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Species composition and forest conditions of true mangroves in Kapa at Kadan Island, Myeik Archipelago, Myanmar

Abstract

The survey was conducted in the mangrove forest around the Kapa Village in Kadan Island, Myeik Coastal area, in April 2018. Transect lines in shoreline, seaward and landward, and plot based on Point Center Quarter Method (PCQM) P-DATA PRO were used. A total of 18 species of true mangroves were record. Among than 1 species in Near Threaten(NT), 1 species in Critically Endangered(CR), 2 species in Endangered(EN) considered under the IUCN red list. *Rhizophora apiculata* and *R.mucronata* are the dominant species in the area. *Aegialitis rotumdifolia, Avicennia marina, Excoecaria aglocha, Heritiera littoralis, Sonneratia graffithii, Xylocarpus mucronata* and *Nypa fruticans* are the least species in the area. Among the three study sites of Kapa, Landward zone is the most distributed of species and shoreline zone is the least distributed. The complexity index was found 2.5 to 67.3.The total forest density 0.17 to 0.39m^2 and mean height 3.2 to 4.7m. The mean important value of *Rhizophora apiculata* was heights; the *Nypa frucan* was least. The environmental parameters such as salinity and temperature of seawater, and temperature and pH of soils of each study site were presented.

Keywords: species composition, vegetative structure, environmental parameters, mangrove forest, myeik coastal areas, kadan island, landward, seaward, shoreline, transect lines, zonal pattern

Volume 9 Issue 3 - 2020

Soe Win U,[1] Tin Zar Ni Win[2]
[1]Department of Marine Science, Mawlamyine University, Myanmar
[2]Department of Marine Science, Myeik University, Myanmar

Correspondence: Soe Win U, Department of Marine Science, Mawlamyine University, Myanmar, Email soewinarine@gmail.com

Received: June 15, 2020 | **Published:** June 30, 2020

Introduction

Myanmar has a long coastline, including three coastal regions as Rakhine, the Ayeyarwady Delta and Gulf of Martaban, Tanninthayi coastal regions which is 2832km .Among the three coastal regions, Tanintharyi coastal zone is the longest coast line about 1200km in length and has the richest diversity of coastal habitats and constitutes over 800 Islands. There are estuaries, delta systems, numerous offshore islands and a considerable diversity of coastal habitats including coral reef, mangroves, sandy beaches and mudflats. In these mangroves, 46% are included in Ayeyawady, 37% in Taninthayi and 17% in Rakhine. Mangrove areas of Myanmar stand at about 8th position in world and 3th position in South Asia mangroves (Giesen et. al,2007).[1] Kadan Island is situated at the eastern part of Myeik coastal areas. And then, it is the biggest island in Myeik Archipelago. Today, mangrove forests are being degraded and destroyed on a larger scale globally through the natural disturbance and anthropogenic activities such as transforming to agriculture land, aquaculture ponds, salt ponds/ land etc., which are major causes of their degradation and loss of mangroves ecosystem.

Materials and methods

The present study was conducted in the mangrove forest near the Kapa village in Kadan Island, Myeik Coastal (lat12.23427ºN, long 98.22497º E) in April 2018, Figure 1. A total of six transects line were laid the at the mangroves community of Kapa, Kadan Island Figure 1. A total of six random transects were set up based on the different forest condition (*ie* shoreline, seaward, landward) at the Kapa, Myeik coastal Area. The transect lines were measured by using measuring tape in meter. The distances and intervals of each transect were shown in Table 1.Totally, 15 sampling plots were set up in each transect. The measurement of plot is 10m^2, respectively. Each plot subdivided into four quadrants. Only one of nearest tree was recorded in each quadrant. The data of vegetation was recorded by using Point Center Quarter Method (PCQM) according to Dohdouh and Koedam (2006). Then, the variable parameters such as the stem density (De), basal area (Ba) for each species and for entire mangrove stand, the complexity index (C.I), the relative density (De_r), the relative dominance (Do_r), the relative frequency (F_r) and the importance value (I.V) for each species were calculated by using Microsoft Excel-base Workbook P-DATA-PRO_1000 (Version 5.01) software.

