

# Current Status and Potential of Some Important Species of Mangrove Forest in Kien Giang and Ca Mau Provinces, Vietnam

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## Abstract

Identifying the component and distribution of some important species of mangrove forest in Kien Giang and Ca Mau will be useful for the strategy of mangrove forest protection development. After a preliminary survey of the entire forest, random measurements of 3 plots were used to calculate the coefficient of variation as a basis for calculating the sample size needed to conduct forest surveys. The area is required for the study is 1,666 ha, with a 95% confidence level and 10% error; each plot needs 100m<sup>2</sup>. The results of survey show that natural forests and coastal forests (apart from shrimp farms) are the main protective forest belt of the coastal line, so there are only 17 species belonging to 11 families of plants including 14 species woody plants, three shrub species, in which the *Rhizophora* (*Rhizophora apiculata*- Duoc) and *Avicennia* (*Avicennia sp.* -Mam) families are dominate. Regions can be grouped into four sub-regions depending on number of species as well as component of each species. At the similarity level of 40% of the plots, it can be divided into 5 groups. The analysis results show as follows: Group 1 has dominant species like Euphorbiaceae (*Excoecaria agallocha*- Gia), Group 2 dominant species is White *Avicennia* (*Avicennia alba* -Mam trang), Group 3 has 4 dominant species: White *Avocado*, *Avicennia*, *Sonneratia* (*Sonneratia sp.*), *Rhizophora*. Group 5 has 2 dominant species as Black *Avicennia* (*Avicennia officinalis*- Mam den) and *Rhizophora* (*Rhizophora apiculata*-Duoc). In conclusions, Mangroves and Black *Avicennia*, it should be considered for developing and protecting mangrove forest.

**Keywords:** *Avicennia* (Mam); Mangrove; Myrsinaceae (Su); *Rhizophoraceae* (Vet, Duoc)

## Introduction

Western mangroves in the Mekong Delta, mostly located in Kien Giang province and part of Ca Mau province borders An Minh district of Kien Giang; from An Minh to Ca Mau due to erosion of the sea, the area of natural forest in this area is severely damaged, so the area of natural mangrove forest is mostly in Kien Giang province. Vietnam has 3,260 km from Mong Cai, Quang Ninh province to Dat Mui, Ca Mau province. With a long coastline, many regions and regions have different natural conditions, so the distribution of mangrove species is also different. Particularly, mangrove forests in the west of Kien Giang and Ca Mau have more than 308 km from the Cambodian border to the boundary of Ca Mau Cape. Mangroves are typical ecosystem in the estuary of tropical and subtropical coastal areas, with rich and diverse biological resources, which are the boundary between land and sea, so it plays a particularly important role in the protection of sea dykes, fixed sediment encroachment on the sea, limiting the harms of storms, protecting accretion, preventing coastal erosion, limiting saltwater intrusion, protecting ecological environment [1,2].

The Western Sea region of Kien Giang province including An Minh, An Bien and Rach Gia city, Hon Dat, Kien Luong and Ha Tien town have more than 208 km of coastline, of which about 170 km of mangrove forest distribution with a total area of forests and coastal protective forest land of 8,365 ha (Kien Giang Department of Agriculture and Rural Development, 2012). In recent years, due to various reasons, the area of mangrove forests has been seriously destroyed, affecting production and people's lives in coastal areas. According to data from the Ministry of Agriculture and Rural Development, the area of mangrove forests in the whole country in 1943 was 408,500 hectares, until 1982 only 252,000 hectares (General Department of Forestry, 2010) [3,4].

The surface water environment of the coastal area is affected by many factors such as extensive and intensive shrimp farming areas, residential areas and aquatic processing facilities along the region. The rule of delta formation is due to the accumulation of accreted sediments, the mudflats gradually rise and rise, at low tide the ground is exposed. These are conditions for suitable species to spread seeds to grow, then stabilize and develop into a forest related to a group of Mam species (*Avicennia sp.*). When the population of *Avicennia* forest has formed and the mudflats are stable, other species such as Su and Vet ... will follow to continue

strengthening soil, until the mud soil has stabilized. For those reasons, the topic: "Identification of the component and distribution of some important species of mangrove forest in Kien Giang and Ca Mau" was carried out to determine the composition and distribution of some important species of mangrove forests in Kien Giang and Ca Mau provinces, from that strategy for protecting mangrove forest will be done in future [5,6].

