

Phytosociological Studies on Tropical Peat Swamps

1. Classification of Vegetation at Narathiwat, Thailand

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Abstract Natural forests and many types of the secondary vegetation under the influence of human activities, are remained in the peat swamp areas at Narathiwat, Thailand. All types of the peat swamp vegetation were studied in the field and phytosociological classification of the vegetation was proposed in accordance with the concepts and methods of the Zurich-Montpellier School. Two series of the community rings were distinguished by the soil condition ; sandy soil and peat.

Key Words: Peat Swamp / Vegetation / Community Ring / Phytosociology / Peninsula Malaysia / Thailand

In the Southeast Asian coastal areas along Peninsula Malaysia, the eastern part of Sumatra, and the northern part of Borneo are vast areas of swamps composed of peat soil. This type of soil had formed under the influence of sea and brackish waters. According to Driessen (1978), the total area of peat swamp and marsh in the tropical areas is about 30 million hectares, of which the Southeast Asian tropical areas account for 20 million hectares or 2/3 of the total. The total areas of peat in Thailand comprise about 45,264 hectares and the vast majority, 60 per cent (26,600 hectares) is found in Narathiwat Province (Vijarnsorn & Panichapong, 1987). Agricultural development in this area is more difficult than other areas and much of the natural forest and vegetation remained as of 10-20 years ago.

There has not been much research with regards to vegetation in peat swamps except for Anderson (1964), Wyatt-Smith (1959), etc. Details of vegetation and the ecosystem in peat/acid-sulfate soil areas is therefore not very clear. We had the opportunity to study vegetation of the peat swamp area at Narathiwat province of Thailand during the months of March, July and August of 1987, August of 1988, August of 1989 and December of 1990.

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OUTLINE OF THE STUDY AREAS

The study area, the Narathiwat area, is located at the center of Peninsula Malaysia facing the Bay of Thailand (between 6° 50' and 25' latitude north and 101° 50' and 102° 5' longitude east). This area is adjacent to Malaysia separated by the Bang Nara River (Fig. 1). The

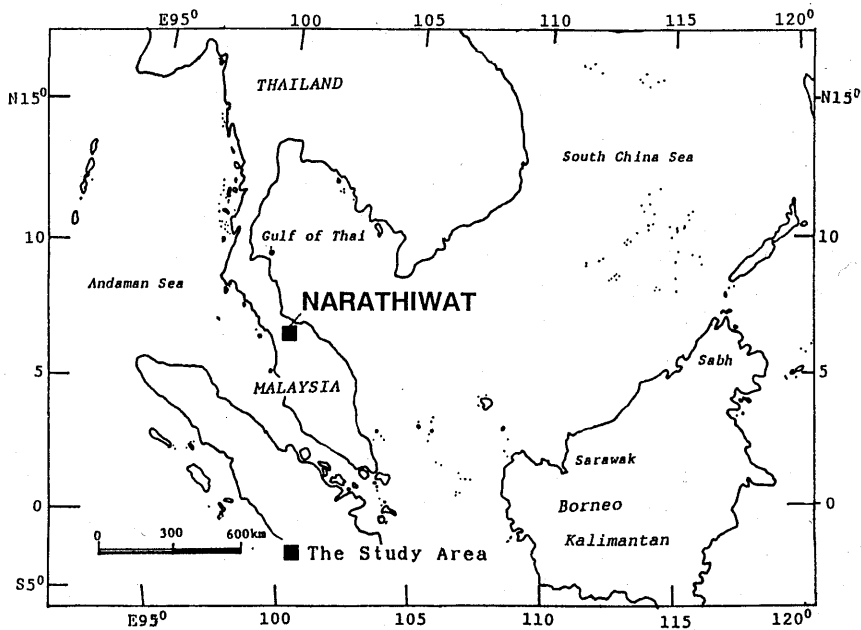


Fig. 1. Map showing the location of the survey area.

climate of the area is "Af (climate of tropical rain forest without distinct dry season)" according to Koppen's classification. Mean temperature 27.6 degrees Celsius while the average of total rainfall is 2,560.2 mm (1973-85 ave.). The relative humidity ranges from 77 to 83 per cent. The heaviest rainfall is in the months of November and December. During these 2 months, the total rainfall accounts for 50 per cent of the year's total. During the rainy season, most of the coastal area, which are used for paddy fields or pasturage, become flooded and have depths of a few meters.

Coastal wetland (that is peat/acid-sulfate soils) at Narathiwat can be found behind the sand dunes along the 10 km NW to SE coastlines of Narathiwat. These coastal wetlands have depths of 1-5 meters and characterized by peat soil. Ordinarily because of high temperature organic material in swamps become decomposed. However, in the coastal wetlands of Narathiwat, because of long-term flooding of about 1-3 meters high, the organic materials experience slow rate of decomposition.

The peat of the tropical zone consists mainly of sediments from woody remains such as roots, branches, and tree trunks; whereas the peat of the temperature and arctic zones are of the herbal type. Moreover, original or natural vegetation of peat swamp of the tropics is of the forest-type, while that of the temperature or arctic zones is of the grassland type. A thin peat layer is found also on the surface of periodically waterlogged facies of heath forest known in Sarawak, as kerapah (Whitmore, 1988). However, peat soils in the tropical, temperature, and arctic zones are all classified into the soil unit, "Histosols (organic soils)", by the Soil Taxonomy of the USDA and FAO/UNESCO.

A multitude of limitations and problems are encountered in the exploitation of peat. Some of these problems are water-logging conditions, high water table, low inherent nutrient status including low macro and micro nutrients, high organic conditions, poor conditions for mecha-

nization and irreversible shrinkage if excessively drained.

FLORISTIC CHARACTER OF THE STUDY AREAS

In Tropical Asia there are tree main kinds of swamp vegetation (forest types); mangrove forest under the influence of seawater, freshwater swamp forest and peat swamp forest. Peat swamps, mainly receive moisture solely from rainfall which contains very much smaller amounts of dissolved nutrients.

