



Diversity analysis and present status of Mangroves from Kerala, West coast of India

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ABSTRACT

A study was conducted on the diversity and structural analysis of the mangroves in ten districts of Kerala state. A total of 15 true mangrove species belonging to 9 genera and 7 families were enumerated. The true mangrove species are confined to salty-marshy environment along back waters. The study resulted considering the ten districts of Kerala, the diversity relatively high in Kollam and Kasargod compared to other districts. The continuous anthropogenic activities possess threat to the survival of mangroves. At present the mangrove continuity are lost and are faced destruction. Urbanization, tourism development and chemical discharge are some of the major common threats that decline mangrove ecosystems in the study area. Thus the management of the present mangrove is urgent for a sustainable living.

Key words: Mangroves, Kerala, Diversity, Urbanization.

I. INTRODUCTION

Mangroves are salt tolerant plants of tropical and subtropical intertidal regions of the world distributed mainly between latitudes 25° N and 25° S. Mangroves were found in more than 120 countries and territories around the world. Mangroves in India account for about 5 percent of the world's mangrove vegetation and are spread over an area of about 4,500 km² along the coastal State. Biodiversity is prevalent in the tropical estuarine system, particularly in the intertidal forested vegetation known as Mangrove [1]. India has only 2.66% of the world's mangroves, covering an estimated area of 4,827 sq. km. Kerala has 590 km long coastline constituted by long stretches of backwaters with mangroves and species of diverse ecology and presently the mangrove area is estimated to be about 17 sq. km, of which 36% is



either completely degraded or is degrading. The mangrove vegetations of Kerala cover an area of 1671 hectares and are found as discrete and isolated patches in different parts of the state [2]. Kerala mangroves are becoming endangered due to the lack of scientific attention [3].

Banerjee *et al* [4] reported 32 species under 24 genera of 19 families from Kerala. However, Basha [5] could observe only 27 species under 21 genera of 17 families. Unni [6] and Khaleel [7] reported 18 true mangrove species and 23 associates from the state. Anupama and Sivadasan [8] reported only 15 true mangroves. Madhusoodhanan and Vidyasagar [9] found 15 species of true mangroves but could locate only 33 associates in the state. Recently Mini *et al.* [10] reported 24 species of mangroves and 98 species of mangrove associates in Kerala. Mangroves of Kerala are less complex in terms of tidal creek networks compared to the dense complex networks of mangrove ecosystems along the east coast of the country [11].

II. MATERIALS AND METHODS

Information on the mangroves of Kerala was collected through field studies during January 2014 to December 2016. The present study was conducted in the ten districts of Kerala. Study site and broad investigation on the extent of mangrove distribution and diversity was carried out the intertidal zones of Kerala.

Quadrat analysis (field study)

Quadrat analysis was done the intertidal zones of Kerala state. The structure of the mangrove was studied in terms of quantitative characters includes Dominance, Evenness. For



quadrat analysis, the study area was divided into ten districts of Kerala. Each region was again sub divided into 5 x5 sizes of 3 quadrats.

Diversity indices of true mangrove species of ten districts were studied. Shannon Wiener Index (Diversity index), Species richness and Species evenness of mangroves were also statistically analyzed and compared using PAST 3.20 Paleontological Statistics software [12].

All the ten districts were visited and collected maximum accessible data on mangroves, include its diversity, spatial attributes, decline status of study site are collected.

Diversity index, species richness and species evenness of mangroves

Shannon –Wiener index

The Shannon –Wiener index for mangrove diversity has been studied as per Shannon – Wiener [13] using the following formula

$$H_s = - \sum_{i=1}^s (P_i)(\ln P_i)$$

Where, H_s = diversity in a sample of the species

S = the number of species,

P_i = the relative abundance of ' i^{th} ' species or kinds,

N = the total number of individuals,

n_i = the number of individuals of i^{th} species,

\ln = log base



Species richness was calculated Whittaker [14] with the following formula,

$$D = \frac{n}{\sqrt{N}}$$

Where, n = the number of different species in the sample

N = the total number of individual organism in the sample.

Species Evenness was calculated by the following formula

$$E = H / \ln (S)$$

Where, H = diversity index value

S = number of species in the sample.

