

**NOTES ON THE PREDATION OF
Lymnaea truncatula (Müller, 1774)
BY THE ENDEMIC AZOREAN ZONITID
Oxychilus (Drouetia)atlanticus (Morelet & Drouét, 1857)**

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ABSTRACT: *Lymnaea truncatula* Müller is a freshwater mollusc, introduced in São Miguel, Açores, responsible for the transmission of fascioliasis, a cattle disease of great economic impact on the island. Two biotopes of *L. truncatula* were investigated in order to identify the most common flora and malacofauna associated with these biotopes. In order to control *L. truncatula* a Zonitidae species endemic to the Açores, *Oxychilus atlanticus*, was tested and preliminary results are given.

As *Lymnaea truncatula* is common in environments disturbed by human intervention and *O. atlanticus* prefers undisturbed, natural habitats, several ecological changes must be induced before the introduction of that predatory species.

INTRODUCTION

Fascioliasis by *Fasciola hepatica* L. was first detected in 1962, in São Miguel, Açores, brought from the mainland in infected sheep. Since 1983 the Veterinary Services of the island, based on the number of animals controlled at municipal slaughters, confirmed the growth of the disease (Mendonça, 1987). *Lymnaea truncatula*, the only intermediate host of *F. hepatica* in the Açores, was first recorded by Backhuys in 1975; its distribution, restricted to the eastern half of São Miguel (figure 1) (Mendonça, 1987; Martins, in press) and the biotopes where it is found, suggest a recent anthropic introduction.

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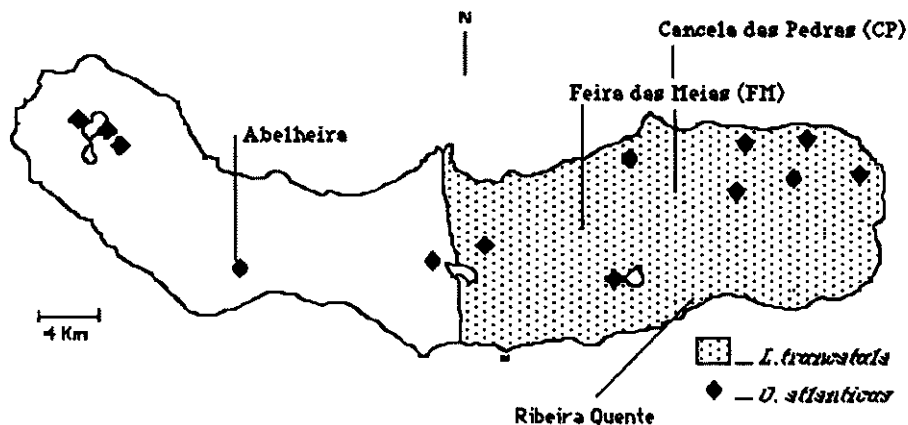


Figure 1 Distribution of *L. truncatula* and *O. atlanticus*, on São Miguel island.

The control of *L. truncatula* can be effected by indirect means, such as changing environmental parameters of the habitat, or directly over the population, namely through chemical or biological control. The application of the latter method has been successfully tested, mostly through the usage of zonitid species, as predators on *L. truncatula* (Moens, 1980, 1982a,; Moens & Vase, 1986; Rondelaud 1975, 1977, 1979, 1980).

Our research is divided in two main subjects: field work studies on the biotopes of *L. truncatula* and laboratory predatory experiments, to assess of the predatory aptitude of *Oxychilus (Drouetia) atlanticus* on *L. truncatula*. The aim of this work is to present a preliminary report on the flora and malacofauna associated with anthropic habitats of *Lymnaea truncatula*, with remarks on the impact of human and natural disturbance, and to present preliminary data on the predatory activity of *O. atlanticus*.

Oxychilus atlanticus, endemic to the Açores, was observed already in the 1870's to predate on molluscs (Arruda Furtado, unpublished); it is widely distributed on the island in different habitats but it is absent from the anthropic habitats of *L. truncatula*. It is expected, then, that a previous change of environmental parameters should happen before an introduction of this predator in habitats of *L. truncatula*. If successful, this action should avoid the introduction in the ecosystem of the island of a foreign predatory species already proven effective against *L. truncatula*.

MATERIALS AND METHODS

A - Biotopes

a - *Lymnaea truncatula*

A qualitative study was carried out on the flora and malacofauna of two biotopes of *L. truncatula* infected with fascioliasis (Mendonça, 1987): a mudhole and a bog. The climatic and soil characteristics are summarized in Table 1.

