DIVERSITY OF MACRO-INVERTEBRATES IN THONDAMANARU LAGOON

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ABSTRACT: *Macro-invertebrates are considered as effective bio indicator of the aquatic ecosystem. Aim of this study is to documenting the diversity and abundance of macro-invertebrates of Thondamanaru lagoon. Sampling was done fortnightly basis from November 2021 to October 2022 from selected 3 sampling sites in Thondamanaru lagoon (S1- beyond the barrage, in front of Field Work Center; S2- near to the barrage and front of Selva Sannathi Kovil and S3- near to sand bar). Samples were collected from each site by using hand net and scoop. A total of 1222 individuals from 7 arthropod families and 15 mollusc families were identified. Based on their morphological characters, 31 taxa were identified by using standard keys. Among all recorded taxa, Gastropods Cerithidea cingulata (24% - 38%) and Clithon oulalensis (31% - 46%) were the most abundant in all the selected sites in Thondamanaru lagoon from family Potamididae and Neritidae, respectively. Macrobrachium sp. (site S1), Penaeus indicus and Penaeus monodon (site S2) were least abundant (1 %). Occurrence of identified taxa at site S3, Libinia emarginata, Oratosquilla oratoria, Murex trapa, Cernuella virgata and Olivancillaria gibbosa were recorded as the least abundant species (≤ 1%). Species richness and Simpson Index were showed significant difference (p <0.05) among three sites. According to the Shannon Weiner (H) and Simpson (D) Indices, the highest species diversity was observed in Site 3 (H- 1.9018, D- 0.2072) followed by Site 2 (H- 1.1434, D- 0.3683) and Site 1 (H-1.3995, D- 0.2805). The highest abundance of macro-invertebrates was recorded in Site 2 (478) followed by Site 3(466) and Site 1 (278). These results revealed that barrage construction across the Thondamanaru lagoon impact on macro-invertebrate diversity. It is very helpful for the conservation of biodiversity of this lagoon.*

Keywords: Abundance, Barrage, Diversity indices, Macro-invertebrates

1. INTRODUCTION

Sri Lanka is an island surrounded by Indian Ocean. There are around 40 lagoons along Sri Lankan coast line. Thodamanaru lagoon is one of three lagoons in Jaffna, Northern part of Sri Lanka and it separates the Vadamarachchy area from Valikamam and Thenmarachchy area. The lagoon's water is brackish to saline. Barrage with sluice gate, sand bar and bridges are three existing structures, where the barrage was constructed in 1953 across the lagoon at a point about quarter mile from the mouth of the lagoon, it prevents free flow of the sea water. Sand bar is the opening of the lagoon to the Indian Ocean. During the dry season, mouth of the sand bar close and open periodically. When it closes, the lagoon water body change to closed system (Chitravadivelu, 1978; Piratheepa *et al*., 2016).

Macrofauna especially Macro-invertebrates are very important biotic communities. Most of them are aquatic invertebrate animals that can be seen with naked eye. (Gooderham and Tsyrlin, 2002) There are diverse group of animal categories under Phylum Porifera, Coelenterate, Platyhelminthes, Nematodes, Mollusca, Annelids, Arthropods and Echinodermata. Macro-invertebrates are known to be useful bio indicators to determine the healthy status of the aquatic ecosystems and they play a significant role in economic and ecologic of the country. The present study was carried out to investigate the macro-invertebrate diversity of Thodamanaru lagoon.

2. METHODOLOGY

1.1 Study area

The Jaffna peninsula is located at the northern part of the Sri Lanka. It lies within dry zone without any rivers. Much of the part covered by Jaffna estuary, Upparu lagoon and Thondamanaru lagoon. Its geographical coordinates are 80˚08' E-80˚29' E longitudes and 9˚ 34' N- 9˚ 49' N latitudes (Chitravadivelu,1978) (Sachithananthan,1970). The area of the Thondamanaru lagoon origin from the mouth, connecting the lagoon with marine environment directly into the Indian Ocean and the mouth is naturally closed and opens time to time according to the tidal wave's action. The Barrage is a man-made barrier which was constructed in less than a kilometer from the sea mouth (Piratheepa et al., 2016). Three sampling sites were selected in Thondamanaru lagoon.

