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Root fouling organisms of *Rhizophora mucronata* in Rekawa Lagoon, Sri Lanka

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Abstract: Mangrove underwater roots provide habitats for a variety of root fouling organisms. Since there is a dearth of information locally on the fauna and flora growing on such habitats, a study was carried out to study the biodiversity of mangrove root fouling organisms at the Rekawa lagoon (05° 58' N and 80° 50' E). In this study, a mangrove prop root that is hanging freely into the water from each one of the 20 randomly selected *Rhizophora mucronata* trees was cut to collect the fouling organisms from four different zones, namely, the top most, upper middle, lower middle and near the bottom along the root. The number of solitary countable organisms were recorded per unit surface area (m-2) of each one of the four root zones. The abundance of the non-countable colony-forming organisms were determined using the % volume values following the points (volumetric) method. Abundance data were analyzed non-parametrically using the Kruskal Wallis test. Further, the diversity of organisms in each zone of the root were also calculated. Twenty seven different taxa of fouling organisms including countable taxa such as Isopods, Amphipods, Copepods, Polychaets, Bivalves, Heliozoans, Diatoms, *Oscillatoria* sp., Nematodes, Cryptophyta, Bacillariophyta, Phytoplankton, Foraminfera, Chlorellacea and colony forming non-countable taxa such as Rhodophyta, porifera, *Hydra* sp., Ascidiacea, *Ulothrix* sp., Ciliophora and Chlorophyta were recorded. The median abundance of countable organisms was significantly higher in the upper middle zone (2461 m^{-2}) than that in the bottom zone (1057 m^{-2}). Further, the median diversity of these fouling organisms in the upper middle zone was significantly higher (196 m^{-2}) than that in the bottom layer, which showed the minimum diversity (70.83 m^{-2}). However, the median % volume of non-countable organisms did not differ significantly between different root zones. Variation of the abundance and diversity of countable and non-countable fouling organisms in the Rekawa lagoon could be attributed to the prevailing environmental conditions.

Keywords: fouling organisms, prop roots, Rekawa Lagoon, *Rhizophora mucronata*

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Introduction

Mangroves are well adapted plant communities that grow in inter tidal zone of estuaries and lagoons in tropical in the subtropical areas. They are exposed to hard environmental conditions such as high salinity, low oxygen, strong winds and high sunlight. Buttress roots, flying buttresses, surface roots, prop roots, stilt root, spreading roots, knee roots are the major types of roots presence in mangroves. *Rhizopora muconata* is one of the mangrove species which is consisting prop roots (Srikanth *et al*., 2016). Prop roots from the main stems and the branches grow down into the water below low water level (Alonzo *et al*., 2015). Various aquatic organisms colonize and grow on the surface of those underwater prop roots as fouling communities (Ellison and Farnsworth, 1990). Thus, the root fouling communities indicates the ecological role of mangroves and those communities are important as food for mangrove fishes. Studies on such root fouling communities have been conducted by researches such as Belizean mangrove – root communities (Ellison and Farnsworth, 1990) highlighting the importance of the root fouling communities. However, such studies have not been carried out in Sri Lanka. Specially, being a micro-tidal country, the root fouling community may show differences from the macro-tidal countries, however, new researches need to be undertaken on root fouling communities of Sri Lankan mangroves to discuss this suggestion. All the true mangroves in Rekawa lagoon, in southern Sri Lanka, were selected for this study as it is located nearby and having highest species diversity of true mangroves in the southern Sri Lanka. Therefore, the main objective of the current study was to study the root-fouling communities of *R. mucronanta* growing in a selected Sri Lankan lagoon for filling the above study gap.

Materials and Methods

Rekawa Lagoon (05° 58’ N and 80° 50 E) was selected for the current study. During January 2017, twenty *R. muconata* trees were randomly selected from the Rekawa Lagoon and one random root (freely hanging in to water bottom) from each tree was cut and removed. The root length that had been submerged in water was selected as the “study length” for studying the root fouling communities. The study length of the root was divided to equal 4 zones and the diameter in each zone was measured.

