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THE ELLOBIIDAE (GASTROPODA: PULMONATA) COMMUNITIES FROM A BOULDER SHORE AND A SALT MEADOW IN THE SAI KUNG PENINSULA, HONG KONG

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ABSTRACT

The distributions of the Ellobiidae on a boulder shore and in salt meadow habitats were studied. Five species of ellobiids were present in the boulder shore and nine in the salt meadow. Although only *Microtralia alba* and *Pedipes jouani* were absent from the salt meadow, the relative abundances of the species at both sites showed a marked difference, thus revealing peculiar ellobiid assemblages. Transects showed horizontal and vertical zonation on the rocky habitat, with *Laemodonta minuta* dominating. The salt meadow habitat was dominated by *Cassidula plecotrematoides* on the exposed, seaward, portion and *Melampus triticeus* was the commonest ellobiid on the protected, landward, part of the meadow.

INTRODUCTION

The Ellobiidae, commonly known as mangrove or marsh snails, are an important group of the high-intertidal and supralittoral communities of tropical and subtropical regions. Studies dealing with the ecology of mangrove biota have included some of the commonest species (Berry 1963; Brown 1971; Sasekumar, 1974; Murti and Balaparameswara Rao 1977; Morton and Morton 1983; Li and Gao 1985). Their importance on rocky shore habitats, however, has been underestimated and few studies mention their presence (Morton 1955; Martins 1978; 1980; Morton and Morton 1983). The various workshops convened in Hong Kong have yielded important information on the shores of that area. However, works published on the malacofauna of the rocky littoral of Hong Kong have overlooked this group of primitive pulmonates (Jiang and Zhou 1982; Takenouchi 1985).

The present work intends to help close the gap in information on the distribution of the ellobiids of the high-intertidal/supratidal area, thus inviting further research on their role in these communities and their adaptations to such a highly stressed environment.

SITES AND MATERIALS AND METHODS

Sites

To allow comparison of the ellobiid fauna of the rocky shores with that of a better known salt meadow habitat, two sites were selected:

(a) Flynn Point, Hoi Ha, Sai Kung Peninsula. Located in a protected bay, this sheltered boulder shore presents very short, steep, intertidal and supratidal zones. The piled up boulders are large, tightly fitting against each other, thus avoiding habitat mobility. No intertidal pools were found and the high-tide waters penetrate underneath the boulders all the way to the farthest landward site. Debris and silt collect in the crevices created by contiguous boulders, at various levels, sometimes creating false bottoms. Terrestrial plants grow only on the landward limit of the boulders which, in that area, are partially buried in soil. A good account of the communities of this type of habitat was provided by Morton and Morton (1983, 86–125).

(b) Shore by YMCA, Wu Kai Sha, Sai Kung Peninsula (Tolo Harbour). This salt meadow shore backing a sandy beach is composed seaward of an agglomeration of cobble stones and shell debris (oysters), covered with *Ischaemum aristatum* L. from the highest-intertidal to low supratidal, shaded by sparse *Lumnitzera racemosa* (Gaetrn.) mangrove trees which are densest at the highest point of the shore; a sharp slope follows landward, creating a tidal pool with sea-water seeping through the pile of shell debris, the bottom covered with a mat of *Chaetomorpha*; a feeble run-off of fresh-water soaks the ground above high tide. Sparse plants of *Paspalum* sp. appear here and there from the algal mat just landward of the high-tide pool; a little further inland *Imperata cylindrica* (L.) Beauv. dominates, followed by *Zoysia* sp. and *Fimbristylis* sp. Morton and Morton (1983, 208–20) adequately describe this type of habitat.

Methodology

Two transects were surveyed with quadrats of 25 × 25 cm a few metres from each other at Hoi Ha and at Wu Kai Sha; a profile was made for each transect by levelling a string over the site and measuring vertical heights at the ends of each quadrat. All the ellobiids within each quadrat were collected in order to assess their relative abundances and size distribution, the latter, however, not included in this work. At Hoi Ha, vertical distributions were recorded for both transects. Non-ellobiid species were not collected and reference to them will be made here (see Morton and Morton 1983, for the common fauna of these types of habitats).

The list of ellobiids encountered is given in Table 1 and the species are illustrated in Figure 1.