The peat swamp forest and grassland are unique vegetation with a high proportion of endemic taxa. Prior to 1975, most of the peat swamps in Narathiwat province were remained undeveloped due to permanent water-logging, dense forest vegetation and inaccessibility. However, due to steady needs of land for agricultural production, vast areas of the swamps was developed. At present, two hundred and ninety eight flowering plants have been observed in the natural forest of the Narathiwat peat swamps, including 70 species of commercial timber trees, many of which are restricted to the area (Niyomdham, 1988).

A study of floristic composition of the peat swamp forest and the adjacent tidal forest in Narathiwat province, Thailand, has been undertaken by the staff of the Forest Herbarium, Royal Forest Department since 1983. So far 88 families and 298 species of flowering plant and 13 families and 18 species of ferns have been recorded, of which 48 species are regarded as new records for Thailand.

METHODS

The present work was carried out on the vegetation growing in the area of peat/acid-sulfate soils. All types of vegetation, from natural to substitutional and from herbaceous to forest vegetation, was investigated by the present field survey. The vegetation was studied in accordance with the concepts and methods of the Zurich-Montpellier School.

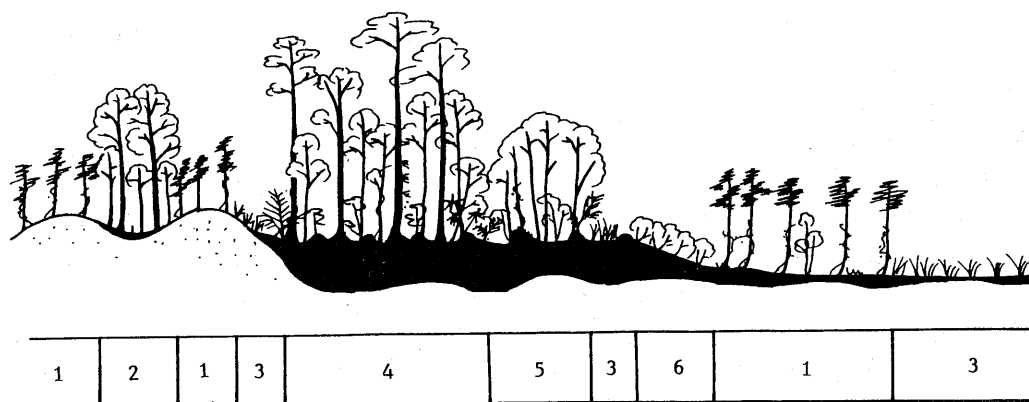


Fig. 2. Actual vegetation profil of the peat swamp area at Narathiwat, Thailand.

1: *Lygodium microphyllum*-*Melaleuca cajuputi*-community and *Evodia roxburghiana*-*Melaleuca cajuputi*-community, 2: *Schima wallichii*-*Fagraea fragrans*-community, 3: *Chrysopogon orientalis*-*Massia trisetata*-community, 4: *Baccauria bracteata*-*Endiandra macrophylla*-community, 5: *Macaranga pruinosa*-community, 6: *Lygodium microphyllum*-*Melastoma malabathricum*-community and *Rhodomerytus tomentosa*-community.

It was determined that each and every stand selected for the survey had to have an area extending over the minimum survey space in habitat which showed homogeneous physiognomy, and therefore, could be judged evenly. All the species within the stand were checked to make a complete species list by layer. The Braun-Blanquet method was employed to determine comprehensively the cover class and sociability of the species in each layer. The cover degree-abundance scale follows Braun-Blanquet in 1951 and Miyawaki & Suzuki in 1980. Another quantitative estimate per taxon is its sociability rating. Under sociability is meant the grouping or touching of individuals of the same species or taxon, the clumping or clustering of that one species within the confines of the sampled area. The sociability scale follows Braun-Blanquet in 1951 and Miyawaki & Suzuki in 1980. Simultaneously, assessments were made of habitat conditions, human impact, micro-topography, soil conditions etc.

The data of releves collected in the field surveys, were put together into raw tables. The raw tables were rearranged into frequency tables, differential tables, summary tables, etc. From the integrated summary table, the species recognized as characterizing or differential species were arranged. Finally, the vegetation were classified into communities, considering all the data available.

RESULTS: PLANT COMMUNITIES (Phytosociological Classification)

FOREST VEGETATION

The natural forests in the peat swamp of Thailand are highly developed than those of Sarawak and Brunei. All of the forests carry mixed peat swamp forest, which is similar in structure and physiognomy to lowland dipterocarp evergreen rain forest but with fewer component species per unit area, a lower canopy (maximum ca. 40 meters) and prominent pneumatophores.

In Thailand, the natural coastal peat swamp forests can only be found at Narathiwat especially near the village areas of Kok Chun Bet and Ban Pa Wai, but the area of natural forest is decreasing every year due to burning and draining. The peat swamp forests of Narathiwat are divided into four types which are distinct in structure and floral character. The first type is a typical mixed swamp forest on the thick peat layer. The second type is a *Macaranga*-dominated swamp forest on the thick peat layer. The third type is a *Melaleuca*-dominated forest on the thin peat layer or sandy conditions. The last type is a *Fagraea*-dominated forest on the sandy soil with thin peat layer.

1. *Baccauria bracteata*-*Endiandra macrophylla*-community (Table 1)

In Thailand, the areas of the primitive untouched or natural peat swamp forests are restricted to a few inaccessible pockets such as Ban Pa Wai, To Daeng, Kok Chun Bet and the neighboring at Narathiwat.

