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VERTICAL DISTRIBUTION OF NEMATODES (NEMATODA) AND HARPACTICOID COPEPODS (COPEPODA: HARPACTICOIDA) IN MUDDY AND SANDY BOTTOM OF INTERTIDAL ZONE AT LOK KAWI, SABAH, MALAYSIA

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ABSTRACT. - The approach taken in the present study was to perform a sampling of the nematodes and harpacticoid copepods and to measure certain pore water parameters in muddy and sandy sediments. The Redox Potential Discontinuity (RPD) layer in muddy sediment occurred within the top few millimetres. This contrasted strongly with the deep RPD layer found at the similar tidal height on the sandy sediment. The difference in redox conditions between the muddy and sandy sediments is possibly due to the differences in hydrodynamism. The bulk of nematodes in sandy was found a little deeper than muddy areas. The activity of the many burrowing animals in the muddy and sandy areas may play a role in the oxidation of the sediments and thus influence the vertical distribution of the nematode and harpacticoid copepods. The vertical nematode species showed zonation vertically from the surface to the 30 cm depth of the sediment. The occurrence of the nematode species below the RPD layer indicated their ability to tolerate sulfides and to utilize the high density of microbial organisms in this layer. The presence of low concentration of dissolved oxygen of the pore water was also responsible for the vertical distribution. The nematodes feeding groups 1A (selective deposit feeders), 1B (non-selective deposit feeders) were abundant in the top 15 cm, whereas the 2A (epigrowth feeders) group was abundant in the top 5 cm of the sediment layer. Their distribution was related to the availability of food such as benthic diatom and other algae in the sediment.

KEY WORDS. - Nematodes, Harpacticoid copepods, vertical distribution.

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INTRODUCTION

The free-living nematodes and harpacticoid copepods are two major groups of meiofauna in most of the marine habitats in the world. Meiofauna is defined sufficiently by sieve mesh sizes (1000 – 42 um) as summarized by Thiel (1983). The vertical distribution of the meiofaunal studies found that majority of the fauna is located in the upper 2 cm of sediment. Most previous workers have observed the decline in numbers of meiofauna with increasing depth in both mud and sand substrates (see Tietjen, 1969; McLachlan, 1978). Vertical distribution is typically controlled by the depth of the redox potential discontinuity (RPD) level. Primary factor responsible for the vertical gradients in the RPD is oxygen and oxidation state of sulfur and various nutrients. The densities of meiofauna were greatly reduced when the redox potential dropped below +200 mV (McLachlan, 1978). Harpacticoid copepods are the most sensitive meiobenthic taxon to decreased oxygen : their distribution is confined to oxic sediments.

Studies are still lacking on vertical distribution of meiofauna in Malaysia. No meiofaunal vertical distribution studies have been carried out in Sabah, east Malaysia. The present study was purposed to find the vertical zonation of nematodes and harpacticoid copepods in the muddy and sandy sediments and its relation to certain environmental parameters of the sediments in Lok Kawi beach, Sabah, east Malaysia. Interest was centred on the vertical distribution of the nematodes species.

MATERIALS AND METHODS

Lok Kawi beach was chosen in the present study. It was located at 116° 2' E and 5° 52' N (Fig. 1). It was chosen because two habitats, namely, sandy and muddy substratum existed together and thus it would be logistically easier to carry out sampling. The Lok Kawi beach is located approximately 6 km southwest of Kota Kinabalu town center. The beach lies in a southwest to northeast direction and stretching approximately 4.5 km along the Lok Kawi coastline parallel to the Putatan road. The beach extends about 0.6 to 1 km out into the shallow foreshore water of the Lok Kawi coast during low tide.

The northeast of the Lok Kawi beach consists of muddy area. The area is sheltered due to the presence of sandbar in front of it. The sediment is muddy with the mangrove trees such as *Rhizophora* sp. and *Avicennia* sp. scattered in the coastline area. The domestic effluent of the Putatan River and the drainage from Kampung Meruntum influenced the area. Scattered patches of the seagrass beds (*Enhalus* sp.) have been found in the area.

The southern part of the muddy area is the sand flats. Sand flats running from Kampung Meruntum on the northeast to Pulau Mantukud on the southwest. Small isolated patches of coral reefs mostly covered by patches of dead coral rubbles and sand can be seen at the western part of the beach. The sand flats receive domestic effluent from the Lok Kawi army camp and Desa Cattles (chicken slaughtering). The domestic effluent discharge at the high tide is marked at positions shown in Fig. 1.

