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Coastal zooplankton in the waters of Iligan City, Northern Mindanao, Philippines

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Abstract. The relationship of physicochemical paramaters of the water and the composition, diversity and abundance of zooplankton assemblage in the nearshore waters surrounding Iligan City were investigated. Hydrological parameters assessed in the waters revealed values that are within the standard set by the Philippines Department of Natural Resources for marine fauna and flora to thrive and be abundant. Rich composition of mesozooplankton was observed with a total of 103 zooplankton comprising the community. Among these zooplankton, copepods were the most numerous group with *Canthocalanus pauper, Paracalanus parvus, Oncaea venusta, Acartia erythraea* and *Oncaea media* being the most dominant species in all sampling stations. In terms of copepod diversity profile, relatively high Shannon index (H': 3.1-3.5) were noted implying that the area is teeming with diverse species of copepods. Although copepods were the most common zooplankton in the area, other groups, namely the protochordates, chaetognaths and chordates (fish eggs and fish larvae) were also abundant. Results of the Canonical Correspondence Analysis (CCA) revealed that water motion may be responsible to the high abundance and diversity of the copepods since this factor can lead to the mixing and transport of more copepods into the area. Hence, the high abundance of these certain groups of zooplankton may imply the high potential of the areas to be used as nursery ground for fish and other macroinvertebrates thereby further supporting the importance of maintaining the marine sanctuary already established in the area.
Key Words: diversity, abundance, copepods, tropical nearshore waters.

Introduction. Zooplankton hold a vital place in the marine food web since they pass on the by products such as organic energy produced by photosynthetic algae to higher levels in the food web such as pelagic fish and shrimps which are consumed by the top predators, i.e. humans. Of the members of zooplankton, copepods are the most numerous constitutents and even acknowledge as the most dominant among the multicellular organisms on earth. They are so plentiful, popular and frequently encountered that they even outnumber the land insects although the insects have more species compared to that of the copepods (Mauchline et al 1998). Knowledge in the abundance and distribution of zooplankton is crucial in comprehending the ecology of these minute creatures because such may pinpoint the abiotic and biotic parameters that may be accountable in controlling and affecting their distribution. For instance, studies have shown that water mass properties such as the water current, can act as a driving force in transporting certain copepods and zooplankton from its point of origin to neighboring bodies of water (Tseng et al 2011; Hwang & Wong 2005; Hsieh et al 2004; Gomez et al 2000; Lopes et al 1999; Gowen et al 1998). Others have also documented certain copepods as warm/cold or shallow/deep water indicators species (Hwang et al 2007; Noda et al 1998; Chihara & Murano 1997; Kang et al 1990). By demonstrating the role of zooplankton community as effective indicators to changes in the environmental conditions of the ocean, their significance in the pelagic realm is therefore undisputed. Due to this, the investigation on the effect of hydrological factors specifically on the assessment of diversity and abundance is necessary. The objectives of the present study are to determine the different zooplankton assemblage, and point the abiotic factors that may influence this community in the nearshore waters surrounding Iligan City, Northern Mindanao, Philippines.

Material and Method. Iligan City is one of the industrialized cities in Northern Mindanao which is located at 8.25° North latitude, 124.4° East longitude and 401 meters elevation above the sea level and is politically subdivided into 44 barangays, 14 of which are considered coastal barangays (https://en.wikipedia.org/wiki/Iligan). The waters surrounding the city is part of the well-known Iligan Bay in Mindanao which is renowned to be abundant in fishery resources. Using a GPS (GPS map 76S, Garmin), six sampling stations were established within the coastal waters of Kiwalan, Dalipuga and Lugait (Figure 1). In Dalipuga, a marine sanctuary was established more than a decade ago, while industries are present in Kiwalan (i.e. Granexport Manufacturing Corporation) and Lugait (i.e. Holcim Philippines Incorporated). Stations 1, 2, 3 were positioned 0 m away from the reef edge, while stations 4, 5, 6 were situated 500 m away from the shorelines of Kiwalan, Dalipuga and Lugait, respectively. Samples were collected on June 2014 at daytime in order to avoid intense exposure to strong wave and sun during sampling.