Table 1. Description of the Selected Sampling Sites in Thondamanaru Lagoon

Sampling site	Description	GPS location
Site 1	Beyond the barrage- Infront of the Field Work Center	Latitude 9.812792 (N) Longitude 80.128874 (E)
Site 2	Near to the barrage and front of Selva Sannathi kovil	Latitude 9.812405 (N) Longitude 80.131116 (E)
Site 3	Near to the sand bar which is directly open to the Indian Ocean.	Latitude 9.820413 (N) Longitude 80.134641(E)

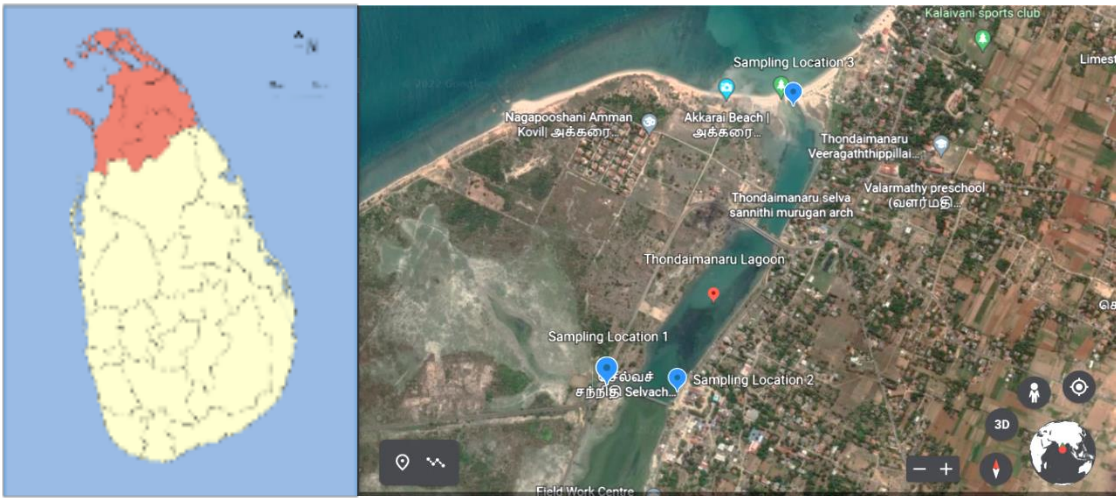


Figure 1. Geographical Location of Thondamanaru Lagoon and Sampling location
(Source: Google Earth)

