Reasons to move far away: studying the drivers of *Carpetania matritensis* (Hormogastridae: Crassiclitelatta) dispersive potential.

A. Martínez Navarro[1]*, S. Jiménez Pinadero[1], Daniel F. Marchán[1], D. Trigo[1]

1 Departamento de Biodiversidad, Ecología y Evolución, Facultad de Biología, Universidad Complutense de Madrid, C/ José Antonio Nováis, 28040, Madrid, Spain
*Author for correspondence: alejma21@ucm.es

Introduction

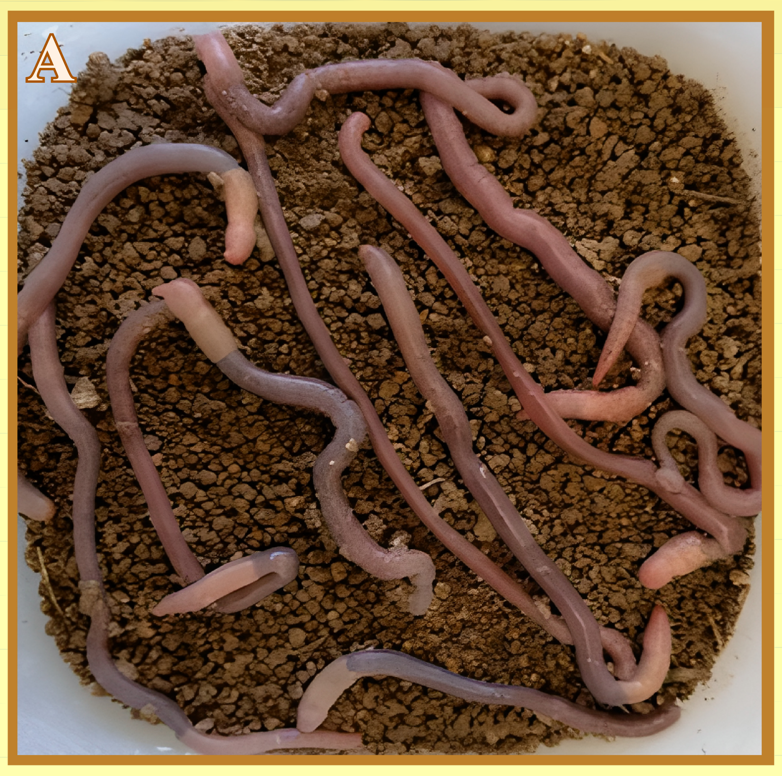
Dispersal is a **crucial process** that plays a key role in the dynamics of ecological communities. The drivers of the dispersal behavior have been described for a large number of organisms, but it is still **unknown for soil fauna**, which is the basis for a wide variety of ecosystem services. The cryptic species of the genus *Carpetania* are isolated by narrow boundaries, positing **limited active dispersal ability** or the existence of **ecological barriers as possible causes of their genetic isolation and speciation.** The aim of this work is to study the **dispersive potential of *Carpetania matritensis*** to understand its behavior and the factors involved.

