

Ecological Footprints for Aquaculture Possibility in Selected Mangrove Regions of Jaffna, Sri Lanka

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Abstract— The present study was carried out to analyze the possibility of practicing aquaculture in selected mangrove regions in Jaffna, Sri Lanka. A detailed study on the possibility of undertaking aquaculture has been carried out in Sarasalaai and Kapputhu mangrove regions. The water quality parameters were measured, organic matter was estimated and available fish species were collected and identified during the study period. Samples were collected in the second week of each month from June 2016 to November 2016. Water quality parameters such as water temperature, salinity, pH, dissolved oxygen, water depth and turbidity were measured. Organic matter was estimated for soil samples collected from the study areas. Water quality parameters were analyzed by two sample t-test using minitab13. Identification of all collected fish species were confirmed according to the standard literature by observing their morphological and meristic characters. Statistical analysis shows no significant difference between Sarasalaai and Kapputhu in water temperature ($P = 0.062$), salinity ($P = 0.402$), dissolved oxygen ($P = 0.773$), pH ($P = 0.262$) and water depth ($P = 0.798$). Significant difference ($P = 0.001$) was observed for turbidity in both locations. High percentage of organic matter was observed in Sarasalaai. The identified fish species in both locations were *Chanos chanos*, *Platycephalus fuscus*, *Oreochromis mossambicus*, *Nematalosa nasus*, *Hyporhamphus limbatus*, *Hemiramphus marginatus*, *Etroplus maculatus*, *Gerres abbreviatus* and *Gerres oyena*. The most abundant species found in Sarasalaai was *O. mossambicus* and in Kapputhu were *O. mossambicus*, *C. chanos*, *G. abbreviatus* and *G. oyena*. The present investigation inferred that the specified species can be cultured in the said regions. However, a long term study on seed resources, environmental and climatic conditions of particular site would ensure more details on culture aspects of these species.

Keywords— Aquaculture, *C. chanos*, *G. abbreviatus*, Mangrove, *O. mossambicus*

INTRODUCTION

Fisheries in Sri Lanka contributes about 1.3% to the GDP (CBSL, 2016), with fish and fishery products providing about 70% of the animal protein consumed in the country. Aquaculture is still in its infant stage and is limited to coastal shrimp culture and the production of fish seed for stocking; farming of food fish in seasonal tanks and ornamental fish for export are other coastal activities. Mangroves are intertidal forested wetlands confined to the tropical and subtropical regions. In Sri Lanka, mangrove forests are found scattered mainly along the north-western, north-eastern and eastern coasts bordering lagoons and riverine estuaries.

In the present study two locations were chosen because there are intense mangroves in those regions and no studies were performed, yet. The present study was carried out to analyze the possibility of undertaking aquaculture practice in those selected mangrove regions in Jaffna, Sri Lanka.

MATERIALS AND METHODOLOGY

A. Study area

The Sarasalaai mangrove region is located in the longitude of $80^{\circ}10.262'$ and latitude of $09^{\circ}41.147'N$. Kapputhu mangrove region is located in the longitude of $80^{\circ}10.782'E$ and latitude of $09^{\circ}44.017'N$ (Figure 1).

B. Sample collection

Samples were collected in the second week of each month (from June 2016 to November 2016). Water samples and soil samples were collected by using water sampler, and mud sampler, respectively. Random samples of fishes were collected from fishermen once a month.



Figure 1: Sampling locations in Jaffna Peninsula: Sarasalaai (L1) and Kapputhu (L2) (Source: Google Earth)

C. Sample analysis

SmarTROLL handheld multi parameter was dipped into the water and water quality parameters such as water temperature, salinity, pH and dissolved oxygen were recorded. The depth of the water body was measured by meter rod. Turbidity meter was used to measure the turbidity.

The collected mud samples were kept in Hot Air Sterilizer and allowed to dry in $104^{\circ}C$ for 5 hours. The crucible was weighed

using electronic balance. A 5g of dried mud sample was added in the crucible and total (crucible +mud sample) weight was measured. The crucible was incinerated at 600°C for 5 hours in muffle furnace. Then crucible and sample weight was measured, from that weight loss (amount of organic matter) was calculated.

D. Fish species identification

All fish species were brought to laboratory and identification of all collected fish species were confirmed according to the standard literature (Munro, 1995) by observing their morphological and meristic characters.

STATISTICAL ANALYSIS

Water quality parameters were analyzed by two sample t-test using minitab13. Differences were declared statistically significant at $p < 0.05$, where significant differences were detected, the means were separated by the least significant difference (LSD) –Turkey test at 5% probability level.