The location of start point and end point were marked by using GPS for each transects line in the study areas. The environmental parameters such as soil temperature, soil salinity, soil pH, water salinity, and water temperature were measured at the field immediately. The species identification was carried out according to the following references, Selvam et al.,[2–5] For all recorded mangrove species: flower, fruit, bud, leave, root and stem were recorded by using digital camera.

Results and discussion

In the present study area, total of 18 species belong to 11 genera from 9family in the Kapa, Myeik Coastal Area of true woody mangrove plants was recorded. They are 5 species in Rhizophoraceae, 3 species in Avicenniaceae, 2 species in Sonneratiaceae, Meliaceae, and Sterculiaceae, 1 species in Euphorbiaceae, Myrsinaceae, Plumbaginaceae and Aracaceae at Kapa, Myeik Coastal Area. The Systamatic positions of classification of recorded species were described in Table 2.

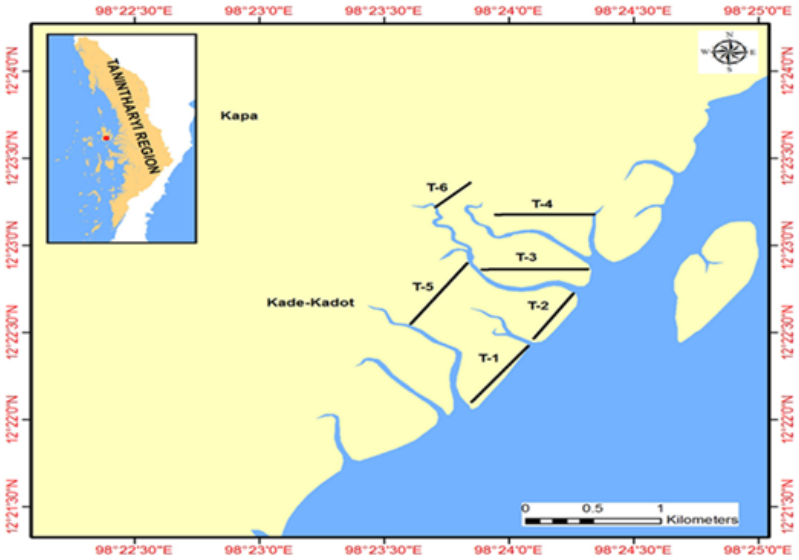

Figure 1 Map showing the location of the sampling area near the kappa village, katan Isand, Myeik Archepelago.

Table 1 The location, distance of transect, and plot interval of each transect near the Kapa mangrove in Myeik Archipelago, Taninthayi Coastal Area

Sr. No.	Transect	Latitude	Longitude	Distance (m)	Plot interval (m)
1	T -1	12°.22´ 15.786" N	98°23´58.171" E	450	30
2	T -2	12°.22´ 42.780" N	98°23´42.797" E	675	45
3	T -3	12°.22´35.808" N	98°24´10.685 "E	525	35
4	T -4	12°.23´17..283" N	98°23´46.373" E	375	25
5	T -5	12°.22´51.361" N	98°24´4.965" E	825	55
6	T -6	12°.23´.10..847" N	98°24´8.540" E	600	40

Table 2 A classified list of true mangrove species in the study sites

Sr. No.	Species	Family	Habit	Local name	IUCN read list
1.	*Rhizophora apiculata*	Rhizophoraceae	Tree	Payon-Apho	LC
2.	*R. mucronata*		Tree	Payon-Ama	LC
3.	*Bruguiera. parviflora*		Tree	Saung-Nge	LC
4.	*Ceriops tagal*		Shrub	Baing-Dough	LC
5.	*C. decandra*		Shrub	Ka-Pyaing	NT
6.	*Avicennia alba*	Avicenniaceae	Tree	Thame-Net	LC
7.	*A. officinalis*		Tree	Thame-Net	LC
8.	*A. marina*		Tree	Thame-Net	LC
9.	*Xylocarpus granatum*	Meliaceae	Tree	Pinle-Ohnn	LC
10.	*X. moluccensis*		Tree	Kyat-Nan	LC
11.	*Sonneratia graffithii*	Sonneratiaceae	Tree	Lanbu	CR
12.	*S. alba*		Tree	Lanbu	LC
13.	*Heritiera formes*	Sterculiaceae	Tree	Kanazo	EN
14.	*H. littoralis*		Tree	Kanazo	LC
15.	*Aegialitis rotundifolia*	Plumbaginaceae	Shrub	Padan-Pin	NT
16.	*Aegiceras corniculatum*	Myrsinaceae	Shrub	Butalet, Kaya	LC
17.	*Excoecaria agallocha*	Euphorbiaceae	Tree	Tayaw	Data deficient
18.	*Nypa fruticans*	Aracaceae	Palm	Dani-Pin	LC