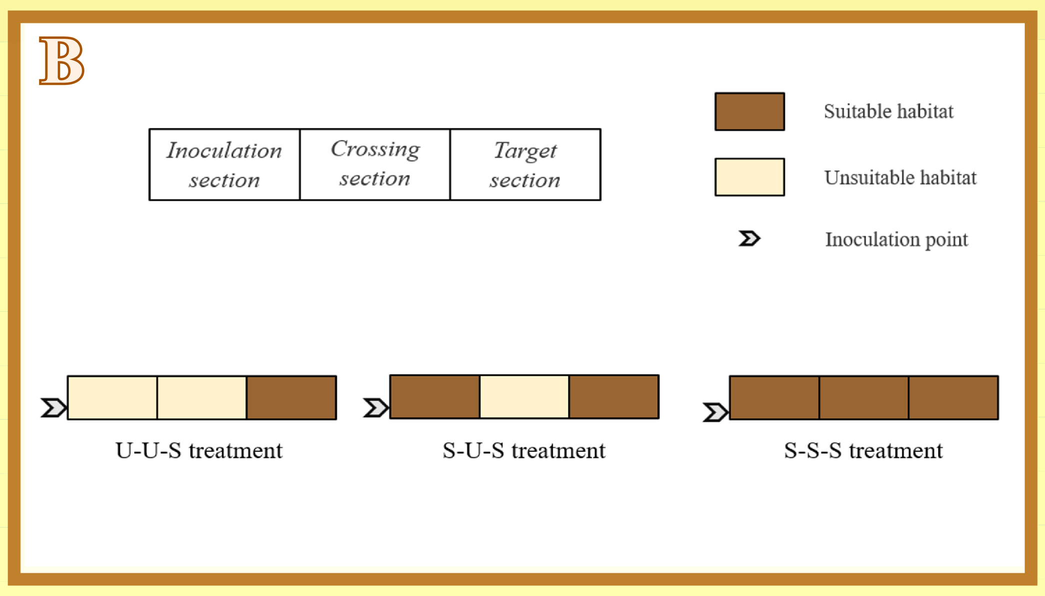
Materials and methods

288 individuals of the species *C. matritensis* **(A)** were collected from El Molar (Madrid, Spain). The experiments were carried out in horizontal, tubular corridors divided in three identical sections: inoculation, crossing and target (from left to right). To study the effect of habitat quality on the dispersive potential, **three different treatments** were performed. These treatments differ each other depending on the habitat type filling the inoculation, crossing and target section respectively: suitable (S; soil from el Molar) or unsuitable (U; sand). **(B)**