## Material and Methods

### Descriptives of Research Place

Kien Giang and Ca Mau are two provinces in the Mekong delta, located from 101° 30' to 105° 32' Eastern Longitude and from 9° 23' to 10° 32' Northern Latitude. This area is shown in Figure 1.

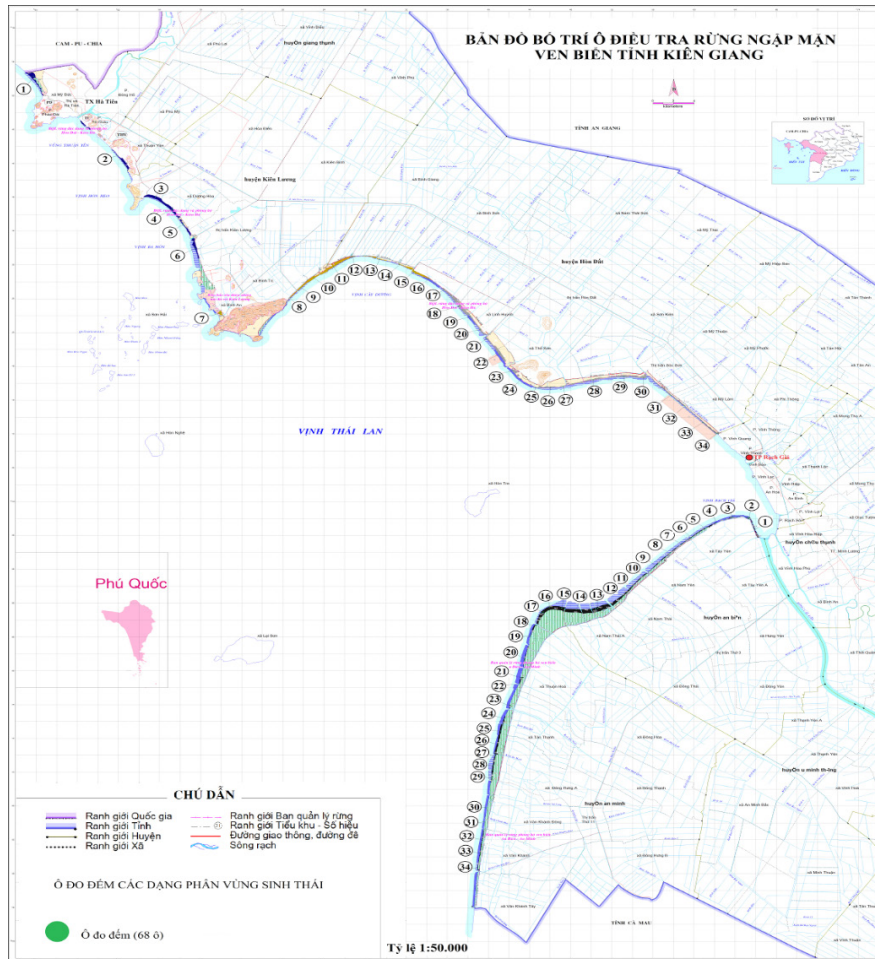


Figure 1: Map of plot arrangement measuring mangrove forest in the study area

### Survey Methods

After a preliminary survey of the entire forest, random measurements of 3 plots were used to calculate the coefficient of variation [7]. Depending on the purpose of the investigation, the accuracy is controlled differently. In the given agro-forestry research, the reliability is usually equal to 95% and 10% of the given error. The number of sample plots required for investigation ensures reliability is calculated according to the formula [8]:

$$n = \frac{4N(S\%)^2}{N(\Delta\%)^2 + 4a(S\%)^2}$$

where: n: Number of plots  
 a: Area of sample plot  
 %: Preset Error (10%)  
 N: Total capacity (N=f/a)  
 F: Area of survey region

S%: Coefficient of Variation;  $S\% = \frac{S}{\bar{X}} * 100$

where: S: Sample Standard Error

$\bar{X}$  : Sample average

Applying the above method to calculate the number of sample plots to be investigated, it is necessary to first investigate 3 sample plots to calculate the coefficient of variation on trunk diameter at 1.3 m (D1,3) of sample plots. Area of each plot is 10m x 10m = 100m<sup>2</sup> due to typical determination, so the distance determined based on the forest distribution surveyed and the previous coordinates determined, determine the relevant values to calculate, the results are as follows:

Average = 6,73787  
S = 0,2108

Stdev = 4,787777  
S% = 21,08%

$$N = \frac{F}{a} = \frac{\text{Area of survey region}}{\text{Sample plot Area}} = \frac{1.666\text{ha}}{100\text{m}^2} = \frac{16.660.000\text{m}^2}{100\text{m}^2} = 166.600$$

$$N = \frac{4N(S\%)^2}{N(\Delta)(\Delta\%)^2 + 4a(S\%)^2} = \frac{4*166600*444.37}{166600*100 + 4*100*444.37} = 8.8$$

Based on the West Sea mangrove current status map of Kien Giang and Ca Mau provinces, survey lines were arranged from the mainland to the sea so that the plot was located at the center of the forest belt. The points and survey plots were defined in advance coordinates on the digital map as a basis for determining the field location. The total number of plots was 68 plots on 2 routes, each of which has 34 plots shown in Figure 1.

**Characters for Measuring:** Determining tree species, trunk diameter at breast height (D1,3), peak height (Hvn), average diameter of tree canopy (Dt) perpendicular 2 toward the East-West and South-North, deduce the canopy section (Gt) by the formula:

$$Gt = \left(\frac{D}{2}\right)^2 \times \pi$$

**Growth Level:** Quality classification of standing trees (He) is the growth level of trees according to a scale of 5 (1 point is dead tree; 2 top tops; 3 normal growth plants; 4 good growth trees of copper 5 plants with strong growth, outstanding height, straight body, high branches).

### Data Analysis Methods

Microsoft Excel 2013 was used to analyse data and graph. PRIMER 6 software was used to analyze species similarities: Variables where standardized by Square root method, then set the same matrix according to Bray-Curtis method and draw branch diagrams by group average (Group average) to consider at similar levels. SPSS version 10.0 software was used to process data, using the ANOVA method and Duncan test at the 5% significance level to compare the differences among the study areas [9].

## Results and Discussion

### Components of Plant Species

No.	Families	Scientific name	Local name
1	Myrsinaceae	<i>Aegiceras corniculatum</i>	Su
2	Avicenniaceae	<i>Avicennia alba</i>	Mam trang
3	Avicenniaceae	<i>Avicennia marina</i>	Mam bien
4	Avicenniaceae	<i>Avicennia officinalis</i>	Mam den
5	Rhizophoraceae	<i>Bruguiera cylindrical</i>	Vet tru
6	Rhizophoraceae	<i>Bruguiera gymnorhiza</i>	Vet du
7	Euphorbiaceae	<i>Excoecaria agallocha</i>	Gia
8	Combretaceae	<i>Lumnitzera littorea</i>	Coc do
9	Combretaceae	<i>Lumnitzera racemosa</i>	Coc trang
10	Areecaceae	<i>Nypa fruticans</i>	Dua nuoc
11	Rhizophoraceae	<i>Rhizophora apiculata</i>	Duoc
12	Rhizophoraceae	<i>Rhizophora mucronata</i>	Dung
13	Sonneratiaceae	<i>Sonneratia caseolaris</i>	Ban chua
14	Sonneratiaceae	<i>Sonneratia ovate</i>	Ban oi
15	Annonaceae	<i>Annona reticulate</i>	Binh bat
16	Verbenaceae	<i>Clerodendro inerme</i>	Chum gong (Ngoc nu bien)
17	Malvaceae	<i>Hibiscus tiliaceus</i>	Tra

**Table 1:** Plant species component of mangrove forest in Kien Giang province

The results of the mangrove forest survey show that natural forests and coastal forests (apart from shrimp farms) are the main protective forest belt of the coastal line, so there are only 17 species belonging to 11 families of plants including 14 species of woody plants, three species of shrubs, in which the *Rhizophora* (Duoc) and *Avicennia* (Mam) families are dominate. Details of plants and species of mangrove forest are shown in Table 1.

Research area depending on ecological conditions can be divided in four sub-regions that are shown in Figure 2.