Four transects perpendicular to sea were established on the beach during low tide on June 1992 (Fig. 1). Transect one (T1) was located in the muddy area while transect two (T2), transect three (T3) and transect four (T4) were located on the sandflats area. Five 1 m^2 quadrats running from Mean High Water Neap (MHWN) to Mean Low Water Neap (MLWN) were

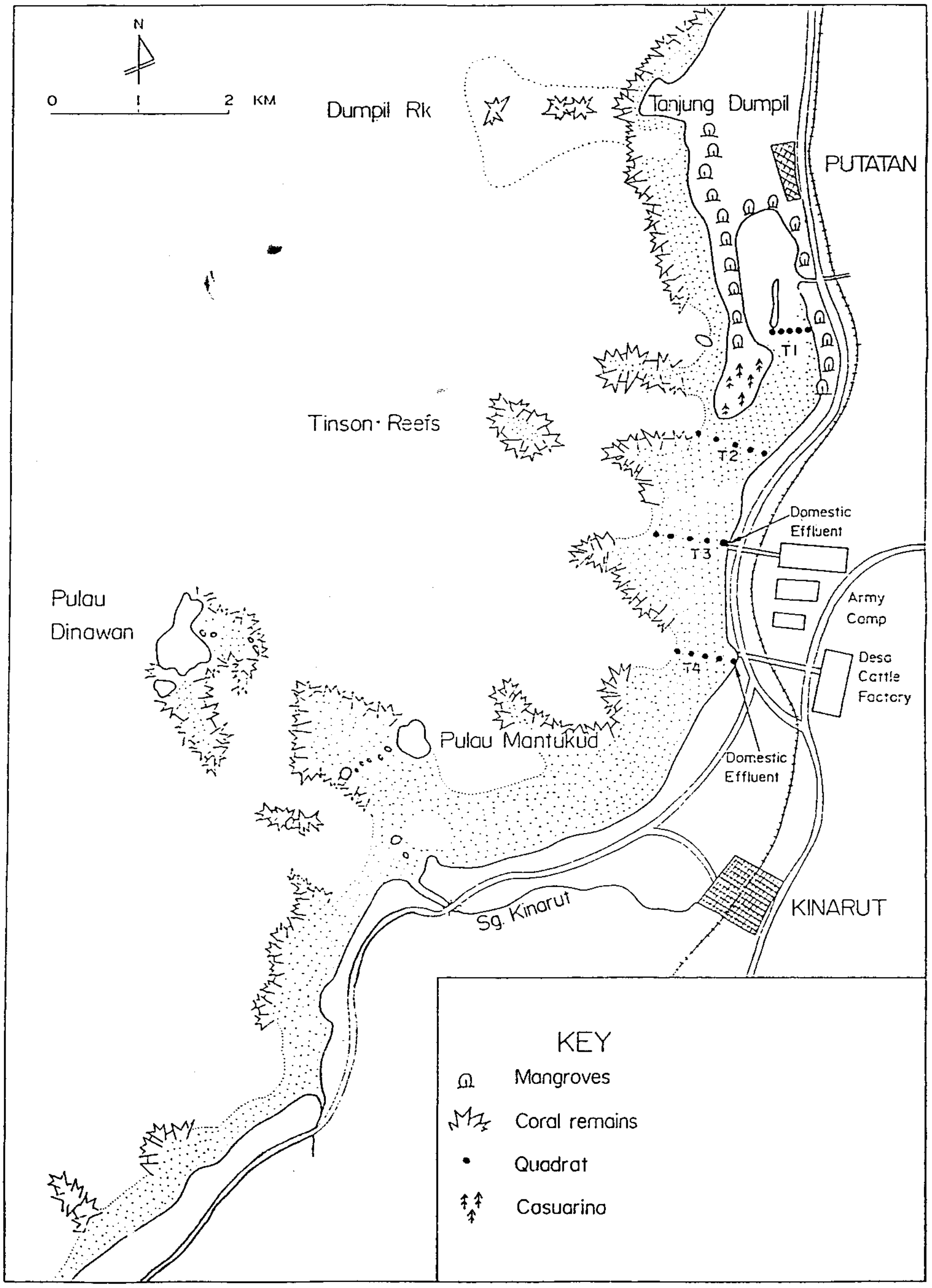

Fig. 1. Map showing the location of the four Transects at Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia.

located along the transect generally at height intervals of 0.95 metres (Fig. 2) using the surveying technique of Moore (1979). One of these quadrats was then leveled to the nearest standard Chart Datum point, which in every case was a tide gauge. The environmental parameters such as depth of the pore water level, brown layer of the sediment and dissolved oxygen of the pore water were measured following the methods recommended by Shabdin (1998). The environmental parameters such as depth of the pore water level and brown layer of the sediment were measured by pushing the 7.01 cm^2 transparent tube to a depth of 30 cm into the sediment. Then the tube was pulled out from the sediment and the ruler was used to measure the sediment brown layer in the tube. The hole that were left after the tube was pulled out from the sediment was then widened with a scoop to enable to see the first point (from the surface) of the pore water out. The nearest pore water level from the sediment surface was considered as the depth of pore water level. The depth of water from the sediment surface was measured with a ruler.