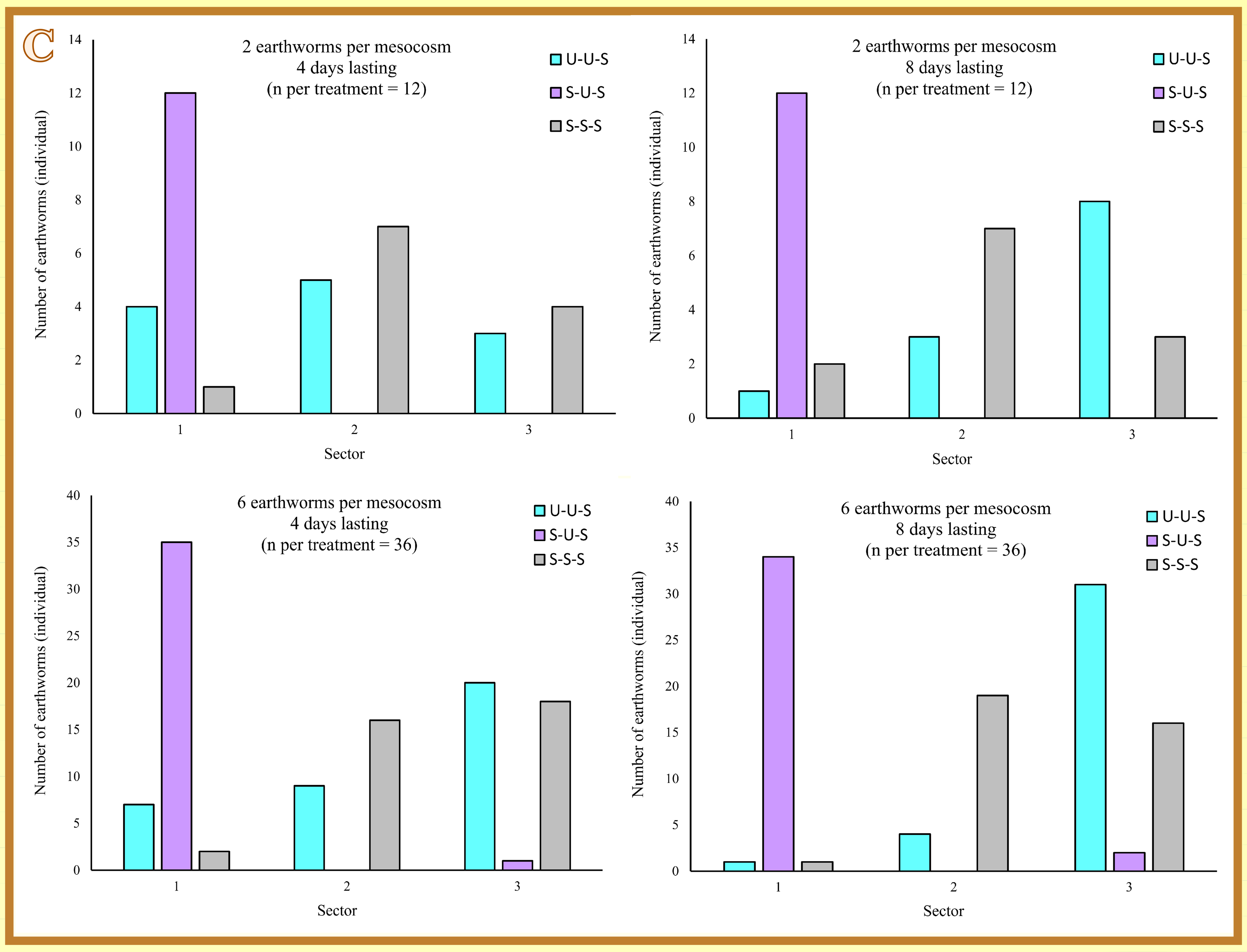
Earthworms were inoculated at **two categories of conspecific density** (2 and 6 individuals per mesocosm) to study the effect of conspecific density, and they were exposed to the treatments during **two periods of time** (4 and 8 days). For each combination (treatments*density*time), 6 replications were performed, giving a total of 72 sample units. At the end of the experiment, the number of individuals in each section were counted.

