

The composition and spatial distribution of scavenging hyperbenthos in the Cape d'Aguilar Marine Reserve, Hong Kong

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Baited traps with a 5 mm diameter opening were deployed 9 cm off the seabed in the Cape d'Aguilar Marine Reserve, Hong Kong. In contrast to analogous studies from boreal waters, lysianassoids accounted for 0.5% of the total number of trapped hyperbenthos. Species of Tisbe (Copepoda: Tisbidae), Ceradocus (Gammaridea: Melitidae), Nebalia (Leptostraca: Nebaliacea), unidentified benthic ostracods, Neanthes cricognatha (Polychaeta: Nereidae) and a species of Lepidepcreum (Amphipoda: Lysianassoidea) were caught in a decreasing order of numerical importance. A spatial segregation of trapped fauna was identified between the reserve's shallow Lobster Bay (< -2 m Chart Datum (CD)) and deeper-waters (between -6 and -17 m CD) outside it. Ceradocus sp. monopolized the trapped fauna in the former area, while the other species were caught almost exclusively from the latter. Insignificant Ceradocus sp. catch differences between baited and control traps suggested that they functioned only as 'habitat traps' for this species. Almost all other organisms attracted to the bait were hyperbenthic scavengers. Their absence from the shallows might be due to the coarser and lower organic contents of the sediments, also related to faster flow rates here. Finally, we confirm that in subtropical Hong Kong, lysianassid amphipods are not as significant hyperbenthic scavengers as they are in boreal waters.

Keywords: carrion, bait trapping, scavengers, lysianassoids, amphipods, leptostracans, copepods

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INTRODUCTION

Macrophagous scavenging is a common trophic strategy in all marine habitats (Biernbaum & Wenner, 1993). Britton & Morton (1993, 1994) reviewed scavenging in the sea and concluded that almost all phyla have necrophagous representatives, although the existence of obligate necrophages is more debatable (Stockton & DeLaca, 1982; Smith, 1985; Sainte-Marie, 1986a; Sainte-Marie *et al.*, 1989; Kaiser & Moore, 1999; Morton & Yuen, 2000; Ruxton & Houston, 2004). Carrion usually serves, therefore, as a dietary supplement (Britton & Morton, 1994).

Bait trapping has been used to catch marine fisheries invertebrates, such as crabs and lobsters, for centuries (Busdosh *et al.*, 1982; Biernbaum & Wenner, 1993). Secondary arrivals to baited traps after epibenthic macrofaunal and fish exclusion have also been studied for more than a century (Chevreux, 1900) and have shown that lysianassoids often account for 100% of all organisms drawn to such traps in boreal deep-sea environments (Paul, 1973; Dahl, 1979; Jannasch *et al.*, 1980; Ingram & Hessler, 1983; Sekiguchi & Yamaguchi, 1983; Smith & Present, 1983; Hargrave, 1985; Nishida *et al.*, 1999).

An increasing number of studies in shallow coastal waters of hyperbenthic species attracted to baited traps, however, have identified a gradual diminishing lysianassoid importance

from high to low latitudes. As in great depths, lysianassoids virtually monopolize the necrophagous fauna of shallow waters at high latitudes. In the Beaufort Sea, they account for >99% of organisms attracted to bait (Busdosh *et al.*, 1982). Their numerical importance at lower latitudes is more variable and gives way progressively to various other organisms (Sekiguchi *et al.*, 1982), but still mostly crustaceans. For instance, 75% of all trapped scavengers were cirrolanid isopods along the west coast of South Africa (34°S) (Griffiths *et al.*, 2000) and 34% of total captured organisms comprised leptostracans off the coast of California (32°N) (Biernbaum & Wenner, 1993).

The aims of this study were therefore: (i) to capture and identify necrophagous hyperbenthic organisms in the study area using baited traps with other benthic macrofauna and fish excluded; (ii) identify spatial variations in the composition of any captured species within the study area; and (iii) compare the so-identified community with previous regional and local studies, notably an earlier investigation of temporal variations in scavenging within the Cape d'Aguilar Marine Reserve (Lee & Morton, 2004).

