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THE MICROHABITAT OF COMMON GASTROPODS IN PAGBILAO MANGROVES (PHILIPPINES) AND THEIR LOCOMOTORY RESPONSE TO SALINITY AND TEMPERATURE

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ABSTRACT

In the Pagbilao mangal 13 species of gastropods occurred in six microhabitats. *Littorina scabra* was the most agile and tolerated a wide range of salinities and temperatures. *Nerita planospira* was the least tolerant to high temperatures. The response of *Ellobium aurisjudae* was the slowest and it preferred a low salinity range. *Terebralia sulcata* could withstand high temperatures and moderately high salinities. The conditions of their microhabitats are comparable to their responses to temperature and salinities.

INTRODUCTION

THE MANGROVE ecosystem is characterised by the interaction of a number of environmental factors to such an extent that sometimes zonation of organisms is noticeable. The current microhabitat occupied by them reflects their degree of adaptation to gradients of environmental factors. In mobile species such as gastropods, elimination by unfavourable factors is minimised by emigrating to a favourable environment. Salinity and temperature could be considered as the two important environmental factors affecting the estuarine organisms (Kinne, 1967).

Mass mortality by high temperature (Broekhuysen, 1940) and low temperature (Crisp, 1964) in gastropods has been observed in the field. It has been shown that molluscs are capable of adapting to high salinity (Biginski and Pierce, 1978) and low salinity (Devi *et al.*, 1984) by altering the amino acid pool.

In the earlier studies on the Philippine molluscs, most of the mangrove gastropods have been listed (Berdach, 1981). This study was nndertaken to investigate the locomotory response of 4 common species of mangrove molluscs to different salinities and temperatures and thus to understand the reasons for occupying their present microhabitat.

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MATERIALS AND METHODS

The Pagbilao mangrove forest is located in the Southern Luzon, Philippines (Long. 121° 45' E and Lat. 14° 05'N). The microhabitat of the gastropods was noted during field trips from June to December 1983.

For the laboratory experiments, four abundant species were selected. They were *Ellobium aurisjudae* Linnaeus, *Littorina scabra* Linnaeus, *Nerita planospira* Anton and *Terebralia sulcata* Born. Ten individuals of each species was placed in 120 ml tall measuring cylinders with 200 ml of water and covered with black paper. The number of individuals emerging from water at regular time intervals was noted. The temperature regimes were from 10°C to 45° C at 5° C intervals. The salinities used were from 10 ppt to 40 ppt at 5 ppt intervals. The experiment for salinity variation was carried out at room temperature and the temperature variation was done at 25 ppt salinity. These constants were closer to the field conditions. Salinity was determined using a salinometer and a water bath was used to obtain the desired temperature.

Since different species had different speeds, the possible error in the response due to intrinsic speeds of the species was eliminated by normalizing the speeds at 30° C temperature and 25 ppt salinity. Throughout the experiment pH was maintained around 7. The experiment was repeated with fresh specimens and average results were used to plot graphs.

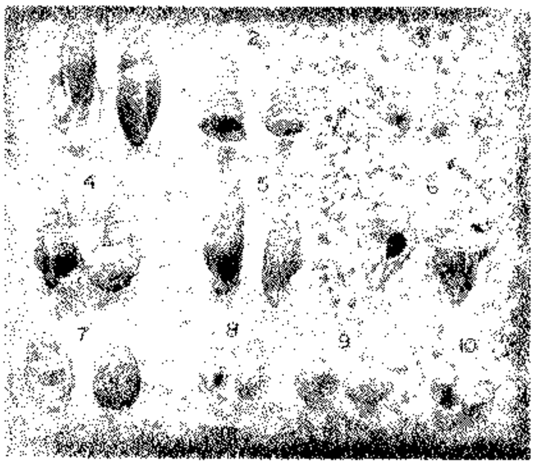

Fig. 1. Common gastropods of the Pagtilao mangroves: 1. *Ellobium aurisjudae* Linnaeus; 2. *Telescopium telescopium* Linnaeus; 3. *Cerithidea quadrata* (Sowerby); 4. *Terebralia sulcata* Born; 5. *Terebralia sulcata* Born - Juveniles; 6. *Naquetia capucina* Lamark; 7. *Nerita planospira* Anton; 8. *Cerithium patulum* Sowerby; 9. *Phsttautrigona* Torschel and 10. *Littorina scabra* Linnaeus

RESULTS

The common gastropods of this mangrove area are shown in Fig 1. Most of the specimens collected in the field had a size range corresponding to this figure, except *Telescopium telescopium* Linnaeus which normally grows to a large size. The microhabitat of 13 gastropods collected in relation to the tidal levels is given in Table 1. According to this Table, six microhabitats of gastropods could be identified in this mangal.