In this research, the phytosociological data of the natural mixed swamp forest were collected from 4 stations (3 stations at Kok Chun Bet and 1 station at Ban Pa Wai) and summarized into the *Baccauria bracteata*-*Endiandra macrophylla*-community with a rather restricted flora. The community is composed of: a) a tree layer-1 having a height of 35-42 meters; b) a tree layer-2 having a height of 20-28 meters; c) a shrub layer with a height of 10-13 meters; and d) a herb layer of biologically poor characteristics, having a height of 2-4 meters. The total number of species in the community ranges from 38 to 51 based on the data collected from the 4 stations. The surveyed area of each station is 1,050-1,600 square meters. Most of the component species are tree species, having still-roots, buttresses and pneumato-

phores. Pneumatophores are characteristic features in certain species: peg-like ones are diagnostic of *Stemonurus secundiflorus* (Icacinaeae); stilt like roots pneumatophores of *Elaeocarpus macrocerus* (Elaeocarpaceae); bridge-like roots of *Neesia altissima* (Bombacaceae); and looped of *Horsfieldia crassifolia* (Myristicaceae) and *Xylopia fusca* (Annonaceae) and knee-like of *Ganua montleyana* (Sapotaceae). The main species of tree and sub-tree layers are *Stemonurus secundiflorus*, *Eugenia tumida* (Myrtaceae), *Endiandra macrophylla* (Lauraceae), *Camptosperma coriaceum* (Anacardiaceae), *Ganua moileyana*, *Baccauria bracteata* (Euphorbiaceae), *Neesia altissima*, *Sandoricum emarginatum* (Meliaceae), *Litsea resinosa* (Lauraceae) etc. The shrub layer, meanwhile, consists of *Eugenia spicata*, *Neesia altissima*, *Sandoricum emarginatum*, *Cinnamomum rhychnophyllum* (Lauraceae) and palms such as *Licuala longecalycata*, *Eleiodoxa conferta*, *Pinanga riparia*, and *Nenga pumila*. *Eleiodoxa conferta* and *Licuala longecalycata* are very common palms in the forest. The herb layer is mainly composed of *Rhaphidophora minor* (Araceae), *Aglanema nitidum* (Araceae), *Hypolytrum nemorum* (Cyperaceae) and the climbing Fern, *Stenochlaena palustris* (Pteridaceae). Climbing species and ground flora are comparatively poor. Normally, ground flora are very sparse but are denser in open spaces (gaps) in the forest.

Some of climbers and epiphytic plants are not listed in the phytosociological community table, because they were difficult to be identified and were located on the higher layer. In the peat swamp forest, climbers are very sparse, except for certain places where clustering thorny rattan occurs. These are *Calamus caesius*,

Table 1. *Baccauria bracteata*-*Endiandra macrophylla*-community

Relieve no.:	1	2	3	4
Field no.:	L	N	A	J
Area of releve(qm):	1600	1600	1050	1200
Height of tree layer-1(m): T1	35	42	40	38
Cover of tree layer-1(%): T1	60	50	15	75
Height of tree layer-2(m): T2	20	24	28	21
Cover of tree layer-2(%): T2	30	40	60	20
Height of shrub layer(m): S	10	10	10	13
Cover of shrub layer(%): S	30	30	30	60
Height of herb layer(m): H	2.5	2	4	3
Cover of herb layer(%): H	40	25	30	10
Total no. of species:	38	51	51	43

<i>Eugenia cereiformis</i> (Bl.)DC. (Myrtaceae)	T1	1.2	.	.	.
	T2	1.2	.	.	.
	S	.	+	+	+
	H	.	.	.	.
<i>Stemonurus secundiflorus</i> Bl.(Icacinaeae)	T1	1.1	.	.	.
	T2	2.3	1.2	+	.
	S	+	+	2.3	2.3
	H	.	.	.	.
<i>Eugenia rumida</i> Duth. (Myrtaceae)	T1	1.1	.	.	.
	T2	.	2.3	1.1	1.2
	S	2.3	2.2	2.3	1.2
<i>Endiandra macrophylla</i> (Bl.) Boerl.(Lauraceae)	T1	2.2	3.3	.	1.1
	T2	2.3	+	+	2.2
	H	.	.	+	2.2
<i>Ganua moileyana</i> Pierre (Sapotaceae)	T1	3.3	3.3	.	2.2
	T2	2.2	+	3.3	+
<i>Baccauria bracteata</i> Muell. Arg. (Euphorbiaceae)	T2	+	+	2.2	+
<i>Neesia altissima</i> Bl. (Bombacaceae)	T1	+	+	1.1	1.2
	S	.	1.2	+	+
<i>Litsea resinosa</i> Bl. (Lauraceae)	T1	T2	+	2.3	1.1
	S	+	2.2	+	+
<i>Freycinetia angustifolia</i> Bl. (Pandanaeae)	T1	+	+	2.2	+
	S	+	2.2	+	+
<i>Asplenium nidus</i> L. (Aspleniaceae)	T2	+	+	+	+
	S	+	+	+	+
<i>Camptosperma coriaceum</i> (Jack) Hall.f.(Anacardiaceae)	T1	+	1.1	.	.
	T2	.	.	1.1	.
<i>Blumeodendron kursori</i> (Hook.f.)Smith (Euphorbiaceae)	T1	T2	3.3	1.1	.
	S	.	.	.	.
<i>Xylopia fusca</i> Maing. (Annonaceae)	T1	T2	2.1	.	1.1
	S	.	.	.	.
<i>Stenochlaena palustris</i> Bedd. (Pteridaceae)	S	+	+	+	+
	H	.	+	2.3	.
<i>Sandoricum emarginatum</i> Hiern (Meliaceae)	T1	.	2.2	.	3.3
	T2	.	.	.	.
	S	.	+	+	+
<i>Eugenia spicata</i> Lamk. (Myrtaceae)	S	.	+	+	+
<i>Aglanema nitidum</i> Kunth (Araceae)	H	2.3	+	+	+
<i>Licuala longecalycata</i> Furt. (Palmae)	S	.	.	1.2	.
	H	3.3	.	3.3	1.1
<i>Rhaphidophora minor</i> Hook.f. (Araceae)	H	+	+	+	+
<i>Horsfieldia crassifolia</i> Warb.(Myristicaceae)	T1	T2	.	1.1	1.1
	S	.	.	.	.
<i>Macaranga pruinosa</i> (Miq.)H.A. (Euphorbiaceae)	T1	T2	.	.	2.1
	S	.	.	.	.
<i>Cinnamomum rhychnophyllum</i> Miq. (Lauraceae)	S	.	.	.	.
<i>Chisocheton divergens</i> Bl. (Meliaceae)	T2	.	.	.	.
<i>Myristica elliptica</i> Wall. (Myristicaceae)	T1	S	1.2	.	+
<i>Dacryodes incurvata</i> (Engl.) Lam. (Sauraceae)	T1	.	.	.	.
<i>Polyalthia glauca</i> (Hassk.) Boerl. (Annonaceae)	T2	.	.	.	1.2
<i>Tetracera loureiri</i> Pierre (Silleniaceae)	S	.	.	.	+
<i>Hypolytrum nemorum</i> Spreng (Cyperaceae)	H	1.2	.	.	.
<i>Eugenia oblata</i> Roxb. (Myrtaceae)	S	1.2	.	1.2	.
	H	.	.	.	.
<i>Freycinetia javanica</i> Bl. (Pandanaeae)	H	+	+	+	+
<i>Caryota mitis</i> Lour. (Palmae)	H	.	.	.	.
<i>Uncaria roxburghiana</i> Korth. (Rubiaceae)	S	H	+	+	+
<i>Aglanema marantifolium</i> Bl. (Araceae)	H	.	+	+	+
<i>Daphnia racemosa</i> Korth. (Oxalidaceae)	T2	.	+	+	+
	S	.	.	.	.
<i>Myristica maingayi</i> Hook.f. (Myristicaceae)	T2	S	.	.	+
<i>Lithocarpus bennettii</i> (Miq.) Rehd. (Fagaceae)	T1	.	.	.	1.1
<i>Polyalthia curtisii</i> Ridl. (Annonaceae)	T1	T2	.	.	+
<i>Calophyllum teysmannii</i> Miq. var. <i>anophylloides</i> (King) Stevens (Guttiferae)	S	.	.	.	1.1
<i>Gymnanthera eugenifolia</i> Sincl. var. <i>griffithii</i> (Warb.)Sincl. (Myristicaceae)	T2	.	.	.	+
<i>Dialium patens</i> Baker (Leg.-Caesalpinioideae)	T2	.	.	.	1.1
<i>Paracetone urophyllus</i> A.DC. (Rosaceae)	S	.	.	.	1.2
<i>Garcinia cowa</i> Roxb. (Guttiferae)	T2	.	.	.	+
	S	.	.	.	+
<i>Nenga pumila</i> Wendl. (Palmae)	H	.	3.3	+	2.2
<i>Melanochyla bracteata</i> King (Anacardiaceae)	S	.	.	+	2.3
	H	.	.	.	+
<i>Nephrolepis biserrata</i> Schott (Oleandraceae)	H	.	.	.	+
<i>Eleocarpus macrocerus</i> (Turcz.) Merr.(Elaeocarpaceae)	T2	S	1.1	.	+
<i>Parishia insignis</i> Hook.f. (Anacardiaceae)	T1	.	.	.	+
	S	.	.	.	+