MATERIALS AND METHODS

Site and station descriptions

The Cape d'Aguilar Marine Reserve is situated on the south-eastern tip of Hong Kong Island (22°12'N 114°15.5'E) and is

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regarded as having the cleanest waters locally (Environmental Protection Department HKSAR, 2008) (Figure 1A). The reserve encompasses the shallow Lobster Bay, which has two openings into it from the sea: to the east and the south-west. Because the Cape d'Aguilar Marine Reserve is located in the south-eastern wave-exposed quadrant of Hong Kong it is semi-exposed (Morton & Wu, 1975), but is partly sheltered by the island of Kau Pei Chau. The local tidal regime is generally unequally semi-diurnal at the times of spring tides with a regular transition to diurnal at the times of neaps. Tidal currents and wave action have created a complex topographic pattern of gullies and sandbanks within the reserve and at low spring tides two ramparts are unveiled within it: one to the east, the other to the south-west (Morton & Harper, 1995) and these demarcate Lobster Bay at the centre of the reserve.

Six stations were designated in the present study (Figure 1B). Stations L1 and L2 were situated at a depth of ~ 1.5 m Chart Datum (CD) inside Lobster Bay. Because these two stations abut the narrow eastern gap, they are constantly under the impact of waves from the east, particularly during the north-east monsoon in winter. Water movements here average $0.19 \text{ m}\cdot\text{sec}^{-1}$, ranging between 0.06 and $0.63 \text{ m}\cdot\text{sec}^{-1}$ (Clark, 1997). Station L3 was also located along the south-western rampart of Lobster Bay at a depth of -0.5 m CD. Stations M1 and M2 were located at depths of ~ 6 m CD to the south-west of Lobster Bay. These five sampling stations were over sand and a deeper mud station (D1) was established at a depth of ~ 17 m CD yet further to the south-west but still inside the perimeter of the marine reserve. Details of the six stations and their respective granulometries are described by Lee (2004).

Trap design

Traps were made from 250-ml, transparent, bottles with an opening of 5 mm to exclude gastropods, fish, crabs and prawns from the traps because they are numerous in the study area and would have blocked the entrance (Morton & Chan, 2000) and were not, anyway, the objects of interest.

The bait comprised 10 g pieces of crab tissue, as suggested by Sainte-Marie (1986b), in this case *Charybdis feriatius*

(Linnaeus, 1758) (Crustacea: Decapoda). This bait weight was also chosen because at the end of each trial, there were still large pieces of tissue remaining in the traps to ensure an ample supply of food for any trapped animals. The bait was put into 4.0 mm-mesh bags, large enough for scavenging hyperbenthos to access and burrow into the contained bait, but prevent the bait from detaching and clogging the mesh at the trap aperture. Empty mesh bags were placed in control bottles.

Trapping experiments

Two sets of five traps (comprising three baited and two un-baited controls) were deployed at a distance of between 20 and 30 cm from each other at each of the six stations for three days to avoid any catch biases arising from tidal conditions (Morritt, 2001) and the day-night cycle (Sainte-Marie, 1986a, b, 1987). This experiment was repeated three times at time intervals of between two weeks and one month. Details of the trap design and trapping experiments are further elaborated upon in Lee (2004).

Statistical analyses

UNIVARIATE ANALYSES OF CATCHES

The numbers of individuals of each species captured per trap on each sampling occasion were calculated for every station. Data from the three baited bottles and two un-baited controls in each set of five traps were averaged separately to give a better mean and to avoid pseudo-replication. Total catches and the catches of each dominant taxon were examined for both normality and heterogeneity using Shapiro-Wilk and Bartlett's tests, respectively. If either were not normally distributed or had unequal variances, data were $(x + 0.5)^{1/2}$ -transformed, as suggested by Moore & Wong (1995, 1996) and Morritt (2001). Catches were subsequently compared between the six sampling stations using a two-way analysis of variance at a significance level of $P = 0.05$ using the SAS Release 8.02 software. If significant spatial distributions were identified, *a posteriori* pair-wise multiple comparisons using

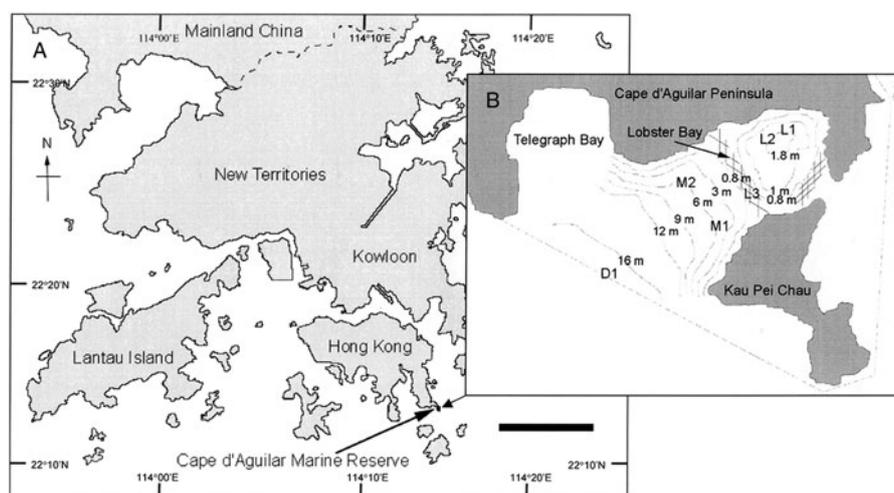


Fig. 1. (A) A map of Hong Kong showing the location of the Cape d'Aguilar Marine Reserve; (B) the depth contours. The cross-hatched areas represent ramparts. Scale bar: 10 km.

the Student–Newman–Keuls correction were carried out, again at $P = 0.05$.