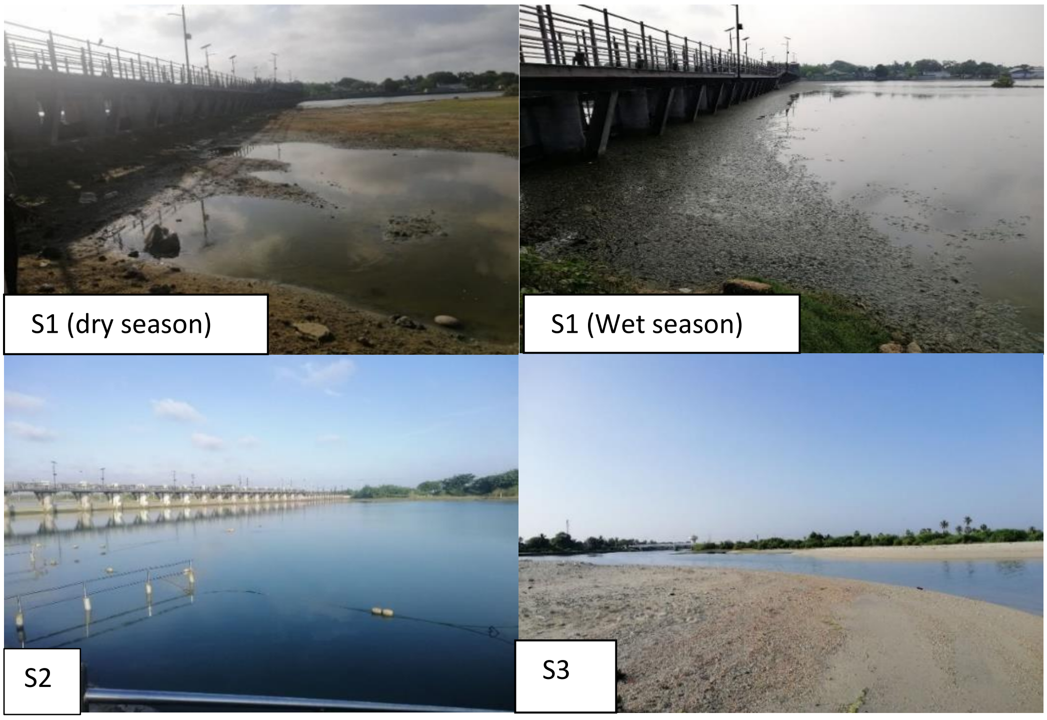


Figure 2. Thondamanaru Lagoon and Selected Sampling Sites (S1, S2 and S3)

1.2 Sampling

Sampling was done fortnightly basis from November 2021 to October 2022 in early morning 6.45 a.m-8.30 a.m. from three sampling sites (S1, S2 and S3).

Mud samples were collected from each sampling sites with the help of scoop by using Quadrat method randomly (50cm×50cm). Abundance of Macro- invertebrate were recorded. Collected mud samples were dissolved by water samples of respective sampling sites. The dissolved mud samples were sieved by using series of mesh size sieve set. The mesh sizes are 4000 microns, 2000 microns, 500 microns, 250 microns, 125 microns, and 63 microns from top to bottom, respectively.

The macro-invertebrates were sorted as dead and alive states. The dead shells were washed properly by the respective water samples collected from Thondamanaru sampling sites; then soaked them in 70% ethanol for 20 minutes to clean the macro-invertebrates. The alive macro-invertebrates were allowed to die and the dead bodies were removed from the organisms (shells) using forceps and cleaned them by using water samples from sampling sites and then placed them in 70% ethanol. Then all the cleaned organisms were dried fully under the sun light for 24 hours (Vithusha et al., 2021).

1.3 Identification of macro-invertebrate

The macro-invertebrates were identified by using standard keys and literatures based on the morphological features (Carpenter and Niem, 1998; Chitravadivelu, 1993; De Bruin et al., 1995; Fernando, 1977; Malik Fernando, 2009; Fernando and Olivia 2002).

1.4 Data analysis

Data was analyzed in qualitative and quantitative manner. Biodiversity can be quantified by using diversity Indices which were used to estimate the species abundance, species richness their evenness in each selected sampling site. Shannon – Weiner species diversity Index, Simpson's diversity Index and the collected data were computerized to perform One-way ANOVA to determine the significance difference among sampling sites.

Shannon Weiner Diversity Index (H');

$$H' = -\sum_{i=1}^{S} Pi\ lnPi$$

Where, ni = Number of individuals of ith species,
N = Total number of individuals,
Pi = Importance probability for each species.

