ZOOPLANKTON DIVERSITY AND DISTRIBUTION IN THE WATERS OFF TANINTHARYI REGION, MYANMAR

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Abstract

The zooplankton samples from 23 stations in the waters off Tanintharyi Region were collected by R/V DR. Fridtjof Nansen (August – September 2018). The 209 species and 35 taxa of zooplankton were observed in the present study area. Copepods were the most abundant and dominant species at all stations. *Acrocalanus gibber, Paracalanus parvus, P. aculeatus, Nanocalanus minor, Undinula vulgaris, Acrocalanus longicornis, Corycaeus andrewsi*, and *Canthocalanus pauper* were very common in the study waters. The highest species composition was recorded (141 occurrences) at St 854 and the most abundant (6622 no/m^3) at St 796. Zooplankton diversity of (*H'* > 3.9) were represented high values in three fish spawning grounds of the Tanintharyi Region. The species diversity of *H', D'* and *E'* values were usually high at stations close to the coast.

Keywords: Abundance, composition, copepods, Tanintharyi Region, zooplankton.

Introduction

Plankton are composed of the phytoplankton and zooplankton found near the surface in aquatic environments. There are two groups used to classify zooplankton by their development stages: meroplankton (temporary plankton) and holoplankton (permanent plankton). Zooplankton are central components of marine ecosystems, forming the base of most marine food webs. The important zooplankton organisms, including copepods, cladocerans, decapod larvae, rotifers, ciliates, artemia, and copepods are the food for fish larvae (Santhosh and Anil, 2014). Calanoid and cyclopoid copepods were the principal prey for fry fish, and harpacticoid copepods were the essential invertebrate food items (Whitfield, 1985).

The three surveys (2013-2018) of R/V DR. Fridtjof Nansen conducted plankton sampling, hydrographic parameters (CTD), pelagic trawl and bottom- trawl sampling and benthos sampling in Rakhine, Ayeyarwaddy and Tanintharyi Waters. The scientific data, including the distribution and diversity of different species at various trophic levels (Phyto- and zooplankton, fish eggs, and larvae), played a vital role in sustainable fisheries management Myanmar waters.

The objectives of the present study were - to observe the composition and abundance of zooplankton, to illustrate the distribution of zooplankton species, to determine the zooplankton abundance related to environmental parameters and to evaluate the diversity of zooplankton.

Materials and Methods

Marine ecosystem survey in Myanmar waters was carried onboard R/V DR. Fridtjof Nansen for six weeks (August–September 2018). Twenty-three zooplankton sampling stations, including three fish spawning grounds (spawning triangles) in Tanintharyi Coastal Waters, were designated (Figure 1). The WP2-net (56 cm diameter and mesh size 180 µm) was hauled vertically at a speed of ~0.5 ms-1 at the water depth of 30m for each station. The sample was preserved in seawater with a solution of 4% formaldehyde buffered with borax and was deposited Marine

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Science Laboratory for species identification and quantification. Zooplankton was identified up to species levels with references to Kasturirangan (1963), Borror (1973), Newell and Newell (1973), Arvin(1977), Wells (1984), Conway and White (2003), Conway (2003), Boxshall (2004), Mulyadi (1997a,b), Al-Yamani (2011a,b) and Conway (2012a, b). The subsamples of zooplankton were counted under a binocular microscope and calculated for abundance (no/m^3). The Jaccard similarity index JI = j / (a + b-j) was used to analyze potential similarities/dissimilarities of zooplankton species composition between stations (Shamsudin and Yasin, 1996). Zooplankton species diversity (*H´*), evenness (*E´*), and richness (*D´*) were calculated as follows, using the formula of Shannon and Weaver, 1963 and Pielou, 1966. *H´* = -∑ Pi *ln Pi , *E´* = *H´* / ln S, *D´* = S-1 / ln N (Ludwig and Renylods,1998). All statistics data were analyzed by the R program.