RESULTS

Hoi Ha

The profile of transect 1 (Fig. 2) shows a steep surface gradient closely paralleled by that of the basal substratum, which is almost entirely covered at high-tide. The relative

Table 1
Systematic list of the Ellobiidae collected from the Hoi Ha [HH] and Wu Kai Sha [WKS] transects.

Family Ellobiidae H. and A. Adams *in* Pfeiffer, 1854	
Subfamily Ellobiinae H. & A. Adams *in* Pfeiffer, 1854	
Genus *Ellobium* Röding, 1798	
Ellobium chinense (Pfeiffer, 1856)	[WKS]
Subfamily Pythiinae Odhner, 1925	
Genus *Pythia* Röding, 1798	
Pythia cecillii (Philippi, 1847)	[WKS]
Genus *Cassidula* Férussac, 1821	
Cassidula schmackeriana Moellendorff, 1885	[WKS]
Cassidula plecotrematoides Moellendorff, 1885	[HH, WKS]
Genus *Laemodonta* Philippi, 1846	
Laemodonta exarata (H. and A. Adams, 1854)	[WKS]
Laemodonta typica (H. and A. Adams, 1854)	[HH, WKS]
Laemodonta minuta (Moellendorff, 1885)	[HH, WKS]
Genus *Auriculastra* Martens, 1880	
Auriculastra subula (Quoy and Gaimard, 1832)	[WKS]
Subfamily Pedipedinae Fischer and Crosse, 1880	
Genus *Pedipes* Scopoli, 1777	
Pedipes jouani Montrouzier, 1862	[HH]
Genus *Microtralia* Dall, 1894	
Microtralia alba (Gassies, 1865)	[HH]
Subfamily Melampinae Stimpson, 1851	
Genus *Melampus* Montfort, 1810	
Melampus triticeus (Küster, 1844)	[WKS]

horizontal and vertical distribution of the ellobiids is, thus, apparently compacted, although trends in patterns of zonation can be detected (Figs. 2 and 3). The animals show a definite preference for deeper substrates, *Cassidula plecotrematoides* venturing somewhat closer to the surface; juveniles of this species were found closer to the bottom and lower in the intertidal zone, whereas the adults occurred over the widest vertical range. *Microtralia alba* occurred mostly above or at high-tide level and is the most 'terrestrial' of the five species of ellobiids obtained from this community; some large individuals were found underneath rocks partially buried in soil (see also Martins 1992). *Pedipes jouani* and *Laemodonta minuta* were often found together, the latter being the most abundant (Table 2) and widespread ellobiid, both horizontally and vertically. *Laemodonta typica*, the rarest, preferred the lowest intertidal region of the transect and was consistently found in deeper substrates.

The profile of transect 2 (Fig. 4) shows a smoother surface gradient and an irregular basal substratum, the high-tide water penetrating deeper landward underneath the boulders, as in the previous transect. The trends observed in transect 1 are here less ambiguously expressed (Fig. 5). *Microtralia alba*, although occurring in low numbers (Table 3), is clearly a landward species (Fig. 6), appearing usually under buried rocks or deep within crevices where silt and soil collect. *Cassidula plecotrematoides* clustered near, although not above, the high-tide line; most juveniles were found further into the