Simpson's Diversity Index

Simpson's Diversity Index is a measure of species diversity, used to quantify the biodiversity of a habitat. It takes into account the richness (number of species present), as well as the evenness (relative abundance) of each species. A high value for D is 'good' and means the habitat is diverse, species rich, and low value for D is 'poor' and means the habitat is low in species. The value of D ranges between 0 & 1; 1 represents infinite diversity and 0, no diversity. It was calculated by using the formula,

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

n = the total number of organisms of a particular species

N = the total number of organisms of all species

III. RESULT AND DISCUSSION



The diversity analysis of true mangrove species found maximum in Kasargod and Kollam districts and minimum in Kottayam and Malappuram (Table-2,3 and Figure-1,2,3,4).

The true mangroves in Kerala are mainly categorized into three, viz. dense, scattered with accommodation and declined ones. Of these three categories, the major category is the scattered one with accommodation.

Distribution of true mangroves in different intertidal zones of Kerala is shown in (Table-1). Species like *Acanthus ilicifolius*, *Excoecaria agallocha*, *Avicennia officinalis*, *Rhizophora mucronata* and *Sonneratia caseolaris* are the species found in all the districts of Kerala. However, *Rhizophora apiculata* is widely distributed in Kasargod, Kozikode, Ernakulam and Kollam districts.

Acanthus ebtacteatus is going to be the endangered ones and found small community in the districts of Malappuram and Kannur. The three species of the genus *Bruguiera*, *B. cylindrica* has comparatively good distribution, and which is not recorded in Kottayam district. *B. gymnorhiza* is a rare species which is not recorded from Kannur, Kasargode and Thiruvananthapuram. *B. sexangula* is going to be the endangered species, which is represented only in Ernakulam and Kottayam. *Kandelia kandal* is also a rare species which is distributed in all districts except Trivandrum. *Rhizophora apiculata* reported in Kollam and Ernakulam, whereas, *Sonneratia alba* is becoming rare due to its small populations in the districts of Kollam, Kozhikode, Kannur and Kasargode. *Lumnitzera racemosa* is the rarest mangrove species in Kerala found only Kollam. *Aegiceras corniculatum* is going to be the endangered ones mangrove species in Kerala found only Kollam and Kannur. *Avicennia*



marina is one of the rare mangrove species in Kerala found in Kollam, Kannur and Kasargod districts.

The study revealed *Lumnitzera racemosa* and *Bruguiera sexangula* are the threatened species found in west coast of Kerala. *Bruguiera sexangula* is also found in few places where in their population is facing further degradation [10].

Veli and Poovar are one of the famous mangrove sites in Trivandrum which have undergone severe degradation due to urbanization. *Lumnitzera racemosa*, one of the rare mangrove species in Kerala, has showed limited distribution in Ayiramthengu area and this region found to be irreparable process of destruction. Mangrove destruction is observed in some areas of the district, it is found that signs of reclamation of mangroves in some areas of Kollam district. Asramam is one of the most large mangrove forest in Kollam district had go through smashing due to shrimp farming.

Alappuzha consists of very less stretch of mangrove in the state. Alappuzha was once famous for backwaters and intertidal zones, in which mangroves to withstand luxuriant growth. Aroor region have good mangrove patches in Alappuzha district. In Kottayam district, mangroves are mainly seen in Kumarakom. Tourism is causing severe damage to the existing mangroves in Kumaragam. Luxuriant growth of mangroves found in the protected areas of Kavanattinkara under KTDC. Ernakulam district occupy third highest extent of mangroves in the state after Kannur and Kozikode district. In Ernakulam district the mangroves had undergone severe degradation. The major threat was developmental activities Developmental projects causes degradation of mangroves in Panangad, Vypin, Mangalavanam and Puthuvypin.



Thrissur district confined in backwaters regions of Chettuwei, Azhikode and Kodungallur. Malappuram district occupy very less extent of mangroves. Ponnani lake, Tirur, Padinjarekkara and Purathur are the main locations of mangroves in Malappuram.