LC, least concern; NT, near threatened; En, endangered; CR, critically endanger

Citation: Win SU, Win TZN. Species composition and forest conditions of true mangroves in Kapa at Kadan Island, Myeik Archipelago, Myanmar. *J Aquac Mar Biol.* 2020;9(3):92–99. DOI: 10.15406/jamb.2020.09.00283

The distribution trends of recorded species along the transects in study site was presented in Table 3 and the forest of vegetation assemblage in study site shown in Table 4. *Rhizophora apiculata , R.mucronata* and *Sonneratia alba* are most dominant species in the study sites and *Aegialitis rotumdifolia ,Excoecaria aggallocha, sonneratia graffithii* and *Xylocarpus moluccensis* are least in the study sites. And then *Rhizophora apiculata* and *R.mucronata* were distributed the near all study sites, *Aegiceras corniculatum, Avcenia alba* and *Avicennia marina* were distributed the shoreline, *Aegiceras corniculatum, Avcenia alba* and *Bruguiera parviffora* were distributed the seaward and then *Avicennia officianalis, Cerops dencandra, C.tagal, Heritiera forms, H.littoralis, Sonneratia alba , S.graffithii, Xylocarpus granatum* and *X.moluccensis* were distributed the landward.

Table 3 Zonal distribution of mangrove species of Kapa in Myeik Archipelago, Taninthayi Coastal Area

Sr. No	Species	Zonation					
		Shoreline		Seaward		Landward	
		T-1	T-2	T-3	T-4	T-5	T-6
1	*Aegiceras corniculatum*	-	+	+	-	-	-
2	*Aegialitis rotumdifolia*	-	-	-	+	-	-
3	*Avicennia alba*	-	+	+	+	-	-
4	*Avicennia officinalis*	-	-	+	-	+	+
5	*Avicennia marina*	-	+	-	-	-	-
6	*Bruguiera parviffora*	-	-	+	+	-	-
7	*Ceriops decandra*	-	-	-	-	+	+
8	*Ceriops tagal*	-	-	-	-	+	+
9	*Excoecaria agallocha*	-		-	-	-	+
10	*Heritiera formes*	-	-	-	-	+	+
11	*Heritiera littoralis*	-	-	-	-	-	+
12	*Rhizophora apiculata*	+	+	+	+	+	+
13	*Rhizophor amucronata*	+	+	+	+	+	-
14	*Sonneratia alba*	-	+	+	+	+	-
15	*Sonneratia graffithii*	-	-	-	-	+	-
16	*Xylocarpus granatum*	-	-	+	-	+	-
17	*Xylocarpus moluccensis*	- -	- -	- -	- +	+ -	- -
18	*Nypa fruitcans*	-	-	-	+	-	-
Total		2	6	8	7	10	7
Symbols; (+)=present, (-)=absent							

Table 4 Total forest of vegetation assemblage in Kapa at Myeik Archipelago ,Taninthayi Coastal Area

Summary of PCQM based forestry parameters							
Sr. No		Shoreline		Seaward		Landward	
		T-1	T-2	T-3	T-4	T-5	T-6
1	Number of PCQM sample points	15	15	15	15	15	15
2	Total number of quadrants	60	60	60	60	60	60
3	Number of empty quadrants	0	0	0	0	0	0
4	Number of tree species	2	6	8	6	10	7
5	Proportion of multiple- stemmed trees (%)	3	30	7	2	5	5
6	Mean number of stems in multiple stemmed	3	2.3	2.3	2	2.3	2
7	Mean height (m)	4.6	4.7	4.4	3.2	4	4.4
8	Total forest density (trees/m^2)	0.19	0.23	0.17	0.23	0.39	0.27

Table Continued...