Species with presence 1 no.: *Ixora grandifolia* Zoll.(Rubiaceae) S+, *Eleiodoxa conferta* Burr.(Palmae) H-1,2, *Ficus* sp. 1 (Moraceae) H+, *Evoidia roxburghiana* Benth.(Rutaceae) H+, *Daemonorops angustifolia* Hart. (Palmae) H+, *Cyrtostachy. randa* Bl.(Palmae) no.2: *Myristica cinerea* Bl.(Myristicaceae) T2+,H+, *Ficus* sp.2 (Moraceae) S+, *Poikiliospermum suwalensis* Merr.(Moraceae) S+, *Ficus* sp.3 (Moraceae) S+, *Ixora javanica* Bl.(Rubiaceae) S-, *Homalium imbricatum* Ridl. (Pandanaeae) S+, *Amorea rubiginosa* Hiern (Meliaceae) S+, *Dillenia pulchella* Gilg.(Dilleniaceae) S+, *Bomolomena griffithii* Hook.f. (Araceae) H-, *Pandanus militaris* Warb.(Pandanaeae) H+,2, *Ficus* sp. 4 (Moraceae) H+, *Homalium mayana* Hook.f.(Annonaceae) T2+, no.3: *Coniothalamus giganteus* Hook.f. & Th. (Annonaceae) S-1,2,H+,2, *Lumniza morinda* DC.(Rubiaceae) S-+2, *Mussaenda glabra* Vahl. (Rubiaceae) S+, *Ficus punctata* Thib.(Moraceae) H+, *Ficus* sp. 5 (Moraceae) S-+2,H+, *Dracena* sp.(Agavaceae) H+, *Bhesa indica* Ding Hou (Celastraceae) T2-1,2,S+, *Uvaria rufa* Bl.(Annonaceae) S-+2,H+, *Barringtonia racemosa* Roxb. (Barringtoniaceae) S+, *Paramisya longispina* Hook.f.(Rubiaceae) S+, *Crinia caryocarpa* Indra (Dilleniaceae) S-+2, *Alstonia pneumatophora* Backer (Apocynaceae) T1-2,1,2,1.1,S-+2, *Chilocarpus costatus* Miq.(Apocynaceae) H+, *Grewia comocosa* Juss.(Tiliaceae) S+, *Ficus* sp. 6 (Moraceae) S+, *Illex cyrtos* Bl.(Aquifoliaceae) T2-1.1, *Endiandra glauca* Merr.(Cyperaceae) H-2,2, no.4: *Chaetocarpus castanocarpus* Thw.(Euphorbiaceae) H+, *Cryptocarya* sp. S+, *Eugenia longifera* (Presl.) E. VILL. S+, *Bracteanthus palustris* Bartell. (Ochnaceae) S+, *Nomophloe umbelliflora* Bl.(Lauraceae) T1-1.1, *Sterculia* sp. (Sterculiaceae) T1-, *Colocasia* sp. (Araceae) H-, *Schefflera heterophylla* Harms (Araliaceae) H+, *Arcan* sp.(Palmae) S+, *Tetracera Indica* Merr.(Dilleniaceae) S-2,2, *Arcan* *trindleri* Roxb.(Palmae) S+, *Tarenna hoensis* Pittard (Rubiaceae) S-+2, *Ficus* sp. 7 (Moraceae) S+, *Dia ella anefifolia* Red.(Liliaceae) H+, *Nepheium glabrum* Nicolson (Sapindaceae) S+, *Polystichia lateriflora* King T2-2,2,S+, *Diospyr s lanceifolia* Roxb.(Ebenaceae) H+.

Location & date: 1:Kok Chun Bet(Nar thwat, Thailand) at 10. August 1987, N:Kok Chun Bet(Narathiwat, Thailand) at 13. August 1987, A:Ban Pa Wai(Narathiwat, Thailand) at 6. August 1987, J:Kok Chun Bet(Narathiwat, Thailand) at 28. August 1989.

