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## Diversity and Evenness of Mangrove Trees in Thasala, Sichon and Pakpaneang District, Nakhon Si Thammarat Province, Thailand

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**Abstract** Diversity and evenness of mangrove trees in Thasala, Sichon and Pakpaneang district, Nakhon Si Thammarat province, Thailand were studied of mangrove trees in each district was conducted from December, 2016 to June, 2017. The surveying used the Line Transect method in the scope of area 50 x 200 meters for each district (station). The result showed that the diversity and evenness of mangrove trees in Thasala, Sichon and Pakpaneang district were found 29 species and 18 families. The most abundance are *Avicennia alba* BL (31.05%), *Bruguiera cylindrical* L. (27.12%) and *Rhizophora apiculata* Blume (9.30%), respectively. The kind of mangrove trees in Thasala, Sichon and Pakpaneang district, Nakhon Si Thammarat's coastline. The most abundance were founded 16 species and 6 families of trees, it is the highest number of total mangrove trees in this experiment is 3088 (78.28 percent). The second abundance were founded 4 species and 4 families of ground cover, it had the number of total ground cover from this experiment is 557 (14.12 percent), The third abundance were founded 8 species and 7 families of shrub, it had the number of total shrub in this experiment is 288 (7.30 percent), The less abundance was founded 1 species and 1 families of climbing, it had the number of total climbing from this experiment is 12 (0.30 percent). The diversity indices of this study were shown in Thasala, Pakpaneang and Sichon district are 0.67 0.45 and 0.47, respectively. The evenness indices of this study was shown in Thasala, Sichon and Pakpaneang district are 0.14 0.13 and 0.11, respectively.

**Keywords:** diversity, evenness, mangrove trees, shrub, ground cover, climbing

### Introduction

Thailand's coastline lengths of 2673 km, of which 1878 km, the Gulf coasts cover 1700 kms and Andaman seacoasts covers 973kms (Siripong, 2010). Nakhon Si Thammarat province borders part of western shoreline of

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the gulf of Thailand and it is one of the major areas of mangroves around this shallow sea. Relatively large areas of mangroves still remain along the coasts of Surat Thani, Songkla, Samut Sakorn and Chantaburi provinces that border gulf of Thailand. Coastline of Nakhon Si Thammarat province borders Kanom, Sichon, Thasala, Pakpanang, and Hau Sai district, which receives the largest volume of mangrove area. Nakhon Si Thammarat receives about 2000 mm of annual rainfall of which 50 per cent is received in less than three months, from November to January with north east monsoon. The mean annual temperature is 27.2 degrees C with 83 percent relative humidity. A semi diurnal tidal pattern prevails with a range that does not exceed 1 m. (Nakhon Si Thammarat province Meteorological Station, 2015). The mangrove forests are continuing degradation and destruction, there is a critical need to understand the biodiversity of mangrove ecosystems, more so in the countries, boarding the Indian Ocean, since this is the place of origin for mangroves where the losses of the habitats are the greatest (Kathiresan and Bingham, 2001).

The objectives were evaluated of the diversity and evenness of mangrove trees of Nakhon Si Thammarat's coastline in Thasala, Sichon and Pakpanang district, Nakhon Si Thammarat province, Thailand.

## **Materials and methods**

### ***Study area***

A study area of the diversity and evenness of mangrove trees of Nakhon Si Thammarat's coastline in 3 Districts : 1) Thasala, 2) Sichon and 3) Pakpanang, Nakhon Si Thammarat province, Thailand. In each district (station) were used as the areas for field study of 50 x 200 meters.

### ***Field study***

A field study of the diversity and evenness of mangrove was used Line Transect method in the scope of area 50 x 200 meters for each district (station).

### ***Analysis and classified of the mangrove trees***

The analysis of data the diversity and evenness of mangrove trees was used the formula  $H = -\sum^s (p_i) (\log_2 p_i)$  and  $E = H / H_{\max}$  (Brower *et al.*, 1997) for evaluating the diversity and evenness of mangrove trees.

## Results

### *Kind of mangrove trees*

The kind of mangrove trees in Thasala, Sichon and Pakpaneang district, Nakhon Si Thammarat's coastline. The most abundance were founded 16 species and 6 families of trees, it is the highest number of total mangrove trees in this experiment is 3088 (78.28 percent). The second abundance were founded 4 species and 4 families of ground cover, it had the number of total ground cover from this experiment is 557 (14.12 percent), The third abundance were founded 8 species and 7 families of shrub, it had the number of total shrub in this experiment is 288 (7.30 percent). The less abundance was founded 1 species and 1 families of climbing, it had the number of total climbing from this experiment is 12 (0.30 percent) Table 1.