Summary of PCQM based forestry parameters							
Sr. No		Shoreline		Seaward		Landward	
		T-1	T-2	T-3	T-4	T-5	T-6
9	Total forest density (trees/0.1ha)	186.2	235	174.7	230.4	388.6	267.3
10	Total basal area (m^2/0.1ha)	1.48	4.65	3.18	1.94	4.37	3.4
11	Total frequency (%)	133.3	246.7	193.3	160	213.3	226.7
12	Complexity Index (using mean height)	2.5	30.8	19.8	8.7	67.3	28

The physiochemical studies were also conducted in the study site and the data were presented in the Table 5-6. According to the table, the average water salinity was highest 30.5‰ in shore line but the lowest water salinity 28 ‰ is the landward. The average soil salinity was highest 30.5‰ in landward but shoreline is least 28.8‰. The water temperatures range is the 27.4ºC-31.0ºC while soil temperatures range is the 26.4ºC-29.7ºC in the study sites. And then the average Soil pH is the highest in shoreline and least in seaward (Figure 2-7).

Table 5 Forest parameter of different mangrove species of Kapa in Myeik Archipelago, Taninthayi Coastal Area

Sr. No.	Species	Mean basal area	Mean relative density	Mean relative dominance	Mean relative frequency	Mean importance value
1	*Rhizophora apiculata*	1.2	37.2	32.6	35.4	177.6
2	*Rhizophora mucronata*	0.5	11.7	11.8	12.0	53.4
3	*Bruguiera parviffora*	0.4	15.0	9.2	13.0	51.7
4	*Ceriops tagal*	0.4	12.5	9.2	10.9	40.3
5	*Ceriops decandra*	1.4	10.0	32.6	10.2	52.0
6	*Avicennia alba*	0.1	3.1	2.1	5.3	15.1
7	*Avicennia officinalis*	0.7	3.3	15.9	6.3	25.5
8	*Avicennia marina*	0.4	3.3	8.8	6.3	18.4
9	*Xylocarpus granatum*	0.4	5.8	14.7	6.4	35.0
10	*Xylocarpusmoluccensis*	0.9	1.7	34.5	2.9	39.1
11	*Sonneratia graffithii*	0.1	3.3	1.4	5.4	10.1
12	*Sonneratia alba*	1.9	10.8	51.8	16.7	88.5
13	*Heritiera formes*	0.8	30.0	24.3	23.5	77.8
14	*Heritiera littoralis*	0.2	5.8	4.4	7.5	17.7
15	*Aegicerascorniculatum*	0.1	10.0	1.7	10.3	22.1
16	*Excoecaria agallocha*	0.1	10.0	1.7	10.3	22.1
17	*Nypa fruticans*	0.1	1.7	4.0	2.9	8.7
18	*Aegialitis rotumdifolia*	0.0	8.3	1.5	10.3	20.2

Table 6 The environmental parameter of the Kapa in Myeik Archipelago, Taninthayi coastal Area

Sr. No.	Transects	Water salinity (‰)	Soil salinity (‰)	Water temperature (°C)	Soil temperature (°C)	Soil pH
1	T-1	29.0	30.0	31.0	27.6	5.9
2	T-2	32.0	27.6	29.5	28.6	5.8
3	T-3	30.0	24.5	29.4	29.7	5.6
4	T-4	30.0	36.5	27.4	26.9	5.6
5	T-5	30.0	27.5	27.4	26.4	5.8
6	T-6	26.0	33.5	29.8	29.6	5.8

