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Abundance and Species Composition of Harpacticoid Copepods from a Sea Grass Patch of South Andaman, India

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Abstract: Abundance and species composition of Harpacticoida (Copepoda) inhabiting blades of *Thalassia hemprichii* and their canopy sediments were examined during the study period. Eleven different meiofaunal taxa were recorded from the study site, among which the blades comprised nine taxa and the canopy sediment constituted all eleven taxa. Harpacticoid Copepods were the dominating meiofaunal component in blades (86%) as well as in canopy sediments (57%) of *T. hemprichii*. A total of 47 species belonging to 34 genera distributed within 14 families of harpacticoid copepods were recorded. Harpacticoids on canopy sediments were significantly higher (t-test, $p<0.05$) compared to the seagrass blades. *Canuellina nicobaris* was the most abundant species followed by *Scottolana longipes* and *Harpacticus spinulosus* in both habitats. Higher diversity (H') and equitability (J) of harpacticoid species were found in blade. Bray Curtis similarity shows that two distinct clusters of species in the habitats.

Keywords: Andaman, canopy sediment, meiofauna, seagrass blades, *Thalassia hemprichii*

INTRODUCTION

Copepods inhabit all available benthic habitats and show considerable species diversity in the sea (Wells, 1976). Harpacticoids are permanent members of meiofauna that always remain within the meiofaunal size range 63-500 µm (Gray and Elliott, 2009). They are highly mobile crustaceans (Hicks and Coull, 1983) which represents second most abundant meiofaunal group in marine sediment, while nematodes were dominant (Olafsson, 1995). In the coastal environment, harpacticoids have been associated with seagrass (De Troch *et al*., 2003; Hicks, 1986; Walters and Bell, 1986, 1994) and form a large part of the phytal meiobenthos (Wells, 1976). They function as a key taxon among the seagrass-associated fauna, which is due to their habitat specificity (Bell *et al*., 1988; Bell and Hicks, 1991; De Troch *et al*., 2001; Hicks, 1977, 1980, 1986). And feed on sediment microbes (Hicks and Coull, 1983) and benthic diatoms (Montagna, 1984). Seagrass patches generally have rich assemblage of fauna compared to adjacent unvegetated sediment (Orth *et al*., 1984). Seagrass patches have key ecological functions in the intertidal region such as, it stabilize sediments, reduce particle resuspension (Terrados and Duarte, 2000), provide substrate for epiphytes and epizoan to attach and nursery grounds for fishes, shrimps and a variety of invertebrate taxa. The knowledge on harpacticoid copepods is limited from coastal waters of Andaman (Wells and Rao, 1987). Further, the studies on marine Harpacticoida associated with macrophytes are lacking. In view of the importance and scarcity of reports from this area, an investigation was carried out in the coastal waters of South Andaman, East Coast of India, to assess the relationship between copepod abundance on blades and sediments of *T. hemprichii.*

MATERIALS AND METHODS

Study site: The present study was conducted at intertidal region of Kodiyaghat (11°31.719'N, 092°43.409'E) in South Andaman (Fig. 1). This area is a rocky coast with medium to coarse sand with very little detritus supporting patches of seagrass, *T. hemprichii*. Numerous tidal pools, dead corals and the area are mostly invaded by different seaweeds. The intertidal region is submerged during high tide and exposed during lowest low tide when tidal level is less than 0.30 m. Sampling was carried out during lowest low tide.

Environmental parameters: Physico-chemical parameters such as temperature, salinity and pH were measured from seagrass patches during months of December 2010, January and February 2011 using thermometer, refractometer and pH meter respectively. The water samples were collected simultaneously for the estimation of Dissolved Oxygen by following standard procedure of Winkler's method (Grasshoff *et al*., 1983).