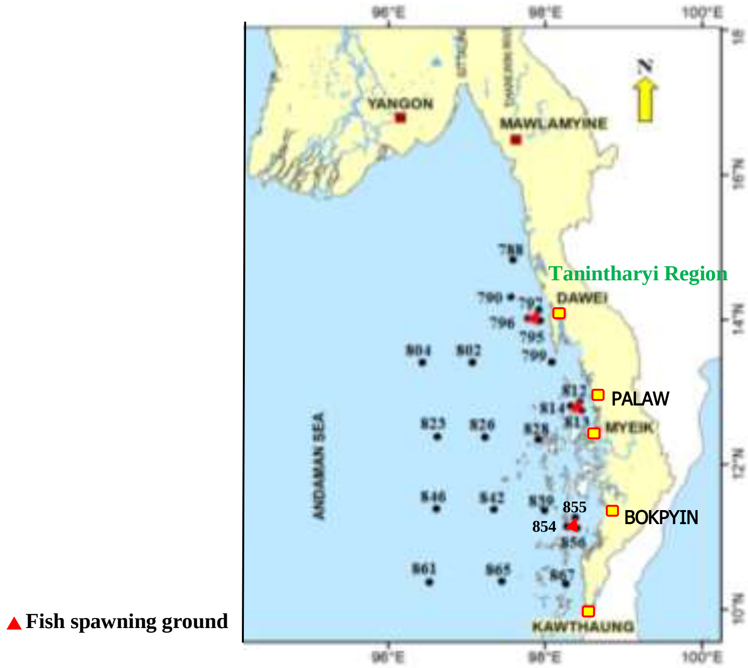


Figure 1 Zooplankton sampling stations in the waters off Tanintharyi Region

Results

Composition

Zooplankton communities comprised of 209 species under 11 phylum and 35 taxa (Table 1). Zooplankton including 7 species of Protozoa, 4 species of Foraminifera, 5 species of Radiozoa, 12 species of Cnidaria, 1 species of Ctenophora, 7 species of Annelida 13 species of Chaetognatha, 13 species of Mollusca, 4 species of Cladocera, 7 species of Ostracoda, 66 species of Calanoida, 24 species of Cyclopoida, 9 species of Harpacticoida, 10 species of Amphipoda, 1 species of Isopoda, 3 species of Mysidae, 4 species of Euphausidae, 3 species of Decapoda and 16 species of Appendicularia were identified up to species level. The 35 taxa of meroplankton which were not identified to generic or species levels incorporated the larvae of Anthozoa, Bryozoa, Polychaeta, Mollusca, Decapoda, Copepoda and Echinodermata. Copepoda was the most diverse group containing the highest number of species (102), followed by Chaetognatha (32), Mollusca (13), Cnidaria (12) and Amphipoda (10). The highest zooplankton species composition of (141) was found at St 854 (near Owen Island) whiles the lowest species composition of (32) at St 828 (near Thayawthahangyi Island) (Figure 2). The clusters of sampling stations associated with zooplankton species composition were analyzed by Jaccard Index (JI).

Dendrogram illustrated that the dissimilarity of the groups or clusters of sampling stations ranged between 0.4 and 0.9 (Figure 3).

Among calanoid copepods, *Acrocalanus gibber*, *A. longicorni, Paracalanus parvus*, *P. aculeatus, Nanocalanus minor*, *Undinula vulgaris, Corycaeus andrewsi and Canthocalanus pauper* ranged between 96 -87% composition was very common in the present study waters. The percent occurrence of *Corycaeus speciosus*, *C.catus*, *C.latus*, *Oithona nana O.attenuata O. similis, Oncaea venusta*, *O.clevei*, *Oikopleura longicauda*, *O.fusiformis, Euterpina acutifrons,* and *Flaccisagitta enflata* represented 87-74% composition was common in the present study area. *Metacalanus aurivilli Calanopia elliptica*, *C.aurivilli*, *C.minor C.thompsoni*, *Labidocera kroyeri L.euchaeta Pontellina plumata*, *P.spinipes*, *P.valida*, *P.fera*, *Tigriopus sp*, *Tortanus forcipatus*, *T.barbatus*, Ctenophora, Bryozoa, Cladocera and Gastropoda larvae were rare (less than 9 % occurrence) in the present study area. Chaetognatha, Decapoda, Euphausidae, Mysidae, Isopoda, Appendicularia, Cnidaria and Polychaeta larvae were more common at St 854 than other stations.

Abundance and distribution

The zooplankton abundance ranged from (515 no/m^3) at St 802 to (6622 no/m^3) at St 796 (Figure 2). The densities of zooplankton were higher at nearshore stations than offshore stations. Copepods were the most abundant species accounting for 79.26% of total zooplankton abundance. The densities of calanoid copepods were 53.94% of total copepods followed by cyclopoids (10.32%), poecilostomatoids (9.33%), and harpacticoids (5.66%) in respective order. Chaetognatha was the second most abundant group after copepods, comprising 7.14% of total zooplankton density. Other major groups observed were Appendicularia (9.24%) and Cnidaria (1%). The rest of the groups contributing <1% of the total density included Euphausiadae, Mollusca, Decapoda, Protozoa, Foraminifera, Chordata, Ostracoda, Annelida, Mysidae, Cladocera, Actinopoda, Radiolaria, Amphipoda, Isopoda, and Ctenophora.

The station-wise abundance and distribution of different zooplankton groups and the dominant copepod species were illustrated in Figure 4A- B. The first fish spawning ground (around Launglong – Bok, Moscos and Maungmagan Islands) was represented as high zooplankton densities of (3787 no/m^3 at St 795), (6222 no/m^3 at 796) and (4599 no/m^3 at St 797) respectively. The most dominant species of *Undinula*, *Nanocalanus*, *Paracalanus*, *Acrocalanus*, *Acartia*, *Candacia*, *Oithona*, *Oncaea*, and *Microsetella* ranged in cell densities from 40 to 51 no/m^3 in the first spawning ground (Figure 4A). The zooplankton abundance with the moderate numbers ranging (from 1353 to 2435 no/m^3) were observed at St 812, 813 and 814 in the second fish spawning ground (near Thamihla, Anyin-pho-Anyin-ma, and Kawdwe Islands). *Nanocalanus*, *Paracalanus*, *Acrocalanus*, *Eucalanus*, *Euchaeta*, *Acratia*, and *Lucicutia* were the significant components of copepods (ranging from 53-23 no/m^3) in the second fish spawning ground. The high numbers of zooplankton were observed between 2976 no/m^3 and 4599 no/m^3 at St 854, 855 and 856 in the third fish spawning ground (near Owen, Aleman and Kawye Islands). The key copepod species including *Nanocalanus*, *Paracalanus*, *Undinula*, *Acrocalanus*, and *Centropages* were in high abundance (ranging from 53-30 no/m^3) in the third fish spawning ground. Among fishing grounds, the highest zooplankton abundance was found in the first fish spawning ground. The twenty zooplankton groups except Copepoda were regarded as (<15%) of the total zooplankton abundance in all fish spawning grounds (Figure 4A-B).