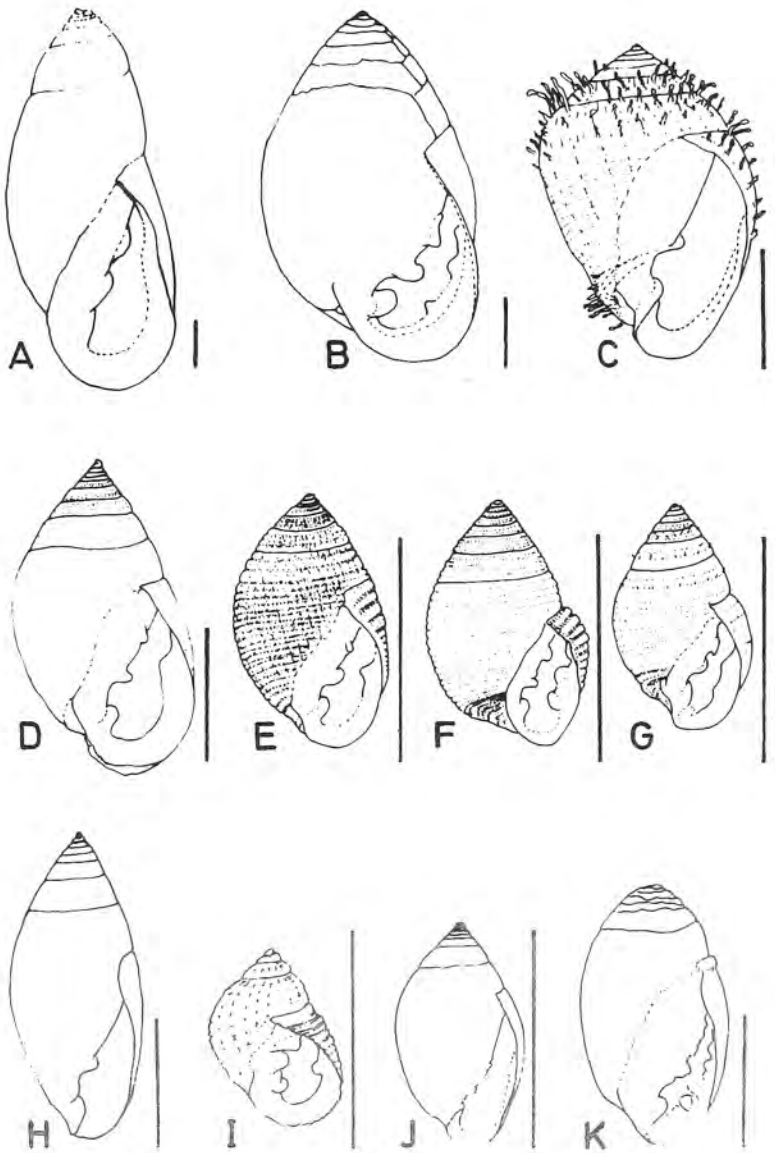

Fig. 1. Ellobiid species encountered in the transects. *A, Ellobium chinense*; *B, Pythia cecillii*; *C, Cassidula schmackeriana*; *D, Cassidula plecotrematoides*; *E, Laemodonta exarata*; *F, Laemodonta typica*; *G, Laemodonta minuta*; *H, Auriculastra subula*; *I, Pedipes jouani*; *J, Microtralia alba*; *K, Melampus triticeus*. Scale bars = 5 mm.

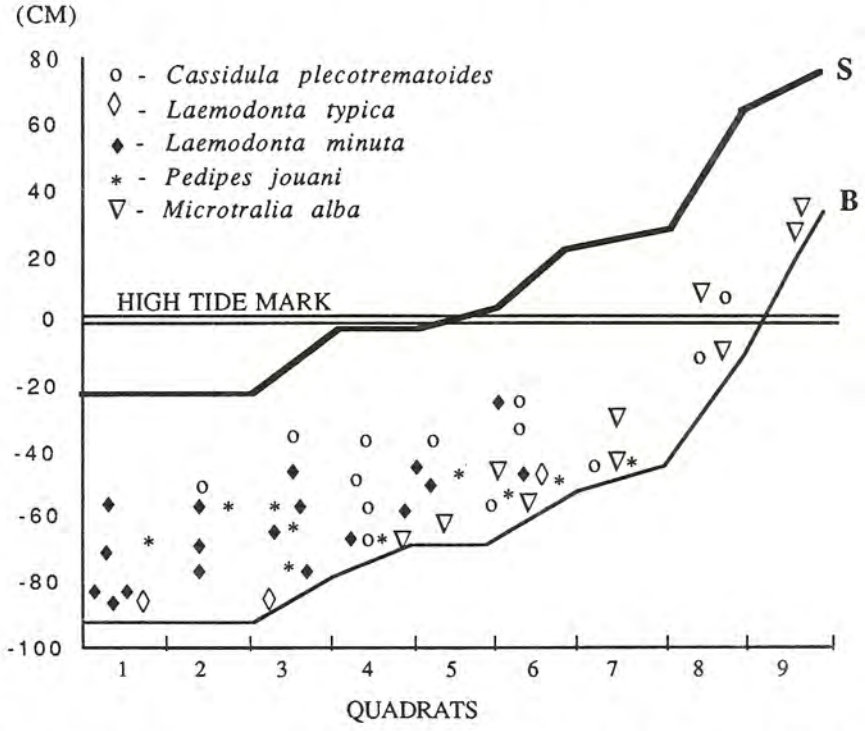

Fig. 2. Profile of transect 1, Hoi Ha, showing the vertical and horizontal distribution of the ellobiids. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders.