**Table 1.** Kind of mangrove trees on Nakhon Si Thammarat's coastline in 3 Stations :1)Thasala, 2) Sichon and 3) Pakpaneang district, NakhonSiThammarat province, Thailand

Scientific Name	Family	Kind of Mangrove Trees				Station			N	%
		Tree	Shrub	Ground cover	Climbing	1*	2*	3*		
<i>erbera odollam</i> Gaertn.	APOCYNACEAE	✓	-	-	-	10	-	-	10	0.25
<i>Hibiscus tiliaceus</i> L.	MALVACEAE	✓	-	-	-	15	10	-	25	0.63
<i>Excoecaria agallocha</i>	EUPHORIACEAE	✓	-	-	-	20	20	52	92	2.33
<i>Avicennia alba</i> Bl.	AVICENNIACEAE	✓	-	-	-	1,162	14	49	1,225	31.05
<i>Avicennia officinalis</i> Linn	AVICENNIACEAE	✓	-	-	-	30	20	20	70	1.77
<i>Rhizophora mucronata</i> Poir	RHIZOPHORACEAE	✓	-	-	-	34	-	33	67	1.70
<i>Rhizophora apiculata</i> Blume	RHIZOPHORACEAE	✓	-	-	-	28	279	60	367	9.30
<i>Bruguiera cylindrica</i> L.	RHIZOPHORACEAE	✓	-	-	-	20	-	1,050	1,070	27.12
<i>Kandelia candel</i>	RHIZOPHORACEAE	✓	-	-	-	30	-	-	30	0.76
<i>Thespesia populnea</i>	MALVACEAE	✓	-	-	-	5	-	-	5	0.13
<i>Thespesia populneoides</i>	MALVACEAE	✓	-	-	-	12	-	-	12	0.30
<i>Sonneratia caseolaris</i> (L.) Engler	SONNERATIACEAE	✓	-	-	-	15	-	15	30	0.76
<i>Sonneratio ovate</i> Backer	SONNERATIACEAE	✓	-	-	-	10	-	10	20	0.51
<i>Bruguiera gymnorrhiza</i> L.	RHIZOPHORACEAE	✓	-	-	-	-	-	15	15	0.38
<i>Ceriops tagal</i> (Perr.) C.B.Pob	RHIZOPHORACEAE	✓	-	-	-	-	-	20	20	0.51
<i>Ceriops decandra</i> Ding Hou	RHIZOPHORACEAE	✓	-	-	-	-	-	30	30	0.76
Total of tree									3,088	78.28
<i>Volkameria inermis</i> L.	LAMIACEAE	-	✓	-	-	10	9	-	19	0.48
<i>Pluchea indica</i> Less.	COMPOSITE	-	✓	-	-	20	8	16	44	1.12
<i>Scyphiphora hydrophyllacea</i>	RUBIACEAE	-	✓	-	-	10	-	-	10	0.25
<i>Nypa fruticans</i> Wurm	ARECACEAE	-	✓	-	-	15	-	-	15	0.38
<i>Acrostichum aureum</i> L.	PTERIDACEAE	-	✓	-	-	10	-	-	10	0.25
<i>Acanthus volubilis</i> Wall	ACANTHACEAE	-	✓	-	-	100	-	-	100	2.53
<i>Acanthus volubilis</i> Wall	ACANTHACEAE	-	✓	-	-	50	-	-	50	1.27
<i>Lumnitzera racemosa</i> Willd.	COMBRETACEAE	-	✓	-	-	-	10	30	40	1.01
Total of shrub									288	7.30
<i>Sesuvium portulacastrum</i> L.	AIZOACEAE	-	-	✓	-	200	-	-	200	5.07
<i>Ipomoea pes-caprae</i> (L.)	CONVOLVULACEAE	-	-	✓	-	30	-	-	30	0.76
<i>Suaeda maritime</i>	CHENOPODIACEAE	-	-	✓	-	300	-	-	300	7.60
<i>Acrostichum apaciosum</i>	PTERIDACEAE	-	-	✓	-	-	7	20	27	0.68
Total of ground cover									557	14.12
<i>Derris trifoliata</i> Lour.	FABACEAE	-	-	-	✓	-	-	12	12	0.30
Total of climbing									12	0.30
Total of mangrove trees									3,945	100.00

Remark : 1\* = Thasala District 2\* = Sichon District 3\* = Pakpaneang District

### Diversity and evenness of mangrove trees

The result showed that the diversity of mangrove trees in Thasala, Sichon and Pakpaneang district was founded 29 species and 18 families. The most abundance are *Avicennia alba* BL (31.05%), *Bruguiera cylindrical* L. (27.12%) and *Rhizophora apiculata* Blume (9.30%), respectively. The result showed that the kinds of mangrove trees were found 16 species and 6 families, the kind of shrub was founded 8 species and 7 families, the kind of ground cover was founded 4 species and 4 families and the kind of climbing were found 1 species and 1 family (Table 2).