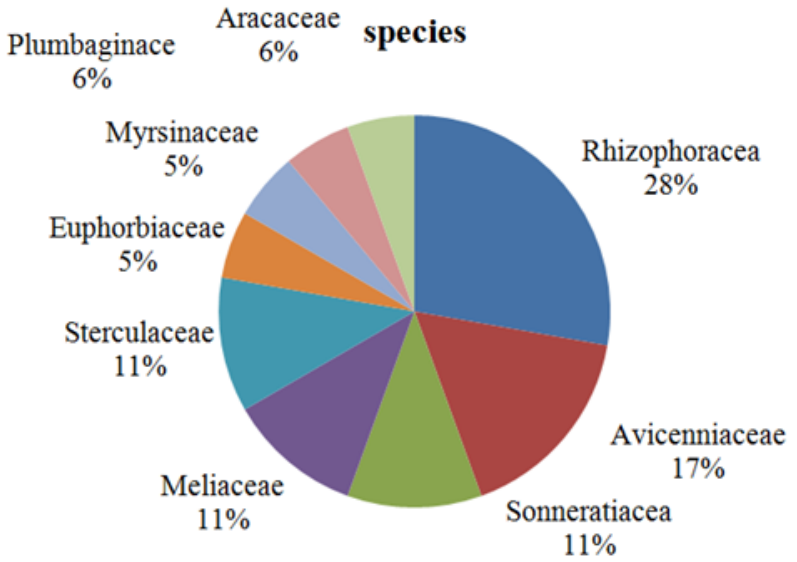

Figure 2 Species composition of mangrove in Kapa at Myeik Archipelago ,Taninthayi Coastal Area.

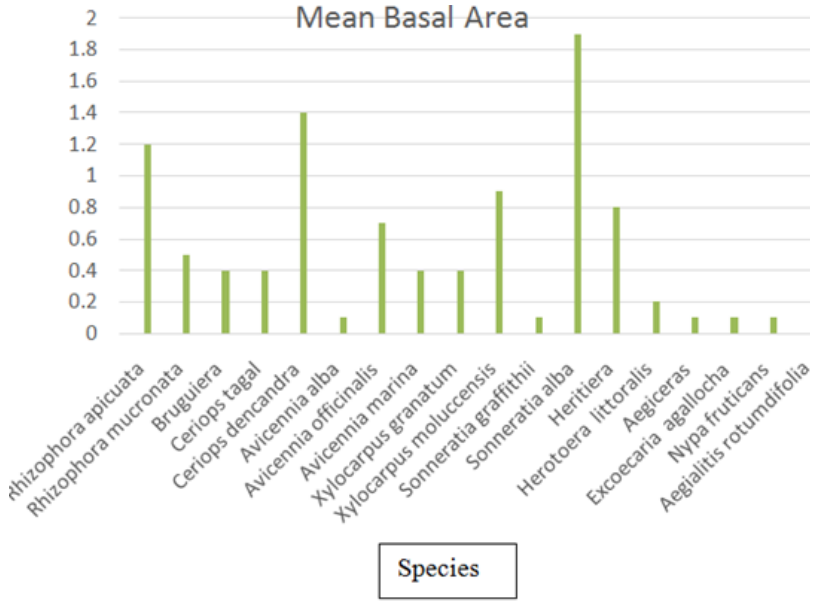

Figure 3 Mean basal area of mangrove species at study site.

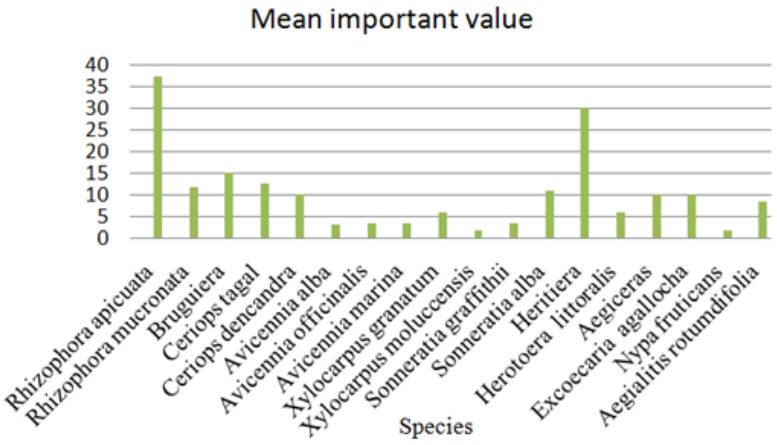

Figure 4 Mean important value of mangrove species at study site.