Shannon evenness (EH); EH = H/ln(S)
Where, H = Shannon–Weiner diversity Index
ln S is natural log of the total number of species recorded.
Simpson's Index was calculated by using following equation:

$$D = \frac{\sum ni(ni-1)}{N(N-1)}$$

Where, ni= the total number of organisms of a particular species
N= the total number of organisms of all species
D= Simpson's Index
ED = Equitability (Evenness) ED =D/S
S is the number of species in the community

3. DISCUSSION AND RESULTS

During the study period, 1222 individuals of macro-invertebrates belonging to 22 families were identified. Among them 7 families belongs to Phylum Arthropoda and 15 families belongs to Phylum Mollusca. 8 Taxa and 1 taxa were identified belong to Class Malacostraca and Class Maxillopoda respectively. 16 Taxa and 6 Taxa were reported belong to Class Gastropoda and Class Bivalvia respectively. Class Gastropoda was the most abundant especially *Clithon oulalensis, Cerithidea cingulata.*

Penaeus indicus

Penaeus monodon

Macrobrachium sp

Ocypode platytarsus

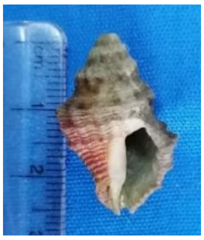
Uca annulipes

Varuna litterata

Libinia emarginata

Oratosquilla oratoria

Balanus amphitrite amphitrite



Morula sp.

Cernuella virgata

Trochus radiatus

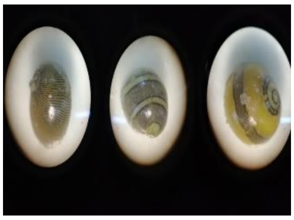
Territella sp.

Cerithidea cingulata

Olivancillaria gibbosa

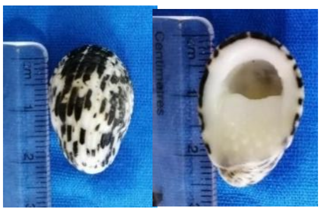
Murex trapa

Planaxis sp.

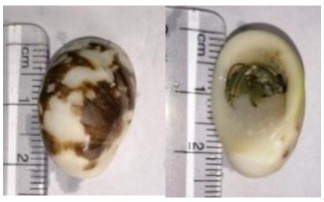


Clithon oulalensis ×40

Cypraea moneta



Nerita albicilla



Nerita polita

Nerita chamaeleon

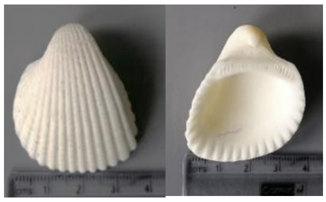
Tonna dolium

Lissachatina fulica

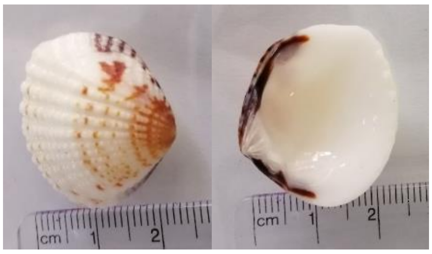
Terebralia palustris

Meretrix meretrix

Maretrix casta



Anandara rhombea



Gafrarium pectinatum

Donax cuniatus

Crassostrea madrasensis

Figure 3. Macro-invertebrate Diversity in Thondamanaru Lagoon

Table 2. Diversity Parameters of Macro-Invertebrates in Thondamanaru Lagoon

Indices		Sampling		
		Site 1	Site 2	Site 3
Simpson's Index	Diversity Value (D)	0.2805	0.3683	0.2072
	Evenness (E_D)	0.0467	0.046	0.0082
Shannon Index	Diversity Value(H)	1.3995	1.1434	1.9018
	Evenness (E_H)	0.7811	0.5498	0.5908
Species richness(S)		6	8	25
Number of individuals		278	478	466

Species composition and quantitative characters of macro-invertebrates have been assessed by using Shannon diversity Index (H') and Simpson diversity Index. Species richness and abundance were lowest in Site 1, but Species richness highest in Site 3(25) and abundance highest in Site 2 (478) (Table 2). According to (Mason,2002), if Shannon-weaver Index value is between 1 to 3 the water body is moderately polluted, less than one for highly polluted. In this case, all three sites were moderately polluted (Ulfah *et al.*, 2019) mentioned the diversity Index criteria are as follows: H' ≤ 1 =low diversity 1< H' ≤ 3 = high diversity. According to his statement, Thondamanaru lagoon shows moderate macro-invertebrate diversity. Simpson

Index range is from 0 to 1, where: high score indicates low diversity and low score indicates high diversity. In our analysis, site 3 showed high diversity than site S1 and S2. Statistically, species richness and Simpson Index were showed significant difference ($p < 0.05$) among three sites.