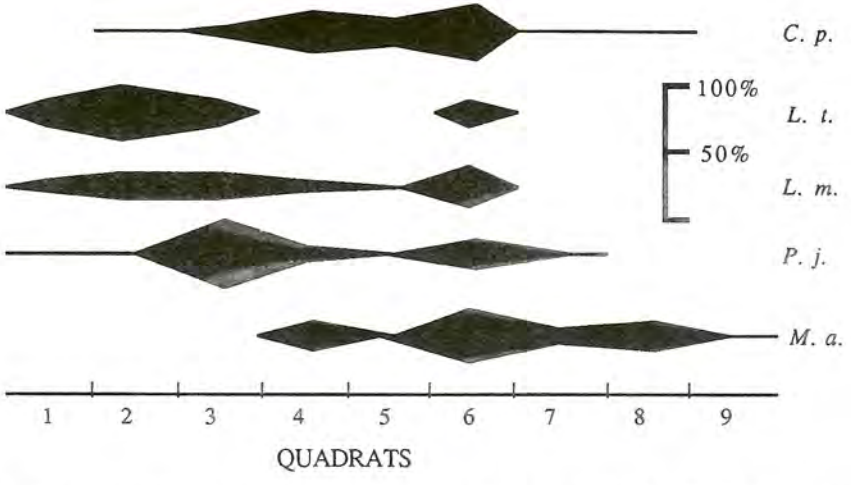

Fig. 3. Horizontal distribution of ellobiids along transect 1, Hoi Ha. *C.p.*, *Cassidula plecotrematoides*; *L.m.*, *Laemodonta minuta*; *L.t.*, *Laemodonta typica*; *M.a.*, *Microtralia alba*; *P.j.*, *Pedipes jouani*.

Table 2
Quantitative distribution of ellobiid species along transect 1, Hoi Ha.
Quadrats (25 × 25 cm) start nearest the water.

Species	Quadrats 1	2	3	4	5	6	7	8	9	Total
C. plecotrematoides		1	3	13	7	15	1	2		42
L. typica	1	2	1			1				5
L. minuta	34	49	39	27	5	67				222
P. jouani	1	1	20	5	2	7	1			37
M. alba				15	2	29	10	16	3	75

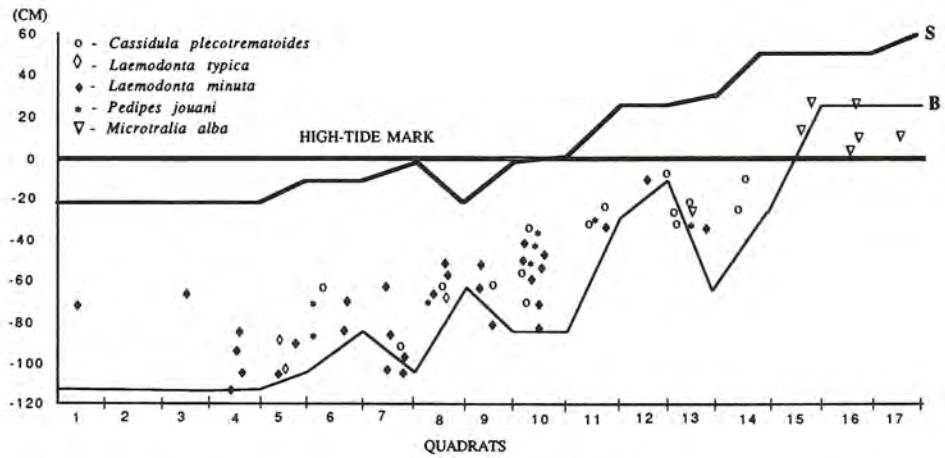

Fig. 4. Profile of transect 2, Hoi Ha, showing the vertical and horizontal distribution of the ellobiids. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders.