Table 1 Inventory list of zooplankton species and larvae recorded in the present study area

Sr.No	Species Name	Sr.No	Species Name	Sr.No	Species Name
	Protozoa	46	*F. robusta*	92	*Euchaeta concinna*
1	*Tintinnopsis gracilis*	47	*Mesosagitta minima*	93	*E. elongatus*
2	*T. radix*	48	*Zonosagitta pulchra*	94	*E. wolfendeni*
3	*T. ampla*	49	*Z. bedoti*	95	*Scolecithrix danae*
4	*T. tubulosa*		**Mollusca**	96	*S.bradyi*
5	*T. directa*	50	*Cresis clava*	97	*Centropages furcatus*
6	*T. butchlii*	51	*C. virgule*	98	*C. yamadai*
7	*Undella columbiana*	52	*Hyalocylis striata*	99	*C. orsinii*
	Foraminifera	53	*Styliola sp*	100	*C. tenuirenis*
8	*Globigerina bulloides*	54	*Cilo sp.1*	101	*C. elongatus*
9	*G. rubesuns*	55	*Cavolinia sp.1*	102	*C. gracilis*
10	*Globorotalia inflata*	56	*Limacina trochiformis*	103	*C.dorsipinatus*
11	*Globoquadrina dutertrei*	57	*L.bulimoides*	104	*Lucicutia flavicornis*
	Radiozoa	58	*Desmopterus papilio*	105	*L.ovalis*
12	*Acanthometron sp.*	59	*Atlanta inflata*	106	*Metacalanus aurivilli*
13	*Acanthochiasma dichontoma*	60	*A. brunnea*	107	*Pseudodiaptomus aurivilli*
14	*Acanthochiasma rubescens*	61	*A. peroni*	108	*P.mertoni*
15	*Hexacontium sp.*	62	*A. lesueurii*	109	*Candacia bradyi*
16	*Acrosphaera spinulosa*		**Arthropoda**	110	*C.catula*
	Cnidaria		**Cladocera**	111	*C.discaudata*
17	*Liriope tetraphylla*	63	*Evadne nordmanni*	112	*C.pachydactyla*
18	*Aglaura hemistoma*	64	*Pseudevadne tergestina*	113	*Acartia erythraea*
19	*Solmundella bitentaculata*	65	*Penilia avirostris*	114	*A.spinicauda*
20	*Euphysa sp.*	66	*Penilia sp.*	115	*A.pacifica*
21	*Diphyes dispar*		**Ostracoda**	116	*A.negligens*
22	*D. chamissonis*	67	*Cypridina sinuosa*	117	*A. danae*
23	*Diphyes sp.1*	68	*Cypridina sp.1*	118	*A.centrula*
24	*Diphyes sp.2*	69	*Cypridina sp.2*	119	*A. sewelli*
25	*Lensia conoidea*	70	*Cypridinodes asymmetrica*	120	*Calanopia elliptica*
26	*L.multicristata*	71	*Pyrocypris sp.1*	121	*C.aurivilli*
27	*Abyla leuckarti*	72	*Pyrocypris sp.2*	122	*C.minor*
28	*A. haeckcli*	73	*Conchoecia elegans*	123	*C.thompsoni*
	Ctenophora		**Copepoda**	124	*Labidocera acuta*
29	*Beroe ovata*		**Calanoida**	125	*L.pectinata*
	Annelida	74	*Nanocalanus minor*	126	*L.minuta*
30	*Callizona sp*	75	*Canthocalanus pauper*	127	*L.pavo*
31	*Vanadis sp.1*	76	*Undinula vulgaris*	128	*L.kroyeri*
32	*Tomopteris elegans*	77	*U. caroli*	129	*L.euchaeta*
33	*T. pacifica*	78	*U. darwini*	130	*Pontellina plumata*
34	*Sagitella kowalewskii*	79	*Acrocalanus gibber*	131	*Pontella danae*
35	*Pelagobia longicerrata*	80	*A. longicornis*	132	*P.spinipes*
36	*Lopadorrhynchus appendiculatus*	81	*A. gracilis*	133	*P.valida*
	Chaetognatha	82	*A. similis*	134	*P.fera*
37	*Aidanosagitta crassa*	83	*A. inermis*	135	*Tortanus forcipatus*
38	*A. regularis*	84	*Paracalanus parvus*	136	*T.barbatus*
39	*A. neglecta*	85	*P. aculeatus*	137	*Temora turbinate*
40	*Flaccisagitta enflata*	86	*P.dubia*	138	*T.discaudata*
41 42	*F.hexaptera* *Pseudosagitta lyra*	87 88	*P.crassiostris* *Calocalanus pavo*	139	*T.stylifera*
43	*Sagitta bipunctata*	89	*E. subcrassus*		**Cyclopoida**
44	*Ferosagitta ferox*	90	*E.monachus*	140	*Oithona nana*
45	*F. hispida*	91	*E.attenuatus*	141	*O.attenuata*
41 42	*F.hexaptera* *Pseudosagitta lyra*	87 88	*P.crassiostris* *Calocalanus pavo*	139	*T.stylifera*
43	*Sagitta bipunctata*	89	*E. subcrassus*		**Cyclopoida**