Among all recorded taxa, gastropods *Cerithidea cingulata* (24% - 38%) and *Clithon oulalensis* (31% - 46%) were the most abundant in all selected sites in Thondamanaru lagoon from family Potamididae and Neritidae respectively. *Macrobrachium* sp. (site S1), *Penaeus indicus* and Penaeus *monodon* (site S2) were least abundant (1 %). Occurrence of identified taxa at site S3, *Libinia emarginata, Oratosquilla oratoria,, Murex trapa, Cernuella virgate* and *Olivancillaria gibbosa* were recorded as the least abundant species (≤ 1%)(Figure 4-6).

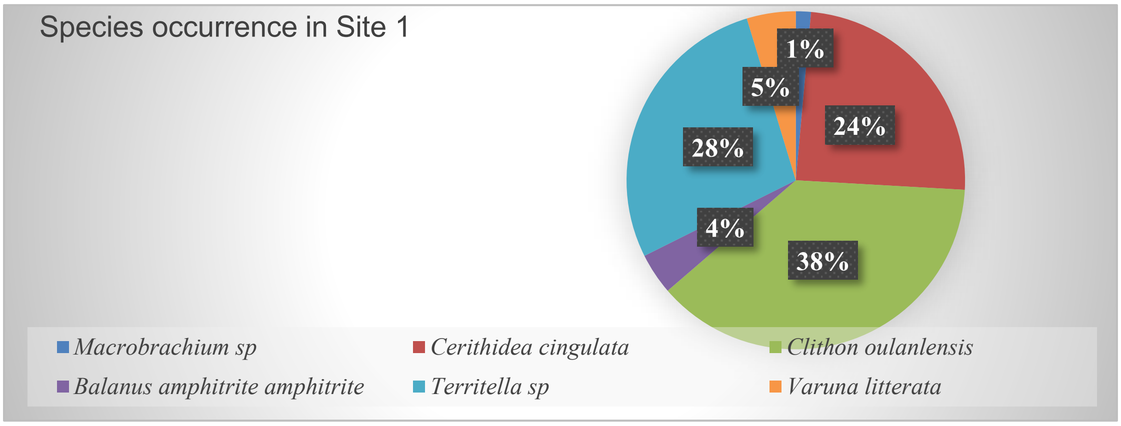


Figure 4. Percentage of Species occurrence in Site 1

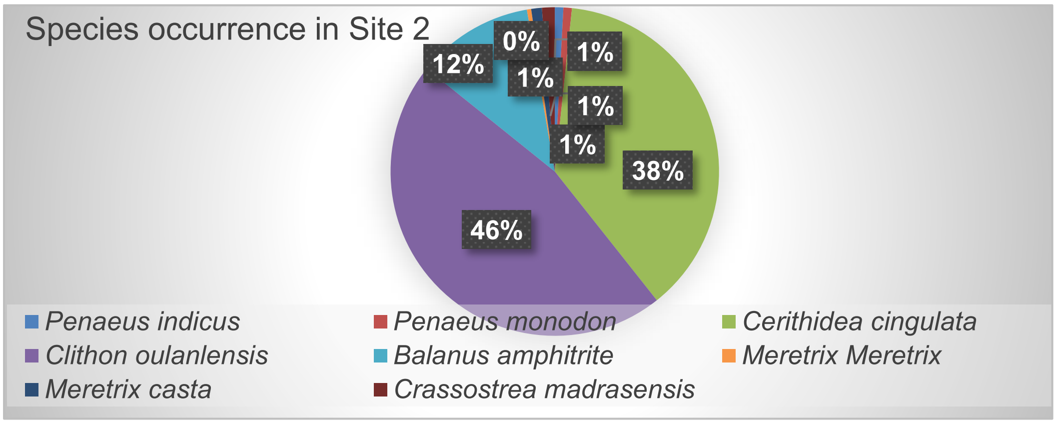


Figure 5. Percentage of Species Occurrence in Site 2

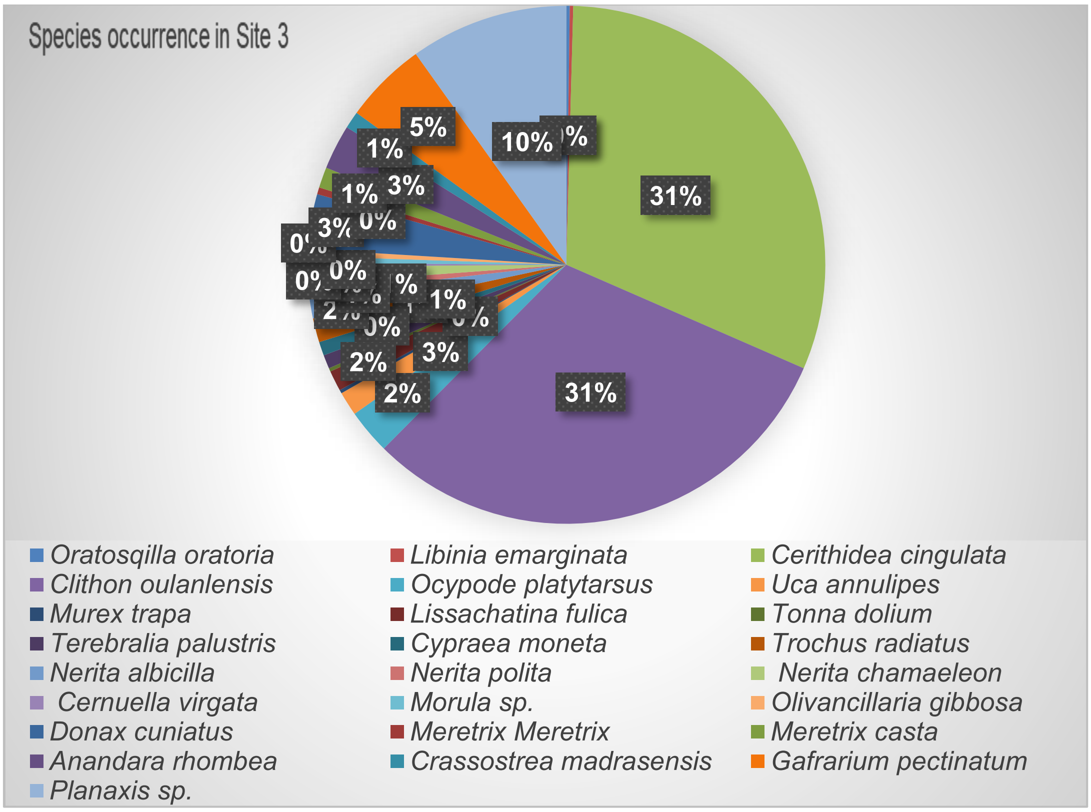


Figure 6. Species Occurrence in Site 3

4. CONCLUSION

In this present study, Diversity and abundance of macro-invertebrate were recorded from selected 3 sites of Thondamanaru lagoon. 31 Taxa were identified including 4 taxa up to genus level and 27 taxa up to species level by using standard keys and literatures based on the morphological features. Among Class Malacostraca, Class Maxillopoda, Class Gastropoda and Class Bivalvia were classified. According to the diversity indices Thondamanaru lagoon, water was moderately polluted and having moderate biodiversity. Following reasons for environmental stressors to biodiversity such as; Introduction invasive species, man-made barrage construction, mangrove degradation, road construction around the part of lagoon, human activities including solid waste dumping, agriculture, run off during rainy season are contributed to decreasing in the macro-invertebrate richness and diversity.

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