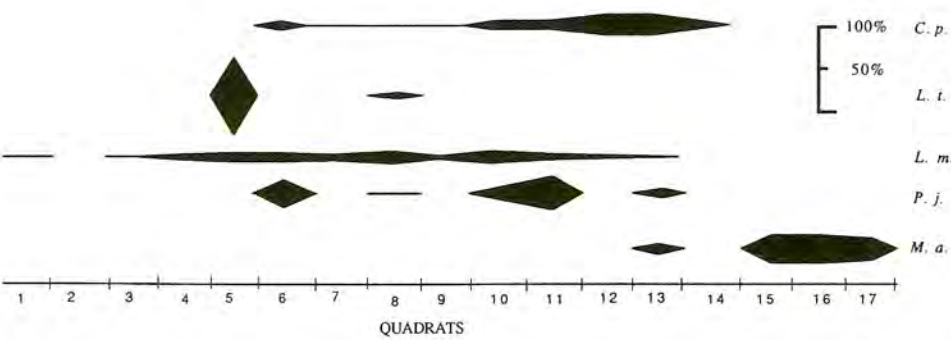

Fig. 5. Horizontal distribution of ellobiids along transect 2, Hoi Ha. *C.p., Cassidula plecotrematoides*; *L.m., Laemodonta minuta*; *L.t., Laemodonta typica*; *M.a., Microtralia alba*; *P.j., Pedipes jouani.*

Table 3
Quantitative distribution of ellobiid species along transect 2, Hoi Ha.
Quadrats (25 × 25 cm) start nearest the water.

Species	Quadrats																	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
C. plecotrematoides						3	1	1	1	4	3	7	7	3				30
L. typica					14			1										15
L. minuta	3		3	21	28	37	20	41	16	38	19	1	2					229
P. jouani						15		1		7	16		3					42
M. alba													1		4	4	3	12

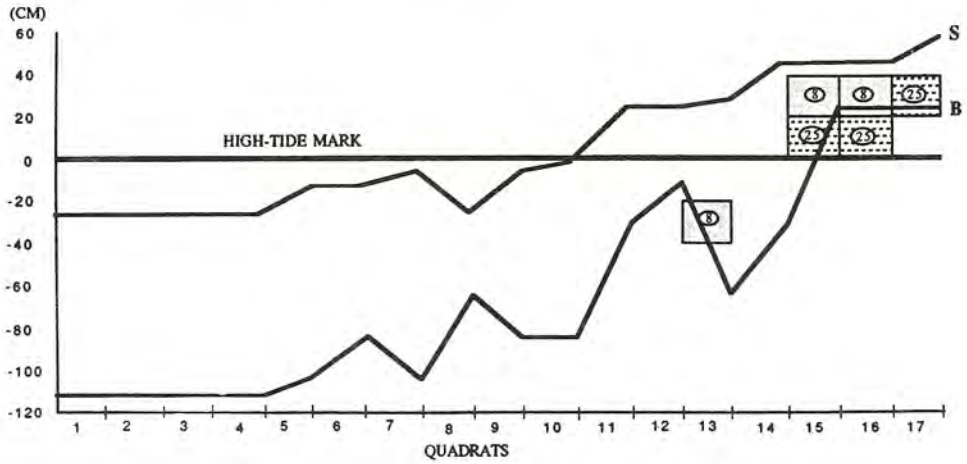

Fig. 6. Vertical distribution of *Microtralia alba* along transect 2, Hoi Ha. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders. Percentage numbers inserted.