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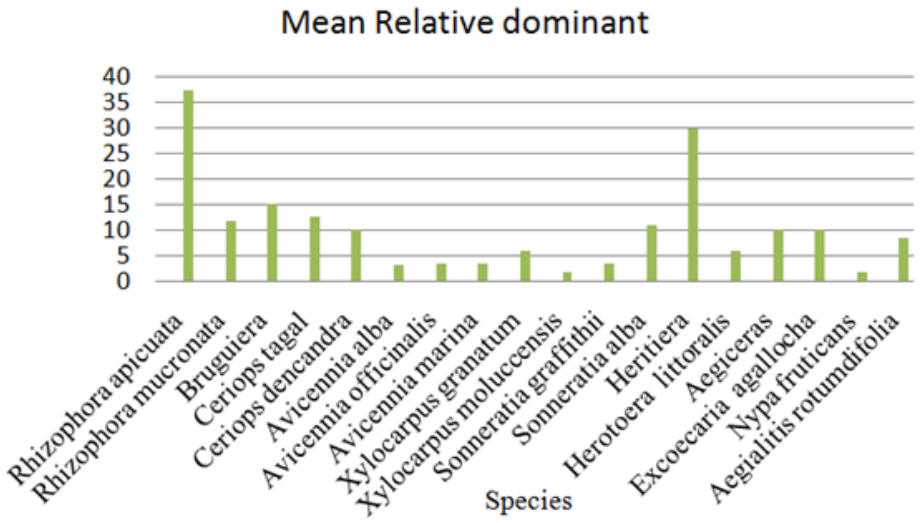

Figure 5 Mean Relative Dominant of mangrove species at study site.

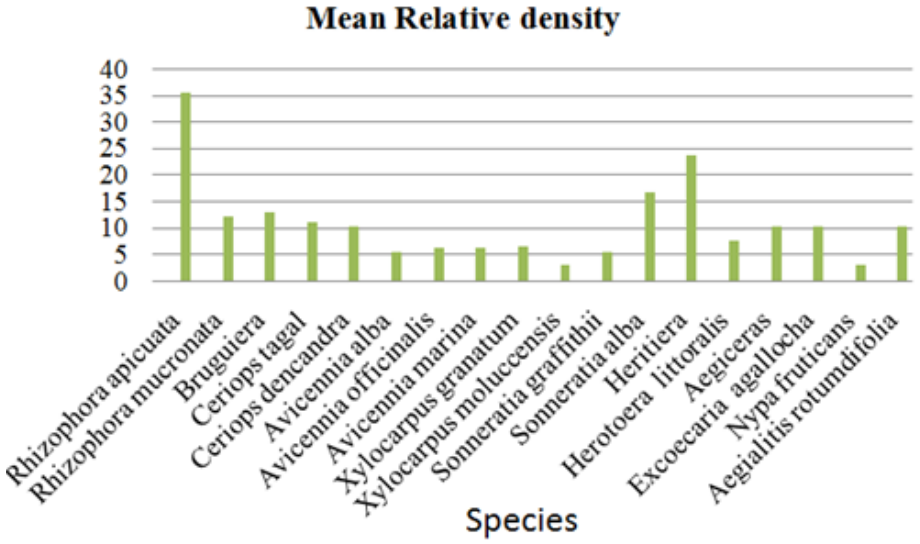

Figure 6 Mean Relative density of mangrove species at study site.