Vadakara, Kallai, Koduvalli, Kotti, Baypoor, Vengalam and Kadalundi relatively good patches of mangroves in Kozikode district. Kozhikode district once occupied good patches of mangroves, but most of these flourish mangroves removed by land reclamation. InKannur. Pazhayangadi, Pappinisseri, Madakkara, Thekkumbad, Valapattanam, Dharmadam and Thalassery regions consists of good patches of mangrove vegetation.

More than 80 per cent of the total mangrove areas under private ownership.. Plant diversity of pure mangroves is also very high in Kollam and Kasargode when compared to other districts (12 out of 15 pure mangrove species). Kannur and Kollam districts which had initiate broad mangrove plantation programmes.

IV.CONCLUSION

The diversity analysis of true mangrove species found maximum in Kasargod and Kollam districts and minimum in Kottayam and Malappuram. However the continuous anthropogenic activities posses threat to the survival of mangroves. Thus the management of the present mangrove is urgent for a sustainable living.



Table-1. True mangroves present in ten districts of Kerala

| Plant species | TVC | KLLM | APPY | KTYM | EKLM | THCR | MLAPM | KOKD | KNUR | KSDE |
|--|-----|------|------|------|------|------|-------|------|------|------|
| <i>Lumnitzera recemosa</i> Willd. | - | + | - | - | - | - | - | - | - | - |
| <i>Sonneratia alba</i> Sm. | - | + | - | - | - | - | - | - | + | + |
| <i>Sonneratia caseolaris</i> (L.) Engl. | + | + | + | + | + | + | + | + | + | + |
| <i>Bruguiera cylindrica</i> (L.) Blume. | - | + | + | - | + | + | + | + | + | + |
| <i>Bruguiera gymnorhiza</i> (L.) Lam. | - | - | + | + | + | - | + | + | - | + |
| <i>Bruguiera sexangula</i> (Lour.) Poir. | - | - | - | + | + | - | - | - | - | - |
| <i>Kandelia candel</i> (L.) Druce. | - | + | + | - | + | + | + | + | + | + |
| <i>Rhizophora apiculata</i> Blume. | - | + | - | - | + | - | - | + | - | + |
| <i>Rhizophora mucronata</i> Lam. | + | + | + | + | + | + | + | + | + | + |
| <i>Excoecaria agallocha</i> L. | + | + | + | + | + | + | + | + | + | + |
| <i>Aegiceras corniculatum</i> (L.) Blanco. | - | + | - | - | - | - | - | - | + | + |
| <i>Acanthus ebracteatus</i> Vahl. | - | - | - | - | - | - | + | - | + | - |
| <i>Acanthus ilicifolius</i> L. | + | + | + | + | + | + | + | + | + | + |
| <i>Avicennia marina</i> (Forssk.) Vierh. | + | + | - | - | - | - | - | - | + | + |
| <i>Avicennia officinalis</i> L. | + | + | + | + | + | + | + | + | + | + |

TVC-Thiruvananthapuram, KLLM-Kollam, APPY-Alappuza, KTYM-Kottayam, EKLM-Ernakulam, THCR-Trissur, MLAPM-Malappuram, KOKD-Kozikode, KNUR-Kannur, and KSDE-Kasargod.