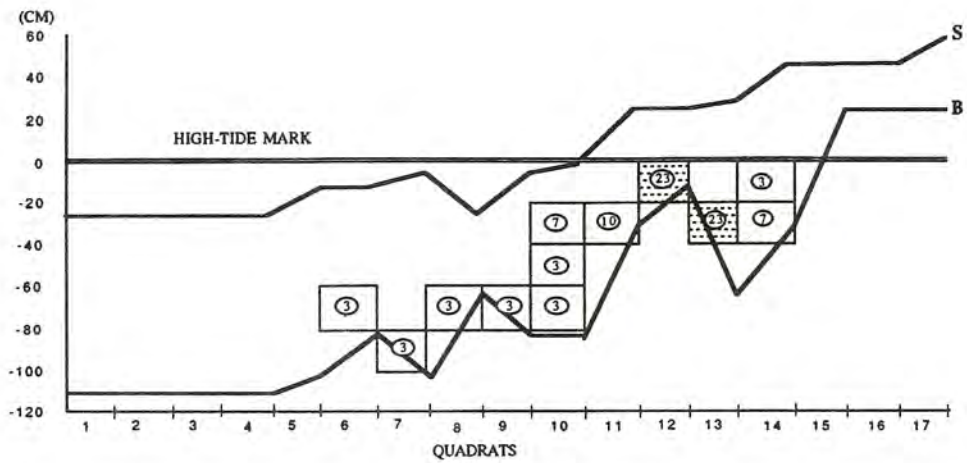

Fig. 7. Vertical distribution of *Cassidula plecotrematoides* along transect 2, Hoi Ha. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders. Percentage numbers inserted.

intertidal and closer to the basal substratum (Fig. 7). *Pedipes jouani* was found in an intermediate zone, both vertically and horizontally (Figs. 5 and 8), preferring crevices where water can run through more freely. The ubiquitous *Laemodonta minuta* was again the most abundant and widespread ellobiid (Table 3; Fig. 9) with its congeneric, *Laemodonta typica*, showing the clumpiest distribution (Fig. 10).

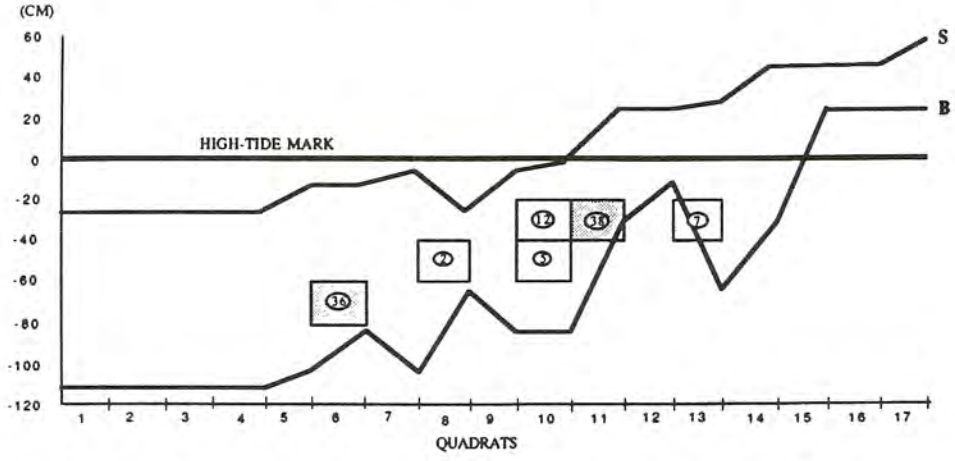

Fig. 8. Vertical distribution of *Pedipes jouani* along transect 2, Hoi Ha. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders. Percentage numbers inserted.

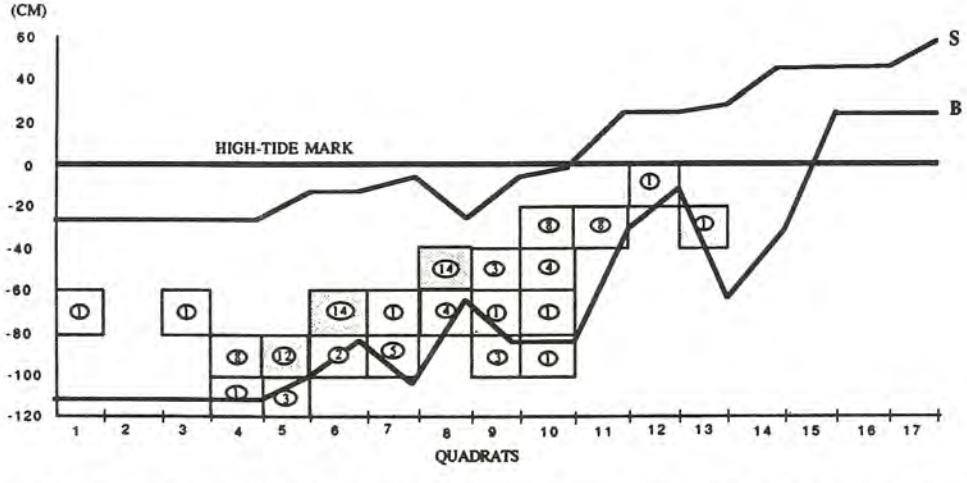

Fig. 9. Vertical distribution of *Laemodonta minuta* along transect 2, Hoi Ha. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders. Percentage numbers inserted.