Sr.No	Species Name	Sr.No	Species Name	Sr.No	Species Name
44	*Ferosagitta ferox*	90	*E.monachus*	140	*Oithona nana*
45	*F. hispida*	91	*E.attenuatus*	141	*O.attenuata*
142	*O. similis*	179	*Tulbergella sp.*		
143	*O.spinirostris*	180	*Rhabdosoma brevicaudatum*		**Zooplankton larvae (Meroplankton)**
144	*O.rigida*	181	*Rhabdosoma sp.*	1	Tentaculate larva of Arachnactis
145	*O.plumifera*	182	*Oxycephalus sp.*	2	Cyphonautes larva of bryozoa
146	*O.brevicornis*		**Isopoda**	3	Nectochaete larva of eulalid
147	*O.setigera*	183	*Idotea emarginata*	4	Young Autolytus
148	*O.simplex*		**Mysidae**	5	Trochophore larva of nereid
149	*Oncaea venusta*	184	*Siriella affinis*	6	Nectochaete larva of nereid
150	*O.conifera*	185	*Promysis orientalis*	7	Young Sagitella
151	*O.clevei*	186	*Mesopodopsis orientalis*	8	Larvae of nepthyid polychaetes
152	*Corycaeus speciosus*		**Euphausidae**	9	Larvae of spionid polychaete
153	*C.latus*	187	*Pseudeuphausia latifrons*	10	Nectochaete of Glycera
154	*C.andrewsi*	188	*Stylocheiron carinatum*	11	Larva of polynoinid polychaete
155	*C.catus*	189	*S.insularis*	12	Syllid polychaete
156	*C.conifera*	190	*S. affinis*	13	Phyllodocid polychaete
157	*C.asiaticus*		**Decapoda**	14	Trochophore larva of sabellarid
158	*Farranula gibbula*	191	*Acetes indicus*	15	young Platynereis
159	*Sapphirina nigromaculata*	192	*A. japonicus*	16	larva of Disoma
160	*S.ovatolanceolata*	193	*Lucifer penicillifer*	17	Nauplius larvae of penaeid prawn
161	*S.stellata*		**Appendicularia**	18	Zoea larvae of penaeid prawn
162	*S.angusta*	194	*Fritillaria pellucida*	19	Mysis larvae of penaeid prawn
163	*Copilia quadrata*	195	*F.formica*	20	Late larva of Acetes
	Order Harpacticoida	196	*Oikopeura cophocerca*	21	Phyllosoma larva of Palinurus
164	*Microsetella norvegica*	197	*O.fusiformis*	22	Larva of Brachyura
165	*M. rosea*	198	*O. longicauda*	23	Zoea larvae of brachyura
166	*Macrosetella gracilis*	199	*O. dioica*	24	Megalopa larvae of brachyura
167	*Miracia efferatia*	200	*O. rufescens*	25	Alima larva of stomatopoda
168	*Euterpina acutifrons*	201	*Stegosoma magnum*	26	Trochophore larva of Mollusca
169	*Longipedia weberi*	202	*Doliolum denticulatum*	27	Veliger larva of janthinid gastropod
170	*Clytemnestra rostrata*	203	*D. gegenbauri*	28	Veliger larva of atlantid gastropod
171	*C.scutellata*	204	*Dolium sp.*	29	Veliger larva of Echinospira
172	*Tigriopus sp.*	205	*D.nationalis*	30	Veliger larvae of gastropod
	Order Amphipoda	206	*Salpa fusiformis*	31	Veliger larvae of bivalve
173	*Phronimella elongata*	207	*S. maxima*	32	Ophiopluteus larva of ophiuroid
174	*Hyperia sp.*	208	*S. cylindrical*	33	late ophiopluteus larva
175	*Lestrigonus sp.*	209	*Iasis zonaris*	34	Echinopluteus larva of echinoid
176	*Phrosina semilunata*			35	Bipinnaria larvae of asteroid
177	*Brachyscelus sp.*				
178	*Glossocephalus milne-edwardsi*				

Diversity

The Shannon diversity index was analyzed based on zooplankton abundance and species composition. The diversity index H' values ranged from 3.23 to 4.56 were usually high values in the coastal stations (Figure 5). Most stations showed the diversity index values $H' \geq 4$ but only one station revealed 3.23. The richness index *D'* values based on species richness were ranging between 5.2 and 19.5. As evenness *E' obtained over* 0.8 in the present study area, the high index values showed no difference among the stations. It exhibited a balanced community of the study waters. The index of diversity showed *H'* ranging from 3.9 to 4.6, richness *D'* (6.8 -18.8) and Evenness *E'* (0.9 - 0.98) respectively in three fish spawning grounds of the study waters. It indicated higher zooplankton diversity and the well-balanced system of the zooplankton community in these fishing grounds.

Environmental Conditions

More uniform temperatures were represented in the present study area, ranging from 28.7 to 27.9 ºC and the mean temperature was 28.3ºC (± 0.21) (Figure 6-7). The correlation of seawater temperature with zooplankton abundance was small negative (r = -0.03). Higher salinity values of seawater (32-33ppt) were recorded in the offshore areas (St 802, 823, 846, 861 and 865) while the lower values of (<30.39 ppt) were observed at in the nearshore stations including three fish spawning grounds (Figure 7). The average salinity value occurred at 30.6 ppt (±1.5) (Figure 6). Zooplankton density showed a medium negative correlation (r = -0.5) with the seawater salinity. In general, the zooplankton abundance was higher in the nearshore stations with low salinity values than offshore stations with high salinity values (Figure 7).