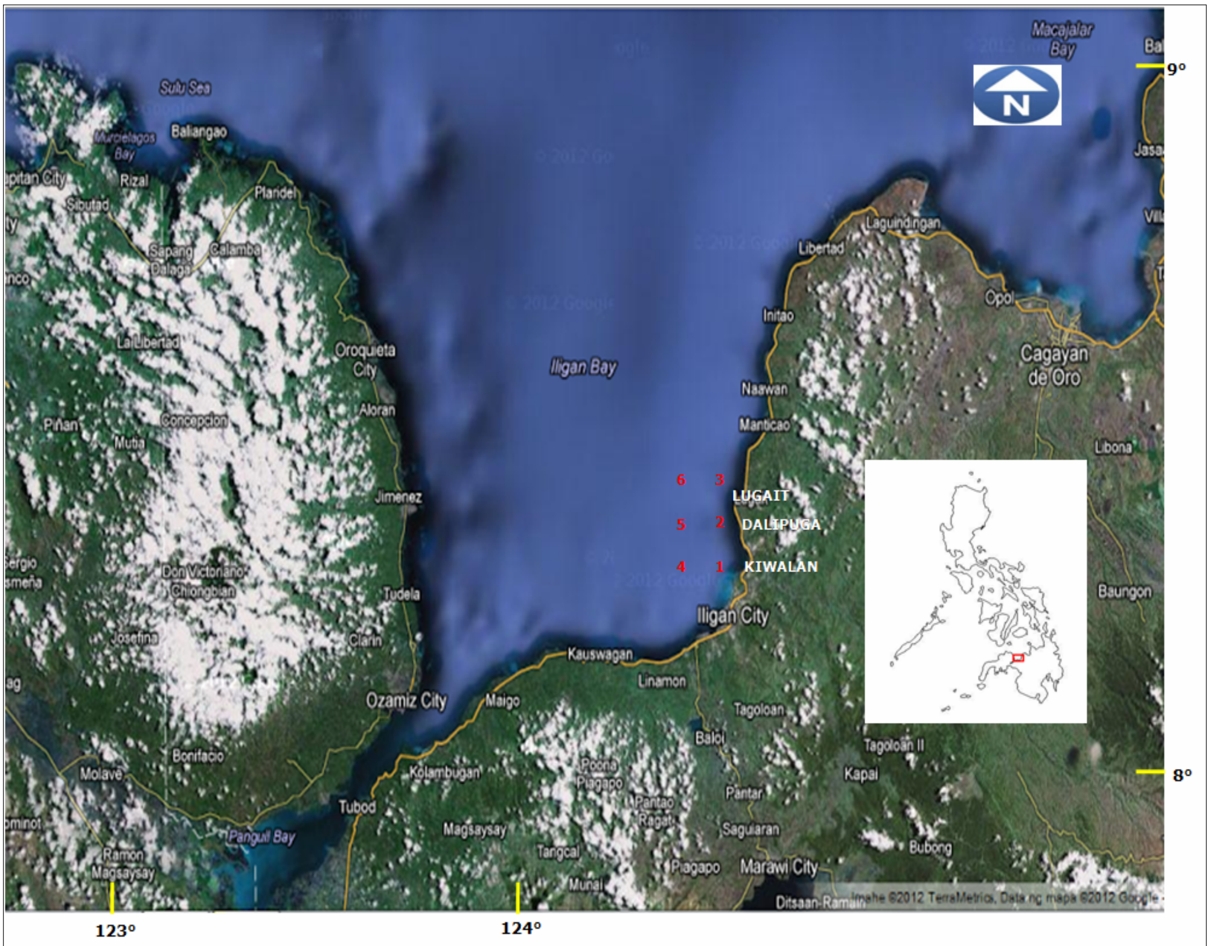


Figure 1. Map of Iligan Bay where the six sampling stations were located. Inset is map of the Philippines with Iligan Bay enclosed in a red rectangle (Source: http:///www.plus.goggle.com).

Mesozooplankton samples were gathered from these stations by lowering the plankton net (mesh size opening: 300 μm) to a 50 m depth and slowly pulled back to the surface. A flowmeter (Rigosha and Co., Ltd No 1687) was used to measure the amount of water that enters the net. As soon as the zooplankton sample was obtained and transferred to a polyethylene bottle, 5% buffered formalin-seawater solution was added as preservative and fixative. In each station, three zooplankton samples were gathered for zooplankton identification and numerical counting. Identification to the nearest taxa were made to individual copepods and zooplankton using standard illustration guides of Al-Yamani et al (2011), Mulyadi (2004), Bradford-Grieve (1999), Todd & Laverack (1991), Yamaji (1962), Owre & Foyo (1967) and Kasturirangan (1963). Numerical countings were done in a Sedgewick-Rafter counting chamber cell where individual copepods and other zooplankton were tallied until it reaches at least 300 individuals. Density (individuals m^{-3}) and relative abundance (%) were computed from the numerical counts of each individuals. Hydrological data, namely pH, temperature and salinity were measured in the field using pen type pH meter (PH-009) and portable refractometer (ATAGO, Japan), respectively. Water motion was quantified following the clod card method of Doty (1971). The Shannon-Weaner Index was employed to calculate the diversity indices, while cluster analysis using Ward method was utilized to identify key clusters of zooplankton among sampling stations. To categorize among the hydrological parameters that may control the abundance of zooplankton among the sampling stations, Canonical Correspondence Analysis (CCA) was used. Statistical tests were computed with the aid of the PAST (PAleontological STastical) software version 2.17 (http://folk.uio.no/ohammer/past/) (Hammer et al 2001).

Results and Discussion

Environmental parameters. Data on hydrological parameters reflected slight variations between stations except for the water motion which showed large differences between sites (Figure 2). For example, subsurface water temperature ranges between 28.5-31.4°C with the highest mean value recorded in station 5. The subsurface water temperature showed variation between stations since water temperatures were taken at different hours of the morning. For instance, low temperature was noted in station 1 because this parameter was measured early in the morning while in the succeeding stations (i.e 5 and 6) temperatures were assessed around noontime. Values in salinity were between 30-31.7 ppt, a range value typical in coastal waters where inputs of freshwater dilutes the seawater. This is expected since the presence of small river tributaries along the areas bring more input of freshwater into the coast therefore resulting to the lowering of the salinity. Moreover, pH values ranges between 8.00-8.29 reflecting a slightly alkaline water common in normal seawater. Water motion mean values showed large differences between stations (3.06 -13.75 sec^{-1}) with stations 2 and 6 showing strong movement of the water. Overall, hydrological parameters in the sampling stations showed values that are within the national standards on water quality guidelines set by the Philippine Department of Environment and Natural Resources (DENR 2008).