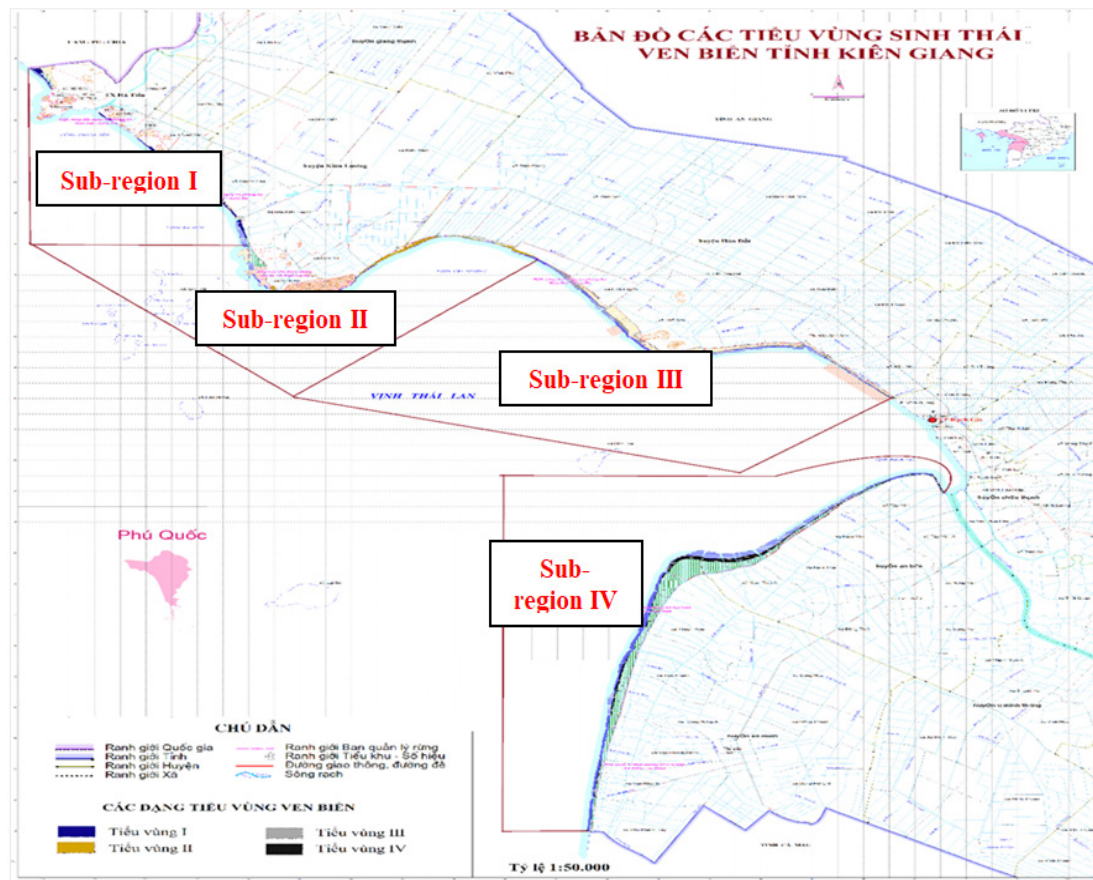


Figure 2: Four sub-regions represent for different ecological conditions in study area

### Growth Characteristics of Mangrove Species in Sub-Region 1

In sub-region 1, there are 7 species with density of 6,100 trees/ha. Species with number of dominant trees are Black *Avicennia*, accounting for 45%; The dominant species in the high tier is Ban oi, which accounts for a low proportion in the community of 11.75%; *Rhizophora* is the species with the second high ratio with the density of 32.5%; *Avicennia* (Mam trang) has a low ratio of 4.9%; Vet du, though accounting for a low rate of 3%; Gia is only 1.9%.

### Growth Characteristics of Mangrove Species in Sub-Region 2

Sub-region 2 has 12 species, expressing biodiversity here. It is higher than other sub-regions; for example, species composition is high, an endemic species is known as Coc do species. This species is being conservation of genetic resources. Besides, the density of forest trees here is quite high, 4,100 trees/ha; regarding density structure, the density of black *Avicennia* is 1,190 trees/ha, accounting for 29%; the second species has high density is White *Avicennia* 20%, the third highest density is Gia about 18%. Species have the fourth highest density is *Rhizophora* with 13%, other species account for less than 1% to 6% including Coc do, Coc trang, Su, Vet du, Ban chua, Tra, Binh bat, Ngoc Nu [10].

### Growth Characteristics of Mangrove Species in Sub-Region 3

In the ecological sub-region 3, there are 8 species: the dominant species with the highest density are Mam trang with 32%, the species with average appearance rate of 13-21% having 3 species of *Rhizophora*, Mam bien, *Nypa* palm; and species with low percentage smaller than 7% such as Gia, Vet du, Ban chua and Dung [11].