Dissolved oxygen concentration in seawater varied from higher levels found in the offshore stations (St 842, 826 and 861) to lower levels observed in the nearshore stations such as St 797 (near Maungmagan Island) and St 799 (near Dawei Point-Shin Maw) (Figure 7). The average dissolved oxygen concentration was recorded at 3.9 ml/l (± 0.7) (Figure 6). The oxygen minimum zone (OMZ) did not occur in the present study waters and dissolved oxygen well saturated at all stations. The changes in dissolved oxygen concentrations and zooplankton abundance occurred in a small negative correlation (r = -0.3).

Discussion

According to the assessment of zooplankton species composition from R/V DR. Fridtjof Nansen Ecosystem Survey in the Southern Myanmar Waters (2013-2018), 212 species and 39 taxa in 2013 (Zin Lin Khine, 2014), and 209 species and 35 taxa in 2018 (the present result, 2020) were recorded. It indicated that the zooplankton species were widely distributed in the present study waters. Copepoda was the most critical group and followed by Chaetognatha, Mollusca, Cnidaria, Amphipoda, and Appendicularia were generally distributed in the present study waters. From the previous results, Copepoda, Protozoa, Chaetognatha, Cnidaria, Isopoda, and Appendicularia were ubiquitous in the southern Myanmar waters (Saw Han Shein 1975, Zin Lin Khine, 2009, 2013, 2014, and Jitlang, *et. al.* 2012).

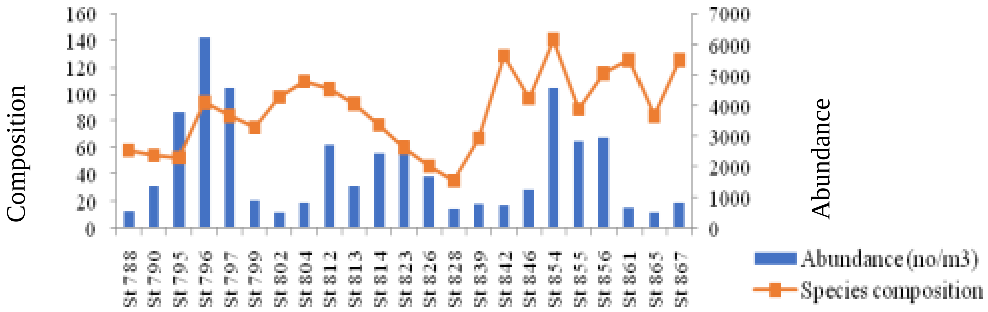


Figure 2 Station wise zooplankton abundance and composition in the present study area

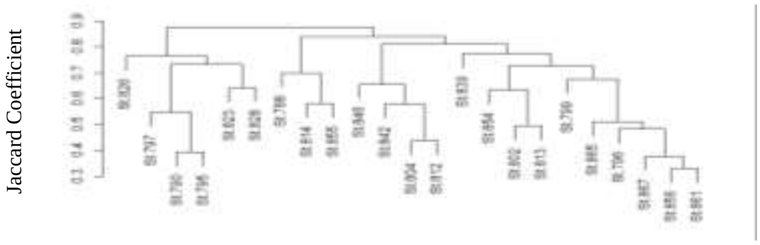
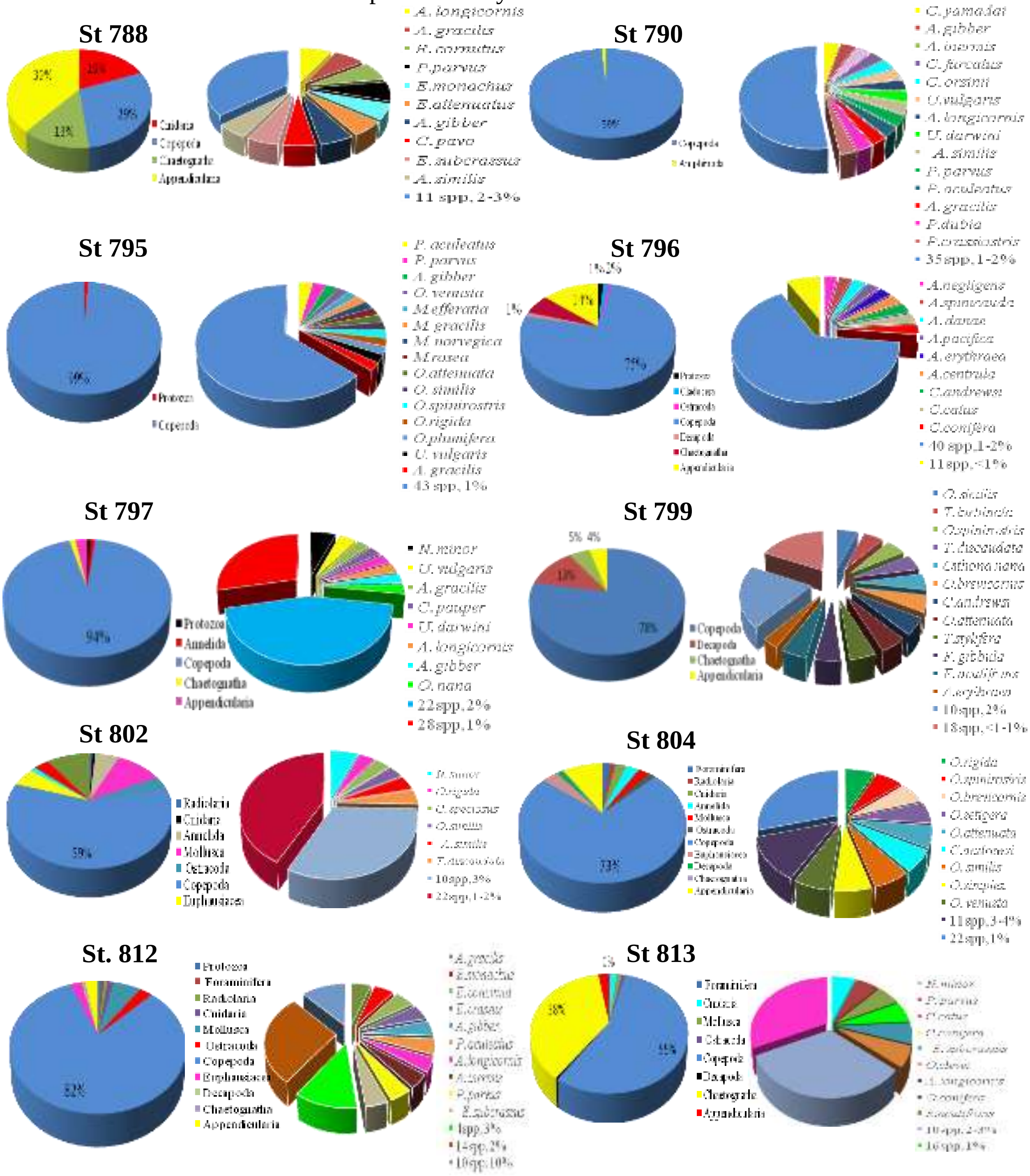