MULTIVARIATE ANALYSES OF THE COMMUNITY OF ORGANISMS TRAPPED

Both classification and ordination techniques were employed to identify groups of biotically similar samples. An ascending hierarchical clustering analysis was conducted using group-average sorting with Bray–Curtis similarities upon fourth-root transformed data. This helped define communities spatially. Subsequently, non-metric multidimensional scaling was carried out to consolidate the results of the clustering dendrogram. Two-way crossed analysis of similarity (ANOSIM) was also accomplished to address statistically significant differences between the six stations and the two trap (baited versus un-baited) types. The species mainly responsible for any community difference were also identified using the SIMPER routine. All the multivariate analyses were performed using the PRIMER 5.2.0 statistical package.

RESULTS

Catch composition

An array of animals was captured over the course of the study (Table 1). A species of *Tisbe* (Harpacticoida: Tisbidae) accounted for 72.0% of the total number of all animals. The second major taxon was amphipods, dominated overwhelmingly by a species of *Ceradocus* (Gammaridea: Melitidae) (22.7%). These two crustaceans were most abundant not only in baited traps but also in the empty controls.

Other frequent but less numerous visitors to the traps included a species of *Nebalia* (Leptostraca: Nebaliacea) currently being described by Lee & Bamber (in preparation) (2.0%), benthic ostracods (1.0%) and *Neanthes cricognatha* (Ehler, 1904) (Polychaeta: Nereidae) (0.5%). In terms of species diversity, amphipods were the highest among all trapped taxa (>11 species). Among all retained visitors to the traps, only lysianassoids, *Nebalia* sp., *N. cricognatha* and benthic isopods occurred exclusively in baited traps.

Univariate analyses of catches

The presence of bait largely determined the total catches (Table 2). Baited traps captured significantly more organisms (mean \pm SD = 45 ± 33 individuals-trap⁻¹) than controls (10 ± 12 individuals-trap⁻¹). Notwithstanding, the numbers of individuals trapped in the presence of bait at Stations M2 and D1 numerically exceeded the others (Figure 2). Further analysis of the data revealed that a spatial pattern was established only if empty control traps were used (Table 2). Among the six stations, the controls deployed at L1 and L2 within Lobster Bay significantly retained more organisms than L3 on the south-western rampart and the deeper-water stations (M1, M2 and D1).

As the species of *Tisbe*, *Ceradocus* and *Nebalia* together accounted for >96% of the total number of organisms caught over the course of the study, more detailed data analyses were separately carried out for them. Data for *Tisbe* sp. have already been reported upon (Lee, 2004). Catches of *Nebalia* sp. resembled *Tisbe* sp. in terms of both spatial

Table 1. A list of hyperbenthos captured from the Cape d'Aguilar Marine Reserve, their abundances per trap and relative proportions over the course the study.

