est généralement bien acceptée alors que ce phénomène n'a que très peu été étudié expérimentalement. Les observations sur le terrain ont permis de distinguer des espèces de surface, qui seraient attirées par la lumière et des espèces édaphiques qui fuieraient la lumière. Cependant, ces effets attractifs ou répulsifs imputés à la lumière peuvent être dus à d'autres facteurs tels que la température ou la sécheresse. Nous avons démontré que des individus de l'espèce *Heteromurus nitidus* (Entomobryidae), placés dans un gradient lumineux (les conditions de température et d'humidité étant homogènes), se regroupaient dans le secteur le moins éclairé. Cette distribution se mettait en place rapidement et persistait après suppression de la lumière. La lumière exerce donc un puissant effet répulsif sur les Collemboles édaphiques.

Mots-Clés: Agent répulsif/Collembole/*Heteromurus nitidus*/Evitement de la lumière.

INTRODUCTION

The idea that light affects the distribution of most Collembola arises from the occurrence of light-sensitive organs [4]. A number of Collembola live in soils, between 1cm and 6 cm depth [2]. We can postulate that one of the facts explaining the avoidance of surface conditions by soil-dwelling species is light avoidance, but we don't know whether these species escape from dryness, heat, wind or light. Experimental proof of behavioural responses to light alone does not yet exist. Some surface-living species have been found to be attracted to light [3, 9] but no experimental results concerning the effect of light alone have been presented. Only Zettel (1989) showed that the photoperiod was involved in the seasonal polymorphism of *Isotoma hiemalis*. Wilson (1975) reported the negative phototaxis of two entomobryid species, *Pseudosinella dobati* (Gisin 1965) and *Heteromurus nitidus* (Templeton 1835), but she did not present any experimental proof. We studied experimentally the impact of light alone on the distribution of the soil-dwelling species *H.nitidus*.

MATERIAL AND METHODS

The sensitivity of *H.nitidus* to light was tested in Petri dishes (diameter 8cm) containing two half-disks (diameter 5cm) of moistened filter paper placed at 1.5 cm distance from each other. Animals arisen from batch cultures on moistened sand, placed in dark chambers since a soil-dwelling species usually lives in a dark environment. Six Petri dishes (replicates) were placed in a natural light (blue sky being the source) gradient in such a way that one half-disk was more enlighted than the other. Shade was made by lid and sides of Petri dishes. Moisture and temperature (20°C) in Petri-dishes were homogeneous and constant. Animals were let a few minutes in ambient light in their culture boxes before placing them in test-boxes to acclimate them to light. Ten *H.nitidus* were introduced in each Petri dish, just between the two half-disks. Their number was counted on each half-disk every 10 min during two hours and a half. The difference in the number of animals between the darker area and the more enlighted one was calculated for each test-box at each time. The mean of

the six replicates was compared to the theoretical null value (= no difference between both areas) at each time by a t-test [6]. Measures at different times were treated separately because they were not independent. Such analyses that does not include time as a factor permit however to follow changes in the distribution of animals over the experimental period.

Another experiment was performed to determine the intensity and the duration of the light effect. In fact, the production of aggregation pheromones by individuals may decrease their locomotory activity [5; 7] to a point that animals, formerly distributed according to their sensitivity to light, may stay motionless even after disappearance of the light gradient. The procedure was the same as above except that five minutes after introducing the animals in the light gradient, they were counted on each half-disk then the boxes were rapidly transferred to a dark enclosure. Animals were then counted every 10 min. Results were analysed as above.

RESULTS AND DISCUSSION

The first experiment indicated that *H.nitidus* individuals left in a light gradient during 140 min were significantly more abundant in the darker area from 10 min up to the end of the experiment (*figure1*). Thus light acts rapidly as a repellent factor for *H.nitidus.*

When animals were placed under a light gradient during 5 min only then transferred to darkness, their number was significantly higher in the darker area and still remained so significantly during 15 minutes after their transfer to darkness (*figure 2*). Thereafter, differences were no longer significant and decreased with time. Consequently, the effect of light on the distribution of *H.nitidus* started abruptly and persisted some time (several minutes) after disappearance of light, probably because of the deposition of aggregation pheromones [5; 7].

Our results corroborate the negative phototaxis assumed by Wilson (1975) and the hypothesis that light influences the distribution of Collembola. Soil-dwelling species escape from light and surface species would be attracted to light [9], even though light is probably not the only factor that influences their distribution, since temperature [10] and dryness [1] may be involved too.

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Legends

Figure 1: Differences in the number of *Heteromurus nitidus* (mean of 6 replicates +/- standard error) between the two moist areas ("less-"– "more enlighted") of filter paper placed in a light gradient during 140 min. Results of t-tests on the departure of these values from zero, are indicated as ** = P<0.01; *** = P<0.001.

Figure 2: Differences in the number of *Heteromurus nitidus* (mean of 6 replicates +/- standard error) between the two moist areas ("less-"– "more enlighted") of filter paper placed in a light gradient during 5 min then placed in darkness during 135 min. Results of t-tests on the departure of these values from zero, are indicated as NS = not significant; * = P<0.05; ** = P<0.01.