Figure 3 Dendrogram showing the Jaccard dissimilarity of zooplankton species composition found 23 stations of the present study area



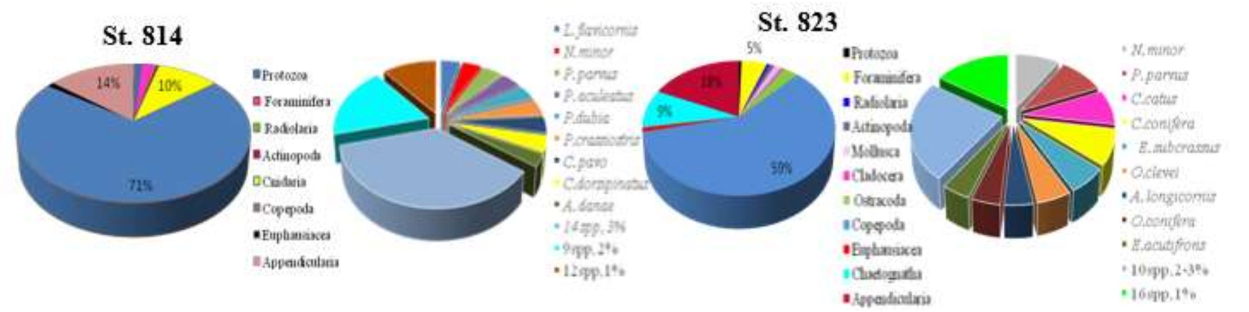
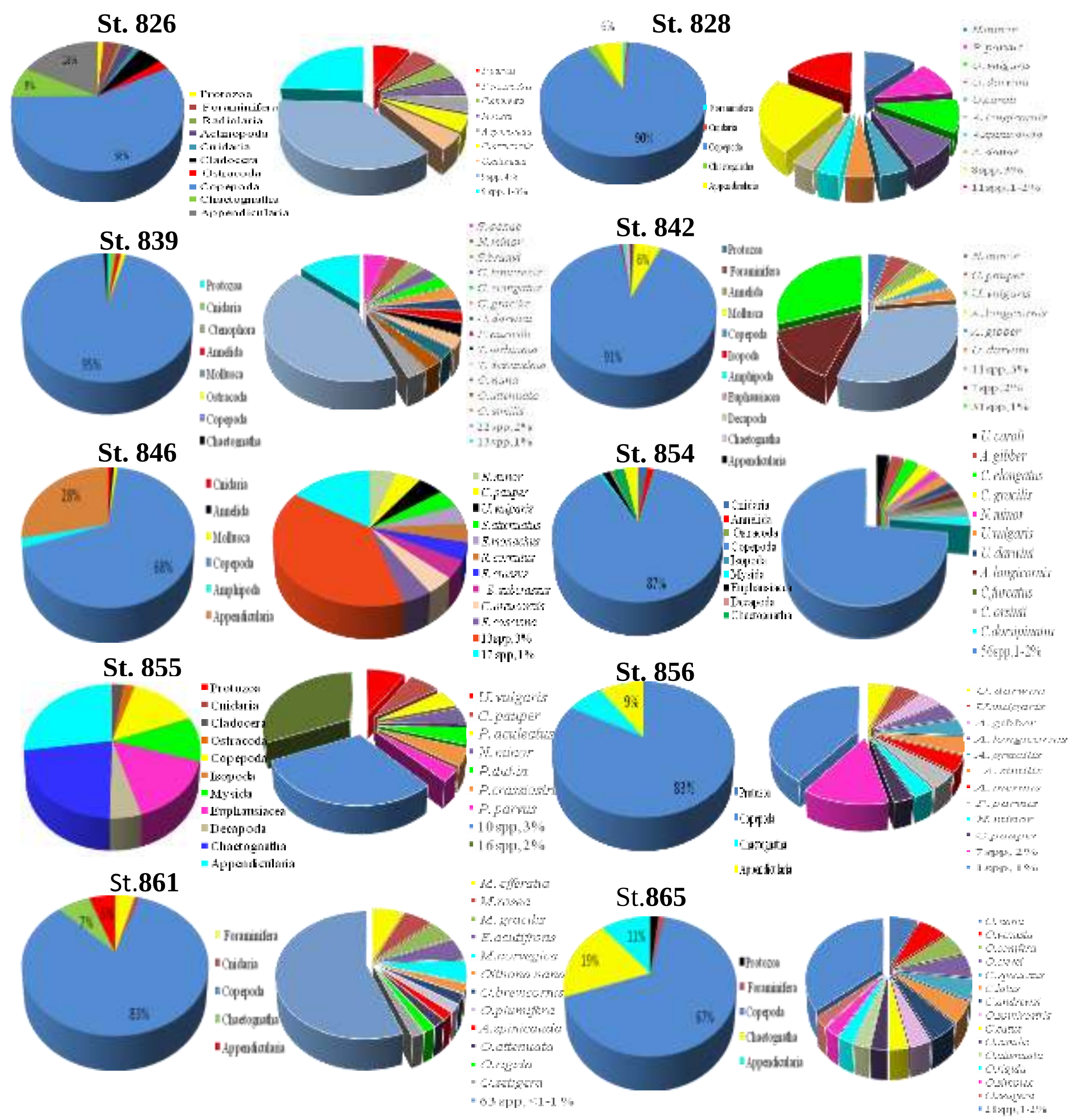