**Table 2.** Diversity and evenness of mangrove trees on Nakhon Si Thammarat's coastline in 3 Stations: 1) Thasala, 2) Sichon and 3) Pakpanaeng district, Nakhon Si Thammarat province, Thailand

Scientific Name	Family	Station			N	%	rank
		1*	2*	3*			
<i>Cerbera odollam</i> Gaertn.	APOCYNACEAE	10	-	-	10	0.25	20
<i>Hibiscus tiliaceus</i> L.	MALVACEAE	15	10	-	25	0.63	15
<i>Excoecaria agallocha</i>	EUPHORIACEAE	20	20	52	92	2.33	7
<i>Avicennia alba</i> BL.	AVICENNIACEAE	1,162	14	49	1,225	31.05	1
<i>Avicennia officinalis</i> Linn	AVICENNIACEAE	30	20	20	70	1.77	8
<i>Rhizophora mucronata</i> Poir	RHIZOPHORACEAE	34	-	33	67	1.70	9
<i>Rhizophora apiculata</i> Blume	RHIZOPHORACEAE	28	279	60	367	9.30	3
<i>Bruguiera cylindrica</i> L.	RHIZOPHORACEAE	20	-	1,050	1,070	27.12	2
<i>Kandelia candel</i>	RHIZOPHORACEAE	30	-	-	30	0.76	14
<i>Thespesia populnea</i>	MALVACEAE	5	-	-	5	0.13	21
<i>Thespesia populneoides</i>	MALVACEAE	12	-	-	12	0.30	19
<i>Sonneratia caseolaris</i> (L.) Engler	SONNERATIACEAE	15	-	15	30	0.76	13
<i>Sonneratia ovate</i> Backer	SONNERATIACEAE	10	-	10	20	0.51	16
<i>Bruguiera gymnorhiza</i> L.	RHIZOPHORACEAE	-	-	15	15	0.38	18
<i>Ceriops tagal</i> (Perr.) C.B.Pob	RHIZOPHORACEAE	-	-	20	20	0.51	16
<i>Ceriops decandra</i> Ding Hou	RHIZOPHORACEAE	-	-	30	30	0.76	13
<i>Volkameria inermis</i> L.	LAMIACEAE	10	9	-	19	0.48	17
<i>Pluchea indica</i> Less.	COMPOSITE	20	8	16	44	1.12	11
<i>Scyphiphora hydrophyllacea</i>	RUBIACEAE	10	-	-	10	0.25	20
<i>Nypa fruticans</i> Wurm	PALMACEAE	15	-	-	15	0.38	18
<i>Acrostichum aureum</i> L.	PTERIDACEAE	10	-	-	10	0.25	20
<i>Acanthus volubilis</i> Wall	ACANTHACEAE	100	-	-	100	2.53	6
<i>Acanthus volubilis</i> Wall	ACANTHACEAE	50	-	-	50	1.27	10
<i>Lumnitzera racemosa</i> Willd.	COMBRETACEAE	-	10	30	40	1.01	12
<i>Sesuvium portulacastrum</i> L.	AIZOACEAE	200	-	-	200	5.07	5
<i>Ipomoea pes-caprae</i> (L.)	CONVOLVULACEAE	30	-	-	30	0.76	13
<i>Suaeda maritime</i>	CHENOPODIACEAE	300	-	-	300	7.60	4
<i>Acrostichum apaciosum</i>	PTERIDACEAE	-	7	20	27	0.68	14
<i>Derris trifoliata</i> Lour.	FABACEAE	-	-	12	12	0.30	19
Total number of mangrove trees		2,136	377	1,432	3,945	100.00	
Diversity Indices		0.67	0.44	0.45			
Evenness Indices		0.14	0.13	0.11			

Remark : 1\* = Thasala District 2\* = Sichon District 3\* = Pakpanaeng District

The result of the diversity indices of mangrove trees in 3 stations of Nakhon Si Thammarat coastline, Thailand, were found the diversity indices of mangrove trees in station one to station three 0.67 0.44 and 0.45,

respectively. The most of the diversity indices were shown on station one (Sichon district) 0.67 and otherwise, the least diversity indices were shown on station two (Thasala district) in 0.44 (Table 1). The result of the evenness indices of trees in 3 stations were found the evenness indices of mangrove trees in station one to station three 0.14 0.13 and 0.11, respectively. The most of the evenness indices were shown on station one (Thasala district) and station two (Sichon district), the least evenness indices were shown on station two (Pakpanaeng district) Table 2.