Wu Kai Sha

The Wu Kai Sha transect was about 20 metres long and of low elevation (Fig. 11). On the exposed zone, *Cassidula plecotrematoides* was the most common ellobiid, particularly at high-tide level (Table 4), among the dense vegetation cover of *Ischaemum*

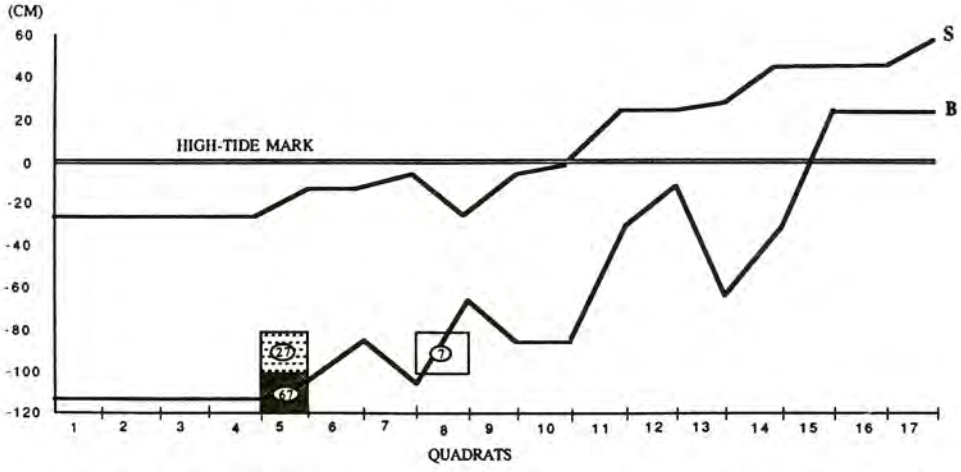

Fig. 10. Vertical distribution of *Laemodonta typica* along transect 2, Hoi Ha. *B*, profile of the basal substratum; *S*, profile of the surface of the boulders. Percentage numbers inserted.

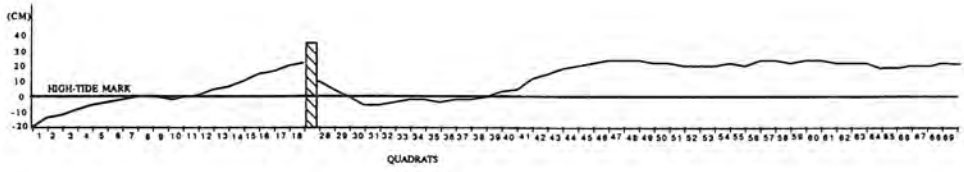

Fig. 11. Profile of transect 3, Wu Kai Sha. Quadrats 19–27 were eliminated for practical reasons, since ellobiids were absent there; the maximum height of the site is shown at quadrat 19.

aristatum. There, the three species of *Laemodonta* were relatively scarce and were found almost exclusively among the piles of oyster shells, sometimes buried 40 cm deep. Worthy of note is the presence of *Laemodonta exarata*, not recorded from the Hoi Ha transects. Ellobiids became rarer and were even absent for some distance under the densest agglomeration of the mangrove tree *Lumnitzera racemosa*, where the ground was of sparse cobbles buried in sand (Fig. 12). Ellobiids started increasing in numbers past the mangrove trees, where the ground deepens and a small high-tide pool forms. The commonest ellobiid in the transect was *Melampus triticeus*, present mostly in the sheltered area of the meadow but extending over most of the transect. There also were found the occasional individuals of *Cassidula schmackeriana* and *Ellobium chinense*, among the mangrove seedlings and *Paspalum* sp. *Auriculastra subula* was deeply buried in shell debris, on black soil; farthest inland, in driest conditions, some specimens of *Pythia cecillii* were found clinging to the stems of *Imperata cylindrica*, near the ground.