Species	Baited trap	Un-baited control trap	Total
Copepoda: Harpacticoida			
Tisbidae			
<i>Tisbe</i> sp.	1336.2 (83.6%)	77.7 (21.3%)	1413.9 (72.0%)
Amphipoda: Gammaridea			
Amphilochidae			
Unidentified species	0.0 (0.0%)	1.0 (0.3%)	1.0 (0.1%)
Amphilochidae			
<i>Ampithoe kava</i> Myers, 1985	0.8 (0.1%)	1.0 (0.3%)	1.8 (0.1%)
Caprellidae			
	0.0 (0.0%)	1.0 (0.3%)	1.0 (0.1%)
Dulichiiidae			
<i>Podocerus crenulatus</i> Myers, 1985	0.0 (0.0%)	1.0 (0.3%)	1.0 (0.1%)
Unidentified species	0.8 (0.1%)	3.9 (1.1%)	4.7 (0.2%)
Melitidae			
<i>Ceradocus</i> sp.	178.3 (11.2%)	265.6 (72.7%)	443.9 (22.7%)
<i>Maera pacifica</i> Schellenberg, 1938	1.3 (0.1%)	1.9 (0.5%)	3.2 (0.2%)
<i>Melita koreana</i> Stephensen, 1944	1.8 (0.1%)	1.2 (0.3%)	3 (0.2%)
Other unidentified gammarideans	5.5 (0.3%)	6 (1.6%)	11.5 (0.6%)
Amphipoda: Lysianassoidea			
<i>Lepidepecreum</i> sp.			
	6.9 (0.4%)	0.0 (0.0%)	6.9 (0.4%)
Unidentified lysianassoids	1.0 (0.1%)	0.0 (0.0%)	1.0 (0.1%)
Leptostraca			
Nebaliacea			
<i>Nebalia</i> sp.	38.7 (2.4%)	0.0 (0.0%)	38.7 (2.0%)
Polychaeta			
Neanthidae			
<i>Neanthes cricognatha</i> (Ehler, 1904)	9.0 (0.6%)	0.0 (0.0%)	9.0 (0.5%)
Unidentified isopods			
	1.0 (0.1%)	0.0 (0.0%)	1.0 (0.1%)
Unidentified benthic ostracods			
	17.0 (1.1%)	2.0 (0.5%)	19.0 (1.0%)
Penaidae			
	0.8 (0.1%)	1.0 (0.3%)	1.8 (0.1%)
Unidentified squat lobsters			
	0.0 (0.0%)	1.0 (0.3%)	1.0 (0.1%)
Unidentified mites			
	0.0 (0.0%)	1.0 (0.3%)	1.0 (0.1%)

distribution and difference between trap types (Figure 2) because both were attracted significantly to baited ones and had a preference for the south-western deeper-water stations (M1, M2 and D1) (Table 3).

No *Nebalia* sp. individuals were recorded from empty controls (Table 1), so that a spatial pattern was identified only for baited traps. Among catches from baited traps, *Nebalia* sp. was not recorded from the shallower Lobster Bay (L1 and

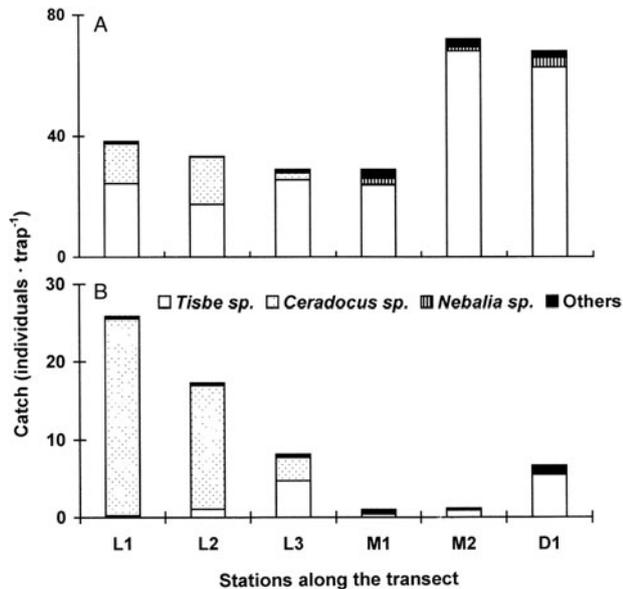


Fig. 2. Average faunal catches from (A) baited and (B) un-baited control traps during the spatial heterogeneity experiment in the Cape d'Aguilar Marine Reserve.

L2) and the rampart station (L3) (Figure 2). Within the south-western deeper-water stations, numbers of *Nebalia* sp. caught at D1 were significantly greater than at M1 and M2.

Opposite to *Nebalia* sp., the catches of *Ceradocus* sp. did not differ between the two trap types (Table 1; Figure 2)

and a reverse spatial distribution was identified. Catches were significantly higher at the two Lobster Bay Stations L1 and L2, followed by the shallow rampart Station L3 but much lower at the south-western deeper-water Stations M1, M2 and D1, irrespective of the presence or absence of bait.

Multivariate analyses of the organisms trapped

Results from ANOSIM showed that species composition differed significantly between baited and control traps (Table 4).

