Biodiversity of zooplankton at some mangrove habitats at Jazan coastal areas

AbdAllah, A.T.*, Ghazwani, A.A. and AlFifi, M.H.

Biology Department, Faculty of Science, Jazan University
*abd_allaht@hotmail.com

Abstract: Distribution of zooplankton is a worthy subject as they are the main source of food for fish. The present work dealt with identification and distribution of zooplankton at mangrove habitats. Almarjan coast mangrove and mangrove near waste station were compared for biodiversity of zooplankton. Water criteria; pH, salinity, surface water temperature, dissolved oxygen and conductivity were compared at both studied areas. Regression analysis between water criteria and zooplankton abundance was examined. Nematoda, Ciliates, Calanoid copepods and *Nauplius* larva were detected at both investigated areas. Species richness were 7 at mangrove near waste station and 8 at Almarjan mangrove. Abundance of zooplankton were higher at Almarjan coast than mangrove near waste station. Data was discussed to highlight the effect of water criteria on zooplankton distribution.
[AbdAllah, A.T., Ghazwani, A.A. and AlFifi, M.H. **Biodiversity of zooplankton at some mangrove habitats at Jazan coastal areas.** *Life Sci J* 2018;15(10):61-65]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 7. doi:10.7537/marslsj151018.07.

Keywords: zooplankton, mangrove, species richness, abundance, water criteria

1. Introduction

Zooplankton play an important ecological role in the marine ecosystem. They are primary food source for fish, crustacean and molluscan animals (Mahdy, et al., 2005, Lee and Stokes, 2006, Abd Allah, 2017). They live at depths up to 350 meter below water surface (Castro and Huber, 2012 and Lee and Stock, 2006). They are characterized by doing dual vertical migration; upward at daylight to follow their preys; the phytoplankton and downward by night being hide from predators (Castro and Huber, 2012).

They live at neritic zone and at epipelagic zone. The marine plankton is further classified as "oceanic plankton" (plankters inhabiting water beyond continental shelves), "neritic plankton" (plankters inhabiting water over lying continental shelves) and "brackish-water plankton" (plankters inhabiting brackish-water areas such as estuaries and mangrove). According to the duration of planktonic life, the zooplankton is classified into two groups holoplanktons and meroplanktons. The permanent members of animal plankton (zooplankton) are called holoplankton. Meroplanktons are temporary members of the zooplankton. They are organisms that live as plankton for only part of their life cycle. Meroplanktons constitute the planktonic larvae of animals from different types of habitats: rocky shores, subtidal communities including kelp beds, and coral reefs, estuaries, and the deep ocean floor. They feed on yolk sacs retained from the eggs that hatched from other plankton. These larvae differ completely from adult stages at their mode of living as adults either live on the bottom or swim as nektons (Nybakken, 1997).

Calanoid and Euphausiid zooplankton are the most important zooplankton in the red sea (Obuid Allah, et al., 2005). Some zooplankton live at 400m depth at areas of low oxygen concentrations (Abdul Azis, et al., 2003). Little work was made about identification of zooplankton and in Jazan. Bakhsh (1994) studied zooplankton as food source for bream fish in Jazan. Farasan report stated the presence of copepod as zooplankton in surface seawater (Farasan report, 2000 and Abu-Zinada, 2001).

The aim of work was to establish a database about zooplankton species inhabiting mangrove at Jazan coastal areas and to define factors that affect the distribution of zooplankton at mangrove habitats at Almarjan coast and near the waste station. The relationship between water quality parameters and density of marine zooplanktons will be determined.

2. Materials and methods

Study site

Almarjan coast and mangrove near waste station were the studied sites (E42˚33′ N16˚90).

Sampling

Zooplankton were collected on monthly basis for three months from the mangrove sites during the period October-December, 2017. Plankton net 353µ (Forestry Supplies) was used for this purpose. Identification of Zooplanktons were according to Bradford-Grieve, et al. (1983), Heron and Bradford-Grieve (1995), Lee and Stocks (2006) and Hickman *et al.* (2011).

Determination of water criteria

Water criteria such as: pH, salinity, turbidity, conductivity, water temperature were measured at the studied sites at the onset of sample collection.