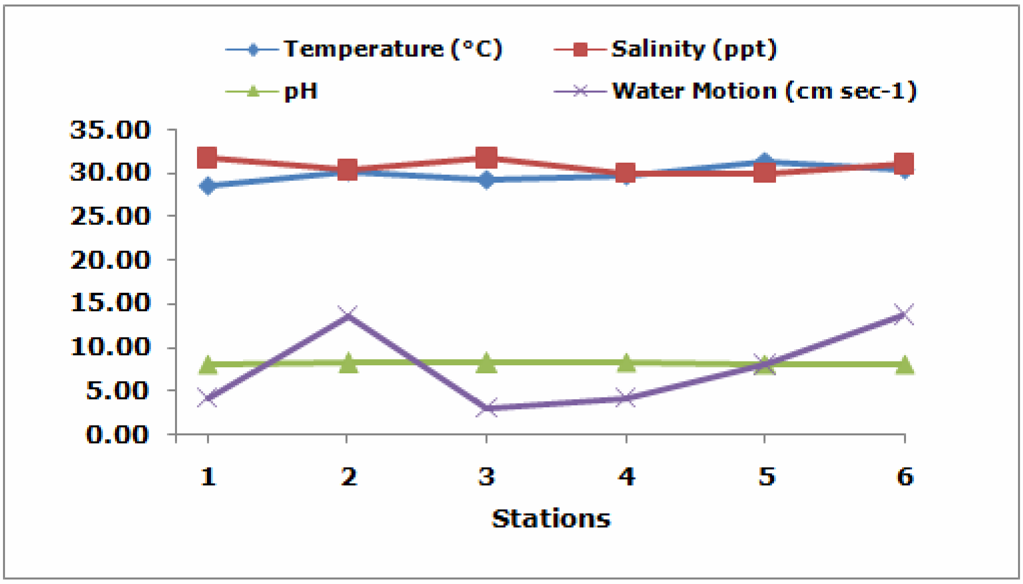


Figure 2. Mean values of hydrological parameters at 6 sampling stations in the nearshore waters of Iligan Ciy, Northern Mindanao, Philippines.

Zooplankton. The nearshore waters surrounding Iligan City comprised of very rich composition of mesozooplankton with a total of 103 zooplankton taxa that belong to

Protozoa, Cnidaria, Chateognatha, Protochordata, Arthropoda, Mollusca, Echinodermata, Annelida, Bryozoa and Chordata (Table 1). Four species belong to Protozoa, 3 species representing Cnidaria, 3 species belong to Chaetognatha, 5 species representing Protochordata, 62 species belong to Copepoda (Calanoida: 44; Cyclopoida: 3; Poecilostomatoida: 14; Harpacticoida: 1), 1 representing Mysidacea, Euphausiacea, Cladocera, Amphipoda, Decapoda, Mollusca; 2 species from Ostracoda, and 18 meroplankton or larval forms.

Among the sampling stations, the highest number of species were recorded in station 3 (81), 76 from station 1, 70 were noted in stations 2 & 4, 60 representatives from station 5, and 59 from station 6 which has the lowest number of species. Out of these 103 taxa, 35 species were commonly observed in all the stations (Table 1, designated by red and black asteriks). Mesozooplankton species diversity (H') were relatively high in all sampling stations along the coast, which are in agreement with those reported in other bodies of neritic waters in the country (H': 3.1-3.2, Angara et al 2013; H': 2.9-3.6, Lacuna et al 2015) that basically reflects high diversity index. Similarly, the abundances were high ranging between 722-1718 ind. m^{-3} with station 1 being the most abundant. Among the mesozooplankton groups, copepoda was the most numerous in all sampling stations (Figure 3) constituting > 50% of the main bulk of the mesozooplankton community. Protochordata was the 2nd most abundant assemblage in the six sampling sites, with the appendicularians as the most numerous member of the protochordates representing an average of 9% of the whole mesozooplankton group. Third in category noted in all stations were chaetognatha and chordata constituting an average of 7% of the total community, with fish eggs comprising the majority of the chordates. The remaining constituents of the mesozooplankton population make up only of < 6% in each stations.

Table 1

Composition, species richness, diversity and mean density (ind. m^{-3}) of nearshore zooplankton and their presence (+) and absence (-) in the six sampling stations in Iligan City, Northern Mindanao, Philippines

Zooplankton taxa	*Stations*					
	1	*2*	*3*	*4*	*5*	*6*
Holoplankton						
Protozoa						
Acantharia spp.	+	+	+	-	-	-
Acanthometron pellucidum	+	-	-	-	-	+
Globigerina bulloides *	+	+	+	+	+	+
Orbulina universa	-	-	+	-	-	-
Cnidaria						
Muggiaea spp.	+	-	+	+	+	-
Lensia spp.	+	-	+	-	+	+
Diphyes spp. *	+	+	+	+	+	+
Chaetognatha						
Sagitta elegans *	+	+	+	+	+	+
Sagitta máxima *	+	+	+	+	+	+
Sagitta spp. *	+	+	+	+	+	+
Protochordata						
Oikopleura cophocerca *	+	+	+	+	+	+
Oikopleura dioica	+	+	-	-	-	+
Oikopleura spp.	+	+	-	+	+	-
Fritillaria spp.	+	-	+	+	+	+
Doliolum spp.	+	+	+	+	+	-
Arthropoda						
Copepoda						
Calanoida						
Acartia clausi	+	-	+	+	-	+
Acartia danae	+	+	+	+	-	-
Acartia erythraea *	+	+	+	+	+	+
Acartia longiremis *	+	+	+	+	+	+