Daemonorops angustifolia and *Korthalsia laciniosa*. Other climbing species such as: *Dapania racemosa*, *Freycinetia angustifolia*, *Freycinetia javanica* and *Freycinetia sumatrana* occasionally appear. Epiphytic plants are frequently found on trees such *Aeschynanthus parvifolia*, *Dischidia acutifolia*, *Dischidia minor*, *Hoya micrantha*, *Hoya parasitica*, *Ficus microcarpa*, *Fagraea acuminatissima*, *Fagraea auriculata*, *Fagraea tubulosa*, *Cymbidium finlaysonianum*, *Dendrobium concinnum*, *Dendrobium crumenatum*, *Dendrobium pensile*, etc. gather with the attractive, showy flowers of *Hedychium longicornutum*. The birds' nest fern; *Asplenium nidus* is a common epiphyte of swamp forests.

The community is developing near the east side coast of the Peninsula Malaysia over marine alluvium. The surface of these extensive peat swamps in the Peninsula is not markedly convex and subject to flooding. In Sarawak, the surface of the swamps is markedly convex and the water table is stilted and higher than that of the surroundings (Anderson, 1964). The genera *Camposperma*, *Horsfieldia*, *Elaeocarpus*, etc. which normally occur in the riparian forests, are also found in the community.

The pH value of the coastal wetlands at Narathiwat is found to be 4.5-6; The depth of the organic peat layer is 3-5 meters, while the depth of the flooding water during rainy season was 1-4 meters. The drainage water is tea-colored (reddish-brown) by transmitted light. During and after the rainy season, the habitat conditions were observed to have changed into an eutrophic one.

2. *Schima wallichii*-*Fagraea fragrans*-community (Table 2)

On the sandy wet habitat of the coastal sand dune area, the *Schima wallichii*-*Fagraea fragrans*-community is a natural forest community of the habitat. Sedimented organic matter in the area is no more than 50 centimeters in depth. The community is composed by 4 layers. On the tree layer-1 (canopy-top), *Fagraea fragrans* (Potaliaceae) is the dominating tree. Total

number of species is 24-25. The tree layer of the community is consisted of the following species: *Fagraea fragrans*, *Persea membranacea* (Lauraceae), *Schima wallichii* (Theaceae), *Litsea grandis* (Lauraceae), *Eugenia grandis* (Lauraceae), *Eugenia grandis*, *E. spicata*, *Mangifera pentandra* (Anacardiaceae), *Palaquium obovatum* (Sapotaceae), *Vitex pinnata* (Verbenaceae), *Carallia brachiata* (Rhizophoraceae), etc.

The flora of the shrub and herb layers are comparatively poor. The layers consist of the following species: *Rhodomyrtus tomentosa* (Myrtaceae), *Grewia tomentosa* (Tiliaceae), *Ilex cymosa* (Aquifoliaceae), *Ardisia littoralis* (Myrsinaceae), *Licuala longecalycata*, *Champereia manillana* (Opiliaceae), *Chaetocarpus castanocarpus* (Euphorbiaceae), etc.

Fagraea-dominated forests such as the *Schima wallichii*-*Fagraea fragrans*-community were common natural or potential natural forests on the coastal sandy wet condi-

Table 2. *Schima wallichii*-*Fagraea fragrans*-community

Relieve no.:		1	2
Field no.:		2-1	2-4
Area of releve (qm):		220	200
Height of tree layer-1(m):		22	22
Cover of tree layer-1(%):		40	50
Height of tree layer-2(m):		14	14
Cover of tree layer-2(%):		60	50
Height of shrub layer(m):		5	6
Cover of shrub layer(%):		40	40
Height of herb layer(m):		1.5	1
Cover of herb layer(%):		10	10
Total no. of species:		25	24
<i>Fagraea fragrans</i> Roxb. (Potaliaceae)	T1	3.3	2.1
	T2	3.3	2.2
	S	2.3	2.2
<i>Litsea grandis</i> Hook.f. (Lauraceae)	T2	1.2	1.1
	S	+	+
<i>Eugenia grandis</i> Wight (Myrtaceae)	T2	2.3	+
<i>Rhodomyrtus tomentosa</i> Wight (Melastomataceae)	S	+	+
<i>Dioscorea glabra</i> Roxb. (Dioscoreaceae)	S,H	+	+
<i>Grewia tomentosa</i> Juss. (Tiliaceae)	S	1.2	+
<i>Ilex cymosa</i> Bl. (Aquifoliaceae)	S	2.3	2.2
<i>Schima wallichii</i> Korth. (Theaceae)	T2,S	+	2.1
	S,H	+	+
<i>Ardisia littoralis</i> Andr. (Myrsinaceae)	S	+	+
<i>Licuala longecalycata</i> Purf. (Palmae)	S	+	+
<i>Champereia manillana</i> (Bl.) Merr. (Opiliaceae)	S	+	+
<i>Eugenia spicata</i> Lamk. (Myrtaceae)	T2	+	3.1
	S	+	1.2
	H	+	+
<i>Chaetocarpus castanocarpus</i> Thw. (Euphorbiaceae)	S	2.3	+
	H	+	+
<i>Calophyllum calaba</i> L. var. <i>bracteata</i> (Wight) Stevens (Guttiferaceae)	H	+	+
<i>Persea membranacea</i> Kosterm. (Lauraceae)	T2	1.2	1.1
	H	+	+
<i>Tetranea lourei</i> Pierre (Dilleniaceae)	S	+	+
<i>Paramignya longispina</i> Hook.f. (Rutaceae)	S	+	+
<i>Melastoma malabathricum</i> L. (Melastomataceae)	S	+	+
<i>Heulandias cassia</i> (L.) Kosterm. (Lauraceae)	S	+	+
<i>Oryzopsis longiflorus</i> (Lamk.) Yamazaki (Rubiaceae)	S	+	+
<i>Labisia pumila</i> Roxb. (Myrsinaceae)	H	+	+
<i>Gynocroches acillaris</i> Bl. (Rhinophoraceae)	H	+	+
<i>Persea blauria</i> L. (Theaceae)	H	+	+
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	H	1.2	+
<i>Mangifera pentandra</i> Hook.f. (Anacardiaceae)	T1	+	2.1
	S	+	+
<i>Vitex pinnata</i> L. (Verbenaceae)	T2	+	2.2
	S	+	2.3
	H	+	+
<i>Carallia brachiata</i> Merr. (Rhizophoraceae)	T2	+	2.3
	S	+	+
<i>Stenochloa palustris</i> Bedd. (Pteridiaceae)	T2	+	+
	S	+	+
<i>Palaquium obovatum</i> Engl. (Sapotaceae)	T2	+	1.1
	S	+	+
<i>Smilax</i> sp. (Smilacaceae)	S	+	+
<i>Draconea</i> sp. (Agavaceae)	H	+	+
<i>Flagellaria indica</i> L. (Flagellariaceae)	H	+	+
<i>Dianella ensifolia</i> Retz. (Liliaceae)	H	+	+