Dissolved oxygen was measured in situ at each quadrat. The hole existed after each core of meiofauna sampling was pulled out from the sediment. A scoop was used to widen this hole. Then, a PVC pipe (15 cm in diameter and 50 cm long) with numerous small holes (0.4 mm diameter) around it was put into the widened hole. The pore water will enter and fill the pipe

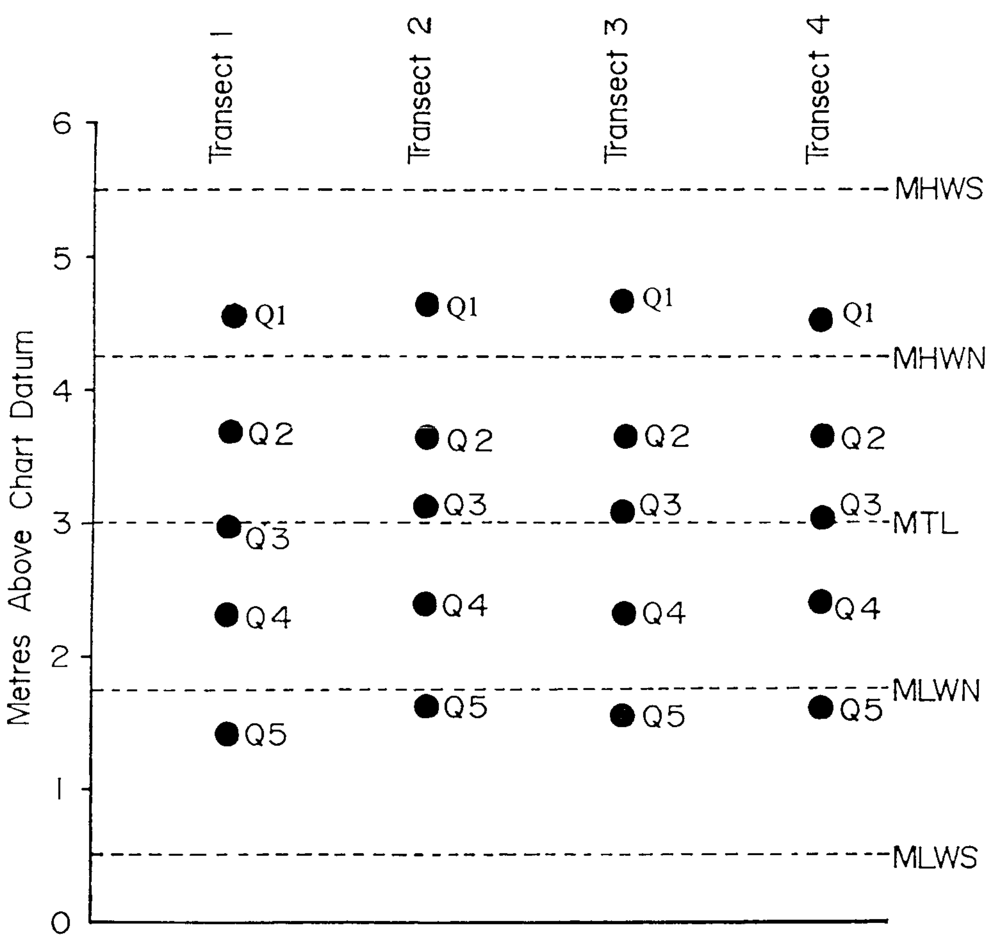

Fig. 2. Intertidal height of sampling quadrats along four perpendicular line transects to the sea at Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia.

cylinder through the small holes around it. The electrode of the hydrolab surveyor was then lowered into the PVC pipe cylinder. The Hydrolab Environmental Data System (model SVR - 2 – Susonde Unit) was used to measure dissolved oxygen in each quadrat.

Two cores (internal diameter 7.01 cm^2) of sediment (40 cm depth) were taken at every quadrat in transect one to four for the determination of redox potential (Eh) vertical profile using the 50 cm Perspex tube. Eh was measured at one cm intervals to a depth of 10 cm and every 5 cm after the 10 cm depth followed the methods recommended of Pearson & Stanley (1979). Two cores of sediment were taken to a depth of 30 cm for grain size and chlorophyll *a* analyses. Two replicate of sediment samples for nematode and harpacticoid studies were taken to a depth of 30 cm with transparent Perspex tube (50 cm long) in each quadrat. The sediment was allowed to move down slowly and cut with thin plate every five cm. The sediment samples were then put into the labeled plastic bags, fixed and preserved with 5% neutralized seawater formalin.

In the laboratory, The grain size analysis followed the methods recommended by Buchannan (1984). The sediment sample preparation technique for extraction of chlorophyll and pheopigments followed those of Wasmund (1984). The spectophotometric method for determination of chlorophyll's followed those of Parsons et al. (1984) using the equations from Jeffrey & Humphrey (1975). The determination of phaeophytins was performed due to the acidification technique from Riemann (1978) and equations given by Parsons et al. (1984).

In the laboratory meiofauna was extracted from the substrate either by sieving or by a combination of sieving and centrifuging techniques. Meiofauna samples from sandy habitat (T2, T3, T4) were extracted using only the sieving method while samples from muddy habitat (T1) were extracted by a combination of sieving and centrifuging techniques.

In the sieving method, the preserved samples were washed through sieves of 500 μm and 32 μm using a fine jet of tap water. The meiofauna retained on the 32 μm sieve was rinsed with freshwater to remove salt. Then, the meiofauna retained on the 32 μm sieve (sample from sandy habitat) was concentrated by washing it to the edge of the sieve and then washed with water from the wash bottle into a petri dish. Then the specimen was placed under stereo microscope for further investigation.