According to the results of the SIMPER analyses, the dissimilarity index between them was 70.5% and *Tisbe* sp. accounted mainly for this difference. Table 4 also shows that if both baited and empty control traps were considered, two major station groups were demarcated, that is: (i) shallow Stations L1, L2 and L3; and (ii) Stations M2 and D1. The species composition at M1 was significantly different from all the shallow water stations and D1, but not M2. Benthic ostracods and *Tisbe* sp. contributed to community differences between M1 and M2–D1 because they were more abundant at the latter. Results from SIMPER analyses, however, show that the dissimilarity index between the shallow (Lobster Bay) sites and the station group of M2–D1 (55.9%) approximated those between the shallow ones and M1 (53.9%). This was only 39.0% between M1 and the other two deeper stations. This means the species composition of catches among the six stations could be allocated mainly to two major groups, that is: (i) the shallow Lobster Bay (L1, L2) and rampart (L3)

Table 2. Statistical analyses (two-way analysis of variance (ANOVA) in the first row and one-way ANOVA in the second and third row) of possible spatial patterns in total catches for Stations L1, L2, L3, M1, M2 and D1, based on $([x + 0.5]^{1/2})$ -transformed data. Significant results at $P < 0.01$ and 0.001 are indicated as two and three asterisks, respectively. Stations not significantly different from each other are underlined.

	Source of variation	df	MS	F	P	Ranks/remarks
Total catch	Main effect	1	215.27	70.4	0.0001***	Baited Control
	Trap (T)	5	6.7	2.19	0.0668	Not significant
	Station (S)	5	13.79	4.51	0.0015**	Significant
	Interaction effect	60	3.06			
	T*S					
Baited	Residuals					
	Main effect	5	7.17	1.56	0.2002	Not significant
	Station	30	4.58			
Control	Residuals					
	Main effect	5	13.32	8.7	0.0001***	
	Station	30	1.53			<u>L1 L2 L3 D1 M2 M1</u>
	Residuals					

Table 3. Statistical analyses (two-way analysis of variance (ANOVA) of catches of species of *Ceradocus* in the first row and (one-way ANOVA) of catches of *Nebalia* in the second row from the Cape d'Aguilar Marine Reserve (Stations L1, L2, L3, M1, M2 and D1). Data were $([x + 0.5]^{1/2})$ -transformed. Significant results at $P < 0.001$ are indicated by three asterisks. Stations not significantly different from each other are underlined.

Catch	Source of variation	df	MS	F	P	Ranks/remarks
<i>Ceradocus</i> sp.	Main effect	1	0.89	1.48	0.2287	Not significant
	Trap (T)	5	31.46	52.1	0.0001***	<u>L1 L2 L3 M1 M2 D1</u>
	Station (S)	5	0.5	0.83	0.5358	Not significant
	Interaction effect	60	0.6			
	T*S					
<i>Nebalia</i> sp. ¹	Residuals					
	Main effect	5	1.2	12.78	0.0001***	<u>D1 M1 M2 L1 L2 L3</u>
	Station (S)					

¹, as no *Nebalia* sp. individuals were captured in this study, only one-way analyses of catches across the six sampling stations were carried out.

Table 4. Statistical multivariate analysis (two-way crossed analysis of similarity) of the taxa trapped at Stations L1, L2, L3, M1, M2 and D1 using baited and un-baited control traps. This test examined for any possible similarity between stations and between trap types. The pair-wise tests identify the possible differences between any two stations if both baited and empty control traps are taken into account. Significant results at $P < 0.01$ are indicated by two asterisks.

Variable	Global R	P
Global test (trap)	0.378	0.001**
Global test (station)	0.465	0.001**
Pair-wise test		
Between L1 and L3	0.22	0.069
Between L1 and L2	-0.031	0.580
Between L1 and M1	0.898	0.002**
Between L1 and M2	1.000	0.002**
Between L1 and D1	0.913	0.002**
Between L2 and L3	-0.094	0.819
Between L2 and M1	0.626	0.001**
Between L2 and M2	0.808	0.001**
Between L2 and D1	0.931	0.001**
Between L3 and M1	0.555	0.001**
Between L3 and M2	0.639	0.001**
Between L3 and D1	0.703	0.001**
Between M1 and M2	0.115	0.083
Between M1 and D1	0.193	0.030**
Between M2 and D1	0.097	0.079

stations; and (ii) the south-western deeper-water ones (M1, M2 and D1).

If only baited traps were considered, the same two clusters were also formed with one of them comprising all the deeper-water stations (M1, M2 and D1), the other the shallower water stations (L1, L2 and L3) (Figure 3A). Similarly, two clusters are identified in Figure 3B with the shallow Lobster Bay and rampart stations on the left, and the south-western deeper-water stations on the right. Both *Ceradocus* sp. and *Nebalia* sp. accounted for the substantial community differences identified between the shallow and deeper waters. *Ceradocus* sp. dominated the former station group, while *Nebalia* sp. dominated the trapped fauna in the latter.