Table 1. Characteristics of the two biotopes.

	Cancela das Pedras	Feira das Meias
Area (m ²)	20	50
Location	north coast	eastern coast
Altitude (m)	550	520
Rainfall (mm/yr)	170-250	150-200
Evaporation (mm/yr)	45-52	47-50
Relative Humidity (%)	86	87
Mean Temperature (°C)	15	15
Soil	Unsaturated andosoil	Unsaturated andosoil

- Cancela das Pedras (CP), Achadinha (Mudhole)

This biotope, strongly influenced by man mostly due to lack of care in its maintenance, results from the runoff from a tank. According to Mendonça (1987) *L. truncatula* presented an average density of 60/m², between July 1985 and April 1986. To allow standardization of results, the biotope was divided in four areas (1 to 4) and malacofauna and flora were listed, according to the degree of drenching (figure 2A)

- Feira das Meias (FM), Lagoa do Congro (Bog)

This biotope, located near a rural road, is strongly influenced by man. According to Mendonça (1987) *L. truncatula* presented an average density of 45/m², between November 1985 and April 1986. In order to list the malacofauna and flora of the biotope, a 10m transect was made,

divided in 3 areas (1, 2 and 4) related to the degree of drenching as expressed above (figure 2B).

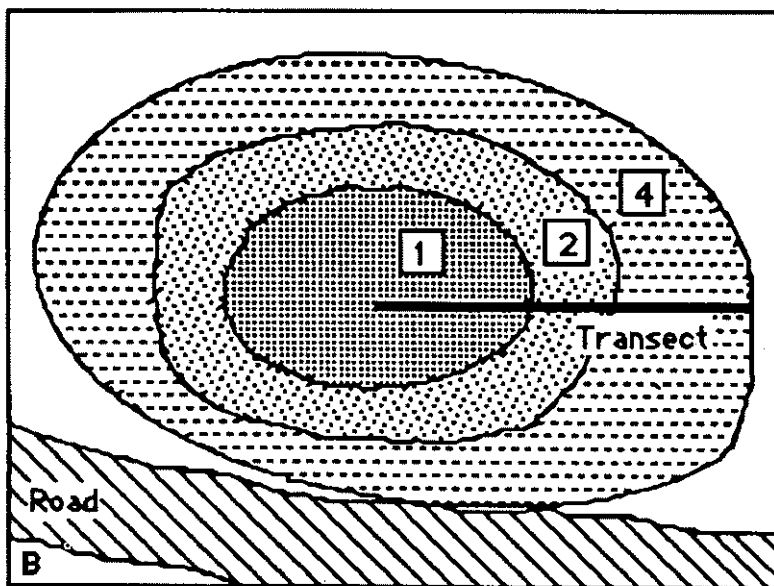
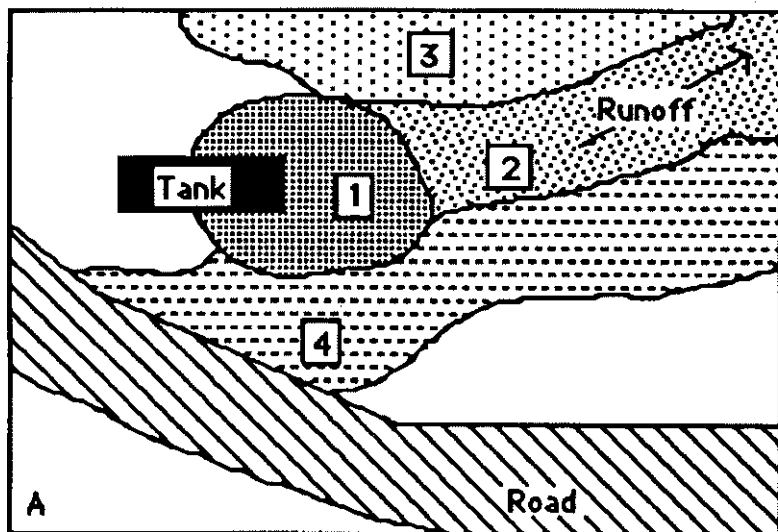


Figure 2 Diagram of the biotopes. Cancela das Pedras (A) and Feira das Meias (B). The degree of drenching decreases from 1 to 4.

b - *Oxychilus atlanticus*

This species has a wide ecological range and it is well distributed on the island (figure 1). It is found in sphagnum, under rocks and among fallen leaves of primitive forests where *Myrica faya* prevails and secondary vegetation of *Pittosporum undulatum* with undergrowth of *Hedychium gardneranum*.