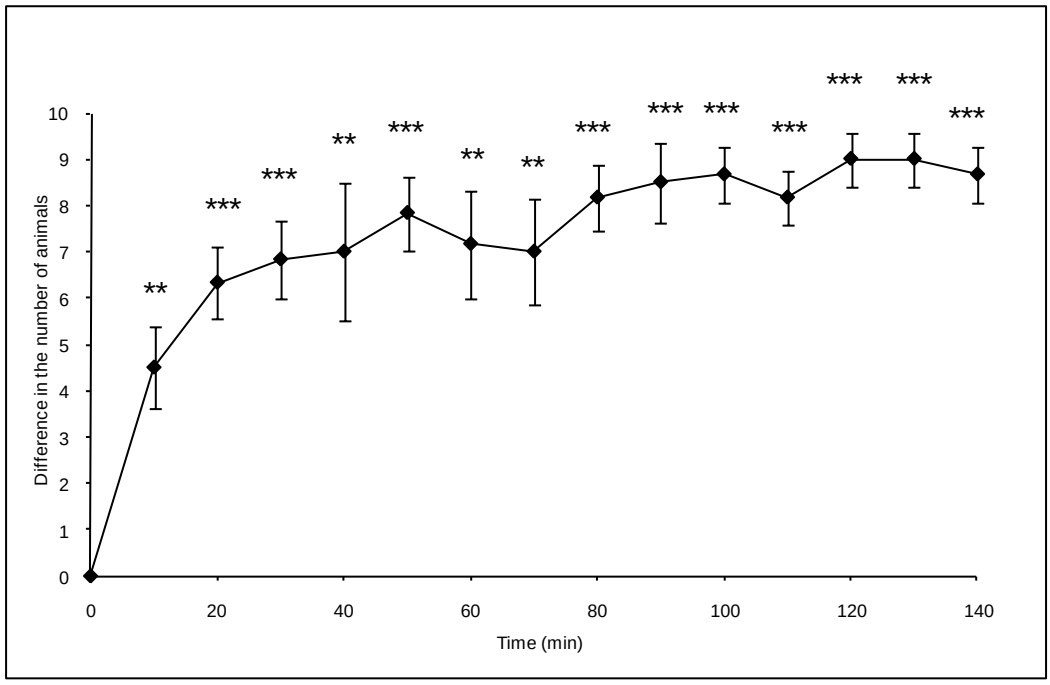
Difference in the number of animals
Time (min)
0
1
2
3
4
5
6
7
8
9
10
0
20
40
60
80
100
120
140
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Fig. 1

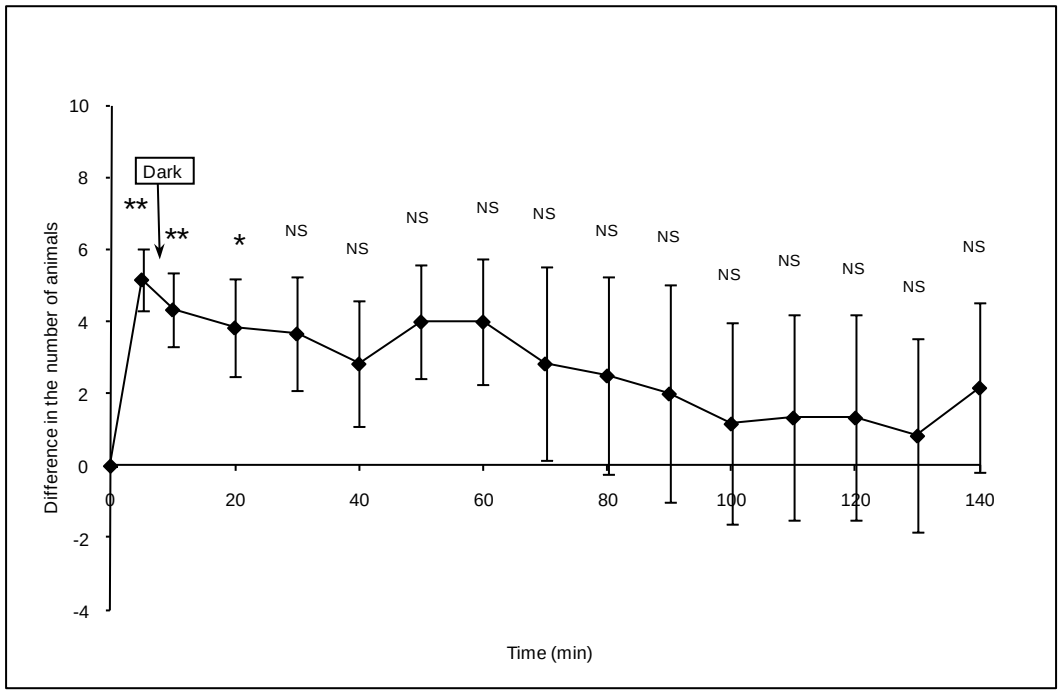
Dark
**
**
*
NS
NS
NS
NS
NS
NS
NS
NS
NS
NS
NS
NS
Difference in the number of animals
Time (min)
10
8
6
4
2
0
-2
-4
0
20
40
60
80
100
120
140

Fig. 2