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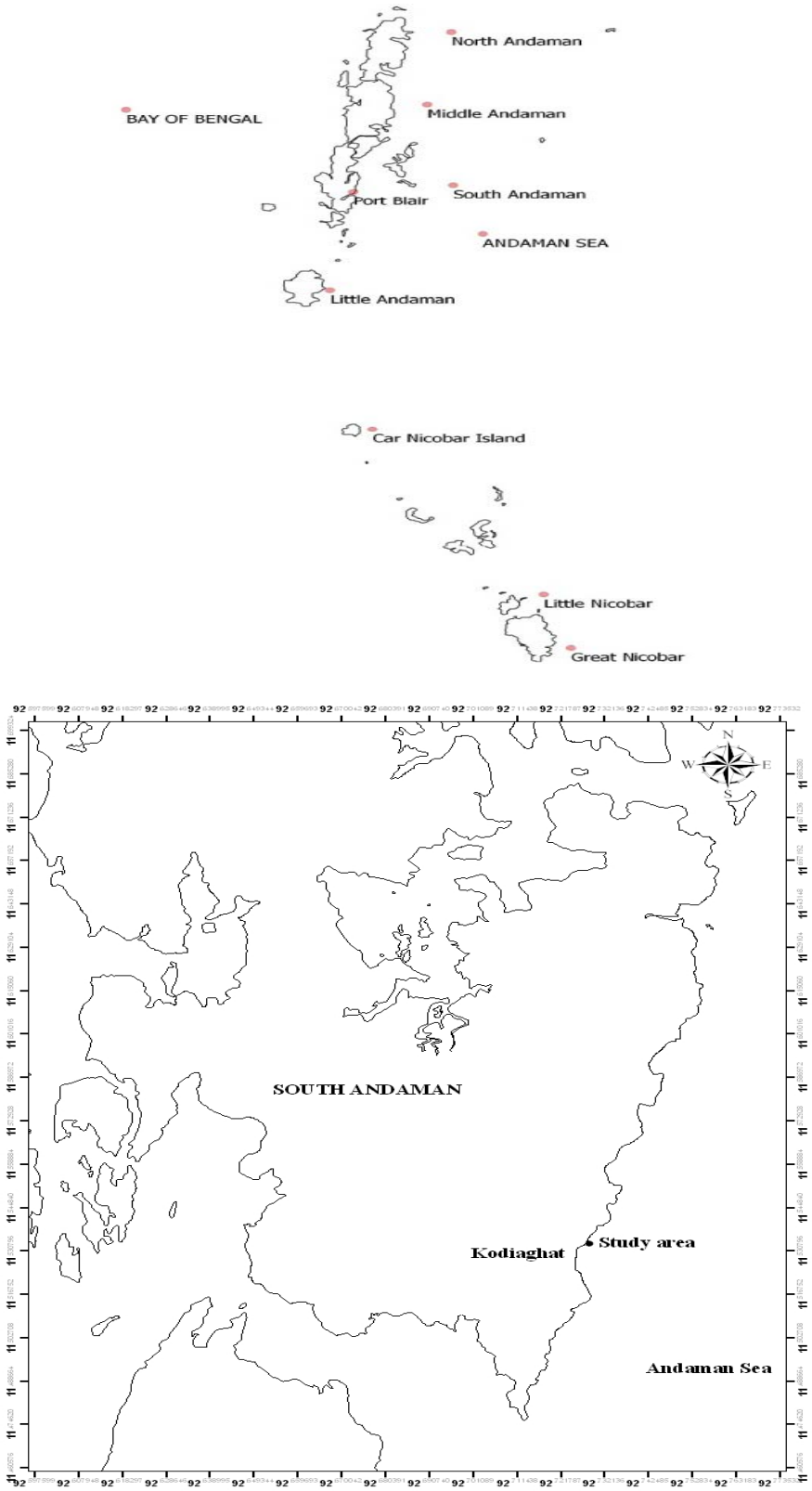

