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Selection of the habitat in the rest phase of the *Helix aspersa* under laboratorial conditions

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Abstract

The objective of this study is to determine the incidence of light and the shape of the raising box on the preferred habitat during the rest phase of rest of the *Helix aspersa*. To do this experiment have taken a sample of 500 animals with an average weight of 1.80+0.05 g and distributed them in 20 raising boxes. The study took place between December and January with decreasing diurnal phase and average temperature of 21.9+0.09 ºC. The rearing boxes were made of translucent plastic, 14.5 x 14.5 x 7.5 cm, and were cleaned daily to avoid the negative effects of excreta, mucus and density. The study lasted of 30 days. Each day resting place, and the orientation with respect to the light, of each snail was recorder. The results indicate that the snails, during the phase of rest, display positive phototropism. They prefer the high places of the box ($p<0.0001$), and they prefer the illuminated places rather than the dark ($p<0.0001$). With respect to the form of the raising box they show preference by the corners of the front walls or ceiling of the box ($p<0.0001$).

Introduction

Habitat selection is an important aspect in heliciculture. Studies by Willig *et al.* (1998) and Attia *et al.* (1997) reported that snails usually present a heterogeneous distribution on the available surface. Consequently, only part of the available surface can be considered as useful. Nevertheless, this statement is not taken into account in heliciculture, where the main criterion considered for breeding management is the number of snails by square meter.

In this sense, determinant factors involved in the heterogeneous spatial distribution should be studied, in order to optimize the available surface, which is one of the limitant factors in snail farming. Simultaneously, this knowledge can also avoid the overpopulation adverse effects.

The mechanism of selection of the physical structure of the habitat and the light intensity acquires great importance in invertebrates (Eterovick and Figueura, 1997; Hill *et al.*, 2004). Both factors influence on the vulnerability of the animals and the protection of their environmental stress (Lima and Dill, 1990: McNett and Rypstra, 2000; Guidetti, 2000).

Therefore, the aim of the present study is to evaluate the effect of light, habitat structure and altitude in the habitat selection of the *Helix aspersa* Müller during the rest period. A laboratorial experience has been designed to study the distribution of the population during the mentioned period.

Material and Methods

Areas of study

Translucent plastic boxes with rounded edges (14.5 x 14.5 x 7.5 cm) were used to housed the snails under controlled laboratory conditions. Habitat selection was studied using four different light levels, three types of structure and two levels of altitude. Therefore, 24 microhabitats with different combinations of the evaluated categories were formed. Also, all microhabitats display the same availability and accessibility.

Boxes were divided in quadrants according to decreasing illumination intensity: A (500 luxes), B (200 luxes), C (50 luxes) and D (25 luxes). Solar indirect illumination was used, but the required illumination grade was obtained by covering the quadrants with plastics of different opacity.

The quadrants were divided in three sectors according to their structural complexity, in order to evaluate the type of surface. Sector 1 corresponds to the smooth zone in the experimental box, sector 2 comprises the edges and sector 3 is conformed by the corners of the boxes.

Finally, the spatial distribution of the snails was evaluated according to the altitude. For this purpose, the ceiling and superior half of the walls were considered as high level (I); and the ground and inferior half of the walls were defined as low level (II).

Animals and experimental conditions

400 young snails *Helix aspersa* Müller were used. Animals were fifteen weeks-old and weighted 1.80 ± 0.05 g. The snails were originally collected from CIFA (Andalusian Agrarian Research and Training Centre). After one-month adaptation to the experimental conditions they were randomly distributed in 20 experimental boxes with 20 animals per box.

In order to evaluate habitat selection without disturbing the normal behaviour of the snails, environmental conditions suitable for their physiological circadian rhythm were reproduced in our laboratory (Garcia *et al.* 2004). The resting period is characterized as a diurnal period in which snails choose the place where they will remain resting during the whole day. The active period is defined as a nocturnal period in which snails eat and have locomotive activity.

Experimental climatic conditions in each period are indicated in Table 1. Thus, relative humidity of 63% and 14h of light were applied during the resting period. In the active period, relative humidity was 76% and snails were in the dark (10 h). This experience was developed from December 2003 to January 2004, and the average temperature was 25,9ºC, ranged between 12ºC and 36ºC. Also, the boxes were cleaned daily to avoid the negative effects of excrements, mucus or density (Herzberg, 1965; Chevallier, 1979; Dan and Bailey, 1982).

Table 1. Environmental conditions.