Acartia negligens	+	+	+	+	-	+
*Acartia spinicauda**	+	+	+	+	+	+
Acartia spp.	+	+	+	+	+	-
Acrocalanus gibber	+	+	+	+	-	+
Acrocalanus gracilis	+	+	+	+	-	+
Acrocalanus longicornis	+	-	+	+	+	-
*Calanopia elliptica**	+	+	+	+	+	+
Calanopia minor	-	-	+	+	+	-
Calanopia thompsoni	+	-	+	+	+	-
Calocalanus pavo	+	-	+	-	-	+
Candacia bipinnata	-	-	+	-	+	-
Candacia bradyi	+	+	+	-	+	+
*Candacia catula**	+	+	+	+	+	+
Candacia discaudata	+	+	+	-	+	+
Candacia longimana	-	+	-	-	+	-
Candacia pachydactyla	+	+	-	+	-	-
Candacia truncata	-	+	+	+	+	-
Candacia spp.	+	+	-	+	+	+
*Canthocalanus pauper**	+	+	+	+	+	+
Centropages abdominales	+	-	+	+	+	-
*Centropages furcatus**	+	+	+	+	+	+
Clausocalanus arcuicornis	-	+	+	+	-	-
Eucalanus attenuatus	+	+	+	+	-	-
Eucalanus elongatus	+	+	-	+	-	-
*Eucalanus mucronatus**	+	+	+	+	+	+
Eucalanus subcrassus	+	+	+	-	-	+
Eucalanus subtenuis	-	-	-	-	+	+
Euchaeta longicornis	+	+	+	+	-	-
Euchaeta plana	+	-	-	-	-	-
Labidocera euchaeta	-	+	+	-	+	-
Metridia brevicauda	+	-	+	-	-	-
*Paracalanus parvus**	+	+	+	+	+	+
Pontellina spp.	+	-	-	-	-	-
Pontellopsis spp.	-	+	-	+	-	-
Rhincalanus nasutus	+	+	+	+	-	-
*Temora discaudata**	+	+	+	+	+	+
Temora stylifera	-	-	+	+	-	-
Temora turbinata	+	-	+	-	-	-
Tortannus forcipatus	+	-	-	-	-	-
Undinula vulgaris	+	+	+	+	-	+
Cyclopoida						
Oithona spinirostris	-	+	+	+	+	+
*Oithona similis**	+	+	+	+	+	+
Oithona spp.*	+	+	+	+	+	+
Poecilostomatoida						
*Copilia mirabilis**	+	+	+	+	+	+
Copilia quadrata	-	-	+	-	-	+
Sapphirina intestinata	-	+	+	-	-	-
Sapphirina stellata	+	+	+	-	+	+
*Corycaeus affinis**	+	+	+	+	+	+
*Corycaeus agilis**	+	+	+	+	+	+
Corycaeus andrewsi	-	-	-	+	-	-
*Corycaeus catus**	+	+	+	+	+	+
*Corycaeus dahli**	+	+	+	+	+	+
Corycaeus spp.*	+	+	+	+	+	+
Oncaea conífera	+	+	-	+	-	+
*Oncaea media**	+	+	+	+	+	+
Oncaea mediteranea	-	+	-	+	-	+
*Oncaea venusta**	+	+	+	+	+	+
Harpacticoida						
Micrositella rosea	-	-	+	-	-	+
Mysidacea	+	-	+	-	-	-
Euphausiacea	-	+	-	-	-	-
Cladocera						

Evadne spp.	-	-	-	-	+	-
Amphipoda	-	-	-	+	-	-
Ostracoda						
Conchoecia spp.*	+	+	+	+	+	+
Euconchoecia aculeata	-	-	+	-	-	-
Decapoda						
Lucifer hanseni	+	-	+	+	-	-
Mollusca						
Creseis spp.	+	+	+	+	+	-
Meroplankton/Larval Forms						
Echinodermata						
Ophiopluteus*	+	+	+	+	+	+
Cnidaria						
Hydromedusa	-	+	+	+	-	+
Leptomedusa*	+	+	+	+	+	+
Annelida						
Polychaete larva*	+	+	+	+	+	+
Mollusca						
Gastropod juvenile*	+	+	+	+	+	+
Bivalve juvenile	-	+	+	-	+	-
Squid juvenile	-	-	-	-	-	+
Arthropoda						
Decapoda						
Crab zoea*	+	+	+	+	+	+
Megalopa	-	-	+	+	-	-
Shrimp nauplius	+	-	+	-	+	-
Shrimp protozoea*	+	+	+	+	+	+
Mysis*	+	+	+	+	+	+
Copepoda						
Copepod nauplius	+	-	-	-	-	-
Cirripedia						
Barnacle nauplius	-	-	-	-	-	+
Stomatopoda						
Squilla larva	-	-	+	-	-	-
Bryozoa						
Cyphonaute larva	-	+	-	-	-	-
Ichthyoplankters						
Chordata						
Fish eggs*	+	+	+	+	+	+
Fish larva	+	+	+	+	+	-
Total number of individuals	**76**	**70**	**81**	**70**	**60**	**59**
Shannon's Diversity (H')	**3.565**	**3.851**	**3.892**	**3.76**	**3.66**	**3.74**
Density (ind. m^{-3})	**1718**	**1404**	**722**	**1326**	**902**	**1682**

Legend: * copepod species present in all sampling stations; *other zooplankton species present in all stations.