Fig. 1: Map showing the location of study area Kodiyaghat in south Andaman

Sampling: Meiofauna samples were obtained from the blades of *T. hemprichii* identified (McKenzie *et al*., 2003) in the study area and its canopy sediments once in a month of December 2010, January and February 2011 and replicate samples were also obtained. A quadrate of 32×32 cm was placed over the seagrass patch. All the blades inside the frame were clipped at the base of the blade sheath, transferred immediately into a plastic bag. Care was taken to reduce the disturbance to the resident blade fauna and avoid the contamination of blades by sediment-dwelling species. After harvesting the seagrass, benthic meiofauna within the quadrate were sampled using Polyvinyl Chloride (PVC) core of 3 cm internal diameter inserted into the sediment down to depth of 7 cm. The sediments were extruded into a separate plastic bag. Blades and core samples were stained with Rose Bengal and preserved with 5% formalin. In the laboratory, collection of meiofauna was on 63 µm sieve after continuous decantation. Meiofauna were sorted and enumerated at the higher taxon level using a binocular microscope and were expressed as numbers per 0.1 m^2. Meiofaunal composition was identified based on different identification keys and standard literatures (Giere, 1993; Higgins and Thiel, 1988; Lang, 1965; Wells, 1976; Wells and Rao, 1987). Specimens of harpacticoids were dissected under a binocular microscope prior to analysis of the pleopods for the identification of the specimen to species level. Statistical analysis such as one-way ANOVA was used to test for differences in distribution of copepod abundance, diversity between seagrass leaf blade and canopy sediment. Biodiversity indices were used by using statistical software PRIMER (version 5) to determine the richness, diversity and equitability of Harpacticoida population during monthly intervals. Cluster analysis was made to find out the similarity of species between two different habitats.

RESULTS

Environmental parameters: Environmental parameters such as temperature (°C), salinity (PSU) and pH for the month of December 2010 were comparatively low where as higher in January 2011 (Table 1).

Meiofaunal composition: In the study period, the following eleven different meiofaunal taxa were recorded in Kodiyaghat: *Copepoda*, *Polychaeta*, *Foraminifera*, *Decapoda*, *Isopoda*, *Nematoda*, *Gastropoda*, *Ostracoda*, *Amphipoda*, *Mollusca* and *Nemertea* among which the seagrass blades constituted nine taxa and the seagrass canopy sediment constituted

Table 1: Environmental parameters calculated during the study period at kodiyaghat

Month	Environmental parameters: Temperature (°C)	Salinity (PSU)	pH	Dissolved oxygen (mg/L)
December	21	21	7.4	4.7
January	28	39	8.7	4.1
February	26	34	8.3	4.0

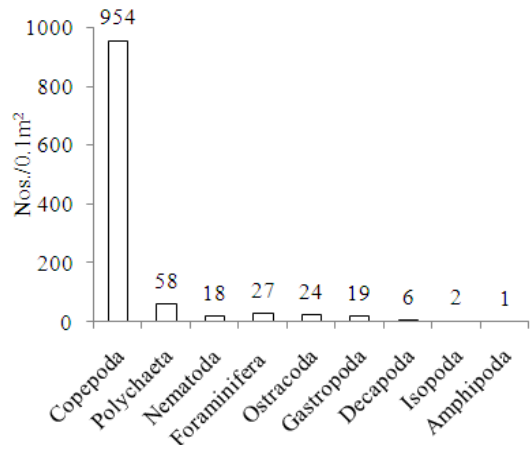

Fig. 2: Meiofaunal composition of seagrass blade (Nos./0.1 m^2) in the study area

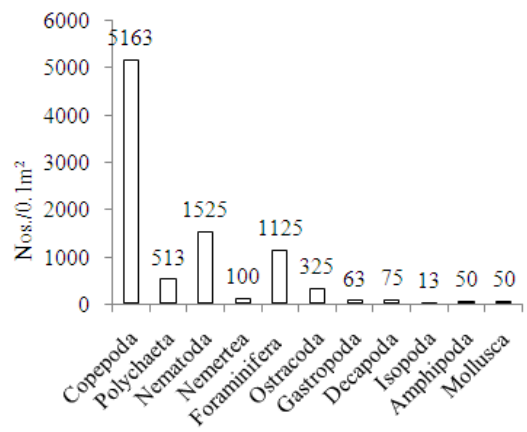

Fig. 3: Meiofaunal composition of seagrass canopy sediment (Nos./0.1 m^2) in the study area

all eleven taxa. Copepod: Harpacticoida were the dominating meiofaunal component in blades (Fig. 2) as well as in sediment samples (Fig. 3). In the blade, copepod constituted 86% of the total meiofaunal density followed by *Polychaeta* (5%) and *Nemetoda*, *Ostracoda*, *Gastropoda* and *Foraminifera* (2% each) and *Decapoda* (1%) whereas, groups such as *Amphipoda* and *Isopoda* were relatively low. Meiofaunal composition in canopy sediment showed