B - Predatory experiments

Lymnaea truncatula came from a drainage ditch at Ribeira Quente, not infected with *Fasciola hepatica* and *Oxychilus atlanticus* from a secondary forest at Abelheira (figure 1). Laboratory experiments followed Moens (1980). Each container received 2 or 10 individuals of *L. truncatula* and 5 individuals of *O. atlanticus*. Experiments were made at temperatures of 10, 12, 14, 16, 18 and 20°C, with 80-90% of relative humidity and 100% of field capacity.

Predation rate (PR) was the average of three experiments and was obtained by counting, each five days, the number of empty shells of *L. truncatula*. Predated *Lymnaea* were substituted by fresh specimens and the vitality of *O. atlanticus* was checked. Slices of carrots, 1 mm thick, were added to half of the experiments, in order to establish the malacophagous aptitude of the predator species. The control did not show mortality.

RESULTS

1 - Biotopes of *Lymnaea truncatula*

a - Cancela da Pedras (CP)

- Flora. This biotope presented a total of 19 species belonging to 11 families (Table 2). Near the tank, where the soil was quite drenched and trampled upon, *Callitriche stagnalis*, *Cardamine pratensis* and *Nasturtium officinale* were dominant. *Poa trivialis*, *Trifolium repens* and *Ranunculus repens* were well distributed over the whole area of the biotope. In proportion with a lower degree of drenching, other species occurred, belonging mostly to the Gramineae, Juncaceae and Polygonaceae. The most disturbed areas (1 and 4) had lower number of species (figure 2A).

- Malacofauna. *Lymnaea truncatula* was the only fresh water mollusc present, well distributed in the whole biotope, mostly on areas 1 and 3 (Table 3). *Oxychilus draparnaudi* was the only zonitid present, well spread in area 2.

Table 2. List of the flora collected at Cancela das Pedras (CP) and Feira das Meias (FM). See figure 2 A&B for interpretation of the numbers under each biotope.

	CP	FM
<i>Agrostis castellana</i> Boiss.& Reuter	3	
<i>Anthoxanthum odoratum</i> L.		2/4
<i>Holcus lanatus</i> L.	3/4	4
<i>Lolium perenne</i> L.	2/3	
<i>Paspalum distichum</i> L.		1
<i>Poa annua</i> L.	2	
<i>Poa trivialis</i> L.	1/2/3/4	1/2/4
<i>Juncus bufonius</i> L.	2	
<i>Juncus efussus</i> L.	3	2/4
<i>Callitriche stagnalis</i> Scop.	1	1
<i>Cardamine pratensis</i> L.	1/2	
<i>Nasturtium officinale</i> R.Br.	1/2	
<i>Mentha suaveolens</i> Ehrh.	2	
<i>Prunella vulgaris</i> L.		4
<i>Lotus uliginosus</i> Schkuhr	2	2/4
<i>Trifolium repens</i> L.	1/2/3/4	
<i>Plantago lanceolata</i> L.	4	4
<i>Polygonum persicaria</i> L.		1/2/4
<i>Rumex conglomeratus</i> Murray	3	
<i>Rumex obtusifolius</i> L.	4	4
<i>Pteridium aquilinum</i> (L.)Kuhn	3	
<i>Ranunculus repens</i> L.	1/2/3/4	2/4
<i>Rubus ulmifolius</i> Schott.	3	
<i>Selaginella kraussiana</i> (G.Kunze)A.Brau		4

b - Feira das Meias (FM)

- Flora. This biotope presented a total of 13 species belonging to 9 families (Table 2). In well drenched areas (1) *Callitriche stagnalis* was dominant. *Poa trivialis* and *Ranunculus repens* were well represented in the transect. The number of species, mostly Gramineae, increased as the soil became less drenched (figure 2b).
- Malacofauna. Two species of freshwater molluscs occurred, *Lymnaea truncatula* and *Pisidium casertanum*. Zonitid species were absent (Table 3).

In these two biotopes, *L. truncatula* was found on places where the water content of the soil exceeded its field capacity for more than 3 months, during the period April - September, what agrees with Moens (1981). In these perturbed areas, the subject was always being renovated and colonised by a micro succession of green algae, a source of food for *L. truncatula*.