Table-2. Diversity Indices, Dominance and Evenness

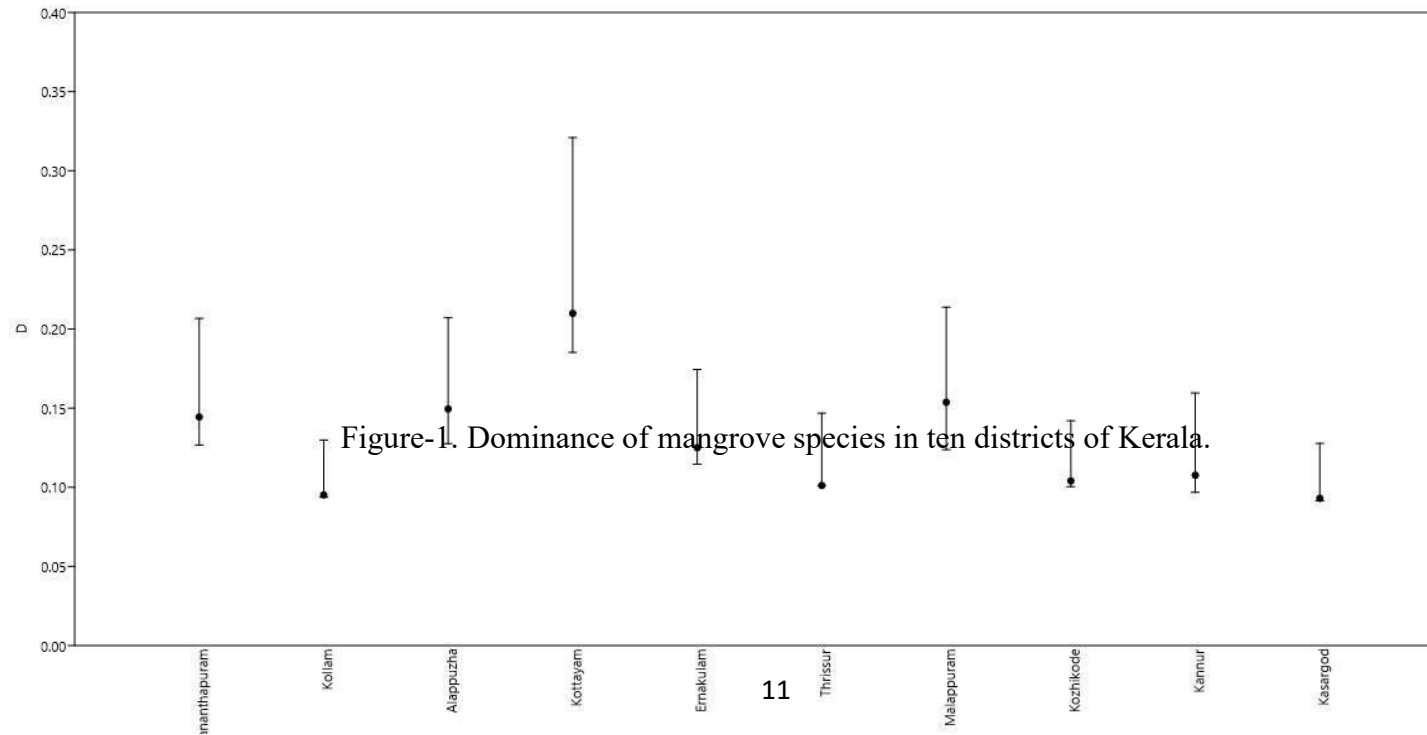
| | Thiruvananthapuram | Kollam | Alappuzha | Kottayam | Ernakulam | Thrissur | Malappuram | Kozhikode | Kannur | Kasargod |
|----------------|--------------------|---------|-----------|----------|-----------|----------|------------|-----------|--------|----------|
| Taxa_S | 9 | 12 | 9 | 6 | 10 | 11 | 10 | 11 | 12 | 12 |
| Individuals | 30 | 64 | 27 | 18 | 48 | 38 | 40 | 62 | 43 | 70 |
| Dominance_D | 0.1444 | 0.09521 | 0.1495 | 0.2099 | 0.125 | 0.1011 | 0.1537 | 0.1041 | 0.1076 | 0.09306 |
| Simpson_1-D | 0.8556 | 0.9048 | 0.8505 | 0.7901 | 0.875 | 0.8989 | 0.8463 | 0.8959 | 0.8924 | 0.9069 |
| Shannon_H | 2.052 | 2.41 | 2.025 | 1.659 | 2.179 | 2.341 | 2.071 | 2.326 | 2.366 | 2.434 |
| Evenness_e^H/S | 0.8651 | 0.9281 | 0.8422 | 0.8758 | 0.8834 | 0.9445 | 0.7934 | 0.9306 | 0.8877 | 0.9502 |