This could be partly attributed to low catches, as shown in Figure 2. Apart from the outliers, a demarcation in trapped hyperbenthic community composition was obvious. The dissimilarity index between the shallow and deeper-water station groups varied between 81.21% and 83.05%. *Ceradocus* sp. mainly accounted for community differences between the shallow and the deep-water stations with faunal dominance of the former station group. No short-term temporal effects over the course of the study period could be identified (Figures 3 & 4).

DISCUSSION

Species composition and comparisons with other locations

The results of the present study provide further evidence in support of the hypothesis of Biernbaum & Wenner (1993) that at lower latitudes a coastal necrophagous assemblage in baited traps is not necessarily dominated by lysianassoids. This study has demonstrated that, in a decreasing order of

importance, *Tisbe* sp., *Nebalia* sp., benthic ostracods, *Neanthes cricognatha* and *Lepidepcreum* sp. are important scavenging members of the hyperbenthic fauna of the Cape d'Aguilar Marine Reserve, if fish and macrofauna are excluded, because their catches using baited traps exceeded those of controls. The trapped lysianassoids accounted for only $\leq 0.5\%$ of the total captured fauna and have not been trapped locally before. It should be stressed that the trapped fauna herein reported upon is likely to represent secondary arrivals, following larger, more agile fish, crabs, prawns and gastropods (Britton & Morton, 1993, 1994). This study, however, provides the first information on a hyperbenthic community of scavenging crustaceans and polychaetes in the shallow coastal waters of Hong Kong and the wider Indo-West Pacific subtropics.

Nishida *et al.* (1999) reported that the trapped fauna might be related to trap entrance aperture size. A 5.5 mm diameter opening allowed the entrance of both lysianassoid amphipods and copepods to baited traps in the deep sea off Japan, leading to intensive predation of the latter by the former. A 2.0 mm aperture size, on the other hand, allowed copepods to pass through but prevented lysianassoids from entering, resulting in a predominance of the former in the traps. Both lysianassoids and copepods were, therefore, suggested to be necrophages exhibiting a mutually exclusive and competitive relationship. Opposite results in this study using traps with a 5.0 mm opening were obtained with a numerical preponderance of *Tisbe* sp. over the melitid amphipod *Ceradocus* sp. Although *Ceradocus* sp. appeared to have a negative correlation with *Tisbe* sp., insignificant differences in catches between baited and control traps indicated that the former was attracted to the structural habitat complexity provided by the trap and not the carrion in it nor the potential prey value of the copepod already inside it. *Ceradocus* sp. is, hence, not a scavenger.

Spatial distribution of necrophagous communities in Hong Kong

This study shows that all identified scavenging hyperbenthic species, including *Tisbe* sp. (Lee, 2004), were generally caught in increasing numbers with increasing depth. Conversely, *Ceradocus* sp. replaced the other scavenging invertebrates in the shallows, regardless of the presence or absence of bait. Small-scaled spatial segregations in amphipod community composition (Sekiguchi & Yamaguchi, 1983) have been usually attributed to various physical factors, such as substratum type (Kirkwood & Burton, 1988), particle size (Robertson *et al.*, 1989), water depth, seabed topography, shoreline characteristics and current speed (Ingram & Hessler, 1983; Arntz *et al.*, 1994). In addition, the fact that no significant differences were identified between trap types for *Ceradocus* sp. indicates that it is not attracted to the bait but to the substratum complexity offered by the traps. *Ceradocus* sp. therefore appears to favour topographic heterogeneity within the shallow, spatially heterogeneous, Lobster Bay because boulders and cobbles, even the epilithic fauna, create many niches into which it can retreat. Those traps herein deployed thus acted solely as 'habitat traps' for this species. Griffiths *et al.* (2000) reported that lobsters entering baited traps were not attracted to the bait but to isopods also drawn to and concentrated there, another example of