In the case of the combination technique, the preserved samples from the muddy habitat (T1) were washed through sieves of 500 μm and 32 μm using a fine jet of tap water. The material retained on 32 μm sieve was concentrated by washing it to the edge of sieve and the excess water removed by placing absorbent paper beneath the sieve. This is important in order to minimize subsequent dilution of the floatation medium. The screenings were then carefully washed into a 250 ml centrifuge bottle using colloidal silica in a wash bottle. The colloidal silica used was Ludox–TM (Du Pont Chemical) diluted to a specific gravity of 1.115 with 4% formalin. The 250 ml centrifuge bottle was then $^3/_4$ filled with Ludox–TM and spun for 5 minutes at 2,709 g. The supernatant was carefully decanted into a 32 μm net held over a beaker whilst rotating the centrifuge bottle to wash off material adhering to the wall. The net screenings were then rinsed free of Ludox and the meiofauna was washed with freshwater from the wash bottle into the petridish for sorting and counting. The centrifuge bottle was then refilled with Ludox–TM and the process was repeated. The method used was found to be 95% efficient (Mohd Long, 1985).

The nematodes and harpacticoids were counted under SV5 Zeiss stereo microscope and Zeiss Axioscope 50 compound microscope. The harpacticoid was identified to the order level only while nematode was identified to the species level. Number of organisms were converted to densities in units of individuals/10 cm^2. The nematode specimens were deposited in the museum of the Faculty of Resource Science and Technology, Universiti Malaysia Sarawak.

RESULTS

Environmental parameters

The variations of vertical environmental factors such as pore water level depth, the brown layer depth, dissolved oxygen, the amount of silt and clay and Redox Potential Discontinuity (RPD), chlorophyll *a* and phaeopigment concentrations at 5 quadrats of Transects 1-4 in the Lok Kawi beach are summarized in Table 1. The records of these factors were expressed following the quadrats sequence from Mean High Water Neap (MHWN) to Mean Low Water Neap (MLWN).

Table 1. Environmental parameters of the study area. RPD - Redox Potential Discontinuity.

Transect	Parameter	Quadrat				
		Q1	Q2	Q3	Q4	Q5
1	Pore water level (cm)	29.1	8.1	17.5	3.1	3.5
	Brown Layer depth (cm)	1.1	0.5	0.5	0.5	1.1
	Dissolved oxygen (mg/l)	0.3	0.4	0.9	0.2	0.4
	Silt and clay (%)	35.9	69.3	43.9	35.9	36.6
	RPD depth (cm)	0.1	0.1	0.3	0.1	0.4
	Chlorophyll *a* (mg/m)	5.2	4.1	3.9	3.5	5.8
	Phaeopigment (mg/m)	3.5	7.9	13.9	10.8	7.7
2	Pore water level (cm)	29.1	8.1	7.1	5.1	8.1
	Brown Layer depth (cm)	5.1	8.1	5.1	8.1	3.5
	Dissolved oxygen (mg/l)	1.1	1.1	1.6	2.1	0.7
	Silt and clay (%)	7.4	7.2	10.1	9.1	6.5
	RPD depth (cm)	3.7	7.8	6.5	6.2	3.7
	Chlorophyll *a* (mg/m)	1.8	5.3	3.4	3.4	2.6
	Phaeopigment (mg/m)	7.7	2.2	0.8	1.1	1.6
3	Pore water level (cm)	29.1	18.1	14.5	5.1	3.1
	Brown Layer depth (cm)	5.1	0.3	4.5	7.1	5.5
	Dissolved oxygen (mg/l)	1.1	1.6	1.5	0.9	0.6
	Silt and clay (%)	11.3	3.4	4.2	6.2	11.4
	RPD depth (cm)	3.7	2.9	5.1	7.3	5.7
	Chlorophyll *a* (mg/m)	2.5	4.6	1.7	2.9	4.1
	Phaeopigment (mg/m)	2.7	2.2	1.4	0.2	5.8
4	Pore water level (cm)	22.5	11.1	9.5	6.1	6.1
	Brown Layer depth (cm)	4.5	3.1	5.5	6.1	6.1
	Dissolved oxygen (mg/l)	0.8	0.8	0.9	0.9	0.6
	Silt and clay (%)	4.1	4.1	3.6	3.3	4.4
	RPD depth (cm)	4.2	3.2	5.2	6.1	6.1
	Chlorophyll *a* (mg/m)	0.9	0.9	4.7	7.6	2.4
	Phaeopigment (mg/m)	0.6	0.4	1.9	2.4	1.1

The pore water depth in all transects showed deeper in sediments on Mean High Water Neap (MHWN) and became closed to the surface towards Mean Low Water Neap (MLWN) except in quadrat 3 of T1 (Table 1). The maximum depth is 29.1 cm (quadrat 1, T1) and minimum is 3.0 cm (quadrat 5, T3).