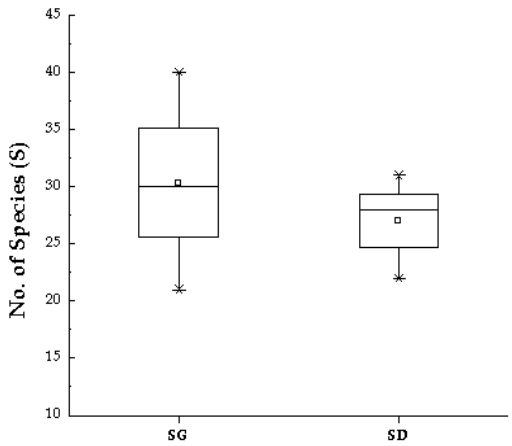

Fig. 4: Number of copepod Species (S) during the study period
SG: Seagrass blade; SD: Seagrass canopy sediment

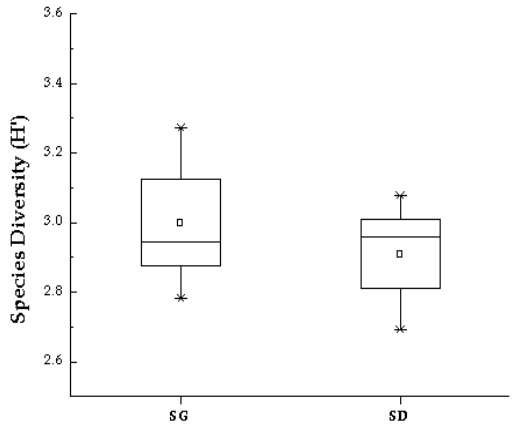

Fig. 5: Shannon-Weiner index (H') of copepod species during the study period.
SG: Seagrass blade; SD: Seagrass canopy sediment

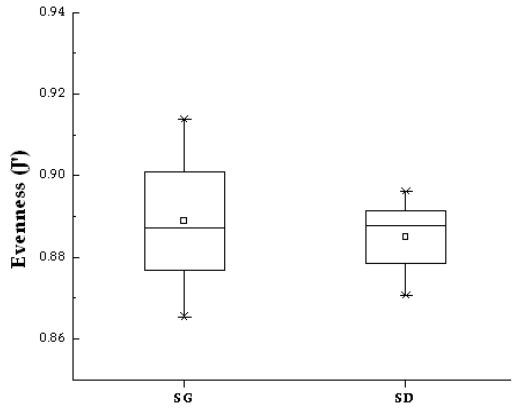

Fig. 6: Equitability (J') of copepod species during the study period
SG: Seagrass blade; SD: Seagrass canopy sediment

almost similar pattern. Harpacticoida contributed 57% to the total meiofauna count followed by *Nematoda* (17%), *Foraminifera* (13%), *Polychaeta* (6%), *Ostracoda* (4%), *Nemetrea*, *Mollusca*, *Gastropoda*, *Decapoda* and *Amphipoda* were 1% each.

Harpacticoid species composition: In this study, a total of 47 harpacticoid copepod species belonging to 34 genera distributed within 14 families were identified (Table 2). Three true phytal dwelling harpacticoid families, *Diosaccidae*, *Harpacticidae* and *Thalestridae* formed a large part of the copepod community on the blades and sediments of seagrass species. The three copepod taxa, *Canuellina nicobaris*, *Scottolana longipes* and *Harpacticus spinulosus* were numerically abundant on the blade and sediment (Table 3). *C. nicobaris*, the numerically predominant harpacticoid, comprised 9.2%. *C. nicobaris* and *H. spinulosus* (7%) had density peaks on seagrass blades, whereas in sediments *S. longipes* showed predominance which comprised 8.5% of the total copepod individuals collected. Some species, *Ectinosoma melaniceps*, *Halectinosoma tenuireme*, *Brianola hamondi* and *Scottolana oleosa* have been categorized as phytal itinerants since their abundance is roughly shared between blade and canopy sediment. The least abundant species, *Apolaophonte hispida*, *Echinolaophonte mirabilis*, *Psammastacus spinicaudatus* and *Peltidium ovale* were found only in sediment. *Eupelte aurulenta*, *Neodactylopus trichodes*, *Stenhelia indica*, *Diosaccus monardi*, *Metamphiascus hirsutus*, *Metamphiascus nicobaricus*, *Helmutkunzia variabilis* and *Laophonte spinicauda* were recorded only on seagrass blade.