RESULTS AND DISCUSSION

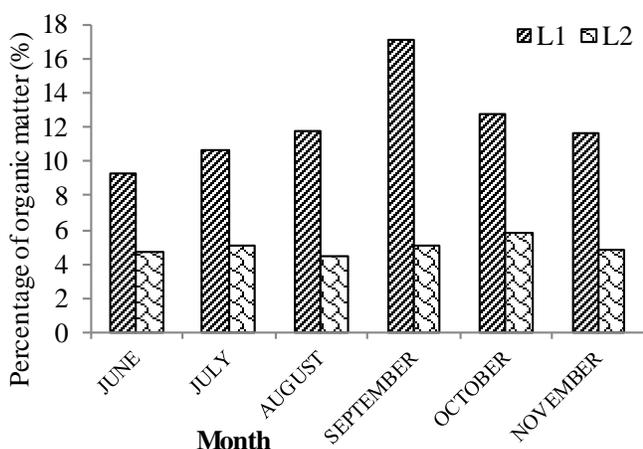


Figure 2: Percentage of organic matter recorded in Sarasaalai (L1) and Kapputhu (L2)

Mangrove forest known to be a place that are highly productive source of an organic matter that give an energy to support variety of estuarine and near shore life (Hasrizal *et al.*, 2009).

High percentage of organic matter was observed in Sarasaalai mangroves (Figure 2) throughout the study period, which might be due to periodic re-suspension of sediments. Highest percentage of organic matter was observed in the month of September 2016, which was 17.11%.

There were no statistically significant differences between Sarasaalai and Kapputhu mangroves in water temperature ($p = 0.06$), salinity ($p = 0.40$), dissolved oxygen ($p = 0.77$), pH ($p = 0.262$) and water depth ($p = 0.79$). As stated above, water temperature, DO, salinity, pH and water depth are the most important water quality parameters which influence on the biodiversity of the particular ecosystem. Those parameters

may be the determinant factors of the available fish species in both locations.

The salinity is a limiting factor in the distribution of living organisms and it changes because the dilution and evaporation act most likely on the fauna in the coastal ecosystem (Paramasivam and Kannan, 2005). Amount of oxygen that can be hold by water depends on the water temperature, the salinity and also the pressure.

There were statistically significant differences between Sarasaalai and Kapputhu in turbidity, as determined by 2t-test ($p = 0.001$) which may cause due to the presence of high organic matter in Sarasaalai mangrove region. For many mangrove areas, high turbidity is needed to protect juvenile fish from predators. Even though it can harm fish and other aquatic life by degrading spawning grounds, reducing food supplies and affect the gill function of certain species. This may affect the abundance of fish species.

In both locations same fish species were identified (Table 1; Figure 4) and most abundance fish species was *Oreochromis mossambicus*. This is highly tolerable species for most of the water quality parameter changes. However commercially valuable species such as *Chanos chanos* and *Gerres abbreviatus* were abundantly found in Kapputhu.

It can be recommended that both mangrove regions are suitable for tidal aquaculture practices because it provides a relatively cheap way of tapping a rich resource. No fertilizers need to be added, as stocks of nutrients are carried by the water into the mangrove environment.

Table.1: Abundance of fish species (Total number of collected fish species from one gill net during 1 hour fishing time (throughout the survey))

Identified species	Common name	% of fish collected in Sarasaalai	% of fish collected in Kapputhu
<i>Chanos chanos</i>	Milk fish	0.3 %	4.23 %
<i>Platycephalus fuscus</i>	Dusky flathead	8.54 %	1.46 %
<i>Nematalosa nasus</i>	Long-ray bony bream	6.4 %	2.54 %
<i>Oreochromis mossambicus</i>	Tilapia	64.0 %	52.25 %
<i>Hyporhamphus limbatus</i>	Congaturi halfbeak	5.19 %	2.82 %
<i>Hemiramphus marginatus</i>	Barred half-beak	6.09 %	3.67 %
<i>Eetroplus maculatus</i>	Spotted etroplus	7.34 %	1.12 %
<i>Gerres abbreviatus</i>	Blue-black silver biddy	1.22 %	18.36 %
<i>Gerres oyena</i>	Lined silver-biddy	0.92 %	13.55 %
Total		100 %	100 %