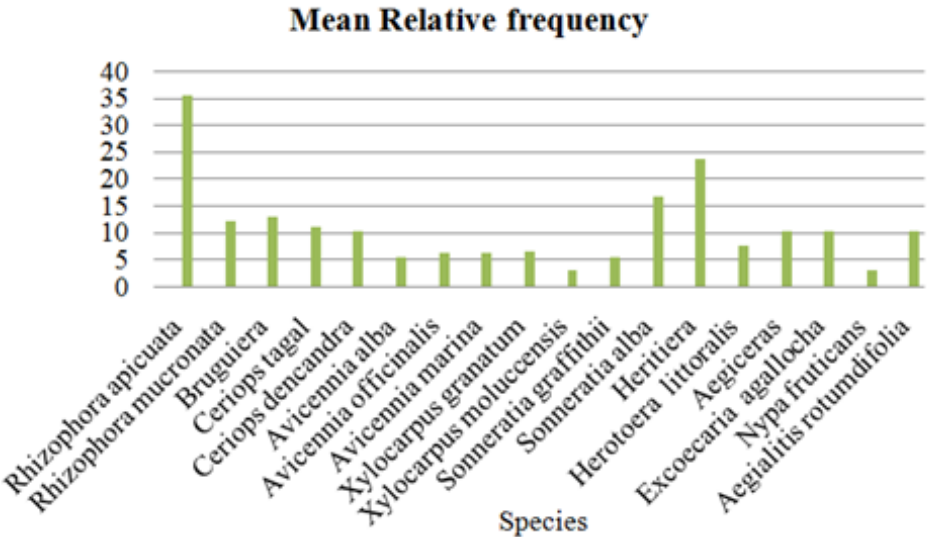

Figure 7 Mean Relative frequency of mangrove species at study site.

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According to latitudinal different, the vegetative structure and types of mangrove formation are unique in each region. The mangrove ecosystem in the tropical regions, along coastal shorelines and associated is important for many flora and fauna. The present study was conducted at six stations which represented different mangrove types in Shoreline, Seaward and landward. The present study deals with the occurrence, composition and vegetative structure of true mangrove in Kapa, Myeik Coastal Area .

There are many previous studies in Myeik and Mawdin Coastal Area. Among them, a total of about 50 species of mangrove,[6] the zonation of true and associate mangrove species distribution,[7] botanical study of importance of mangrove ecosystem for conservation and Management purpose,[8] 44 species of mangrove including true and associate species of mangroves[9] and 30 species including true mangrove and mangrove associates[10] were recorded in Myeik Coastal area. Moreover, the zonation pattern of mangrove in Magyi Tidal Creek by using transect lines method,[11] species composition and zonation pattern of mangrove of Kandon-kani, Amherst and Setse areas,[12] the mangrove reforestation from the Ayeyarwady Delta,[13] The socioeconomic study of Ayeyarwady mangroves and the species composition, zonation and succession of mangrove community along the Magyi coastal area.[14]

In the present study, only true mangrove was recorded by using Point Center Quarter Method (PCQM). A total of 18 species of true mangrove were observed in the present study in Kapa area, Kadan Island. A total of 18 species were distributed in Kapa. *Rhizophora apiculata* was common in all transects. Six species of *Aegiceras corniculatum*, *Avicennia alba*, *A. Marina*, *R. apiculata, R. mucronata* and *Sonneratia abal* were distributed in shoreline areas whereas ten species of *Aegialitis rotumdifolia*, *Aegiceras. corniculatum*, *A. officinalis*, *A. alba*, *Bruguiera parviflora*, *Rhizophora. apiculata*, *R. mucronata*, *Sonneria. alba*, *Xylocarpus granatum*and *Nypa fruticans* were distributed in the seaward areas and then, twelve species of *A . officinalis*, *Ceriops decandra*, *C. tagal*, *Excoecaria agallocha*, *Heritiera formes*, *H. littoralis*, *R. apiculata*, *R. mucronata*, *S. alba*, *S. graffithii, Xylocarpus granatum* and *X. moluccensis* were found to be distributed at the landward area. So landward area was most species and shoreline area was least species.

In measuring the forest parameters, 3 types of transect were laid and recorded the nearest species, the distance of tree from the plot's center and the circumference of selected species at all study sites. The vegetative structure of forests such as numbers of empty quadrant, number of species, proportion of multiple stem trees, mean number of stems in multiple stemmed, mean height, total forest density, total basal area, total frequency and complexity index for each transects were mentioned in Tables 4. Mean density, mean basal area, mean frequency, mean relative density, mean relative dominance, mean relative frequency, and mean importance value were shown in Table 5.