Figure 4 A. Relative abundance of main zooplankton groups (%) and dominant copepods found at each station in the present study area



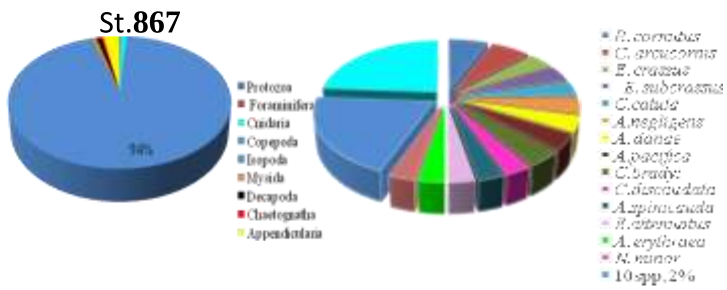


Figure 4 B Relative abundance of main zooplankton groups (%) and dominant copepods found at each station in the present study area

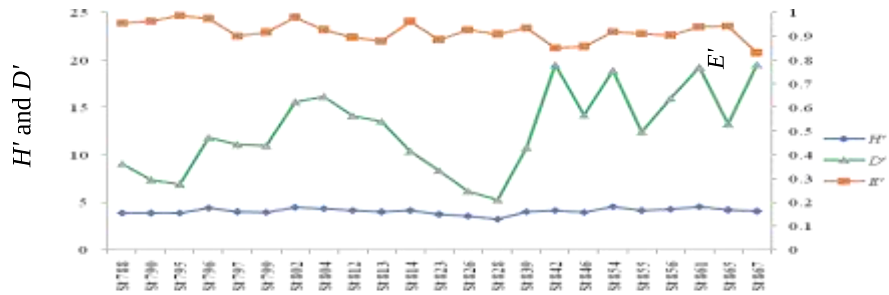


Figure 5 Zooplankton diversity indices by station in the present study area

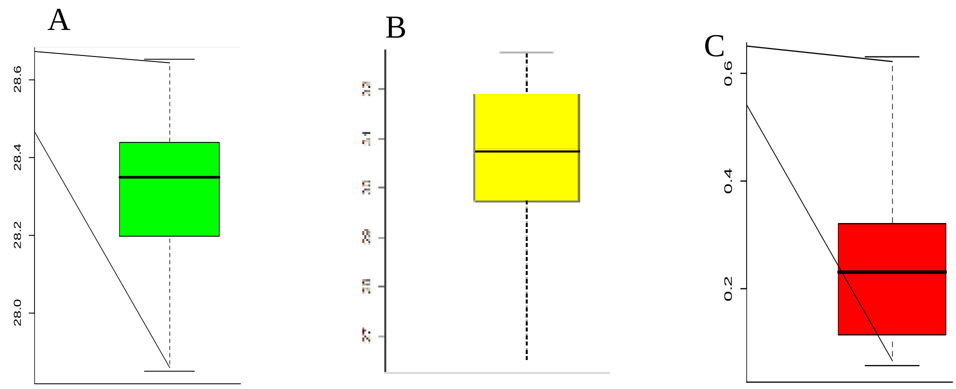


Figure 6 (A-C). Box plot showing the variables for Temperature (ºC), Salinity (ppt), and Oxygen (mg/l) in the present study area