The earthworms' weight gain was calculated to do an ANOVA with the type of treatment as a raking factor. The dispersal rate, defined as the proportion of individuals that were in the target section, was calculated, using it as a responde variable of a GLM (binomial distribution). A GLMM (Poisson distribution) was performed to study a within-subjects effect. Finally, a GLM of the dispersal rate as a function of time was carried out for each treatment. All statistical analyses were performed in R v4.0.3.

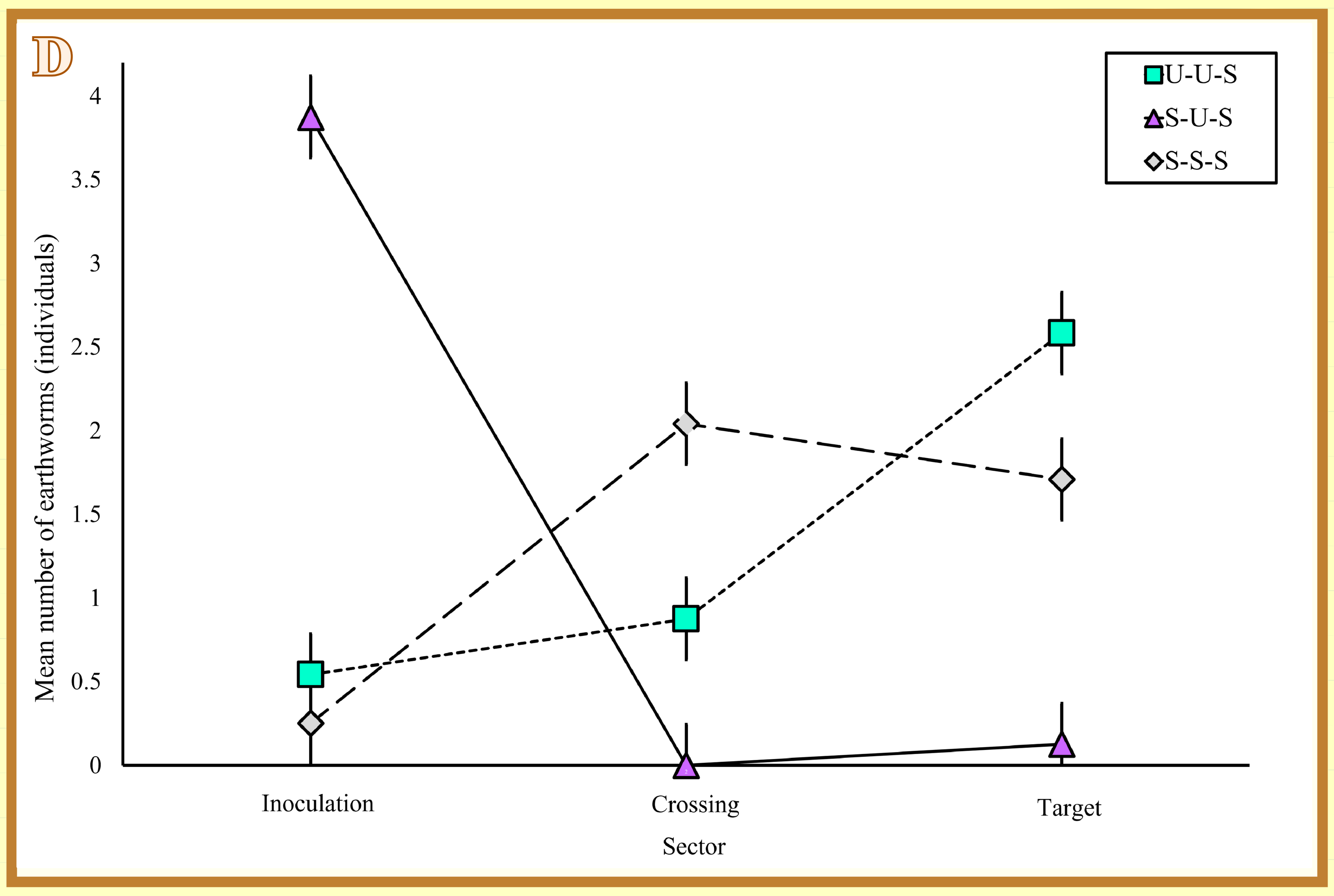




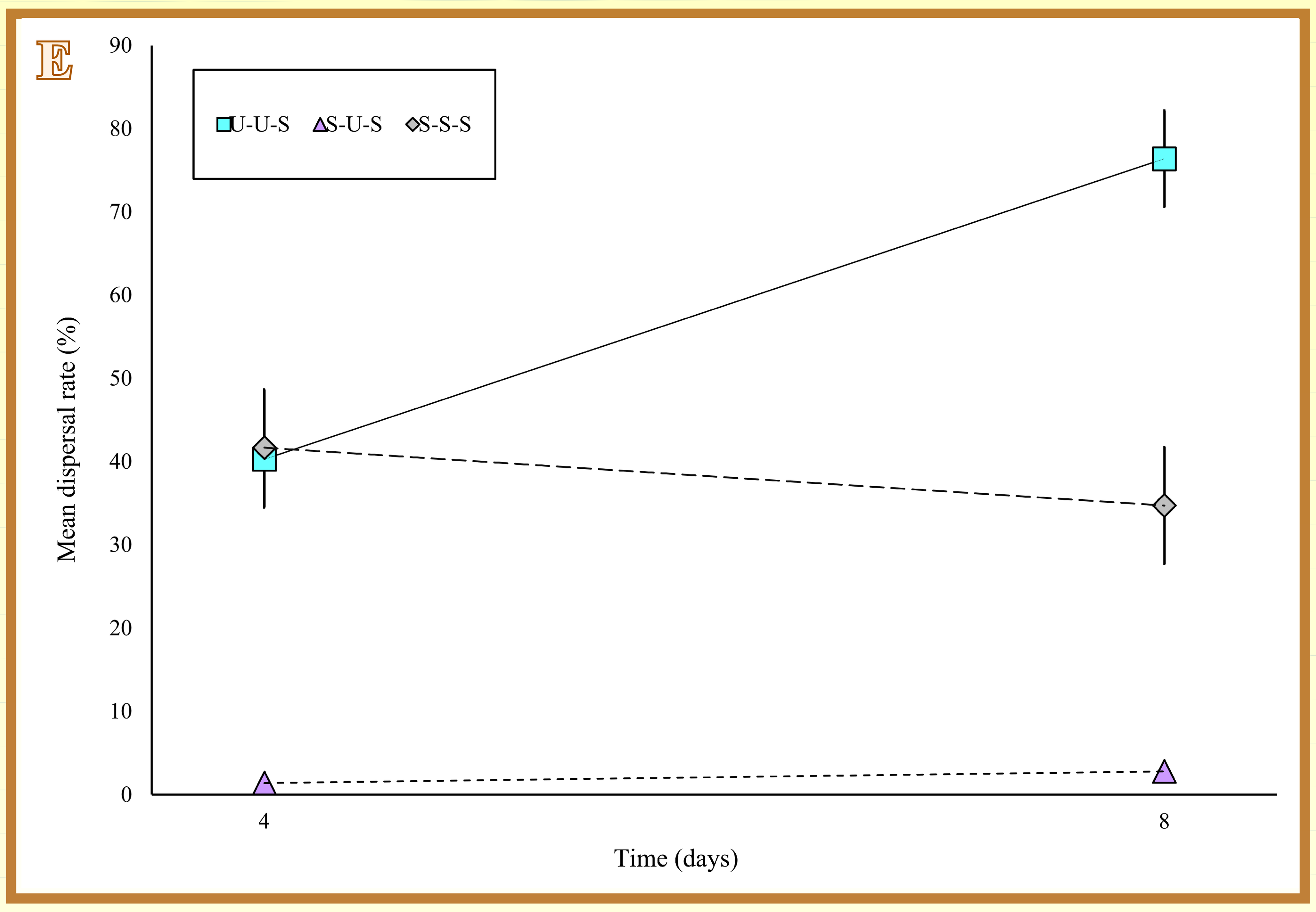
A: individuals of *C. matritensis;* **B**: General design of the mesocosms and representation of the experimental treatments.



Distribution of individuals per sector for every experimental combination (treatment, density and experimental duration). 1 = inoculation sector; 2 = crossing sector; 3 = target sector.



Average number of earthworms per sector for each treatment.



Evolution of the dispersal rate over time for each treatment.

Results

It was detected a **highly significant effect of treatment on dispersal rate** (58.33% for U-U-S treatment, 2.08% for the S-U-S treatment; 38.19% for the S-S-S treatment).

No significant effect of experiment duration or density on the dispersal rate, neither its interactions, **were found.** However, **the effect of time length was close to significance** (p = 0.06907), suggesting that the dispersal rate over time might be different depending on the treatment. **(C)**

The individuals exposed to the U-U-S treatment suffered a weight loss during the experiment. In contrast, **the earthworms of the S-U-S and S-S-S treatments experienced a gain weight.**

The GLMM showed that **the number of earthworms in the inoculation, crossing and target sectors differs between treatments. (D)**

The effect experimental duration on the dispersal rate approaches statistical significance for the U-U-S treatment dataset exclusively, being higher over time **(E)**

Conclusions

The weight loss observed in the U-U-S treatment as well as a higher dispersal rate establishes habitat quality as one of the key drivers of *C. matritensis* dispersive potential. Crossing a physical barrier imposes costs in terms of time and energy, and therefore movement is slower than under optimal conditions, so earthworms would need more time to reach the section where they intend to settle.

C. matritensis does not cross physical barriers if it is in an optimal environment for the species, which would explain the aggregation behaviour observed in this work. This would be consistent with the distribution of *Carpetania* populations in the wild. Differences in dispersal ability within the cryptic species of this genus could explain why *C. matritensis* is one of the most widespread and successful cryptic species in the *Carpetania* range. Further research is needed to understand its dispersive potential in detail, which would allow to predict the future of the species facing climate change.