Species diversity: Copepods were five times abundant on seagrass canopy sediments (5163 individuals/0.1 m^2) compared to seagrass blade habitat (954 individuals/0.1 m^2). The species richness of harpacticoids (Fig. 4) shows maximum number of species (40) was recorded during the month of December and minimum number of species (21) obtained during February in seagrass blade. The number of species recorded in seagrass canopy sediment was low (average: -27.0) compared to seagrass blade (average: -30.3). Relatively higher diversity (H' = 3.27) in the harpacticoid copepod population were found during December in seagrass blade and canopy sediment (H' = 3.07) (Fig. 5). Equitability in species was higher in blade compared to canopy sediment (Fig. 6). Two separate assemblages of species were observed (Fig. 7). The species in the blade together formed one cluster and species in the canopy sediment formed a separate cluster.

Table 2: Occurrence of list of harpacticoid species of the study area

	Species occurrence					
	December		January		February	
Taxa	SG	SD	SG	SD	SG	SD
Family: Harpacticidae						
Harpacticus spinulosus	*	*	*	*	*	*
Family: Canuellidae						
Brianola hamondi	*			*		*
B. sydneyensis Hamond	*			*		*
Canuellina nicobaris	*	*	*	*	*	*
Scottolona longipes (Thompson and A. Scott)	*	*		*	*	*
S. oleosa	*			*		*
S. rostrata	*	*	*	*	*	*
Family: Ectinosomatidae						
Ectinosoma reductum Bozic	*	*	*	*	*	*
E. melaniceps Boeck	*	*	*	*	*	*
Halectinosoma tenuireme (T. and A. Scott)	*	*	*	*		*
Halophytophilus simplex	*	*	*	*		*
Noodtiella ornamentalis	*	*	*	*	*	*
Family: Porcellidae						
Porcellidium ravanae (♂) Thompson and A. Scott		*	*			
P. ravanae (♀)			*			
Family: Peltidiidae						
Peltidium ovale Thompson and A. Scott						*
Eupelte aurulenta	*					
Family: Thalestridae						
Diarthrodes cystoecus Fahrenbach	*	*	*	*	*	*
D. brevipes	*	*	*	*	*	
D. dissimilis	*			*	*	
Neodactylopus trichodes	*					
Idomene maldivae (Sewell)	*		*	*	*	
Family: Parastenhellidae						
Parastenhelia hornelli Thompson and A. Scott	*	*	*	*	*	*
Family: Diosaccidae						
Stenhelia (*Delavalia*) *oblonga* Lang	*		*	*		*
S. (D.) *hirtipes*	*		*	*		
S. (D.) *valens*			*		*	*
S. (D.) *indica* Krishnaswamy	*		*		*	
Diosaccus monardi Sewell	*		*			
Robertsonia adduensis (Sewell)	*					*
R. robusta	*	*	*	*	*	*
Metamphiascopsis hirsutus (Thompson and A. Scott)			*			
M. nicobaricus (Sewell)	*		*			
Typhlamphiascus ovale	*	*	*	*	*	*
Helmutkunzia variabilis	*					
Balucopsylla triarticulata	*			*	*	
Family: Ameiridae						
Ameira parvula (Claus)	*	*	*			*
Family: Paramesochiridae						
Apodopsyllus madrasensis (♂)(Krishnaswamy)				*		
A. madrasensis (♀)		*	*	*		*
Family: Tetrogonicipitidae						
Phyllopodopsyllus longipalpatus (Chappuis)	*	*		*	*	*
P. crenulatus	*		*	*		*
P. stigmosus	*		*	*	*	
Family: Cylindropsyllidae						
Psammastacus spinicaudatus Rao and Ganapati						*
Arenotopa dyadacantha	*	*	*			
Arenopontia (*Neoleptastacus*) *indica* Rao	*	*		*		
Family: Cletodidae						
Cletodes dentatus	*	*		*		*
Enhydrosoma pectinatum	*	*		*		*
Family: Laophontidae						
Laophonte spinicauda (Vervoort)	*					
Echinolaophonte mirabilis (Gurney)				*		*
Langia maculata	*	*	*		*	
Apolaophonte hispida						*