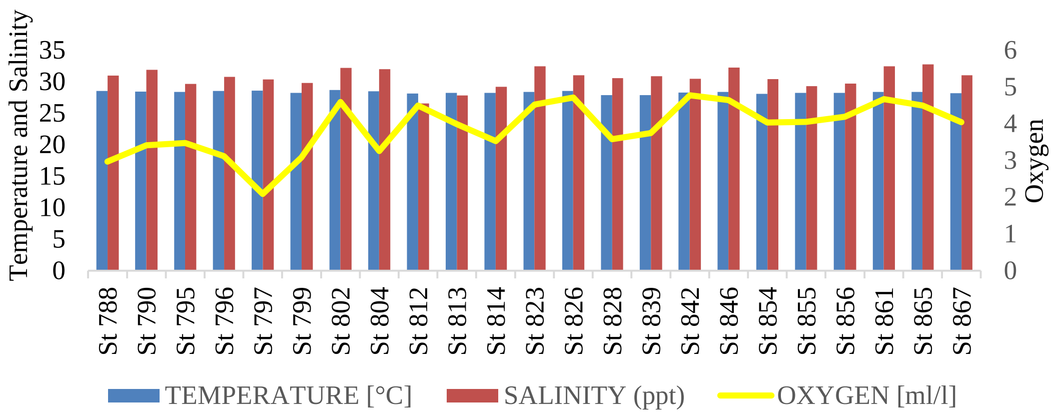


Figure 7 Seawater temperature, salinity and oxygen by stations

Copepods, Protozoa, Cladocera, Crustacea and Mollusca larvae were the important prey for larval fish (Nagasawa, 1993 and Anderson, 1994). The previous and present observations in the study waters proved that the main zooplankton groups supported fish larvae's food.

The previous results (Saw Han Shein 1975, Zin Lin Khine, 2009 and 2014) and present observations (2020) pointed out the major food items including *Undinula, Nanocalanus, Paracalanus, Acrocalanus, Acartia, Candacia, Oithona, Oncaea* and *Microsetella* were the dominant and abundant species in Myanmar waters. Moreover, *Tintinnopsis*, *Globigerina*, *Acetes* and shrimp larvae were generally distributed in the present study areas including fish spawning grounds. Therefore, it was apparent that these above species could improve secondary producers in the present study waters' marine food chain. As *Calanus*, *Paracalanus*, *Acartia*, and *Oithona* were the important prey of fish larvae and planktivores, they were significant links in marine food webs and provided to sustain commercial fish stocks (Turner,2004). *Tintinnopsis, Globige rina, Paracalanus*,*Oithona, Microsetella, Euterpina* and *Acetes* were the main food items for *Sardinella* spp. and *Rastrelliger* spp. (Nyo Nyo Tun, 2013 and Lett Wai Nwe, 2014).

Among copepods, *Acratia*, *Paracalanus, Acrocalanus,* and *Oithona* were extensively distributed during several environmental parameters at almost all stations in the present study area. Likewise, Vineetha *et al*. (2015) observed that *Acratia*, *Paracalanus* and *Oithona* were very common in different hydrological parameters. The present results proved the physicochemical parameters of seawater affecting the abundance of zooplankton. Zooplankton abundance correlated negatively with temperature, salinity and dissolved oxygen. Similarly, Puelles (2019) stated that zooplankton abundance showed a negative correlation with dissolved oxygen concentration. Salinity was the major factor determining the variability of zooplankton abundance while the temperature was the minor factor (Sribyatta, 1996).

In the present observation, zooplankton abundance and diversity were very high in neritic areas including fishing grounds. Zooplankton abundance and diversity played an essential role in the bio-productivity potential of inshore and offshore waters. Different zooplankton as the significant prey could provide fish larvae to sustain fishery stocks in the study waters. It was apparent that the zooplankton community could indicate to assess the status of fisheries resources in the present waters. Jivaluk (1999) recognized that the highest abundance of zooplankton coincided with denser concentrations of fish larvae and the catch of pelagic fish (anchovies and sardines) and demersal fish were high to correspond with the peaks of zooplankton.

Conclusions

Qualitative and quantitative zooplankton studies were conducted to determine the composition, abundance, distribution, diversity, and dissimilarity coefficient values of zooplankton communities in the waters off Tanintharyi Region. Copepods were usually the dominant members of the zooplankton and the main food prey for fish larvae. Zooplankton abundance was increased in the first fishing ground (around Launglong – Bok, Moscos and Maungmagan Islands) and the third one (near Thamihla, Anyin-pho-Anyin-ma, and Kawdwe Islands). As zooplankton abundance changes depend on the physical parameters of seawater, higher zooplankton abundance occurred in the nearshore stations coinciding with low salinity. The overall result mentioned that Shannon diversity values were high in the present study waters. It was an essential point to assess the water fertility of the present study area. As the most extraordinary zooplankton diversity provided the water productivity plentifully, the present study waters could be assessed as high productive area.

Acknowledgments

We are grateful to Dr. Ni Ni Oo, Rector, and Dr. Win Win Than, Pro-rector of Myeik University, for their support in preparing this work. **We appreciate the EAF-Nansen Programme, Norad, IMR, BOBLME, FAO, and DoF- Myanmar for giving the research opportunities.** We would like to express our gratitude to Kathrine Michalsen, Stamatina Isari, Jens-Otto Krakstad, Institute of Marine Research, Bergen, Norway and Dr. Tun Thein, DoF-Myanmar. We would like to gratefulness our colleagues for their cooperation.

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