Responses of the common gastropods to temperature are shown in Fig 2. *N. planospira* was quiescent at 40° C and below 10° C whereas the other three species showed some locomotory response even at 40° C. *E. aurisjudae* had no response below 20° C, *Terebralia sulcata* below 15° C and *L. scabra* below 10° C.

The response of gastropods to salinity is given in Fig 3. *T. sulcata* was quiescent at 40 ppt and below 15 ppt. *E. aurisjudae* was also quiescent at 40 ppt and below 10 ppt. *N. planospira* was inactive at 40 ppt, but *L. scabra* was active throughout the salinity range of 10 ppt to 40 ppt

Fig. 4 shows the time taken for 50% of the population to emerge at different salinities and temperatures. These graphs were constructed from the results obtained from Fig. 2 and Fig. 3

DISCUSSION

Zonation is a feature common to both plants (Macnae, 1968) and animals (Berry, 1964) in the mangal. Although on the hard substrate, such as the mangrove roots zonation is clear (Pinto and Wignarajah, 1980) on the muddy shores or in the forest, zonation is obscure.

In the mangrove habitat there are a number of microhabitats resulting from aquatic, terrestrial and floral components. They give rise to gradients of environmental factors which probably delimit the distribution of gastropods to their present microhabitats. Factors are well inter-related in the mangroves forming a holocoenotic complex (Clarke and Hannon, 1967) such that, ultimately temperature and salinity could effect the organisms in determining their microhabitat.

In general, the lethal limit of the mangrove gastropods in this study were closer to the limits of fiddler crabs, but wider than the tropical fish (Vernberg and Vernberg, 1981). Out of the four species investigated, *N. planospira* showed no response at high temperature ($\geq$ 40° C) and salinities ($\geq$ 40 ppt). Since least adapted organisms to temperature are normaly, restricted to the subtidal zone (Southward, 1958), the occurrence of *N. planospira* to the submerged roots is to be expected. The prolonged period for emergence at 35° C (Fig. 2) could be due to slow movement under stressful conditions. Similar accounts of restriction in distribution due to overheat has been given for *N. scabricosta* and *N. funiculata* (Levings and Garrity, 1983). In the mangroves of Papua New Guinea too, *N. planospira* was restricted to the mangrove roots (Cook *et al.*, 1985). *E. aurisjudae* responded slowest to the changes of the environmental factors, showed a preference for low salinites and a cold sluggishness $\geq$20°C. Its microhabitat was rarely inundated by the tide, but monsoon rains occasionally submerged these gastropods. Little *et al.* (1984) have observed that some Ellobiidae pulmonates like *E. aurisjudae* are inactive when it rains. Since many molluscs can tolerate long periods of immersion in fresh water, it is very unlikely that salinity would become a major limiting factor for *E. aurisjudae* as generalised by Underwood (1979). Probably, temperature, food and humidity could be important factors in controlling its distribution.

TABLE 1. *The microhabitat of common gastropods of Pagbilao mangroves*

Sub-tidal	Inter-tidal	Supra-tidal			
Mangrove roots	River banks and mudflats	Shore trees	Forest trees	Muddy floor	Forest littre
Nerita planospira	*Telescopium telescopium*	*Littorina scabra*	*Pythia trigona*	*Cassidula musterina*	*Elobium aurisjudae*
Certithium patulum			*Cerithidea quadrata*		
Morula squamosa	*Terebralia sulcata*				
Monodonta labio	*Cerithidea micropetra*				
Naquetia capucina					

Like the saltmarsh gastropod *Melampus bidentatus*, *L. scabra* is agile (Price, 1984) quick to respond to changing salinities and temperatures (Fig. 3 and 4). It also has a wide range of tolerance to salinity and temperature. The occurrence of *L. scabra* on trees along the shores subject to fluctuating temperatures and salinities could thus be accounted for. A further selection of the microhabitat was observed