tions with the thin peat or organic layer. But the community is not distributed so widely at Narathiwat and occupies only small areas. Most of the natural forest vegetation on the conditions have been extinguished by human activities.

3. *Macaranga pruinosa*-community (Table 3)

Secondary forests in the coastal areas (peat and sulfate soils) are consisted of *Macaranga pruinosa*-community and *Melaleuca cajuputi*-community. The *Macaranga pruinosa*-community is dominated by *Macaranga pruinosa* of about 20-25 meters in height. Most of the secondary forests in the peat swamp areas is characterized by an even canopy top and single tree species such as *Macaranga*, *Melaleuca* etc. The *Macaranga pruinosa*-community is widely distributed in the peat swamp areas and often occupies large areas. The tree layer-1 of the community has a height of 20-21 meters. The tree layer-2 has a height of 14-15 meters. On the tree layers dominant species of the community are *Macaranga pruinosa* (Euphorbiaceae), *Ganua motleyana*, *Antidesma cuspidatum* (Euphorbiaceae), *Eugenia spicata*, *Elaeocarpus macrocerus*, and *Hypolytrum nemorum* (Cyperaceae). The *Macaranga pruinosa* and some *Macaranga* species are pioneer trees with big trilobed leaves. The pioneer *Macaranga* forest is found throughout the tropical Asia.

The surveyed area of 2 stations at Ban Pa Wai, Narathiwat is 1,400-1,500 square meters. The total number of species is 42-48. Most of the component species was the same as that of the *Baccauria bracteata-Endiandra macrophylla*-community. The cover of herbs in the ground are low, the herb layer is a synusia of tree seedling and there is much bare ground.

The habitat of the community, which is the same as that of the natural forest (*Baccauria bracteata-Endiandra macrophylla*-community), retains rain water all year round and develops "raising bog". The organic peat layer is normally thicker than 1 meter.

The virgin swamp forest; the *Baccauria bracteata-Endiandra macrophylla*-community consists of a mosaic of patches at different stages of maturity. The gaps, which is one type of patches, are recovered from damage by pioneer *Macaranga pruinosa* at Narathiwat. The *Macaranga pruinosa*-community had invaded after logging the natural swamp