The dominance and greater numbers among the copepods in the overall bulkiness of the mesozooplankton assemblage in the marine ecosystem is expected because these minute crustacean group have been controlling the expanse of the pelagic ocean (Miyashita et al 2009; Lopes et al 2007; Schminke 2007). The reasons why these organisms flourished may be due to their small size, brief growth succession and the natural workings of their physiology and anatomy that are already part of their genetic makeup that enables them to be widely distributed and abundant in any regions of the ocean (Schminke 2007). Conversely, the high abundances of the other components of the zooplankton (i.e protochordates, chaetognaths and chordates) in the present study may be largely associated with the high abundance of copepods along the coast since these much bigger in size zooplankton (i.e. chaetognaths) are known to include copepods as their chief source of food (Terazaki 2000). Aside from the dominance of copepods, the abundance of chordates in the forms of fish eggs and fish larvae may indicate the potential of these study areas as nursery ground.

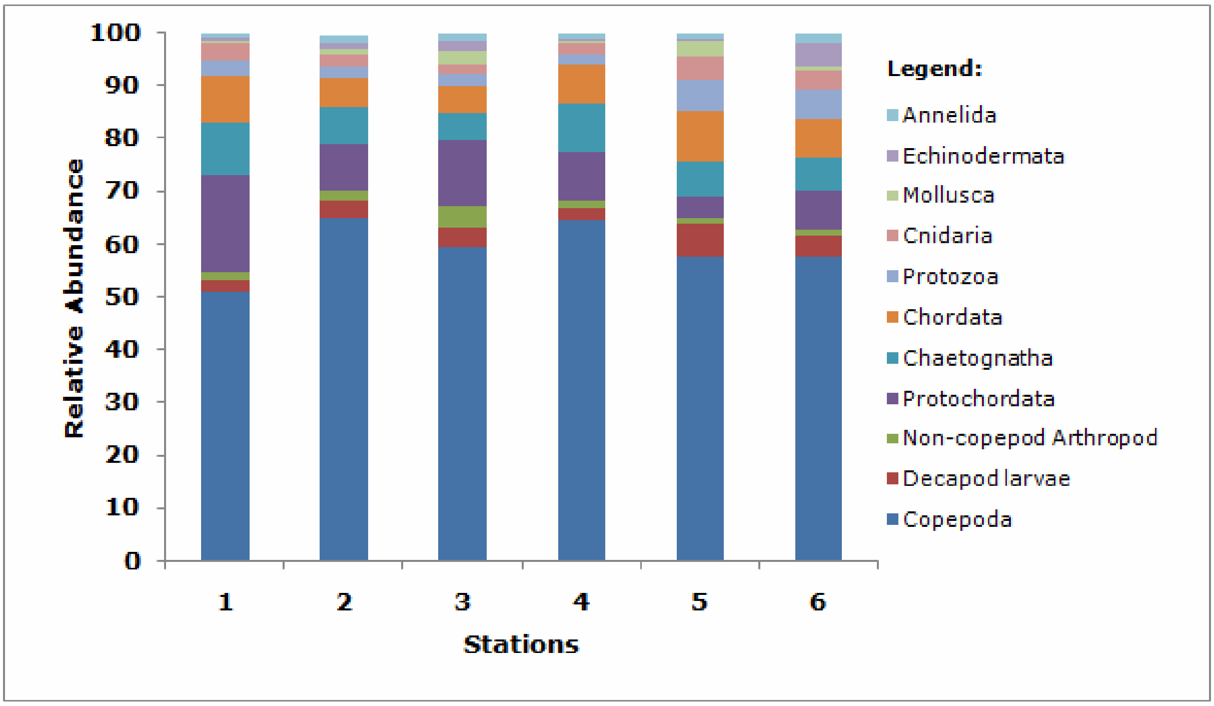


Figure 3. Relative abundance of different mesozoopankton groups in each sampling stations in the nearshore waters of Iligan City, Northern Mindanao, Philippines.