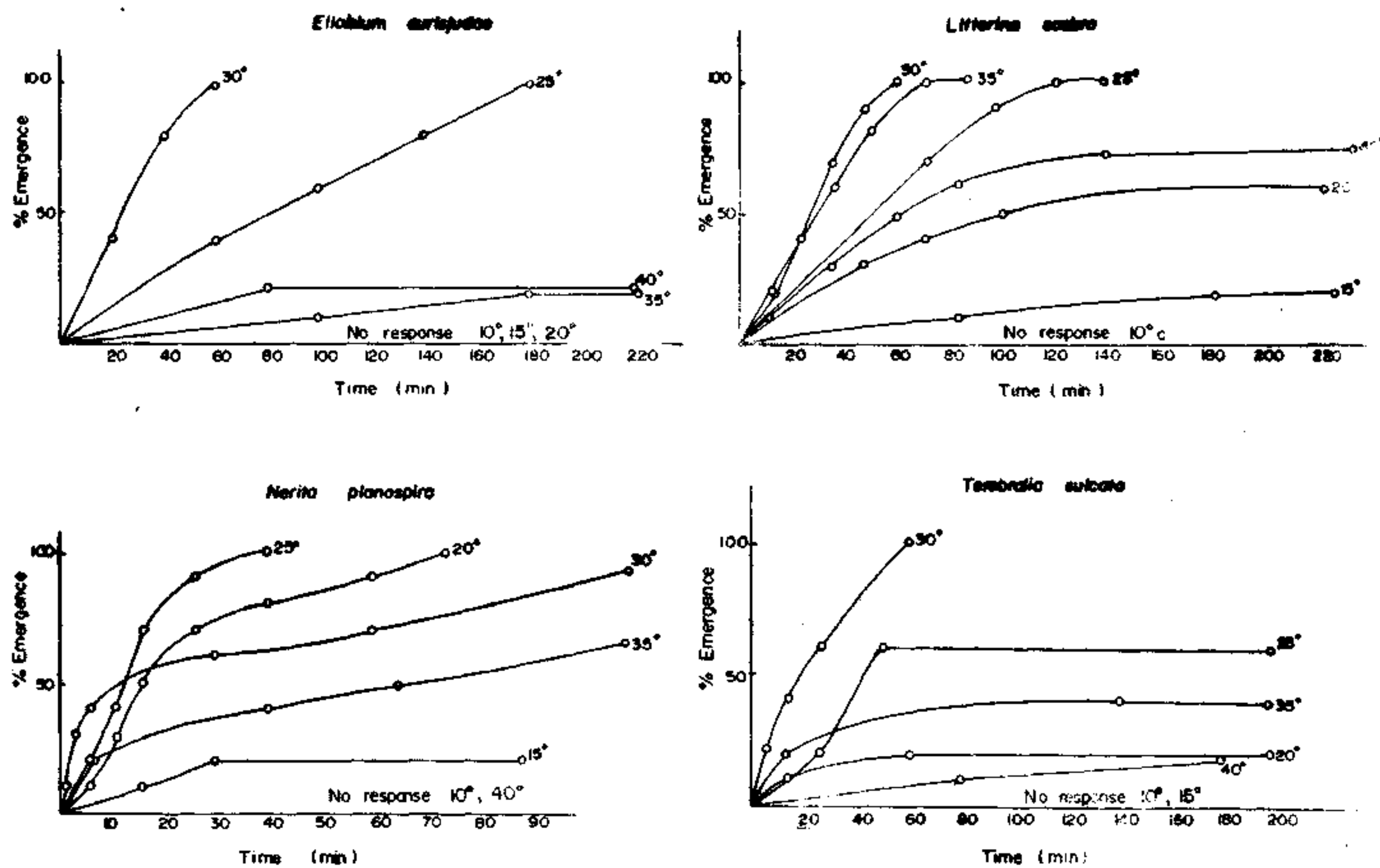

Fig. 2. The locomotory response of 4 mangrove gastropods to varying temperatures.