	Active period			Rest period		
	Min	Mean	max	Min	Mean	Max
Relative humidity (%)	69	76	87	52	63	76
Temperature (ºC)	12.0	21.3	27.0	24.0	30.4	36.0
Light Photoperiod (h)	14 h light and 10 h dark					

Measurements and statistical analysis

This trial was carried out during 35 days, in which the position of snails in the experimental boxes was daily registered. In a preliminary experience the changes in the snails' location were analysed during the resting phase, in order to determine how many checks were needed for studying the habitat selection. The location of the snails was controlled three times a day during the resting phase (at the beggining, at the middle and at the end). No significant differences ($P > 0.05$) were observed in the location changes during the day. Therefore, a daily control realized after 6/7 hours from the beginning of the inactivity period was determined.

Unifactorial variance techniques (ANOVA) were used to establish significant differences in the distribution of snails in relation to the light intensity, physical structure of the habitat and altitude. Furthermore, the existence of homogeneity groups was detected using a multiple range test (LSD).

Results

Light intensity

The effect of light intensity on the spatial distribution was evaluated. The results obtained are indicated in Table 2. Three levels of homogeneity ($P<0.0001$) were observed, and the most illuminated quadrants presented more number of snails/m^2. Thus, snails seemed to prefer being in quadrants A and B with 8.96(c) and 7.18(b) animals, respectively; quadrants C and D presented a homogenous occupation, lower than 2.66(a) and 3.02(a) animals, respectively.

Table 2. Distribution of animals at different levels of light intensity.

Quadrant	Occupation (aa)
A	8.97^{c}
B	7.18^{b}
C	2.66^{a}
D	3.02^{a}

a, b, c; homogeneity levels: $P < 0.0001$

Habitat structure

The effect of the habitat structure on spatial distribution was evaluated. Results are shown in Table 3. Three levels of homogeneity ($P<0.0001$) corresponding to the studied surfaces were observed. The greater occupation corresponded to the corners of the boxes (c) with 8.63 animals. Secondly, the edges of the boxes (b) had an occupation of 5.17 snails and, finally, the smooth surface (a) presented a density 7 times lower than the one at the corners of the boxes.

Table 3. Distribution of animals at different types of surface.

Sector	Occupation (aa)
1	1.22^{a}
2	5.17^{b}
3	8.63^{c}

a, b, c; homogeneity levels: $P < 0.0001$

Altitude

The effect of the altitude in the spatial distribution of the snails was also evaluated. Results are expressed in Table 4. It was observed that a 66% of the animals was placed in the superior part of the experimental boxes, whereas only a 33% was situated in the inferior part ($P<0.0001$). Therefore, the snails seemed to prefer the higher zones during the resting period.

Table 4. Distribution of animals at different levels of altitude.

Altitude	Occupation (aa)
I	16.5^{b}
II	3.5^{a}

a, b; homogeneity levels: $P < 0.0001$

Discussion

The results showed that snails are placed in a heterogeneous way through the available surface during the resting period, and that the three evaluated factors are involved in the habitat selection. Habitat selection has been described in other terrestrial snails. Thus, Willig *et al.* (1998) showed that the spatial distribution in *Caracolus caracolla* depended on the vegetation, and Attia *et al.* (1997) indicated that *Helix aspersa maxima* used to be concentrated around the source of food supply.

The mobile organisms are constantly making choices depending on the environmental conditions (Hughes, 1990; Alcock, 1998). Numerous factors are implicated in the choice making (Hill *et al.*, 2004), and be a complex interaction between endogenous (behaviour, physiology, etc) and exogenous (environmental conditions, food availability, etc.) factors.

Thus, several factors contribute simultaneously to the mechanism of choice, having different influence (Pennings *et al.*, 1988; Barbeau *et al.*, 2004). This study shows that snails preferred to occupy the illuminated and structurally complex zones of the experimental boxes. Also, the high zones of the boxes are the favourite placement of the snails.

These results indicate that the available surface is not completely usable. Nevertheless, this affirmation is not taken in account in heliciculture, and the number of snails by square meter is the only management criterion to be considered. In our experience, the density obtained was of 292 snails aa/m^2 (in a supposedly random distribution). This in an optimal level of density according to Mayoral *et al.* (2004). However, vacant and crowding zones can be observed when the real distribution of snails is considered. The density of sector 1 in quadrant D was 60 aa/m^2, whereas sector 3 in the quadrant A was 1,423 aa/m^2. Therefore, it is important to know the factors involved in the selection of microhabitat to optimize the use of the available surface and to avoid overpopulation problems.

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