Copepods. Among the 4 copepod groups, Calanoida dominated the copepod population (Figure 4) with relative abundance of > 50% (278-616 ind. m^{-3}) in all sampling stations. Poecilostomatoida rank 2nd with abundance of > 20% (96-307 ind. m^{-3}), Cyclopoida was 3rd which attained an abundance of > 5% (34-88 ind. m^{-3}), while Harpacticoida has the lowest abundance of < 1% (1-15 ind. m^{-3}). In terms of the diversity (H') profiles of the copepod group, H' were generally high in each sampling station and were comparable to those documented in the neritic waters in other parts of the country (H': 2.739-3.215, Lacuna et al 2015; H': 2.2-2.9, Angara et al 2013; Lacuna et al 2014) and other Asian regions (H': 3.501-4.046, Ka & Hwang 2011; H':2.14-4.61, Hwang et al 2000; H':1.99-3.3, Lo et al 2001). Calanoids has always been the key contributor among the copepod groups, in particular, and in mesozooplankton assemblage, in general (Lacuna et al 2015; Lacuna et al 2014; Angara et al 2013; Tseng et al 2012, 2013; Ka & Hwang 2011; Uy et al 2006) such that their function as major food source in the aquatic food web has been well established (Uye 2011; Mahjoub et al 2011). Looking at the relative abundance of the copepod population, the top 5 copepods with ≥ 1% of the total population that also occurred in all sampling stations along the coast of Iligan City (Table 1, copepods observed from all stations were noted by a red asterisk) are presented in decreasing order of abundance: *Canthocalanus pauper* (range: 2.1-11%; 8-146 ind. m^{-3}), *Paracalanus parvus* (1.2-7%; 3-124 ind. m^{-3}), *Oncaea venusta* (1.4-6%; 2-133 ind. m^{-3}), *Acartia erythraea* (1.1-4.7%; 11-46 ind. m^{-3}) and *Oncaea media* (1.2-3.4%; 2-93 ind. m^{-3}). The successful colonization of certain copepod species in any bodies of water may be attributable to the individuals' capability to successfully adapt to every environment where the current will carry them. These characteristics can be manifested in the form of the organisms' being euryhaline (can flourish in coastal, neritic, oceanic waters) eurythermal (can be found in the tropics, subtropics, polar waters), having wide range of distribution (cosmopolitan in nature) and diverse feeding preferences (able to change food choices from herbivory to omnivory). In particular, the calanoid copepod *C. pauper* which is the most dominant and abundant species in the present study was also reported in the neritic waters of Casiguran such as Baler Bay (Lacuna et al 2015) and Casiguran Bay and Sound in Northen Philippines, extending towards the seashores of Taiwan (Ka & Hwang 2011), inside the gulf of Thailand (Suvavepun & Suwanrhumpa 1968) and even stretching to the offshore waters in Southern Japan (Noda et al 1998). Subsequently, the

2nd abundant species in our study is *P. parvus* which is another calanoid but small bodied copepod that was likewise recognized and dominant in wide range of habitats from warm to cold waters (Peterson et al 2002; Takahashi & Hirakawa 2001), from the waters in the coast (Lacuna et al 2014; Angara et al 2013; Johan et al 2013; Maiphae & Sa-ardrit 2011) and neritic (Vukanic 2010; Noda et al 1998; Stephen 1984) of the subtropic to the tropic regions of the globe. Further, the wide range of food preference of *P. parvus* from being plant plankton (herbivorous) to a mixed diet eater (omnivorous) (Hafferssas & Seridji 2010) permit them to prosper and become highly abundant. Another abundant calanoid in the present study, *A. erythraea*, was similarly encountered in vast numbers in coastal bays in the Gulf of Thailand (Jitchum & Wongrat 2009). This particular copepod was considered to be the main contributor to the entire copepod community in the said body of water (Suwanrhumpa 1980). Conversely, the much smaller body size Poecilostomatoids, *O. venusta* and *O. media*, that were included in the top 5 abundant copepods in the present study were reported to occur in diverse regions of the ocean. For instance, *O. venusta* frequently appeared in numerous numbers over the expanse of Asian waters of the Northwestern Pacific Ocean (Lacuna et al 2015; Lacuna et al 2014; Angara et al 2013; Hsieh et al 2004; Noda et al 1998) to the tropical waters of the Caribbean (Webber et al 2005) up to the subtropical Southern Brazil (Campaner 1985). Moreover, this species tend to alternate their diet from a mixed one (Turner 1986) to being a detritus consumer (Yamaguchi et al 2002), hence increasing their chances to thrive abundantly in the marine world. On the other hand, *O. media* were reported to be a neritic and oceanic species that tend to be abundant in warm waters in Asia (Angara et al 2013; Chen & Zhang 1965; Chen et al 1974). It is most likely that different modes of survival strategies have been utilized by the highly abundant and dominant members of the copepod assemblage in the coast surrounding Iligan City that grant them the advantage to successfully thrive, flourish and proliferate in a world where survival of the fittest is the law of the game of existence.