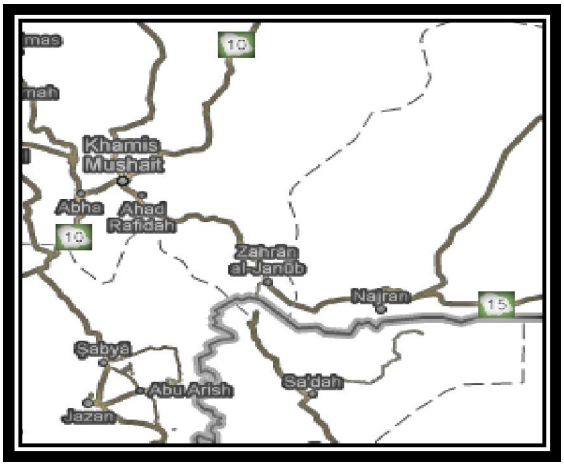

Fig (1) Map showing study areas.

Species richness

Species richness, population density were calculated for collected zooplankton species at studied sites according to Tomisto (2010) and Abd Allah, et al. (2018).

Population density and Relative abundance

Zooplankton were identified by examining collected water samples by Zeiss Research Microscope. For each plankton group, number of individuals at 1ml water sample determines the population density. Ratio of population density of each planktonic group to total densities of all examined groups was the calculated relative abundance.

Statistical Analysis

The effect of water quality changes on the distribution and population density of marine invertebrates was examined through statistical analysis including regression analysis and factorial analysis of variances Using SPSS software program.

3. Results

Identification of Zooplankton

Ciliates, Nematode, Calanoid copepod, *Nauplius* larvae and Gnathostomulida were identified at both study areas. Insect larvae and Cercaria of Platyhelminthes were detected at mangrove near waste station. Rotifera, *Planaria*, trochophore larvae were identified at Almarjan coast mangrove habitat.

Water criteria

pH, Surface water temperature and salinity were non significantly (P>0.05) higher at mangrove habitat of Almarjan coast. Dissolved oxygen and conductivity recorded non significant higher values at mangrove near waste station.

Table (1) Measured physical and chemical water criteria (means± standard deviation) at mangrove near waste station and Almarjan mangrove

	Waste station	Almarjan coast
Surface water temperature (C)	29.47±2.37	31.8±2.6
pH	7.24±0.15	7.48±0.04
Dissolved oxygen	16.8±1.39	14.8±1.45
Salinity	38± 1	38.67±1.53
Conductivity	65.2±0.66	64.07±2.63

Zooplankton abundance

Results of population density study of zooplankton at intertidal zone of mangrove near waste station (Table 2 and Fig 2) showed highest abundance of nematodes. Lowest population density value was recorded for insect larva. Also, recorded zooplankton were identified based on life duration into holoplankton and meroplankton. Of the identified zooplankton 4 groups were holoplankton and only three groups were meroplankton (Table 2).

Table (2) Mean abundance of zooplankton at intertidal zone of mangrove near waste station

Species	Abundance mean±SD	Relative abundance (%)	Taxonomic group	Zooplankton group
Ciliates	83.33±15.27 (9.93)	19.68	Protozoa	Holoplankton
Nematodes	96.67±10.17 (5.396)	22.83	Nematoda	Holoplankton
Calanoid Copepods	66.67±15.27 (6.65)	15.75	Crustacea	Holoplankton
Nauplius larva	56.67±25.17 (4.16)	13.39	Crustacea	Meroplankton
Insect larvae	26.67±15.27	6.3	Arthropoda	Meroplankton
Cercaria	30±8.16	7.09	Platyhelminthes	Meroplankton
Gnathostomulida	63.33±15.27 (10.73)	14.96	Gnathostomulida	Holoplankton
Total	423.34			