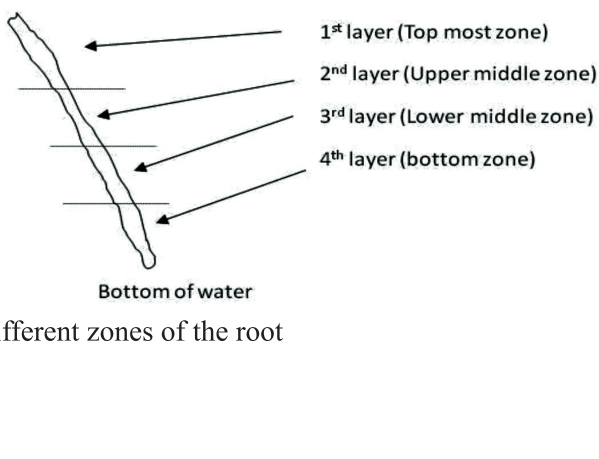

Figure 1: Different zones of the root

Next, all the fouling organisms on each zone were carefully scarped in to separated vials using a sharp knife and they were brought to the laboratory. Using a light microscope, the fouling organisms were identified to the lowest possible taxonomic level. For the countable organisms (who live solitary: for example, isopods, plankton, bivalves, some algae), the abundances of organisms per unit surface area (m^{-2}) of the root were calculated for each root zone. The diversity of roof-fouling organisms for each zone also was calculated using Shannon–Wiener index. The non-countable fouling organisms (who forms colonies: For example, some filamentous Algae, Sponge colonies, Acidian colonies and *Hydra* colonies) were assessed using a simple method adopted from the points (volumetric) method (Hynes, 1950) used in fish gut content analysis. Under this method, at each root zone, each non-countable fouling organism type from that layer were placed on a petri dish as separate lots. Volume of all the lots (Total volume) were visually assigned to 100 points. Next, for each non-countable fouling organism type, its volume was visually compared with the total volume and the volume of the organism type was expressed as a % value out of the total value. Those % volume values were named as "% volume" for each organism types and were compared between the root zones using Kruskal wallis tests.

Data Analysis

Data were summarized in Microsoft Excel and were analyzed using Minitab 16 statistical software. Then they were tested for normality. The data were non-normal even after log and ln transformations. Therefore, the abundance and diversity of the root fouling organisms between the different root zones were compared using separate Kruskal-Wallis tests.

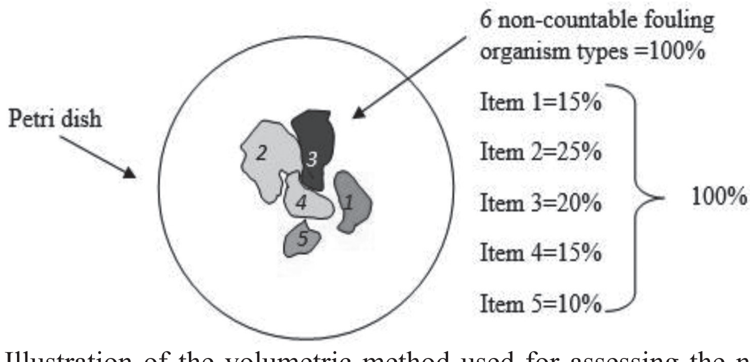

Figure 2: Illustration of the volumetric method used for assessing the non-countable fouling organism types

Results and Discussions

Twenty-seven fouling organism types were identified from all the studied (20) mangrove roots. The identified 16 countable organisms (solitary living animals) are listed in Table 1. Thus it is clear that, the mangrove underwater root surfaces of the Rekawa Lagoon has provided habitats for various fauna types who live solitary. The identified non countable

Table 1: Countable organisms identified

No.	Organism
1	*Asellus* sp. (Subphylum-Crustacea, Order-Isopods)
2	Family – Janiridae (Subphylum-Crustacea, Order-Isopods)
3	Family – Corophiidae (Subphylum-Crustacea, order-Amphipods)
4	Two copepod species (Subphylum-Crustacea, subclass Copepoda)
5	One polychaete species (Phylum-annelida, Class Polychaeta)
6	Young stage of one bivalve species (Class-Bivalvia, Family-Mitilidae)
7	One protists species (Phylum - Sarcodina, Order-Heliozoa)
8	*Melosira* sp. (Bacillariophyta diatom)
9	*Lithodesmium* sp. (Bacillariophyta diatom)
10	*Oscillatoria* sp. (Cyanobacteria)
11	One nematode species
12	Cryptomonas (Phylum - Cryptophyta)
13	*Coscinodiscus radiate* and *Coscinodiscus* sp. (Phylum - Bacillariophyta)
14	Two unidentified phytoplankton species
15	*Discorbis* sp. (Class - Foraminfera)
16	*Chlorella* sp. and *Stigeoclonium* sp. (Family-Chlorellacea)

Table 2: Non-countable organisms identified

No.	Organism
1	*Bostrychia* sp. (Phylum- Rhodophyta)
2	Unidentified sponge (Phylum- porifera)
3	*Hydra* sp. (Phylum-Cnidaria)
4	One species of Calss ascidiacea (Phylum- Chordata)
5	*Ulothrix* sp. (Ulvophyceae)
6	*Wrangelia* sp. (Phylum- Rhodophyta)
7	Ciliate species (Phylum- Ciliophora)
8	Stigeoclonium sp. (Phylum-Chlorophyta)
9	*Cladophora crispata* (Phylum- Clorophyta)

fouling organisms (who form colonies) are listed in Table 2. This indicates that the mangrove underwater root surfaces of the Rekawa Lagoon has provided habitats for both colony-forming and solitary fauna types.