Table 3. *Macaranga pruinosa*-community

Releve no.:	1	2
Field no.:	1	2
Area of releve(qm):	1400	1500
Height of tree layer-1(m):	22	21
Cover of tree layer-1(X):	85	80
Height of tree layer-2(m):	14	15
Cover of tree layer-2(X):	40	30
Height of shrub layer(m):	6	8
Cover of shrub layer(X):	20	20
Height of herb layer(m):	2	1.5
Cover of herb layer(X):	15	20
Total no. of species:	42	48
<hr/>		
<i>Macaranga pruinosa</i> (Miq.)M.A. (Euphorbiaceae)	T1	5.4 5.4
	T2	1.2 1.2
<i>Poikilospermum suaveolens</i> Merr. (Moraceae)	T2	+2 1.1
	H	+
<i>Eugenia cersifolia</i> (Bl.)DC. (Myrtaceae)	T1	1.1 1.1
	T2	1.2 1.2
<i>Eugenia tumida</i> Duth. (Myrtaceae)	T2	2.2
	S	1.2 1.2
	H	1.2
<i>Endiandra macrophylla</i> (Bl.) Boerl. (Lauraceae)	T2,S	+
<i>Chicocheron divergens</i> Bl. (Meliaceae)	T2	+ 1.1
	S	+
<i>Eugenia spicata</i> Lamk. (Myrtaceae)	T2	+
	S	2.2 +2
<i>Nenga pumila</i> Wendl. (Palmae)	S	1.1 1.1
	H	+2
<i>Ganua motleyana</i> Pierre (Sapotaceae)	T2	2.2 3.2
	S	2.2
<i>Sandoricum emarginatum</i> Hiern (Meliaceae)	T2	+
	S	+
<i>Crudia caudata</i> Prain (Leg.-Caesalpinioidae)	S	+2 +2
<i>Stenochlaena palustris</i> Bedd. (Pteridaceae)	H	+2 +2
	S	1.2
<i>Baccauria bracteata</i> Muell. Arg. (Euphorbiaceae)	T2	+
	H	+
<i>Neesia altissima</i> Bl. (Bombaraceae)	T2	+ 1.1
<i>Elaeocarpus macrocerus</i> (Turcz.) Merr. (Elaeocarpaceae)	T1,T2	1.1 3.3
<i>Antidesma cuspidatum</i> Muell. Arg. (Euphorbiaceae)	S,H	2.3
<i>Horsfieldia crassifolia</i> Harb. (Myrticaceae)	T2,S	+ 1.1
<i>Ardisia lanceolata</i> Roxb. (Myrsinaceae)	S,H	1.2 +
<i>Ixora grandifolia</i> Zoll. (Rubiaceae)	T2,S	1.2 1.1
<i>Freylinetia angustifolia</i> Bl. (Pandaniaceae)	T2	+
	S,H	1.2 +2
<i>Stemonurus secundiflorus</i> Bl. (Laciniaceae)	T1	2.2
	T2	3.3
<i>Hypolytrum nemorum</i> Spreng (Cyperaceae)	H	1.2
<i>Derris malaccensis</i> Prain (Leg.-Papilionatae)	T2	+2
<i>Elaeocarpus</i> sp. (Elaeocarpaceae)	H	+
	S	+2
<i>Aglaonema marantifolium</i> Bl. (Araceae)	H	+2
<i>Dacryodes incurva</i> (Engl.) Lam. (Bursaraceae)	T2	+
<i>Tetracaea Lourerii</i> Pierre (Dilleniaceae)	S	+
<i>Rhopidocra minor</i> Hook.f. (Araceae)	H	+
<i>Polyzithia curtisii</i> Ridl. (Annonaceae)	T1	+
	H	+
<i>Calophyllum reysmannii</i> Miq. var. <i>inophylloide</i> (King) Stevens (Guttiferaceae)	T2	+
<i>Melanochyla bracteata</i> King (Anacardiaceae)	H	+
	T2	+
<i>Parishia insignis</i> Hook.f. (Anacardiaceae)	H	+
<i>Uvaria rufa</i> Bl. (Annonaceae)	S	+
	H	+
<i>Grewia tomentosa</i> Juss. (Tiliaceae)	H	+
<i>Mallotus</i> sp. (Euphorbiaceae)	T2	+
<i>Zizyphus</i> sp. (Rhamnaceae)	T2	+
	S	+
<i>Combretum acuminatum</i> Roxb. (Combretaceae)	S	+
<i>Ficus</i> sp. 1 (Moraceae)	H	+
<i>Ficus</i> sp. 2 (Moraceae)	H	+
<i>Ficus</i> sp. 3 (Moraceae)	H	+
<i>Ardisia littoralis</i> Andr. (Myrsinaceae)	H	+
<i>Dioscorea glabra</i> Roxb. (Dioscoreaceae)	H	+
<i>Scirpodendron ghaeri</i> Merr. (Cyperaceae)	H	3.3
<i>Gynotroches axillaris</i> Bl. (Rhizophoraceae)	T2	+
	S	2.2
<i>Chaetocarpace castanocarpus</i> Thw. (Euphorbiaceae)	T2	2.2
<i>Eugenia muelleri</i> (Myrtaceae)	T2	1.1
<i>Lucinsea morinda</i> DC. (Rubiaceae)	T2	1.2
	S	+2
<i>Sterculia bicolor</i> (Sterculiaceae)	S	2.2
<i>Dillenia pulchella</i> Gilg. (Dilleniaceae)	T2	2.3
	S	+
	H	+
<i>Eleiodoxa conferta</i> Burr. (Palmae)	S	1.1
<i>Asplenium nidus</i> L. (Aspleniaceae)	T2	+2
	S	+
<i>Dalbergia parviflora</i> Roxb. (Papilionaceae)	S	+2
<i>Ficus</i> sp. 4 (Moraceae)	T2	+2
<i>Myrsine laevis</i> Bl. (Myrsinaceae)	S	+
<i>Cinnamomum rhynchophyllum</i> Miq. (Lauraceae)	S	+
<i>Gonolobus giganteus</i> Hook.f. & Th. (Annonaceae)	T2	+
<i>Caryota mitis</i> Lour. (Palmae)	S	+
<i>Litsea resinosa</i> Bl. (Lauraceae)	H	+
<i>Taranna hoensis</i> Pitard (Rubiaceae)	S	+
<i>Schefflera heterophylla</i> Barnes (Araliaceae)	S	+
<i>Croton cardiacus</i> Geisel. (Euphorbiaceae)	S	+
<i>Losa indica</i> Merr. (Lecanaceae)	S	+
<i>Archidendron clypearis</i> Nielsen (Mimosaceae)	H	+
<i>Anadenium merrillii</i> Back. (Olacaceae)	S	+
<i>Ficus</i> sp. 5 (Moraceae)	S	+
<i>Ficus</i> sp. 6 (Moraceae)	S	+
<i>Eleocharis orientalis</i> Linn. (Blechnaceae)	S	+
<i>Lygodium microphyllum</i> R.Br. (Schizaceae)	S	+
<i>Gymnopetalum</i> sp. (Cucurbitaceae)	H	+
<i>Tetracera indica</i> Merr. (Dilleniaceae)	S	+

Loc. & date: 1:Ban Pa Wai(Narathiwat, Thailand) at 8. August 1987, 2:Ban Pa Wai(Narathiwat, Thailand) at 27. August 1989.

forest or natural regeneration, but were absent where peat layer and litter had been disturbed or removed by burning and draining.

4. *Lygodium microphyllum*-*Melaleuca cajuputi*-community and *Evodia roxburghiana*-*Melaleuca cajuputi*-community (*Melaleuca cajuputi* forest, Table 4)

The *Melaleuca cajuputi* forest is also a typical secondary forest, dominated by *Melaleuca cajuputi* (Myrtaceae). The forest is widely distributed and often occupies very large areas, from peat swamps to sandy conditions. The habitat of the *Melaleuca cajuputi* forest was directly or indirectly influenced by burning. The *Melaleuca cajuputi* forest, which has root

Table 4. *Melaleuca cajuputi*-forest
1-5: *Lygodium microphyllum*-*Melaleuca cajuputi*-community
6-10: *Evodia roxburghiana*-*Melaleuca cajuputi*-community