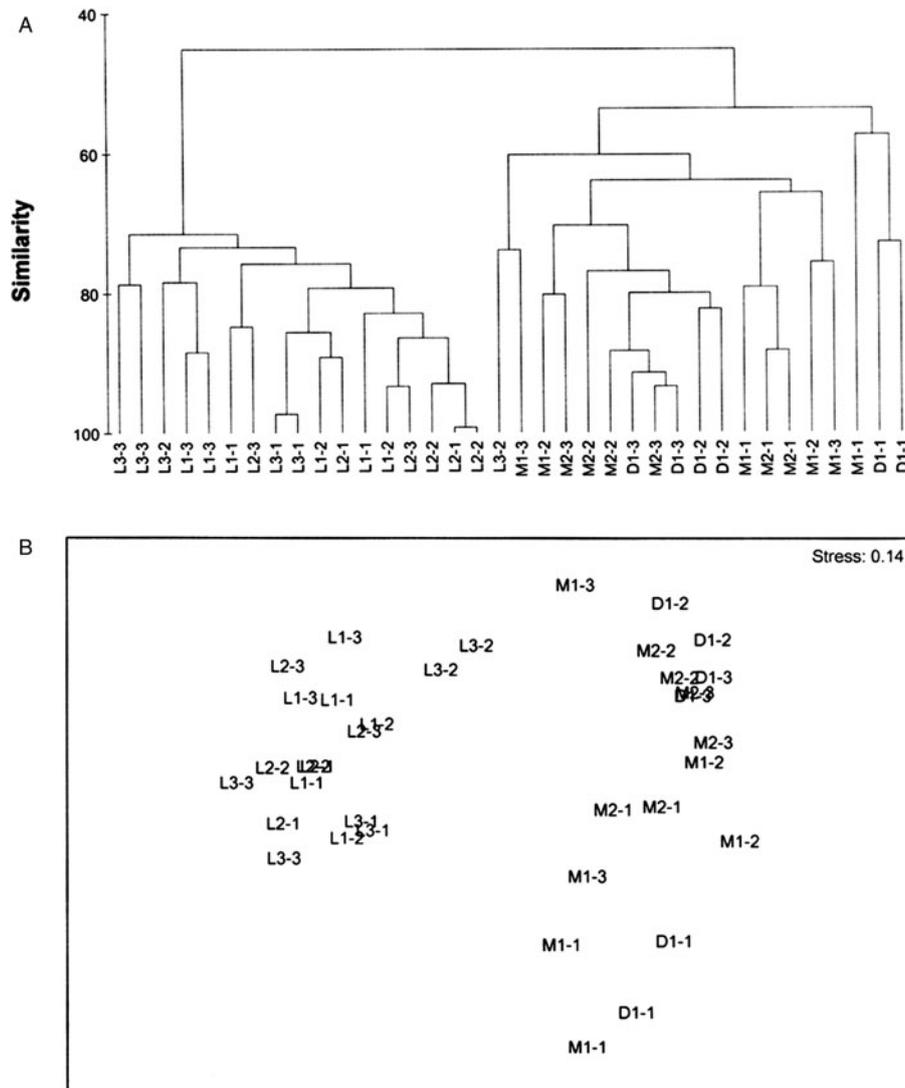


Fig. 3. Multivariate analyses of the taxa caught using baited traps in the spatial heterogeneity experiment conducted in the Cape d'Aguilar Marine Reserve. (A) A dendrogram of ascending hierarchical agglomerative clustering analysis. Data were fourth-root transformed to compute the Bray–Curtis similarities using group-average linking; (B) a two-dimensional multidimensional scaling (MDS) configuration. The stress value is indicated at top right. Symbols are presented as station name followed by first '1', second '2' or third '3' times of sampling. For the empty control traps, samples from Station M1 and sometimes Station M2 acted as outliers, and community composition here appeared to be more variable and, hence, dispersed virtually throughout the MDS configuration (Figure 4).

the bias of 'habitat' trapping. However, this does not seem to be the case for *Ceradocus* sp. (this study).

Low catches of scavengers in baited traps in the shallows may result from the exposed nature of Lobster Bay. The eastern gap between the Cape d'Aguilar Peninsula and island of Kau Pei Chau exposes the enclosed Lobster Bay to strong wave action, particularly in winter. Turbulent waters would act to disperse any chemical cues emanating from carrion and reduce the ability of scavengers to detect potential food sources (Britton & Morton, 1993). However, the scavenging gastropods *Ergalatax contractus* (Reeve, 1846) and *Nassarius pauperus* (Gould, 1850) were caught in 'their hundreds' using baited traps in Lobster Bay (Morton & Chan, 2000). The spatial segregation of the trapped fauna might also be affected by differences in the amount of organic carbon between shallows and deeper-waters. Opportunistic scavengers are thought to supplement their natural diets with carrion (Britton & Morton, 1993, 1994; Kaiser & Moore, 1999). Significantly higher organic content at stations

beyond the western ramparts of Lobster Bay, particularly at Stations M2 and D1, might support more hyperbenthos in the absence of carrion. Composition of the fauna caught by traps in Lobster Bay contrasted sharply with that in the water column, and only *Tisbe* sp. has been obtained locally using plankton nets, where it accounts for <1% of total zooplankton abundance (Lee & Chen, 2003).