The brown layer depth in transect 1 was near the surface of the sediments (Table 1). Its value is in the range of 0.5 - 1.0 cm depth. The values in T2 are erratic along the transect ranging from 3.5 cm (MLWN) to 8.0 cm (MTL). In transect 3 the depth of brown layer increased in depth towards lower level of the beach except in quadrat 5. Similarly, the depth showed the same trends in T4 except in quadrat 1. The sandy transects (T 2,3 and 4) showed deeper brown layer (0.3 - 8.1 cm) than the muddy area (0.5 - 1.1 cm) (T1). Dissolved oxygen values in all transects were variable ranging from 0.2 (T1) to 2.1 mg/l (T2). The lowest values were recorded along the muddy area (T1). The amount of silt and clay in T1 were high (> 36.9%) as compared to T2- T4 (< 11.4%)(Table 1).

The depth of the Redox Potential Discontinuity layer (RPD), taken here as the depth at which the Eh is zero. The RPD along the T1 (0.1 to 0.4 cm) was shallower than others (T2 - T4, 2.9 to 7.8 cm).

Vertical distribution of nematodes

The vertical distribution of nematodes and harpacticoid copepods in Lok Kawi beach are summarized in Table 2. The records of these factors were expressed following the quadrats sequence from Mean High Water Neap (MHWN) to Mean Low Water Neap (MLWN).

The bulk of nematode was contained within the upper 15 cm at T1. It is evident from Table 2 that density of the nematodes reached a peak within the top 5 cm of the mud. In sandy area the majority was distributed within the upper 20 cm with the exception at quadrat 5 of T3.

The vertical distribution of nematodes species in the muddy (T1) and sandy (T2-T3) transects are presented in Fig. 3 and Fig. 4 respectively. The different species showed a different distribution with the increasing depth of the sediments.

Ten groups of species were distributed from surface to 30 cm depth of the muddy area (T1) (Fig. 3). Six groups representing 30 species were zoned from the surface to 25 cm depth. Eleven species were distributed from the surface to 5 cm, 4 species from the surface to 10 cm, 8 species from the surface to 15 cm, 2 species from the surface to 20 cm, 2 species from the surface to 25 cm and 3 species from the surface to 30 cm depth. Secondly, groups representing 2 species were distributed from 5 to 25 cm depths. Lastly, groups contained 2 species occurred from 10 to 30 cm depth.

Seventeen groups were categorized from the surface to 30 cm depth of the sandy transects (Fig. 4). Six groups were zoned from surface to 30 cm, 5 groups from 5 to 30 cm, 3 groups from 10 to 30 cm, 1 group from 15 to 30 cm and 2 groups from 20 to 30 cm. First, the 6 groups contained 47 species. Twenty four species were distributed from surface to 30 cm depth followed by 6 species from surface to 25 cm, 3 species from surface to 20 cm, 3 species from surface to 15 cm, 2 species from surface to 10 cm and 9 species from surface to 5 cm depth of the sediments. Second, the 5 groups contained 13 species were distributed from 5 to 30 cm depths. Third, 3 groups comprised of 4 species were distributed from 10

Table 2. Vertical distribution of the nematode and harpacticoid copepod densities (no. individuals per 10 square cm) at Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia (Nem - nematode, Har - harpacticoid copepod).

Transect	Depth (cm)	Quadrat									
		1		2		3		4		5	
		Nem	Har	Nem	Har	Nem	Har	Nem	Har	Nem	Har
1	5	-	94	670	76	1431	337	1456	250	2430	173
	10	120	-	61	-	691	-	228	-	1155	-
	15	344	-	54	-	1282	-	38	-	423	-
	20	104	-	-	-	162	-	19	-	30	-
	25	35	-	-	-	386	-	19	-	243	-
	30	-	-	-	-	80	-	-	-	-	-
2	5	1628	37	283	5	205	14	649	6	2816	347
	10	889	26	6	4	24	13	343	3	643	7
	15	799	-	33	-	49	-	99	-	232	-
	20	342	-	17	-	25	-	36	-	155	-
	25	385	-	17	-	-	-	27	-	1107	-
	30	45	-	57	-	144	-	27	-	541	-
3	5	680	7	174	57	493	451	517	50	882	17
	10	223	-	111	4	390	230	850	3	168	6
	15	12	-	145	-	508	14	290	-	126	-
	20	74	-	22	-	165	-	103	-	147	-
	25	24	-	-	-	103	-	145	-	147	-
	30	100	-	-	-	78	-	14	-	672	-
4	5	349	3	348	29	551	188	1216	64	2416	39
	10	158	-	308	1	462	57	1196	20	1110	-
	15	-	-	134	-	593	-	746	-	1269	-
	20	16	-	94	-	301	-	397	-	2022	-
	25	16	-	135	-	279	-	311	-	158	-
	30	15	-	40	-	251	-	345	-	40	-

to 30 cm depths. Forth, 1 group representing 3 species was distributed from 15 to 20 cm depths. Last, two groups with 3 species were distributed from 20 to 30 cm depths of the sediments.

The vertical distribution of nematodes feeding types in all transects is presented in Table 3. The distribution of groups 1A, 1B and 2A were from surface to the 30 cm depth of the sediments. The 1A group was abundant above 15 cm depth in all transects. Its distribution was to the depth of 30 cm except at T1. The 1B group showed similar pattern being abundant in the upper 15 cm and decreased in density to a depth of 30 cm. However, its distribution was covered in all depth within four transects. The 2A group was abundant in first 5 cm and showed fluctuation in density from 10 to 30 cm depths. The group 2B (predator/omnivores) was distributed to the depth of 20 cm at T1 and 5 cm at T2. However, this group was absent at T3 and T4.