Abundance of countable organisms

As shown in the Figure 3, median abundance of countable organisms (number per m-2 of the root zone) was highest (2461 m^{-2}) in the upper middle zone while the bottom zone (1057 m^{-2}) showed the minimum.

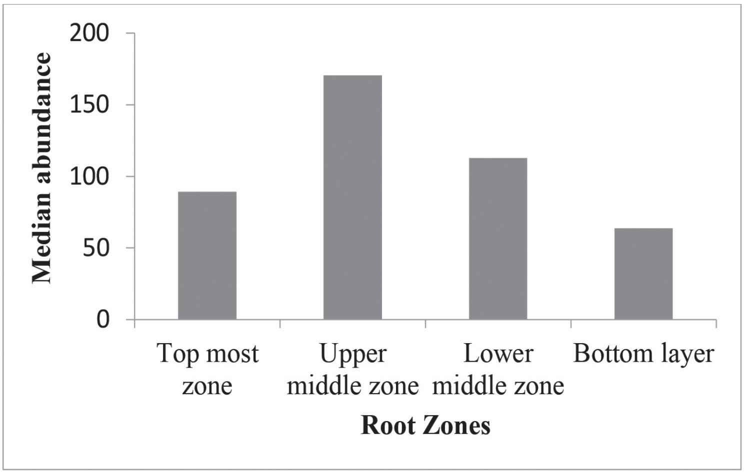

Figure 3: Median abundance of countable Organisms

Diversity of countable organisms (Shannon–Wiener index m^{-2} of the root)

According to Figure 4, upper middle zone showed the highest median diversity (196 m^{-2}) while the bottom layer showed the minimum (70.83 m^{-2}) diversity.

The highest abundance and the highest diversity of organisms in the upper middle zone may have been assisted by relatively calm and clear water prevailing in this middle zone. The lowest abundance and the lowest diversity in the bottom zone could be due to suspending bottom sediments. The low abundances and diversities in the uppermost zone could be due to the reason that the upper most layer is frequently disturbed by surface waves.

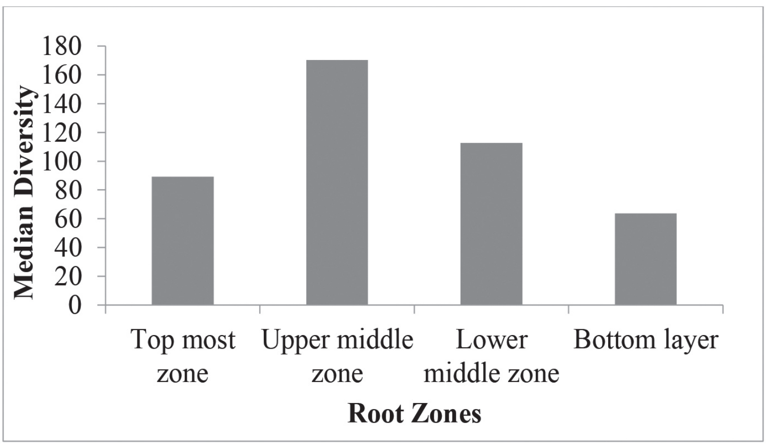

Figure 4: Median diversity of countable Organisms

Table 3: The mean Percent volume of non-countable organisms between the different root

	Bostrychia sp. (Rhodophyta)	Sponge sp. (Porifera)	*Hydra* sp. (Cnidaria)	Calss Ascidiacea (Chordata)	*Wrangelia* sp. (Rhodophyta)	*Ulothrix* sp. (Ulvophyceae)	*Cladophora* sp. (Clorophyta)	Ciliate species sp. (Ciliophora)	*Stigeoclonium* sp. (Chlorophyta)
Top most zone	18	27	3	2	3.25	17.5	11	12.75	5.75
Upper middle zone	18	20.4	0.75	1.1	1.85	30.75	8.25	11.75	6.25
Lower middle zone	32	16.9	1.2	3	2.6	18.7	13.2	9.15	3.1
Bottom zone	34	21.5	0.5	12.5	5.5	19.75	0.75	5.5	0

Percent volume of non-countable organisms (%volume m^{-2} of the root)

Due to unknown reason, the median %volume of non-countable organisms did not differ between the different root zones (Table 3).

Conclusions

The solitary living fouling organisms showed vertical zonation possibly due to physical disturbances such as water turbulence and suspending sediments. However, the colony-forming fouling organisms did not show such vertical patterns. The current research involved limited number of samples due to time limitations and this research should be extended with more replicates for better conclusions.

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