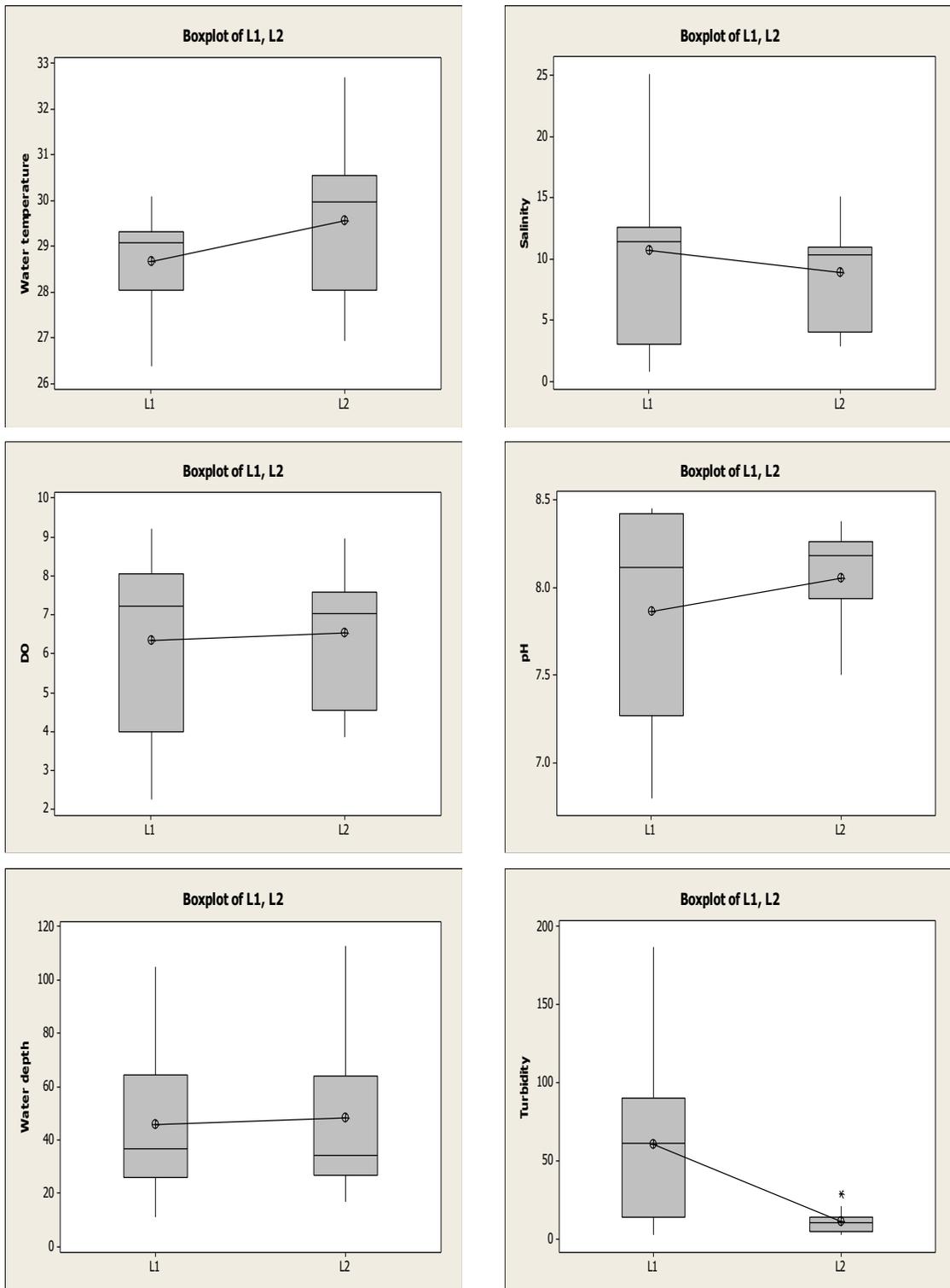


Figure 3: Box plot to show the homogeneity of L1 and L2 for water quality parameters



Chanos chanos
(Common name - Milk fish)



Etroplus maculatus
(Common name - Spotted etroplus)



Oreochromis mosambicus
(Common name - Tilapia)



Gerres oyena
(Common name - Lined silver-biddy)



Hyporhamphus limbatus
(Common name - Congaturi halfbeak)



Platycephalus fuscus
(Common name - Dusky flathead)



Hemiramphus marginatus
(Common name - Barred half-beak)



Nematalosa nasus
(Common name - Long-ray bony bream)



Gerres abbreviatus
(Common name-Blue-black silver biddy)

Figure 4: Identified fish species in Sarasaalai and Kapputhu mangrove waters

CONCLUSION

This study provides the status of water quality conditions of mangrove environment, organic matter content of soil and available fish species. Water temperature, DO, salinity, pH water depth and turbidity were analyzed. There were statistically significant differences between Sarasalai and Kapputhu in turbidity, as determined by 2t-test ($p = 0.001$). High percentage of organic matter was noticed in Sarasalai mangrove water throughout the study period. The most abundance species in Sarasalai was *O. mossambicus* and in Kapputhu were *O. mossambicus*, *C. chanos*, *G. oyena* and *G. abbreviatus*. The present study concluded that the identified dominant fish species can be cultured in the mangrove regions studied currently. However, a long term investigation on fish seed resources, environmental and climatic conditions of particular site would ensure more details on culture aspects of these species.

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