Vertical distribution harpacticoid copepods

The vertical distribution of harpacticoid copepods at T1 was restricted at top 5 cm of the mud (Table 2). However at T2-T4 it was much deeper until 15 cm depth.

Statistical analysis

One tail student t - test was performed to see the correlation between density of total organisms (nematodes + harpacticoid copepods) with the depth in the sediment and redox potential. The density of total organisms is only significant between 0 - 5 cm with 5 - 10 cm depth (t = 45, dt = 2.59, P = 1.68). This showed that the nematodes and harpacticoid copepods were riches in the top 5 cm muddy and sandy transects. However, no correlation was detected by student t-test between density of total organisms with redox potential.

Fig. 3. Vertical distribution of nematode species in the muddy area at Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia.

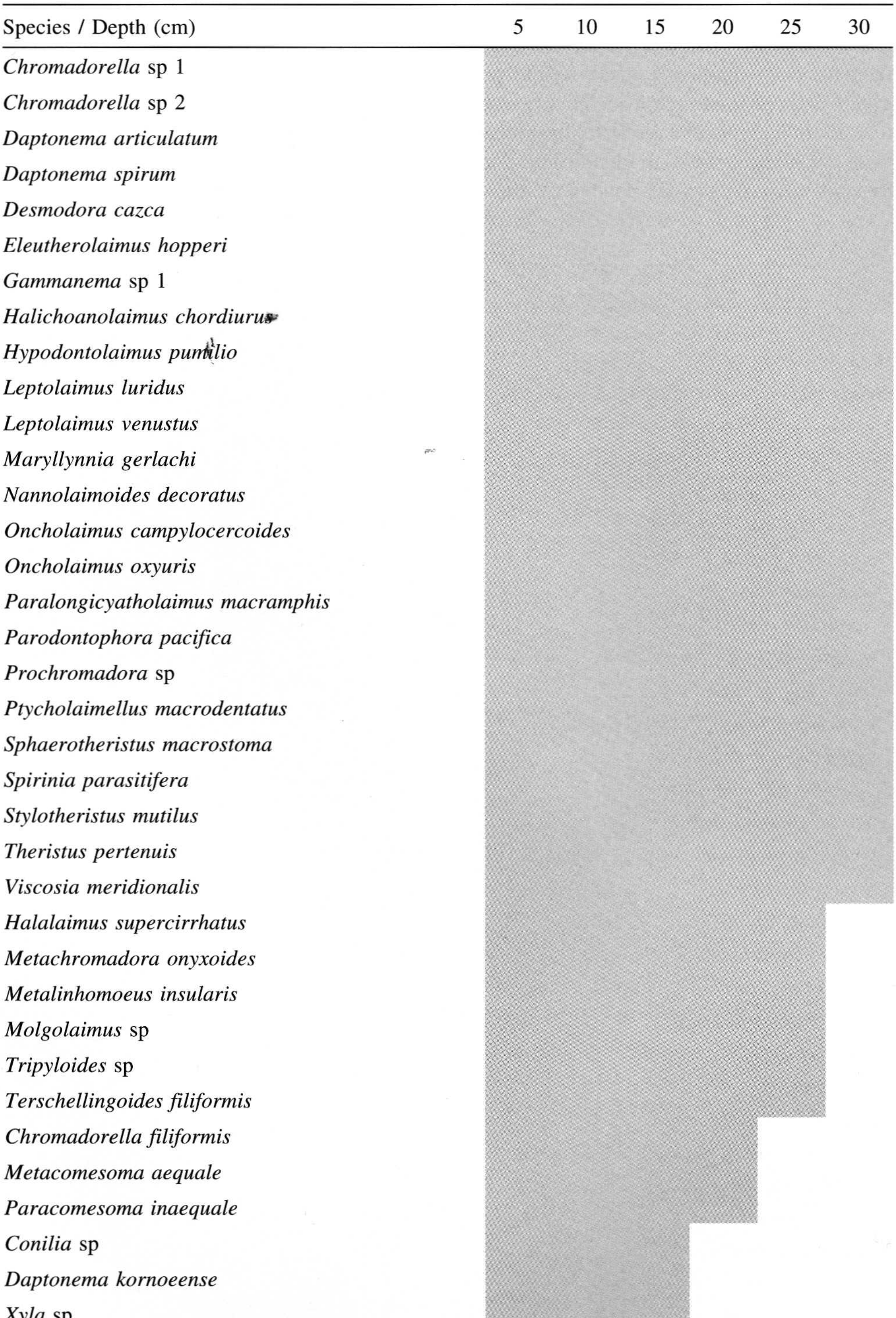

Fig. 4. Vertical distribution of nematode species in the sandy area at Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia.