Table-3. Summary Statistics

| | Thiruvananthapuram | Kollam | Alappuzha | Kottayam | Ernakulam | Thrissur | Malappuram | Kozhikode | Kannur | Kasargod |
|------------|--------------------|----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|
| N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Min | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Max | 7 | 10 | 6 | 5 | 10 | 5 | 10 | 10 | 9 | 11 |
| Sum | 30 | 64 | 27 | 18 | 48 | 38 | 40 | 62 | 43 | 70 |
| Mean | 2 | 4.266667 | 1.8 | 1.2 | 3.2 | 2.533333 | 2.666667 | 4.133333 | 2.866667 | 4.666667 |
| Std. error | 0.5773503 | 0.746207 | 0.5363013 | 0.4700557 | 0.8 | 0.4866471 | 0.8145502 | 0.8273116 | 0.6005289 | 0.7847758 |
| Variance | 5 | 8.352381 | 4.314286 | 3.314286 | 9.6 | 3.552381 | 9.952381 | 10.26667 | 5.409524 | 9.238095 |



| | | | | | | | | | | |
|------------|-----------|----------|------------|-----------|------------|-----------|----------|------------|----------|-----------|
| Stand. dev | 2.236068 | 2.890049 | 2.077086 | 1.820518 | 3.098387 | 1.884776 | 3.154739 | 3.204164 | 2.325838 | 3.039424 |
| Median | 2 | 5 | 1 | 0 | 2 | 3 | 2 | 5 | 3 | 5 |
| 25 prentil | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 |
| 75 prentil | 3 | 6 | 3 | 2 | 5 | 4 | 4 | 6 | 3 | 6 |
| Skewness | 0.9730582 | -0.10185 | 0.969019 | 1.380156 | 0.665669 | -0.170473 | 1.488084 | 0.1164283 | 1.246769 | 0.1024079 |
| Kurtosis | 0.1252747 | -0.2851 | -0.3049967 | 0.7026891 | -0.2272207 | -1.283504 | 1.542531 | -0.6708783 | 2.680157 | 0.5972923 |
| Geom. mean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coeff. var | 111.8034 | 67.73551 | 115.3937 | 151.7098 | 96.82458 | 74.39906 | 118.3027 | 77.5201 | 81.13389 | 65.1305 |



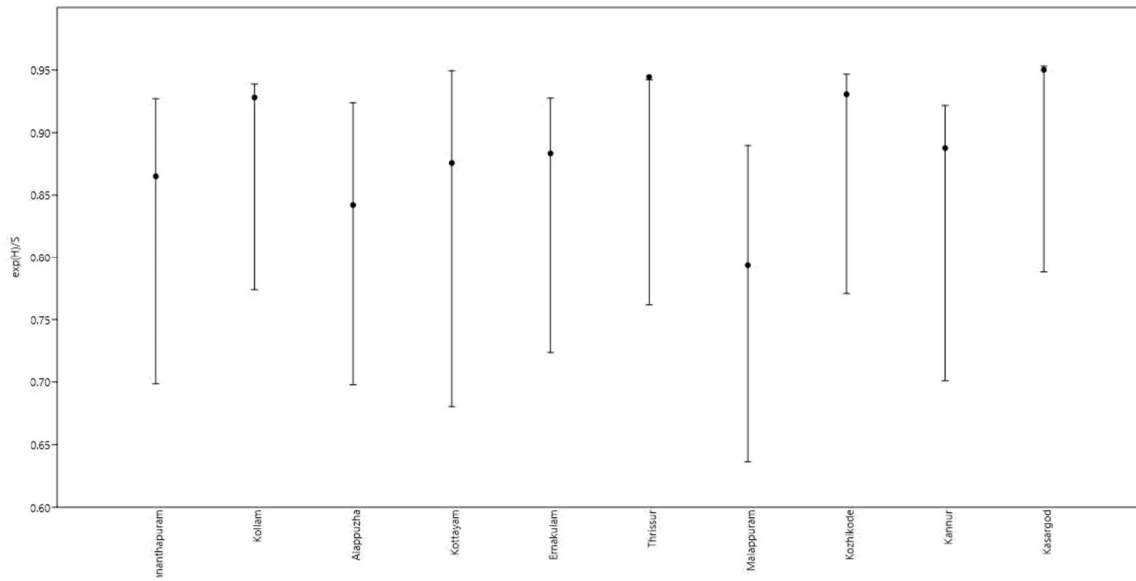


Figure-2. Evenness of mangrove species in ten districts of Kerala.