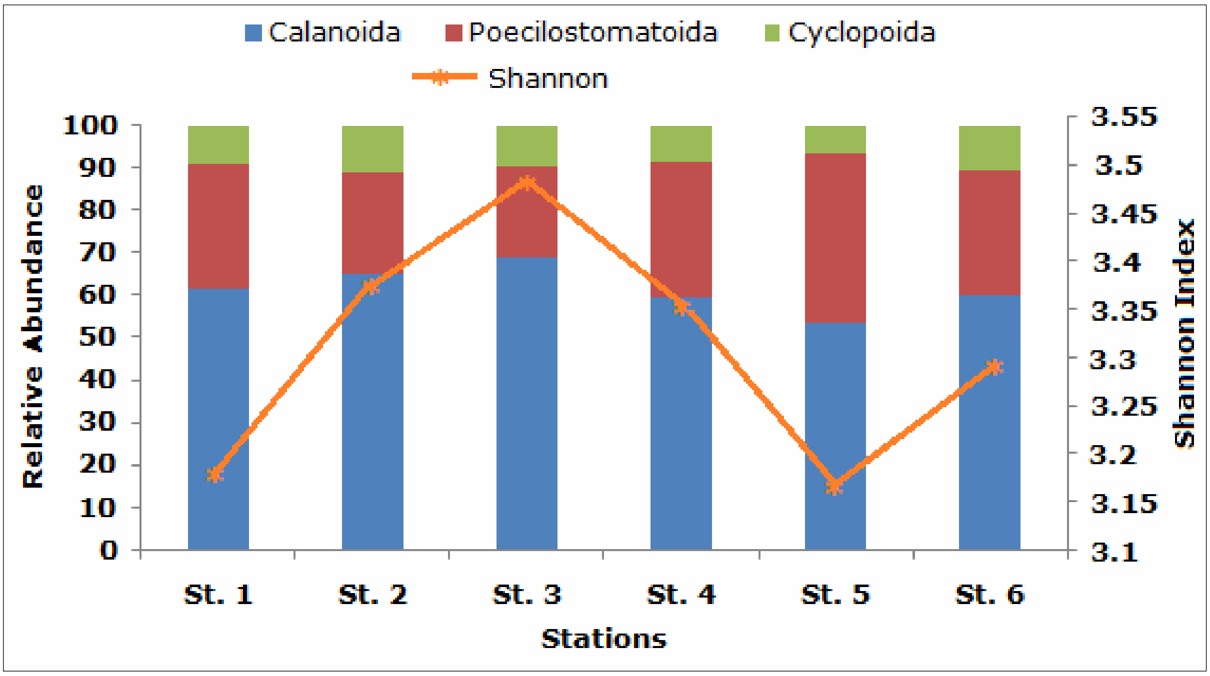
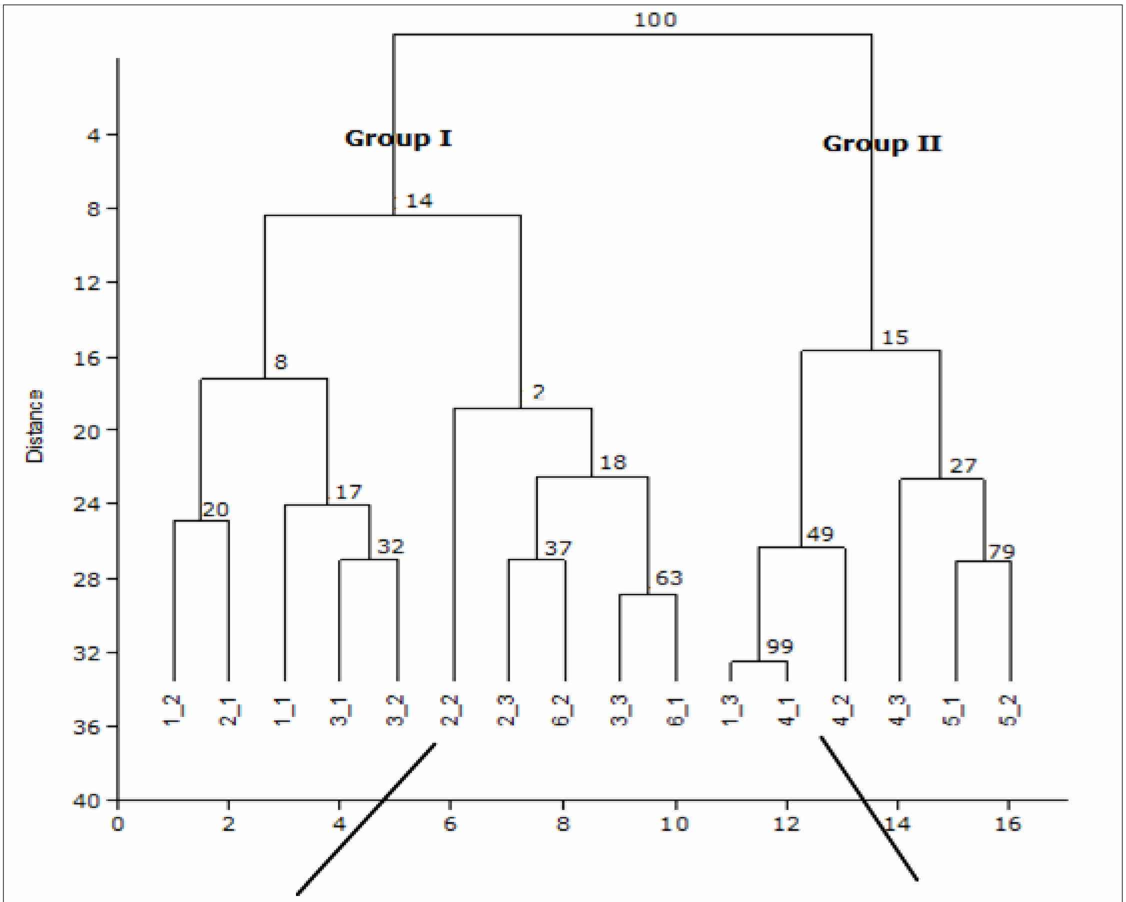


Figure 4. Relative abundance and diversity profile of copepod-groups in each sampling station in the nearshore waters of Iligan City, Northern Mindanao, Philippines.

Based on the dendrogram results of the cluster analysis using Ward's method, the species composition of copepods for all sampling stations were separated into two assemblages (Figure 5). Group I is composed of stations 1, 2, 3, 6 with the following dominant and abundant copepod species: *Canthocalanus pauper, Paracalanus parvus, Undinula vulgaris, Oncaea media, O. venusta, Acrocalanus gracilis* and *Acartia danae*.

Group II is comprised of stations 4 and 5 with *Canthocalanus pauper, Oncaea media, O. venusta, Acartia erythraea, A. longiremis, Paracalanus parvus, Candacia catula* and *Corycaeus catus* dominating this cluster.