Table 4
Quantitative distribution of ellobiid species along transect 3, Wu Kai Sha.
Quadrats (25 × 25 cm) start nearest the water.

Species	Quadrat 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
P. cecillii																		
C. schmackeriana																		
C. plecotrematoides				2	11	9	57	37	24	9	24	30	15	17	16	24	3	1
L. typica						2	5		3									
L. minuta						1			1									
L. exarata	1						2		4		5		5	4				
E. chinense																		
A. subula																		
M. triticeus												1	3	7		19	19	

Species	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
P. cecilli																							
C. schmackeriana			1																				
C. plecotrematoides	12	17	14	5			3									2							
L. typica																							
L. minuta																							
L. exarata	6		1		1																		
E. chinense					1																		
A. subula	2	1																					
M. triticeus					10	10	50	11	19	15	16	11	18	6	15	1	4	6	30	39			

Species	51	52	53	54	56	57	58	59	60	61	62	63	64	65	66	67	68	69	Total
P. cecillii																	5	2	7
C. schmackeriana																			1
C. plecotrematoides																			327
L typica																			10
L. minuta																			2
L. exarata																			29
E. chinense																			1
A. subula																			3
M. triticeus	7	5	3	28	8	7	1	1	1	1	1	2		1	2	4		4	385

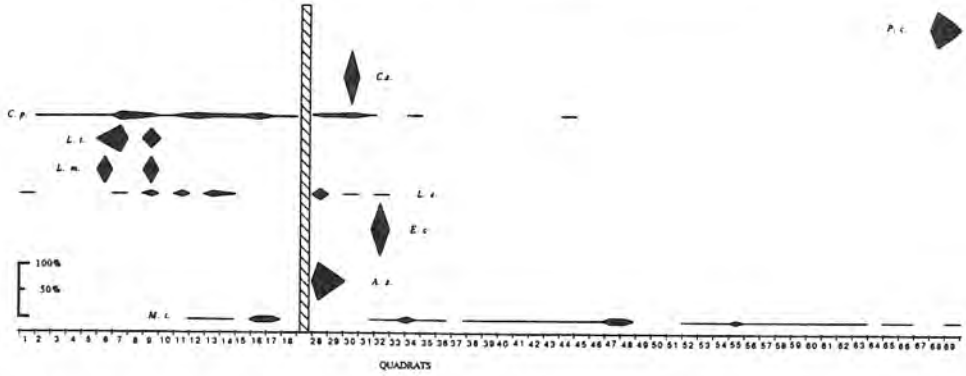

Fig. 12. Horizontal distribution of ellobiids along transect 3, Wu Kai Sha. Quadrats 19–27 were eliminated for practical reasons, since ellobiids were absent there. *A.s, Auriculastra subula*; *C.p., Cassidula plecotrematoides*; *C.s.,Cassidula schmackeriana*; *E.c., Ellobium chinense*; *L.e.,Laemodonta exarata*; *L.m., Laemodonta minuta*; *L.t., Laemodonta typica*; *M.t., Melampus triticeus*; *P.c., Pythia cecillii.*

DISCUSSION

The ellobiid communities of the two sites, although overlapping in absolute species composition, differed considerably in the relative abundances of the constituent species. On the rocky shore, *Laemodonta minuta* dominated in numbers and over a larger area; the most terrestrial species was *Microtralia alba*. *Pedipes jouani*, a novelty for Hong Kong, along with the latter species (Martins 1922), apparently preferred sites where there is some water flow at high-tide. Martins (1980; in press) has recorded a similar distribution of Atlantic *Pedipes* in rolled stone beaches. As important as the horizontal distribution, the occupation of space amongst the boulders allowed vertical zonation, with species like *Pedipes jouani* living mostly above the ground and *Laemodonta typica* preferring the muddy basal substratum of the middle intertidal.

Cassidula plecotrematoides was relatively abundant at both sites, but was particularly common at Wu Kai Sha, on the seaward slope. *Melampus triticeus* was the commonest ellobiid at Wu Kai Sha, dominating the meadow, even where fresh water seepage was noticeable.

For their numbers and distribution, rocky shore ellobiids deserve the same attention that is dedicated to their counterparts of mangroves and meadows.

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