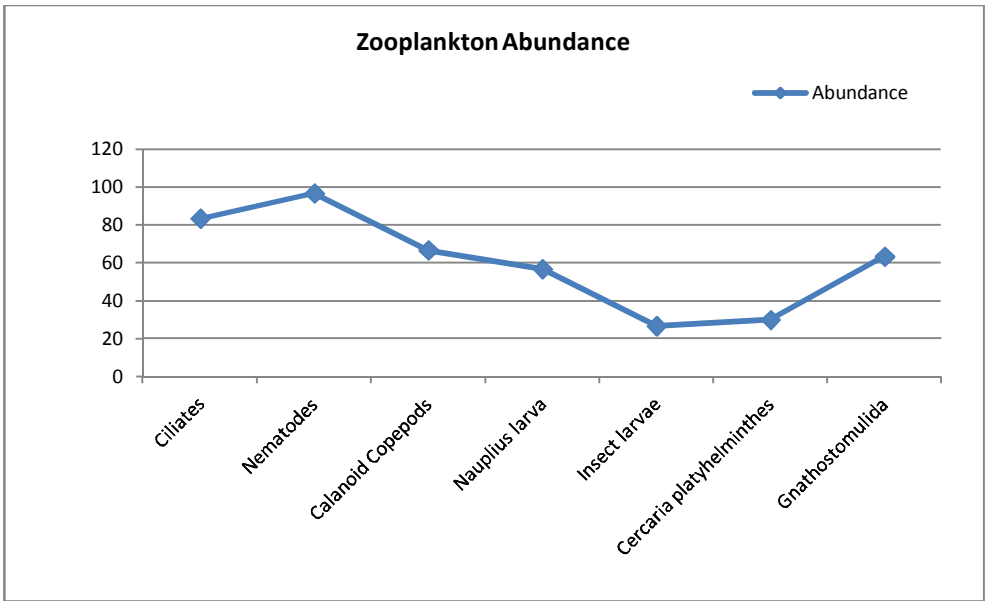

Fig (2) Population density of zooplankton inhabiting mangrove near waste station

Results of population density study of zooplankton at intertidal zone of mangrove at Almarjan coast (Table 3 and Fig 3) showed highest abundane of ciliates. Lowest population density value was recorded for Trochophore larva. Based on zooplankton classification according to the duration of life most of identified zooplankton (6 groups) were holoplankton that spend all life time as zooplankton. While only two zooplankton groups are meroplankton which spend only part of their life span as zooplankton.

Tukey's test of comparison of means for population density of zooplankton at mangrove habitat at Almarjan coast and that near waste station demonstrated significant higher ($P<0.01$) abundance of ciliates or nematodes at Almarjan coast mangrove and higher significant abundance ($P<0.05$) of calanoid copepods, nauplius larvae and Gnathostomulida at mangrove near waste station.

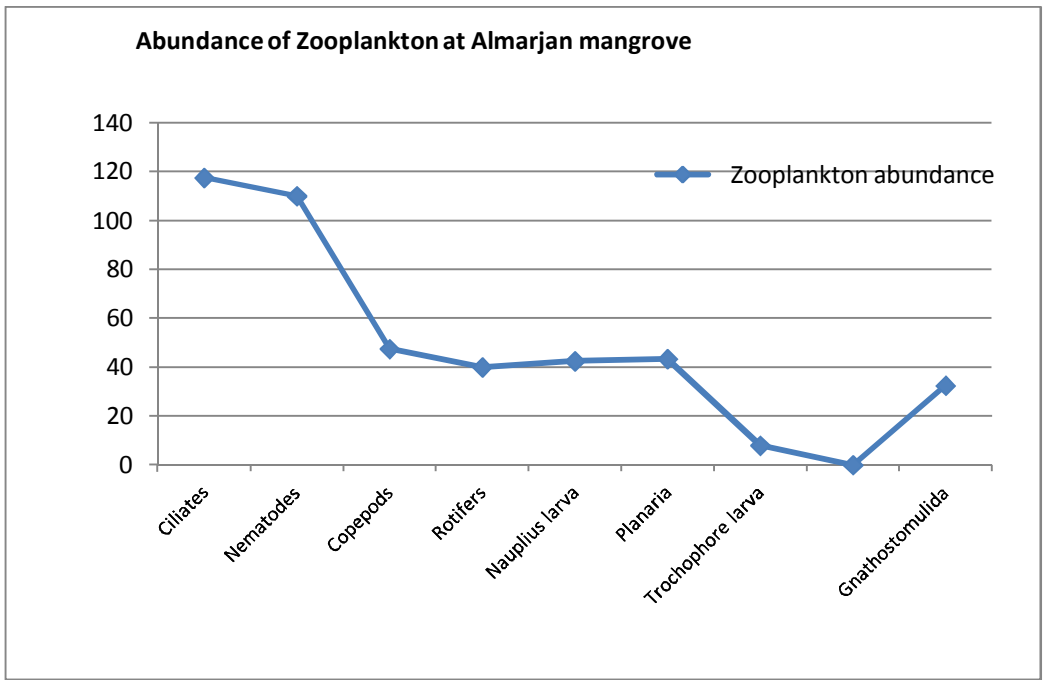

Fig (3) Population density of zooplankton (ind./ml) inhabiting mangrove at Almarjan coast.