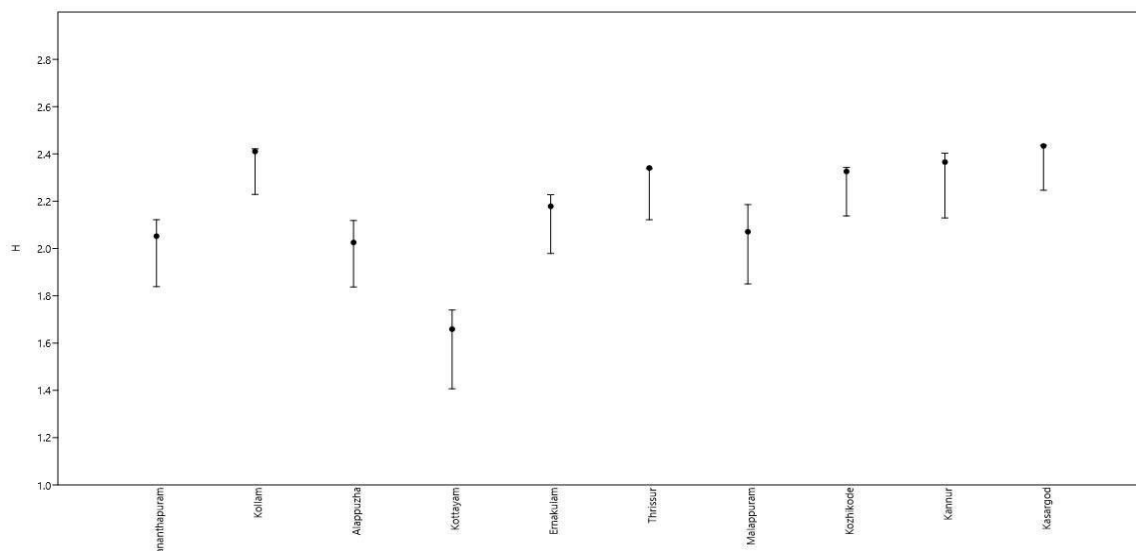


Figure-3. Shannon Diversity Index of mangrove species in ten districts of Kerala.

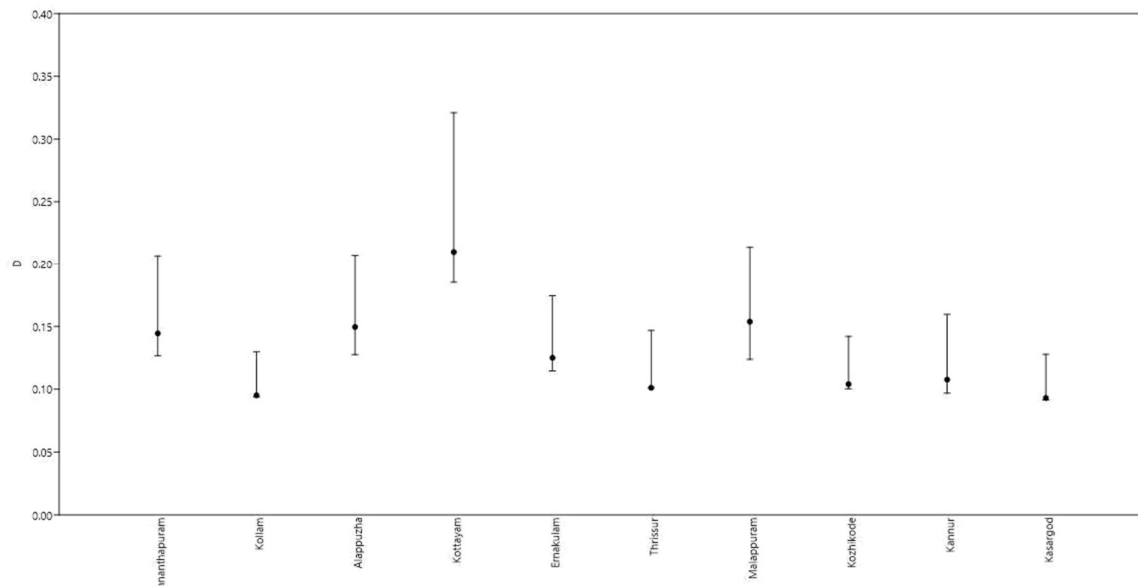


Figure-4. Simpson Diversity Index of mangrove species in ten districts of Kerala

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