In measuring the mean relative density, *Rhizophora apiculata* was the highest group of plants, *Nypa fruticans* was least during the study period in Kapa,. *Sonneria alba* was the most influenced of mean relative basal area but *Aegialitis rotumdifolia* was the least in the study site. Mean relative frequency of *Rhizophora apiculata* is most influenced but *Xylocarpus moluccensis* and *Nypa fruticans* were least respectively in Kapa. And then *Rhizophora apiculata* was the most important species but *Nypa fruticans* is the least in the study sites.

In some cases, zonation may be very irregular or restricted to a particular part of the tidal gradient.[15] Similarly, the zone of study sites termed as Shoreline, Seaward and landward zone. According to the zonation pattern, *Rhizophoraapiculata, R. mucronata* and *S. alba* were distributed at all zones. *Aegiceras corniculatum,Aegialitis rotumdifolia, Avicennia alba, A.officinalis, Xylocarpus granatum,Bruguiera parviflora* and *Nypa fruticans* were distributed only at the seaward and then, *Avicennia officinalis, Excoecaria agallocha, Heritiera formes, H.littoralis Cerop. tagal, C. decandra, Xylocarpus moluccensis X.granatum* and *Nypa fruticans* were at the landward from the Kapa station, Myeik Coastal Area. The structure and composition, called mangrove vegetation structure dynamics, are rarely studied worldwide. The result of present study recognized the various types of dynamics. As the calculated result, mean basal area were variable ranging (0.0 to 1.9), mean relative density ranging (1.7to 37.2), mean relative dominance ranging (1.4 to 51.8), mean relative frequency ranging (2.9 to 35.4 and mean important value ranging (8.7 to 177.6) respectively at Kapa mangrove.

The present study has been carried out in the Kapa mangrove area in Kadan Island. The study site was selected and measured the vegetative structure and recorded the species composition so as to estimate the forest value. The forest type is inner mangrove formation which based on the tidal creeks. A total of 18 true mangrove species were recorded in the study area and some general zonation pattern among the species was recognized within the study period. According to the zonation pattern, the average soil salinity of landward side is the highest but the lowest the average soil salinity is the shore line in the study area. It is note that the soil salinity and water salinity are influencing the distribution of mangrove species along transects. Evidently, landward side is showed the most distributed mangrove species along transects. According to the data, the estimation of mangrove forest can be implemented. In the study areas, most of forest is in good condition but some of the areas are not because of several human impacts and activities. Today, mangrove forests are being degraded and destroyed on a larger scale globally through the natural disturbance and anthropogenic activities such as transforming to agriculture land, aquaculture ponds, salt ponds/ land etc., which are major causes of their degradation and loss of mangroves ecosystem. Thus, it is necessary to conserve the Kapa mangrove areas in proper ways for the sustainable uses in the future.[16–18]

Conclusion

The present study has been carried out in the Kapa mangrove area in Kanda Island . The study site was selected and measured the vegetative structure and recorded the species composition so as to estimate the forest value. The forest type is inner mangrove formation which based on the tidal creeks. A total of 18 true mangrove species were recorded in the study area and some general zonation pattern among the species was recognized within the study period. According to the zonation pattern, the average soil salinity of landward side is the highest but the lowest the average soil salinity is the shore line in the study area. It is note that the soil salinity and water salinity are influencing the distribution of mangrove species along transects. Evidently, landward side is showed the most distributed mangrove species along transects. In the study areas, most of forest is in good condition but some of the areas are not because of several human impacts and activities. Thus, it is necessary to conserve the Kapa mangrove areas in proper ways for the sustainable uses in the future.

Acknowledgments

We are greatly indebted to Dr San Tha Tun, Professor and Head, Department of Marine Science, Mawlamyine University, for his encouragement throughout the study period. We would like to

acknowledge to Dr Myo Min Tun (Lecturer) for reading and preparing this manuscript. We sincerely thank Ko Aung Nge and with his local villagers for their helpful assistance in field work. The first author, Soe Win, would like to thank he beloved family for their physical, moral and financial supports throughout this study.

Conflicts of interest

The author declares that there is no conflicts of interest.

Funding

None.

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