Table 3. Malacological fauna of Cancela das Pedras (CP) and Feira das Meias (FM). See figure 2 A&B for interpretation of the numbers under each biotope.

	CP	FM
<i>Lymnaea truncatula</i> (Müller, 1774)	1/2/3/4	1/2
<i>Pisidium casertanum</i> (Poli, 1791)		2
<i>Arion distinctus</i> Mabile, 1868	3/4	
<i>Arion intermedius</i> Normand, 1852		2/4
<i>Carychium minimum</i> (Müller, 1774)	3	
<i>Cochlicopa lubrica</i> (Müller, 1774)	1/2/3	2/4
<i>Deroceras caruanae</i> (Pollonera, 1891)	2/3/4	
<i>Deroceras laeve</i> (Müller, 1774)	2/3/4	
<i>Deroceras reticulatum</i> (Müller, 1774)	2/3/4	
<i>Lehmania valentiana</i> (Férussac, 1823)		2/4
<i>Helix aspersa</i> (Müller, 1774)		2
<i>Oxychilus draparnaudi</i> (Beck, 1837)	3	

2 - Predatory experiments

Oxychilus atlanticus showed predatory activity on *L. truncatula* and was more effective in the absence of an alternative source of food, independently of prey density. Changing prey density from 2 to 10 (figure 3), with an alternative food source, predatory activity was higher at a prey density of 10, except at the temperature range of 16 - 18°C. When *L. truncatula* was the only source of food, predatory activity was higher at low prey density, except at 20°C (figure 4). Changing the food source, within the same prey density (figures 5 and 6), predatory activity was higher at 10°C and in the temperature range of 16 - 18°C. The results were consistent for both prey densities tested.

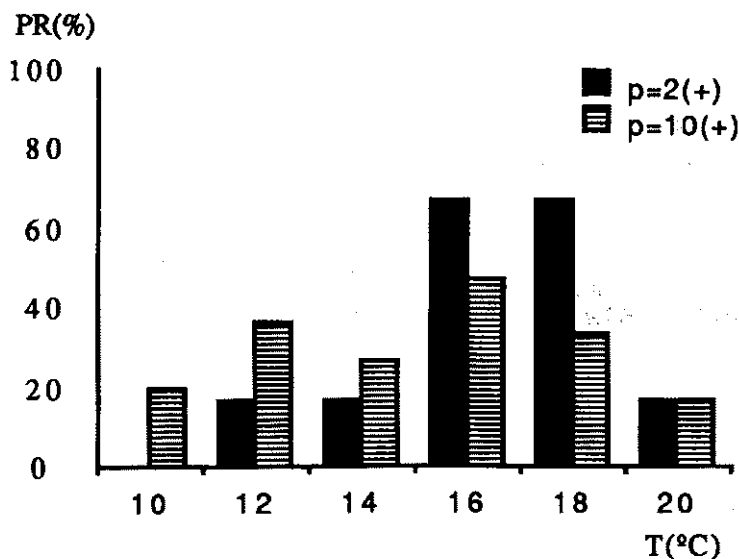


Figure 3 Predation rate (PR) as a function of prey density in the presence of alternative food.

CONCLUSIONS

Cancela das Pedras and Feira das Meias represent typical habitats of *Lymnaea truncatula* in São Miguel island. Both are quite exposed to human disturbance thus favouring the establishment of that opportunistic species. These two biotopes showed common peculiarities in their hydrological characteristics as well as in cover vegetation, expressed by the dominance of Gramineae, Juncaceae and Polygonaceae.