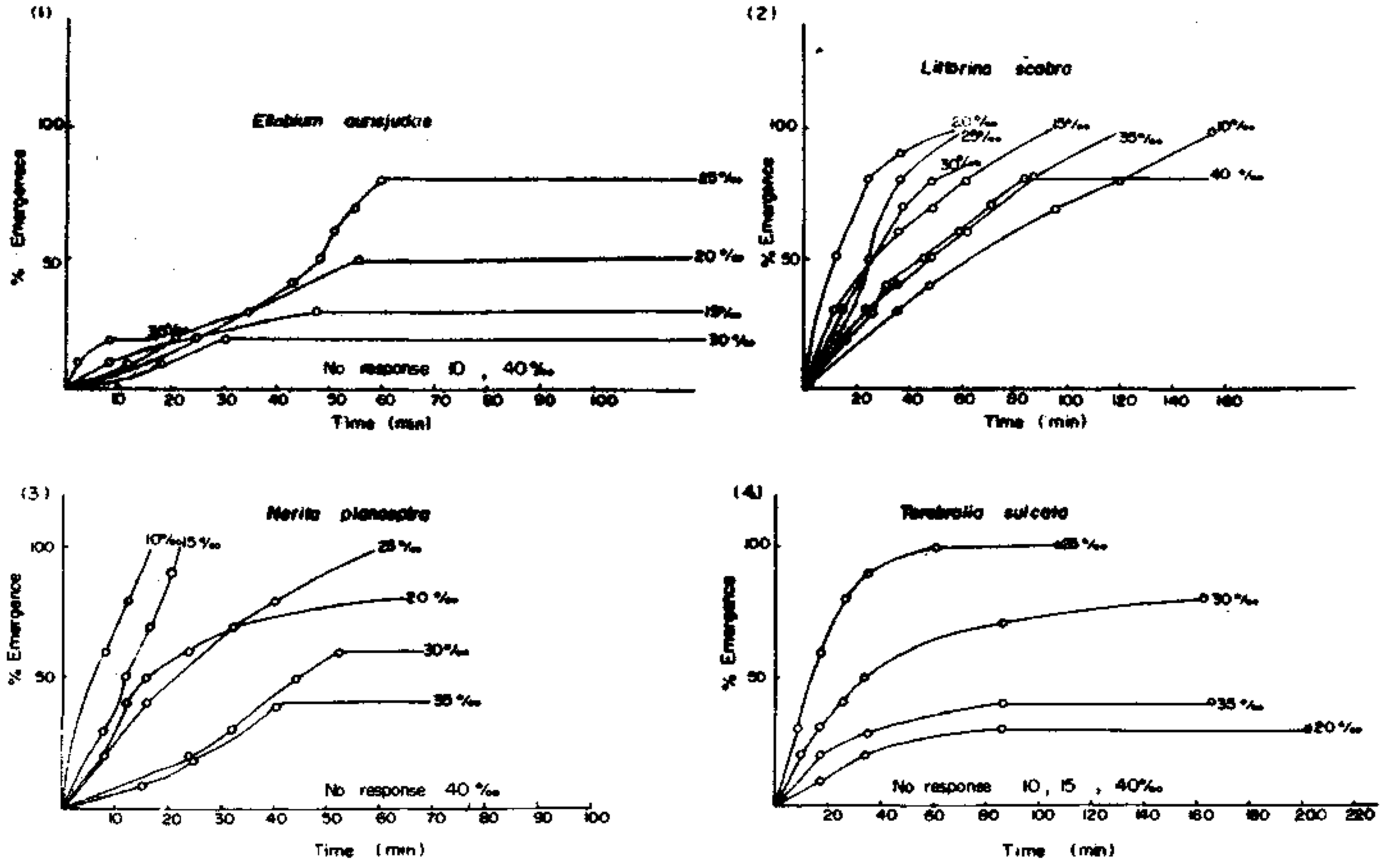

Fig. 3. The locomotory response of 4 mangrove gastropods to varying salinities.