Table (3) Mean abundance of zooplankton at intertidal zone of mangrove habitat at Almarjan coastal zone

Species	Abundance mean±SD	Relative abundance (%)	Taxonomic group	Zooplankton group
Ciliates	117.5±20.16	26.62	Protozoa	Holoplankton
Nematodes	110±8.16	24.92	Nematoda	Holoplankton
Copepods	47.5±9.57	10.76	Crustacea	Holoplankton
Rotifers	40±8.16	9.06	Rotifera	Holoplankton
Nauplius larva	42.5±9.57	9.63	Crustacea	Meroplankton
Planaria	43.36±6.433	9.82	Platyhelminthes	Holoplankton
Trochophore larva	8± 2.16	1.81	Annelida	Meroplankton
Gnathostomulida	32.5±9.57	7.36	Gnathostomulida	Holoplankton
Total	441.365			

Relative abundance

Based on relative abundance data (Table 2); zooplankton at mangrove near waste station were in the following order: Nematodes> Ciliates> Calanoid copepods> Gnathostomulida> Nauplius larva> Cercaria of Platyhelminthes> Insect larvae.

Relative abundance data also showed that zooplankton inhabiting mangrove at Almarjan coast (Table 3) can be arranged as follows: Ciliates> Nematodes> Copepodes> Planaria> Nauplius larvae>Rotifers> Gnathostomulida> Trochophore larva.

Species richness

Species richness was 8 at Almarjan coast mangrove and 7 at mangrove habitat near waste station.

Relationship between water criteria and zooplankton abundance

Regression analysis showed significant effect (r^2=0.757, P<0.05) of conductivity on calanoid copepod. Dissolved oxygen had significant effect (r^2= 0.833, P<0.03) on Gnathostomulida.

4. Discussion

According to the duration of planktonic life, the zooplankton is classified into two groups holoplankton and meroplankton. Calanoid and Euphausiid zooplankton are the most important zooplankton in the red sea (ObuidAllah, et al., 2005, AbdAllah, 2017 and AbdAllah, et al., 2018). Farasan report (Abou-Zinada, 2001) stated the presence of ciliates, nematode and copepod as dominant zooplankton in the surface seawater. The present studies agree with this study and showed the presence of copepod as a holoplankton at the intertidal zone of mangrove habitat At both studied area. Nematodes were the most abundant metazoan zooplankton at mangrove habitat near waste and at Almarjan coast. The results are in agreement with Rombouts, et al. (2013) who found that the nematodes were the most abundant zooplankton.

Few works referred to zooplankton in Jazan (Abou-Zinada, 2001). Zooplankton play an essential role in the food chain at marine ecosystem. They feed on phytoplankton and gain high energy input. Some zooplanktons are carnivorous. They feed on other zooplankton. Animals at higher trophic levels that feed on those zooplankton acquire the necessary energy amount required to perform vital activities (Lee and Stokes, 2006). Biodiversity of zooplankton and the increase in their population densities is indicator of good and healthy marine ecosystem (AbdAllah, 2017). The presence of inorganic or organic pollutants may resulted in the absence of certain species or decrease of population density of existent species (Mahdy, 2005 and ObuidAllah, et al., 2005). This is in accordance with the present study where Trochophore larva and Rotifers disappeared from zooplankton collected from mangrove habitat near waste station that might be affected by the increase of organic contaminants.

Bakhsh (1994) studied the biology of thread bream *Nemipterus japonicus* at Farsan Islands and Jazan seawater and found that the food content of that fish contains copepods and amphipod in food content of the thread bream.

Further studies are needed to study biotic and abiotic factors that affect population density of zooplanktons in different Jazan coastal habitats.

5. Acknowledgement

The authors are indebted to The Dean of Scientific Research, Jazan University for funding this work among 5th future scientist program.