### Growth Characteristics of Mangrove Species in Sub-Region 4

In sub-region 4, there are 10 species and an average density with 2,450 trees/ha. This is the form of forest with many mixed species with 10 species surveyed: species with dominant density are Black *Avicennia* with 49% in all sub-regions, other species with high density such as White *Avicennia* accounts for 27%, *Rhizophora* accounts for 15%, other species such as Gia account for nearly 6%, the rest are accounted for below 1% like Ban oi, Ban chua (*Sonneratia*), Vet du, Coc trang, *Avicennia*, Vet tru [12].

## The Relationship among Communities

There is not significant at similarity relationship of 20%. At the similarity level of 40% of the plots, it can be divided into 5 groups. In each community group or main forest structure type, each forest type has different dominant species [13,14].

- Group 1 has dominant species like Gia, and there are 3 types of structure with total of 3 cells, accounting for 4.41%.
- Group 2 dominant species is White *Avicennia*, and there are 5 types of structure with total number of cells is 14 accounting for 20.58%.
- Group 3 has 4 dominant species: White *Avocado*, *Avicennia*, *Sonneratia*, *Rhizophora*. Of which, White *Avicennia* has 7 types of structure with a total of 7 cells occupy 10.29%. The *Avicennia* species has 4 types of structures with a total of 4 plots make up 5.88%. There are 2 species of *Sonneratia* and *Rhizophora*, each species has 1 type of vicwstructure and only 1 cell, accounting for 1.47%.
- Group 4 has 2 dominant species: *Rhizophora* and White *Avicennia*. In particular, *Rhizophora* is the main dominant species, and there are 9 types of structures with 9 cells account for 13.23%. The rest are White *Avicennia* species with 1 structure type and only 1 cell accounting for 1.47%.
- Group 5 has 2 dominant species as Black *Avicennia* and *Rhizophora*. In particular, Black *Avicennia* is the main dominant species accounting for 22 cells/28 cells. There are 11 types of structures, total of 22 cells accounting for 32.35%. The dominant species is *Rhizophora* with 6 types of structure, a total of 6 plots account for 8.82% of the measured plots.

## Conclusions

The composition and distribution of some species in the West Sea mangrove forest have 17 species of 11 plant families including 14 species of woody plants, 3 species of shrub species. About the relationship between species in the study area at the same level of 40% of plants divided into 5 main groups with 47 community types, 6 dominant species, including Mam den [*Avicennia officinalis*], Mam trang [*Avicennia alba*], Duoc [*Rhizophora apiculata*], Gia [*Excoecaria agallocha*], Ban oi [*Sonneratia caseolaris*]. Vet du [*Bruguiera yipamoriza*]. The distribution of species showed that Mam den [*Avicennia officinalis*] has the highest rate, the second species is Duoc [*Rhizophora apiculata*], and the third species is Mam trang [*Avicennia alba*]. It should be proposed in the afforestation on new land warped in the study area.

**Sub-region 1**, the composition of mudflats has a ratio of clay composition of 12.53%, flesh soil composition of 19.45%, sand of 68.02%. Due to the site conditions, this sub-region has very high sand content of 68%. No new forest planting should be conducted, but natural regeneration should only be conducted so that seedlings can adapt themselves to places where there are favourable conditions.

**Sub-region 2** has natural conditions with the ratio of 4.19% organic, 54.71% clay, 36.10% meat, 9.19% sand, total salt in soil 6.33 ‰, soil pH 8,11, and EC = 9,89mS/cm. This sub-region has a favorable condition of natural fertility, with a sufficient amount of sand, a high content of flesh soil, and a high percentage of organic ingredients, thus it only increases the composition of plant humus into the potting medium with a rate of 5-10% enough.

**Sub-region 3** has ratio of 7.29% soil organic matter, 52.29% clay, 45.89% flesh soil, 1.82% sand, total salt dissolved in 6.44‰ soil, pH 6.89, and EC = 10,06 mS/cm. As this sub-region has high clay and flesh soil content, low sand ratio, high organic composition, it is suitable for plantation and afforestation.

**Sub-region 4**, there are ratio of soil organic matter 2.34%, clay 55.59%, flesh soil 43.84%, sand 0.57%, total soluble salt 8.83 tan, soil pH 7.54, and EC = 13.8 mS/cm. This is a place with a fairly large mudflat, high clay and flesh soil content, low organic matter content in the soil, so it only pays attention to increase the ratio of organic matter in the potting mix from 5 - 10% to increase porosity and humus content for seedlings

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