Fig. 4. Continue

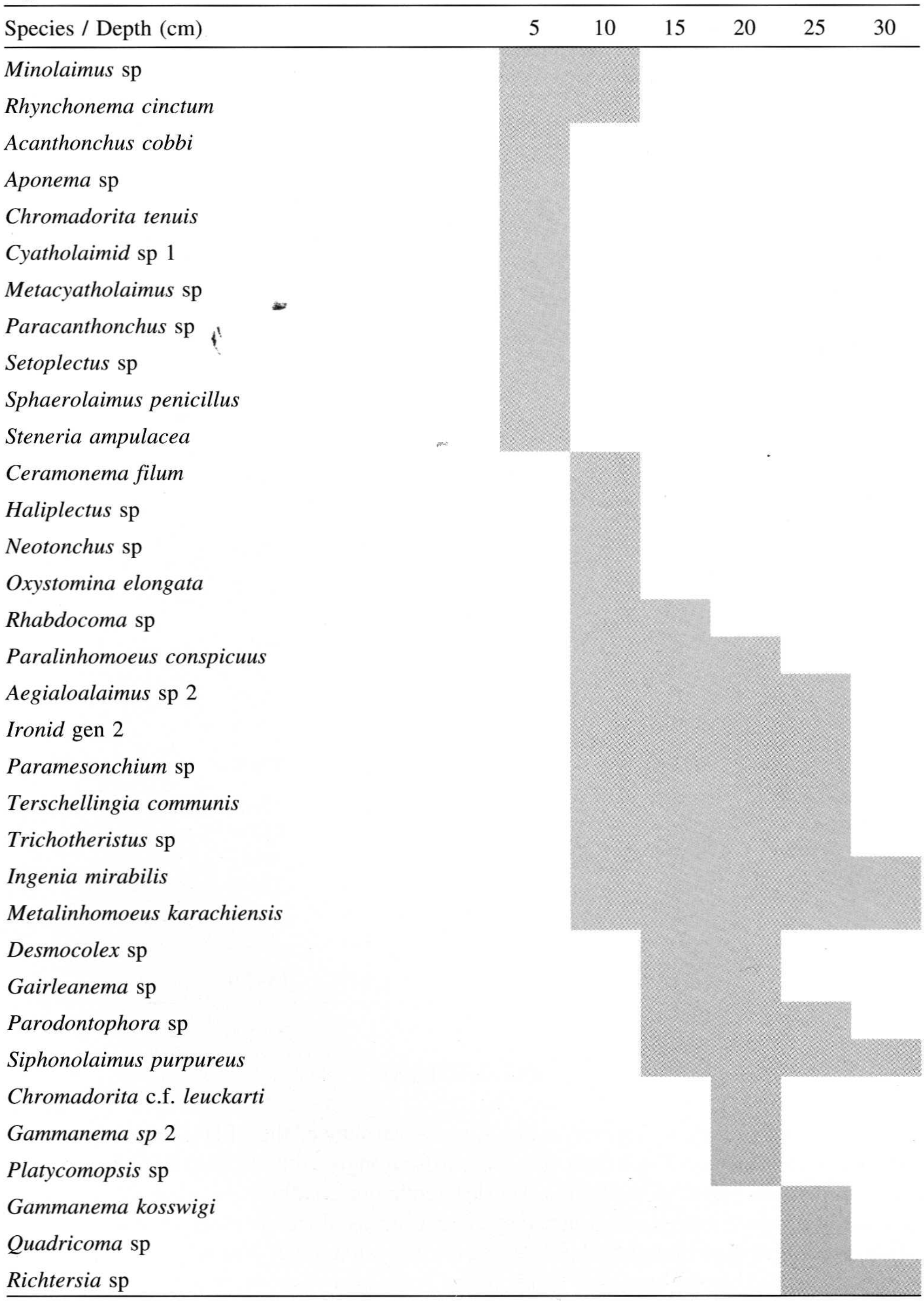

Table 3. Vertical distribution of the nematode feeding types in Lok Kawi beach, Kota Kinabalu, Sabah, Malaysia (no. is mean density of individuals per 10 square cm).

Transect	Depth (cm)	Feeding type			
		1A	1B	2A	2B
1	5	141.8	547.6	607.2	149.4
	10	133.2	263.8	54	-
	15	235.2	113	76.6	3.4
	20	30.6	19.4	6	7
	25	73.2	29	34.4	-
	30	-	16	-	-
	TOTAL	**614.0**	**988.8**	**708.2**	**159.8**
2	5	188.2	414.8	512	1.2
	10	66	137.4	177.6	-
	15	63.2	61.2	118	-
	20	9.4	15	90.6	-
	25	23.8	33.8	249.6	-
	30	5.8	44	113	-
	TOTAL	**356.4**	**706.2**	**1260.8**	**1.2**
3	5	14.8	92	442.4	-
	10	42	139.4	167	-
	15	41.4	110	64.8	-
	20	28	29	45.2	-
	25	18.2	38.8	26.8	-
	30	11.2	34.8	126.8	-
	TOTAL	**155.6**	**444.0**	**873.0**	**-**
4	5	96.6	405.2	474.2	-
	10	150.8	358.4	137.6	-
	15	227	226	95.4	-
	20	151.8	137.4	276.8	-
	25	78.2	17.8	83.8	-
	30	102.2	16.8	19.2	-
	TOTAL	**806.6**	**1161.6**	**1087.0**	**-**

DISCUSSION

The muddy area (muddy sediments) in Lok Kawi beach showed the RPD layer occurs within the top few millimeters (1 to 4 mm). This contrasts strongly with the deep RPD layer found at the similar tidal height on sandy area. The different redox conditions between the mangrove and sandy areas at Lok Kawi beach may be caused by differences in hydrodynamism. Mangrove in Lok Kawi beach is the sheltered (> 36% silt & clay) area while the sandy area is directly exposed to the open sea. Tidal current is stronger at sandy area and the frequency of emmersion / immersion is greater at sandy than at muddy areas. Thus, hydrodynamic forces may lead to greater sediment mixing and hence increased oxygenation on the sandy area.