The trapped hyperbenthic fauna also differed markedly from the macrobenthic community of the study area identified by Morton & Harper (1995, 1997), as well as in the nearby Tai Tam Bay (Ong Che & Morton, 1991, 1995). This may be partly attributable to the different sampling methods employed. In the present study, >10 species of gammarideans were identified, but only one, *Maera pacifica* Schellenberg, 1938, has been reported from Hong Kong previously (Moore, 1990). Although knowledge of Hong Kong gammaridean amphipods (Hirayama, 1990a, b, 1991; Moore, 1990, Lowry, 2000; Horton, 2008) is fragmentary, resulting in the novel species recorded from this study, the dramatic

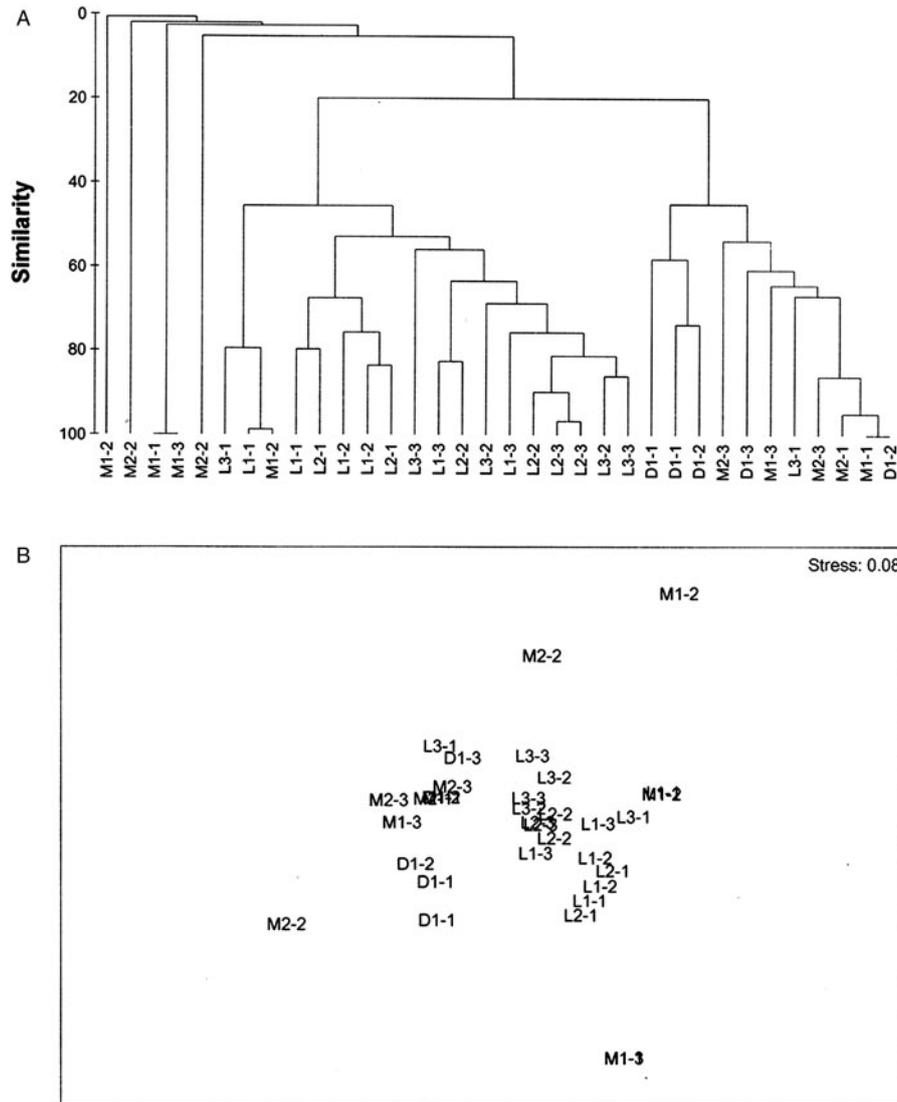


Fig. 4. Multivariate analyses of the faunal community retained using un-baited control traps in the spatial heterogeneity experiment conducted in the Cape d’Aguilar Marine Reserve. (A) A dendrogram of ascending hierarchical agglomerative clustering analysis. Data were fourth-root transformed using group-average linking to calculate Bray–Curtis similarities; (B) a two-dimensional multidimensional scaling configuration. The stress value is indicated at top right. Notations are the same as in Figure 3. Two data points were missing because both controls on a trap-set at Stations M2 and D1 did not capture any organisms.

difference between the benthic community and the trap samples supports the contention of Shulenberg & Hessler (1974) and Nishida *et al.* (1999) that trapping with bait is an efficient means of collecting dispersed, swimming and elusive hyperbenthic species obtained only rarely by other methods.

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