Corresponding author:
AbdAllah, A.T.
Biology Department, Faculty of Science, Jazan University, Jazan, KSA.

References

1. AbdAllah, A.T. (2017) Efficiency of invertebrate animals for risk assessment and biomonitoring of

hazardous contaminants in aquatic ecosystem, A review and status report. J. Environment Risk Assessment and Remediation. 1(1):13-18.
2. AbdAllah, A.T., Marawy, S.G. and Hakawy, A. (2017) Spatial distribution of meiobenthos inhabiting the sandy shore and mangrove habitat of Jazan coast, Red Sea. Journal of Jazan University. In press.
3. Abd Allah, A.T., Sumaili, I.A., Gathmy, M.Y. and Awaf, B.A. (2018) Spatial distribution of marine invertebrates as bioindicator of water quality at intertidal zone of sandy shore habitat. Life Sci J;15(1):51-55.
4. Abdul Azis, P. K., Al- Tisan, I. A., Daili, M.A., Green, T.N., Dalvi, A. G. I. and Javeed, M. A. (2003) Chlorophyll and plankton of the gulf coastal waters of Saudi Arabia bordering a desalination plant. Desalination, 154; 291-302.
5. Abuzinada, A.H. (2001) First Saudi Arabian National Report on the Convention on Biological Diversity. The National Commission for Wildlife Conservation and Development.
6. Bakhsh, A.A. (1994) The biology of thread bream *Nemipterus japonicas* (Bloch) from the Jizan region of the Red Sea. J.KAU. Mar. Sci, 7:179-189.
7. Bradford-Grieve, j. M.; Haakonsen, L. and Jillett, J. B. (1983) The marine fauna of New Zealand: pelagic calanoid copepods: Families Euchaetidae, Phaemidae, Scolecithricidae, Diaixidae and Tharybidae. Memoirs. N. Z. Oceanographic Institute 90: 1-150.
8. Castro, P. and Huber, M. (2012) Marine Biology. Ninth Edition. McGraw Hill publishers.
9. Farasan islands protected area master management plan (2000) National Commission for Wildlife Conservation and Development, Riyadh, 11575.
10. Jost, L. (2006) Entropy and diversity. *Oikos*, 113, 363–375.
11. Heron, G. A. and Bradford-Grieve, J. M. (1995) The marine fauna of New Zealand: Pelagic Copepoda: Poecilostomatoida: Oncaeidae. Memoirs. N. Z. Oceanographic Institute 104:1-57.
12. Hickman, C.P., Roberts, L.S., Keen, S.L., Larson, A., l'Anson, H. and Eisenhour, D.J. (2011) Integrated Principles of Zoology.15th edition. Mc-Graw Hills Higher Education Publishers. Boston, Madrid.
13. Lee, G. and Stokes,J. (2006) Marine Science. An illustrated guide to Science. Chelsea House publishers.
14. Mahdy, A.A. (2005) Taxonomical and Ecological Studies on Marine Zooplankton of the Red Sea, Egypt. Msc. Thesis, AlAzhar University, Assiut, Egypt.
15. Nybakken, J. W. (1997) Marine Biology an Ecological Approach. Addison-Wesley Educational Publishers Inc., 4th Ed. 481 pp.
16. ObuidAllah, A.H., AbdAllah, A.T., Abu-Eldahab, H.M., Abdul-Rahman, N.S. and Mahdy, A.A. (2005) Impact of heavy metal contamination on seasonal abundance of planktonic copepods inhabiting mangrove area in Safaga, Red Sea, Egypt. Egyptian Journal of Experimental Biology (zool.), 1: 57-66.
17. Rombouts, I., Beaugrand, G., Artigas, L.F., Dauvin, J. C., Gevaert, F, Goberville, E., Kopp, D., Lefebvre, S., Luczak. C., Spilmont, N., Travers-Trolet, M., Villanueva, M.C., Kirby, R.R. (2013) Evaluating marine ecosystem health: Case studies of indicators using direct observations and modelling methods. Ecological indicators. 353-365.
18. Tuomisto, H. (2010) A diversity of beta diversities: straightening up a concept gone awry. Part 1. Defining beta diversity as a function of alpha and gamma diversity. *Ecography*, 33, 2-22.

10/21/2018