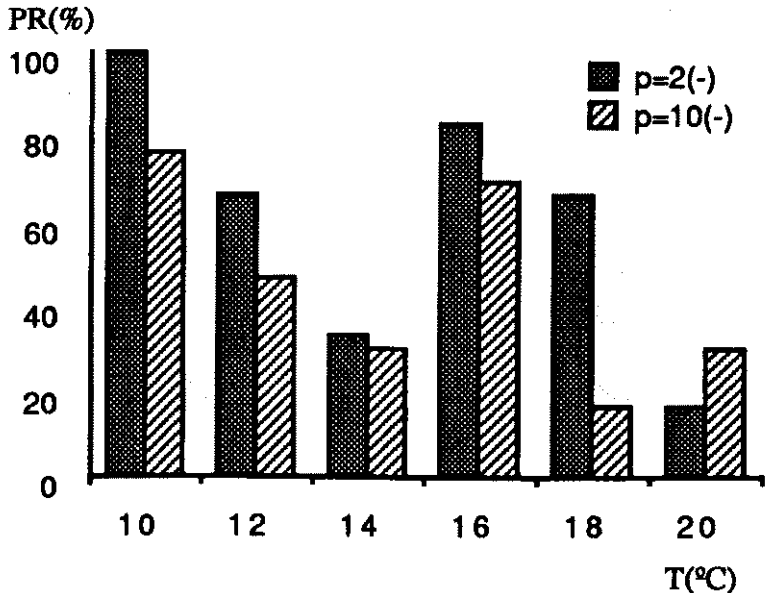


Figure 4 Predation rate (PR) as a function of prey density, in the absence of alternative food.

The occurrence and success of *L. truncatula* depends primarily on two factors: soil moisture and perturbation of the site. The role played by all other factors, such as vegetation, soil type, chemical and physical properties of the water, climatic factors, is determined by their impact on those two factors (Moens, 1981).

In order to control *L. truncatula*, some technical measures should be taken (drainage, grazing densities or isolation of infested areas) and ecological measures should be thought of (favouring the establishment of diverse associations of flora and malacofauna, by changing some environmental parameters).

Oxychilus atlanticus showed good predatory activity at temperatures considered average in the field (16-18°C), when the population density of *Lymnaea truncatula* is usually at its highest. Also, *Oxychilus atlanticus* retained its predatory activity at low temperatures and at low prey density. One must conclude, then, that this endemic malacophagous zonitid can be an efficient controller of *Lymnaea truncatula*.

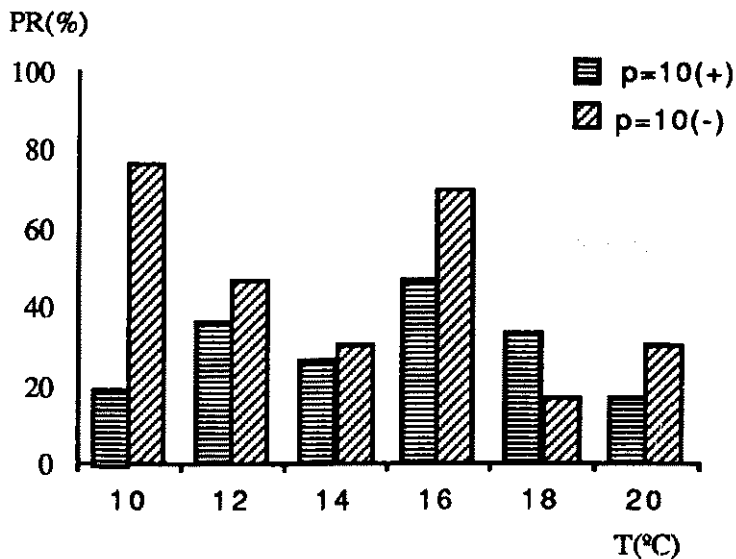


Figure 5 Predation rate (PR) as a function of the presence (+) or absence (-) of food, at $p=10$.

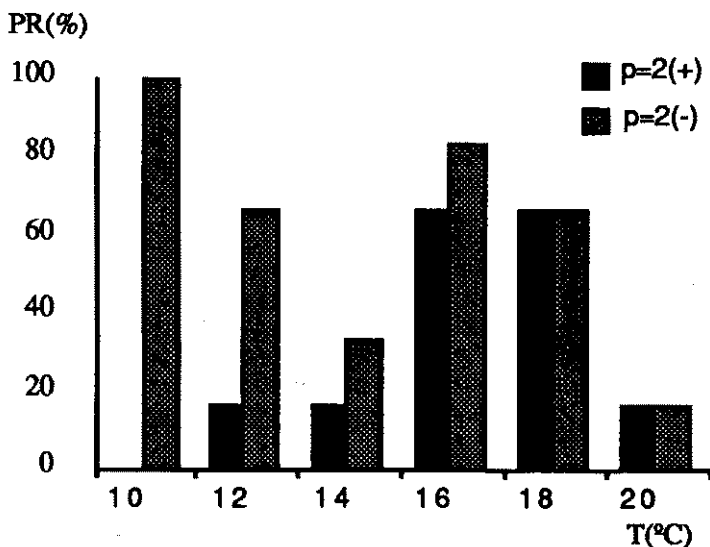


Figure 6 Predation rate (PR) as a function of the presence (+) or absence (-) of food, at $p=10$.

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