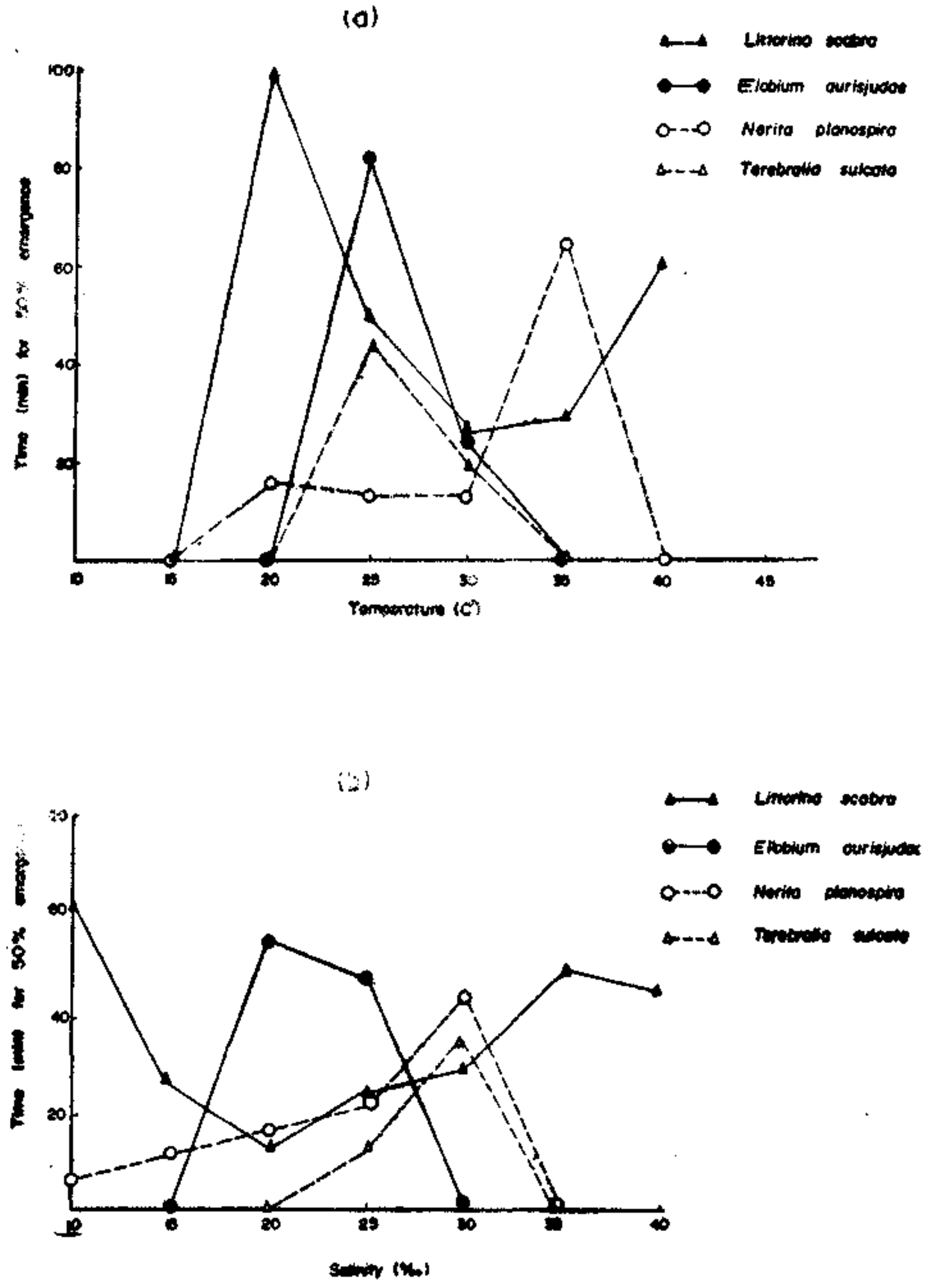

Fig. 4. Time taken for atleast half the population to emerge when immersed in water at (a) different temperatures and (b) salinities.

by Cook *et al.* (1985) in the mangroves of Papua New Guinea where *L. pallescens* is restricted to leaves while *L. scabra* and *L. intermedia* occurred on the bark covered parts of trees.

In this mangal, *T. sulcata* occurred on the river banks and mudflats contrary to its occurrence on the roots in Papua New Guinea (Cock *et al.*, 1985). *T. sulcata* responded within a narrow range of temperatures and salinities (Fig. 3 and 4), probably because of its heavy shell and the habit of partially burying in the mud during the low tide.

According to Fig. 4, the time for 50% of the population to emerge was lowest at 30° C, but there was no common salinity value for all the 4 species indicating the importance of salinity variation for different species. Quick movement out of an unfavourable environment could be due to irritability. On the other hand moderately slow movement would reflect the preference for a habitat and extremely slow movement could be when approaching the quiescent zone.

According to the same figure the response of *L. scabra* showed two peaks in responding to temperature and salinity variations, but all the other species had only one peak. These probably reflect the adjustments of the body fluids to the osmotic pressure of the environment. Increase in oxygen debt with decreasing salinity has been observed in some gastropods (Devi *et al.*, 1984) and in *Cerithidea cingulata* utilization of aspartic acid has been noted in oxygen free sea water (Rao and Rao, 1983). Mussels also accumulate amino acids at high salinities (Biginski and Pierce, 1978) suggesting the physiological changes that take place with the changing environmental factors in molluscs.

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