In the muddy area, more than 84% of the nematode and 100% of harpacticoid copepods were recorded in the top 15 cm and 5 cm layer of the sediment respectively. However, the bulk distribution of nematode in sandy areas was a little deeper than muddy areas. More than 61% of the nematode and 100% of the harpacticoid copepods is distributed in the top 20 cm and 15 cm layer of the sediment respectively. Most workers have observed the decline in numbers of meiofauna with an increasing depth in both mud and sand substrates (Tietjen 1969; McLachlan, 1978). McLachlan (1978) discussed the possible causes for this decline and cited the following factors: i - vertical pH changes, ii - vertical decreases in oxygen, iii - vertical decreases in interstitial water content and iv - vertical decreases in organic matter. In the present study, no attempt was made to measure vertical differences in pH or oxygen. However, the reducing conditions indicated by RPD layer in mangrove especially suggest low availability of free oxygen. The lack of significant correlation's between redox potential measured in this study and the total meiofauna (nematodes + harpacticoid copepods) does not mean that this factor was not contributing to the density variations between depth of the sediment observed. The oxidation of organic matter by anaerobic bacteria is the primary cause of reducing conditions (Fenchel, 1969). However, the activity of the many burrowing animals in the mangrove and sandy areas (field observation) may play a role in the oxidation of the sediments. An oxidized microzone is always visible around the burrows of crabs and sipunculids although the effect of this is probably limited to the immediate vicinity of the burrows (Sasekumar, 1994).

Looking at the vertical distribution of the nematode species closely, it showed zonation from the surface to the 30 cm depth of the sediment. Twenty-four species and three species are distributed from surface to 30 cm depth in sandy and muddy areas respectively. Representatives of the nematode taxa are known from the thiobios (Boaden & Platt, 1971) or the living system of the sulphide biome (Fenchel & Riedl, 1970). Jensen (1981) found nematode species *Sabatieria pulchra* was the only mesohaline comesomatid and one of the few metazoans thriving in the extremely oxygen-depleted sediment in the Baltic. He classified it as an inhabitant of the RPD layer in European sediments, suggesting an ability to tolerate sulfides and to utilize the higher microbial densities in this layer. However there is a debate over how these animals adapt to reduced oxygen levels (Maguire & Boaden, 1975; Powell et al., 1979; 1980; Ott et al., 1983; Meyers et al., 1987) and further, whether the occupied habitats below the RPD are truly anoxic (Riese & Ax, 1979; Boaden, 1980). In the sandy area (T1, T2, T3) of the Lok Kawi beach, species such as *Chromadorita* c.f. *leuckarti, Gammanema* sp. 2, *Platycomopsis* sp., *Gammanema kosswigi, Quadricoma* sp. and *Richtersia* sp. were found below the RPD layer. Similarly, the species such as *Molgolaimus* sp., *Prochromadora* sp., *Gammanema* sp. 1 and *Metacyatholaimus* sp. were also recorded below the RPD layer in muddy area (T1). The species, which its distribution below the RPD layers, were possibly the thiobios species. The distribution of the nematode species below the RPD layer in Lok Kawi beach is possibly due to an ability to tolerate sulfides and to utilize the higher microbial densities in this layer. However, another possibility is the presence of pore water (depth range 3.0 to 29.1 cm) in the sediment, which provides the low concentration of oxygen (0.2 to 2.1 mg/l), for the nematodes to live in such an environment.

The nematodes feeding groups 1A, 1B are abundant in the top 15 cm and 2A group is abundant in top 5 cm of the sediment layer. The selective deposit feeders (1A) group have a minute buccal cavity and are only able to ingest small particles and / or fluid. The non - selective deposit feeders (1B) group have large buccal cavity without dentition and are potentially able to ingest particles of a wider size range including diatoms. The epigrowth feeders (2A) group is abundant in top 5 cm and has small teeth and / or denticles in the buccal cavity. These enable cells to be pierced and the content sucked out or objects scraped off surfaces (Platt & Warwick, 1983). The availability of food (benthic diatom and other algae) in such depth (especially top 5 cm of the sediment layer) is indicated by the concentration of the chlorophyll *a* and pheopigment. These groups consume this food. There is evidence that meiofauna play an important role in making detritus available to macroconsumers (Tenore et al., 1977). The deposit feeders were abundance in the mangrove and one of the sandy areas transects (T4) in Lok Kawi beach. It seems that the deposit feeders play an important role in making detritus available to the macroconsumers. This study contributes to the basic knowledge and baseline data and is a starting point for ecological works on meiofauna in Malaysia.

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