## Discussion

The diversity and evenness observations of trees are varied by area and climatic around the world. In China, *Faguis* confined to the mountains of the evergreen broad-leaved forest zone in subtropical (Hou, 1983) or warm temperate China. It is absent from temperate or cool temperate (Kira, 1991; Cao *et al.*, 1995). In Lisbon, Portugal, street tree community was dominated by *Celtis australis* L., *Tillia* spp., and *Jacaranda mimosifolia* D. which together counted 40% of tree population (Soares *et al.*, 2011). In Bangalore, India, the four most commonly found species; *Albiziasaman*, *Peltophorum pterocarpum*, *Spathodea campanulata*, and *Pongamia pinnata*, while *Albizia samanis* common species that was found less than 10% of the population (Nagendra and Gopal, 2010). The study of street trees on Nakhon Si Thammarat highway includes aspects of diversity, prevalence and environmental benefit provision. The approximated number of the street trees is 300,000 from 83 species, 69 genera, and 31 families (Choothong *et al.*, 2016). The diversity of trees on the Tapae canal waterside, Thong Song District, Thailand were found 1016 trees, 78 species, 65 genera and 39 families. The most abundance family are in GUTTIFERAE, PALMAE, EUPHORBIACEAE, respectively. The five most abundant are: 1) *Garcinia maggostna* L. (13.78%); 2) *Elaeis guinensis* Jacq. (10.83%); 3) *Hevea brasiliensis* Muell. Agr. (8.86%); 4) *Bambusa* sp.. (7.19%); and 5) *Leuaena leucocephala* Lamk. (6.89%), respectively. The diversity indices were found that the most of the diversity indices were shown on station seven 1.25 and the lest diversity indices were shown on station two in 0.58. The most of the evenness indices was shown in station six and station seven were 0.89 and 0.85, respectively. The least evenness indices were shown on station two 0.56 (Na Nakorn *et al.*, 2016a). The most of trees in 16 schools in Thong Song district, Nakhon Si Thammarat, Thailand (Na Nakorn *et al.*, 2016b). The diversity and prevalence of tree in 16 schools had the approximated number of 243 trees from found 242 species, 45 genera and 22 families, the most dominant family is LEGUMINOSAE. The benefit tree use mainly for shading 78 percent and for landscaping and the aesthetics is 22 percent (Na Nakorn *et al.*, 2016b). Density, frequency and dominance of mangrove species at each

station is different. The spread of the species due to several factors, among others: environmental conditions (soil type, pH, salinity, substrate, and current), the availability of propagules, type root sticking propagules, buoyancy propagules, breeding types of mangrove species, and competition among species. Another thing that affects the distribution of this species is a species usefulness to the needs of local communities (Zakaria and Nawaz Rajpar, 2015). Also the diversity and evenness of mangrove trees in Thasala, Sichon and Pakpaneang District, Nakhon Si Thammarat Province, Thailand, it was different from the other area in the word.

## Conclusion

The kind of mangrove trees in Thasala, Sichon and Pakpaneang district, Nakhon Si Thammarat's coastline. The most abundance were founded 16 species and 6 families of trees, it is the highest number of total mangrove trees in this experiment is 3088 (78.28 percent). The second abundance were founded 4 species and 4 families of ground cover, it had the number of total ground cover from this experiment is 557 (14.12 percent), The third abundance were founded 8 species and 7 families of shrub, it had the number of total shrub in this experiment is 288 (7.30 percent), The less abundance was founded 1 species and 1 families of climbing, it had the number of total climbing from this experiment is 12 (0.30 percent). The diversity and evenness of mangrove trees in Thasala, Sichon and Pakpaneang district were found 29 species and 18 families. The most abundance are *Avicennia alba* BL (31.05%), *Bruguiera cylindrical* L. (27.12%) and *Rhizophora apiculata* Blume (9.30%), respectively. The diversity indices of this study were shown in Thasala, Pakpaneang and Sichon district are 0.67, 0.45 and 0.44, respectively. The evenness indices of this study was shown in Thasala, Sichon and Pakpaneang district are 0.14 0.13 and 0.11, respectively.

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