Group I

Taxa	%	Ind. m³
Canthocalanus pauper	7.6	78
Paracalanus parvus	3.9	47
Undinula vulgaris	2.6	44
Oncaea media	2.4	37
Oncaea venusta	2.0	29
Acrocalanus gracilis	2.0	32
Acartia danae	1.6	21

Group II

Taxa	%	Ind. m³
Canthocalanus pauper	3.5	46
Oncaea media	3.2	44
Oncaea venusta	3.0	30
Acartia erythraea	2.8	26
Acartia longiremis	2.1	16
Paracalanus parvus	2.1	43
Candacia catula	2.1	20
Corycaeus catus	2.0	21

Figure 5. Cluster diagram showing similarities in the composition of copepods among sampling sites. The diagram was computed using Ward's method of analysis using Euclidean distance measure (Boot N:1000).

According to the copepod associations as demonstrated by the cluster analysis, stations 1, 2, 3, 6 were closer with each other as observed by the high numbers of copepod species recorded in these stations (species richness ranging between 45-50), while stations 4 and 5 revealed similarity with each other as reflected in its low number of copepod species (species richness was 45: St 4 and 35: St 5). The results reflected in cluster analysis are more or less supported by the results of the CCA (Figure 6) which pinpoint to a specific hydrological factor that may have influenced these clustering. For instance, the clustering of stations 1, 2, 3, 6 which had the highest number of copepod species may be attributed to the strong water motion persistent in these stations (particularly high in stations 2 and 6). It is possible that the water movement may have allowed mixing as well as transport of more species of copepods from neighboring coastal waters thereby leading to high copepod species to these stations. It has been documented that zooplankton distribution is very dependent on the dynamics of water masses in a way that the zooplankton community are being transported via large water masses through the action of strong current (Tseng et al 2011; Gomez et al 2000; Lopes et al 1999; Gowen et al 1998; Sabates et al 1989). Conversely, the slow movement of water recorded in stations 4 and 5 may have resulted to less mixing of water and low copepod species exchange. Despite the probable effect of water motion to the species richness of copepod assemblage in the nearshore waters surrounding Iligan City, interplay of other hydrological/environmental factors like different seasons (Yoshida et al 2006), diel vertical migration (Lo et al 2004), time and day of sampling (Hwang et al 2009), size of mesh openings of the net used (Tseng et al 2011) and biotic parameters (i.e. prey-predators, Rachman & Fitriya 2012) may influence these community.

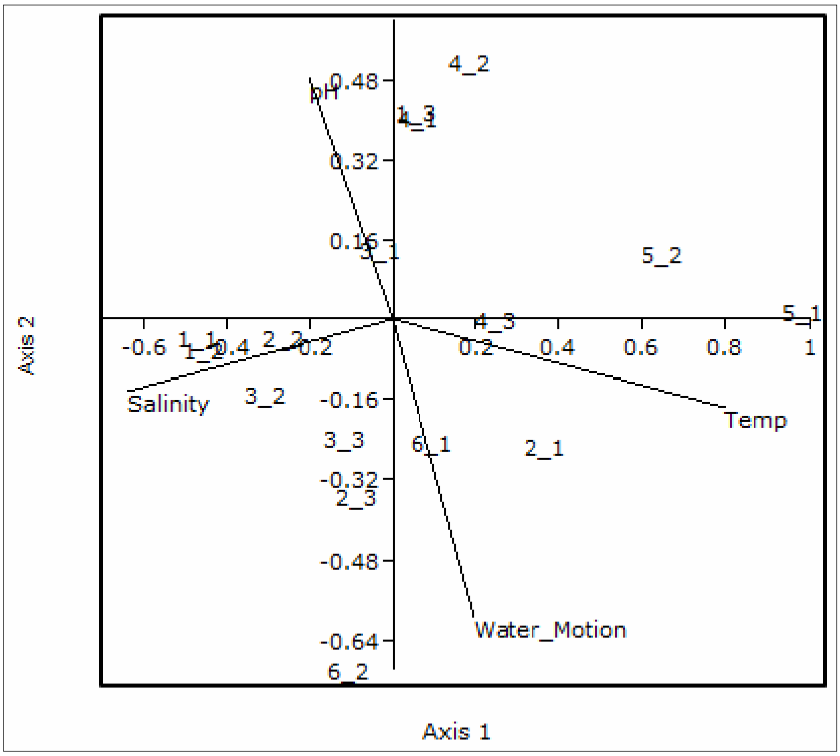


Figure 6. Results of the Canonical Correspondence Analysis- biplot showing the distance among the sampling stations and the hydrological parameters that influence the abundance of copepods in the nearshore waters of Iligan Ciy, Northern Mindanao, Philippines.

Conclusions. The coastal waters surrounding Iligan City in Northern Mindanao, Philippines consisted of highly diverse and rich mesozooplankton species. The copepoda, in particular the calanoids, were the most common and dominant group in the area, although other groups, namely the protochordates, chaetognaths and chordates (fish eggs and fish larvae) were also abundant. Most of the observed dominant and abundant copepod species were possibly linked with the strong movement of water thus contributing to the mixing and transport of more copepod species into the said sampling stations. The results may imply the high potential of the areas to be used as nursery ground for fish and other macroinvertebrates. Since the study areas supports highly diverse and abundant members of the mesozooplankton community, such scenario can therefore greatly sustain the presence of a marine sanctuary that was already established within the vicinity of the sampling stations.

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