*: Species recorded; SG: Seagrass blade; SD: Seagrass canopy sediment

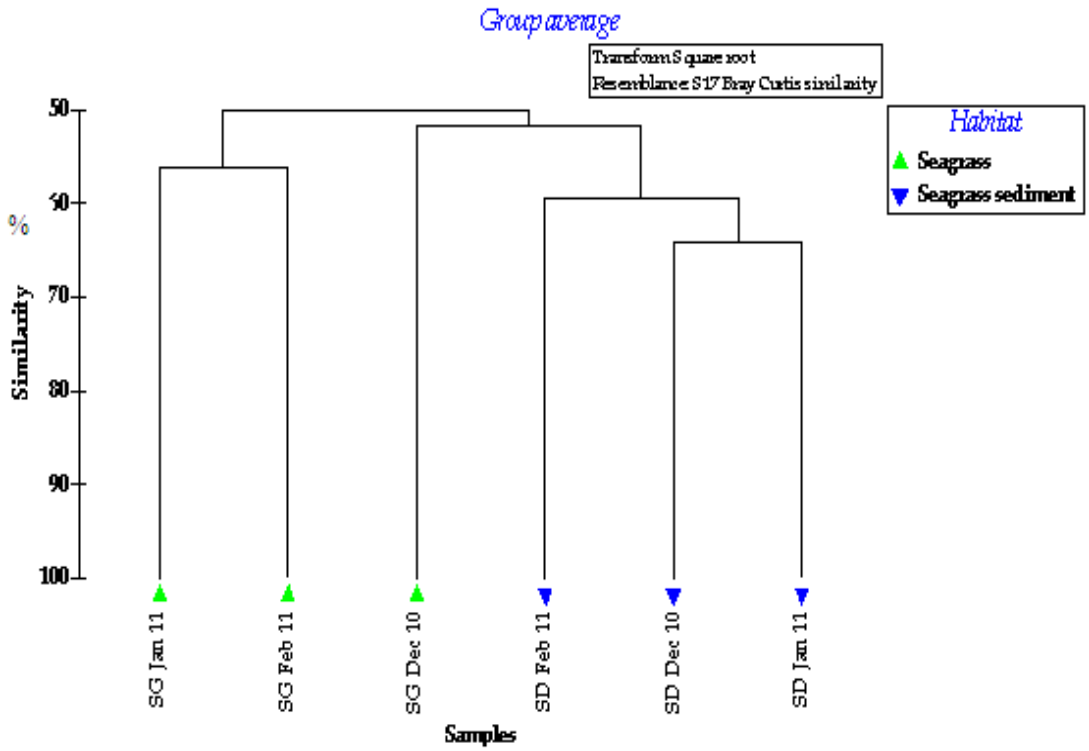

Fig. 7: Bray curtis similarity showing formation of groups in the study area

Table 3: Abundance of harpacticoid species of the study area

Month	Area	Dominant species
December	SG	*Scottolona longipes*
		Canuellina nicobaris
	SD	*Scottolona longipes*
		Helectinosoma tennuireme
January	SG	*Canuellina nicobaris*
		Idomene maldivae
	SD	*Canuellina nicobaris*
		Scottolona longipes
February	SG	*Parastenhelia hornelli*
		Harpacticus spinulosus
	SD	*Apolaophonte hispida*
		Phyllopodopsyllus crenulatus

SG: Seagrass blade; SD: Seagrass canopy sediment

DISCUSSION

Harpacticoida was the most abundant group among the meiofaunal taxa observed in this study. Differences in faunal density between study period, blades and sediments of seagrass are probably due to a number of factors including hydrodynamic regimes, availability of food and substratum for attachment. Relatively higher abundance of harpacticoids in the seagrass environment during December 2010 was observed when all the environmental parameters like Temperature, Salinity, pH and DO were low. This could be due to the influence of the fresh water influx due to the precipitation that provided a continuous supply of organic matter from the land runoff supporting organisms to grow, mature fast, reproduce (matured female obtained in this study) and multiply.

Nematodes generally dominate marine sediments, but it was not so in this study. Harpacticoid copepods were found as the most abundant meiofaunal taxa in both seagrass blades and canopy sediment. This could be due to the low levels of accumulated sediment or detritus (Hicks and Coull, 1983) (Fig. 7). This study showed some similarity with the classification of harpacticoids as rare species, migrators and non migrators as reported by Walters and Bell (1986) in the seagrass environment of Tamba Bay, Florida. Nine species such as *Porcellidium ravanae*, *Peltidium ovale*, *Eupelte aurulenta*, *Laophonte spinicauda*, *Neodactylopus trichodes*, *Apolaophonte hispid*, *Psammastacus spinicaudatus*, *Helmutkunzia variabilis* and *Metamphiascopsis hirsutus* were least frequent and usually low in number in both the habitats. It could be due to the predation pressure by demersal fish species (Alheit and Scheibel, 1982). Hence, the supply of bacteria near these structures could be enhanced and that these areas will be favored by other bacterial consumers (Thistle *et al*., 1984). Families such as *Canuellidae*, *Ectinosomatidae*, *Diosaccidae*, *Thalestridae*, *Harpacticidae*,

Parastenhellidae and *Tetragonicipitidae* were dominant, both in the blades of *T. hemprichii* and its canopy sediment. Maximum number of species was obtained from few families such as *Diosaccidae*, *Canuellidae* and *Thalestridae*, whereas one family such as *Canuellidae* dominated in both the seagrass blade and its canopy sediment. Whereas, *Paramesochridae* was concentrated in the deeper sediment layers near the subtidal seagrasses might be well adapted to stress condition in this realm. *Canuellidae*, which is filter feeders, was concentrated in the upper centimetres of the sediment of tropical seagrass ecosystem from Gazi Bay, Kenya (De Troch *et al*., 2003).

True phytal-dwelling harpacticoids belong to seven families*: Harpacticidae*, *Tisbidae*, *Porcellidiidae*, *Tegastidae*, *Thalestridae*, *Diosaccidae* and *Peltidiidae* as observed in this study have been reported by Hicks and Coull (1983). Families such as *Porcellidiidae* and *Peltidiidae* were numerically least encountered. It may be convenient to consider seagrass and canopy sediment as separate environment, our study shows that they continually share components. Some species such as *Harpacticus spinulosus*, *Canuellina nicobaris*, *S. rostrata*, *Ectinosoma reductum*, *E. melaniceps*, *Noodtiella ornamentalis*, *Diarthrodes cystoecus*, *Parastenhelia hornelli*, *R. robusta* and *Typhlamphiascus ovale* have been categorized as phytal itinerants and their abundance is roughly shared between blades and canopy sediments throughout the sampling period. In the case of *Zostera capncorni* beds (Hicks, 1986) from Pauatahanui Inlet, New Zealand reported that the *Ectinosorna melaniceps* and *Halectinosoma hydrofuge* were phytal itinerants and *Porcellidium* sp., was abundant on *Zostera* plant but it was rare in *T. hemprichii.* This could be due to the non-specificity dwelling on the substratum. Low diversity and equitability in the harpacticoid population in the canopy sediment could be due to our sampling during the low tide when all the copepod species are likely to move to the blade.

CONCLUSION

The findings presented here provide a more extensive documentation of the relationship between copepod abundance on blades and sediments of *T. hemprichii* for the first time in Andaman. Meiofauna studies in seagrass beds have traditionally focused on the epiphytic component of seagrass meiofauna. The niche differentiation for harpacticoid copepods in both seagrass blade and canopy sediment environment illustrated them as one of the keystone species of the high biodiversity. Our future research could be directed towards examining the impact of seagrass morphology on associated biota, particularly Copepoda: Harpacticoida. Both experimental and observational approaches are needed to understand the mechanical links between seagrass canopy structure and associated biota.

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