Releve no.:	1	2	3	4	5	6	7	8	9	10
Field no.:	3	0	0	H-1	H-2	H-1	M-2	M-3	2-2	2-3
Area of releve(ql):	300	225	300	150	225	200	400	500	300	300
Height of tree layer(m):	7	6	7	10	11	12	10	11	9	20
Cover of tree layer(%):	60	40	50	40	35	60	40	40	70	60
Height of shrub layer(m):	4	4	5	5	5	5	5	5	3	8
Cover of shrub layer(%):	30	35	20	20	10	30	30	30	30	70
Height of herb layer(m):	1.5	1.5	1.5	1.5	3	1.5	1.5	1.5	0.5	0.5
Cover of herb layer(%):	70	80	70	70	60	20	15	15	10	15
Total no. of species:	22	15	13	20	22	26	25	23	18	23
Differential species of community:										
<i>Lygodium microphyllum</i> R.Br. (Schizaeaceae)	T	+2								
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	S	3.3	2.3	1.2	+2	+2				
<i>Chaetocarpus castanocarpus</i> Thw. (Euphorbiaceae)	S,H	4.4	3.3	3.4	4.4	4.4			1.2	+
<i>Rhodomyrtus tomentosa</i> Wight (Myrtaceae)	S						2.3	2.2	2.2	+ 1.2
<i>Evodia roxburghiana</i> Benth. (Rutaceae)	T							1.1		
<i>Eupatorium odoratum</i> L. (Compositae)	S						2.3	1.2	2.2	+ 3.3
<i>Tetracera lourei</i> Pierre (Dilleniaceae)	S							1.2	+2	
<i>Dioscorea glabra</i> Roxb. (Dioscoreaceae)	S,H						+2	+2		+
<i>Melaleuca cajuputi</i> Powell (Myrtaceae)	T	4.4	3.3	3.4	3.3	3.3	4.4	3.3	3.3	4.4
<i>Ilex cynosa</i> Bl. (Aquifoliaceae)	S	1.2	1.2	2.2			1.2	2.2	1.2	2.2
<i>Flagellaria indica</i> L. (Flagellariaceae)	S	1.2	1.1	+						1.1
<i>Melastoma malabathricum</i> (Melastomataceae)	S	+2	+	+2			1.2		+2	1.2
<i>Stenochlaena palustris</i> Bedd. (Pteridaceae)	T	1.2		+2						
<i>Ardisia littoralis</i> Andr. (Myrsinaceae)	S	+2	+	+2			+2			+
<i>Gynochthodes sublanceolata</i> Miq. (Rubiaceae)	S								+2	+
<i>Paspalum scrobiculatum</i> L. (Gramineae)	H	1.2	+2	+2						
<i>Oxalis scandens</i> Roxb. (Oxalaceae)	S						+2	+2		
<i>Eugenia spicata</i> Lamk. (Myrtaceae)	S		1.2	1.2						+ 1.2
<i>Ixora javanica</i> DC. (Rubiaceae)	S									
<i>Blechnum serratum</i> A.Rich. (Blechnaceae)	H		1.2	+						
<i>Cissus repens</i> Lamk. (Vitaceae)	S,H									
<i>Antidesma ghaesembilla</i> Gaertn. (Sapotaceae)	S									
<i>Dalbergia parviflora</i> Roxb. (Leg.-Papilionatae)	S									
<i>Breynia vitis-idaea</i> (Burm.f.) (Flacourtiaceae)	S,H						+2	1.2	+	
<i>Vitex limonifolia</i> Wall. (Verbenaceae)	S,H									+
<i>Fimbristylis thomsonii</i> Boeck. (Cyperaceae)	H									+
<i>Dianella ensifolia</i> Red. (Liliaceae)	H									
<i>Pegaea fraxinea</i> Roxb. (Potamogetaceae)	S,H									+
<i>Elaeocarpus robustus</i> Roxb. (Elaeocarpaceae)	S									+
<i>Eugenia nappiformis</i> K. & V. (Myrtaceae)	S							+2		3.3
<i>Oxyceros longiflorus</i> (Lamk.) Yamazaki (Rubiaceae)	H									
<i>Uncaria jsuminiflora</i> Hook.f. (Rubiaceae)	H									
<i>Lepironia articulata</i> Domin (Cyperaceae)	H			+2						
<i>Nepenthes gracilis</i> Korth. (Nepenthaceae)	S									
<i>Neolitsea casia</i> (L.) Kosterm. (Lauraceae)	T							1.1		
<i>Barringtonia racemosa</i> Roxb. (Barringtoniaceae)	S				1.2	1.2				
<i>Acrostichum aureum</i> L. (Pteridaceae)	H					+2				
<i>Cyperus javanicus</i> Houtt. (Cyperaceae)	H				+2	1.2				
<i>Eugenia grandis</i> Wight (Myrtaceae)	T,S						1.1			+
<i>Olea maritima</i> Wall. (Oleaceae)	S,H									+
<i>Leersia hexandra</i> Sw. (Gramineae)	S								1.1	
<i>Lucinasa morinda</i> DC. (Rubiaceae)	S,H									+
<i>Schima wallichii</i> Korth. (Theaceae)	T,S									2.1
<i>Pteris blaurita</i> L. (Pteridaceae)	H									2.2
Species with presence 1 no.: <i>Symplocos adenophylla</i> Wall. (Symplocaceae) T-1,1, <i>Achidendron clypearia</i> Nielsen (Leg.-Mimosoideae) S+,H+, <i>Ixora grandifolia</i> Zoll. & Morton (Rubiaceae) H+, <i>Oncosperma cigillaria</i> Rdl. (Palmae) H+, <i>Licuala spinosa</i> Humb. (Palmae) H+, <i>Antidesma porteri</i> Mez. (Myrsinaceae) S-1,1, <i>Ipomoea digitata</i> L. (Convolvulaceae) H+2, <i>Sarcocobus globosus</i> Wall. (Asclepiadaceae) H+, no. 5: <i>Berris indica</i> (Lamk.) Bennet (Leg.-Papilionatae) S+, <i>Homalium foetidum</i> (Roxb.) Benth. (Flacourtiaceae) S+, <i>Cyperus haspan</i> L. (Cyperaceae) H+, <i>Pteris blaurita</i> L. (Pteridaceae) H+, <i>Antidesma ghaesembilla</i> Gaertn. (Sapotaceae) H+, <i>Caractoparis chaletroides</i> Brongn. (Parkeriaceae) H+, no. 6: <i>Ficus globosa</i> Bl. (Moraceae) T-1,1, <i>Artocarpus gomzianus</i> Wall. ex Trec. (Moraceae) T+, <i>Carallia brachiata</i> Merr. (Rubiaceae) H+, <i>Ficus</i> sp. (Moraceae) H+, <i>Eulophia graminea</i> Lindl. (Orchidaceae) H+, <i>Hydnora</i> sp. (Rubiaceae) H+, <i>Boya parviflora</i> Wall. (Asclepiadaceae) S+, no. 7: <i>Clusia hastata</i> Miq. (Vitaceae) S+, <i>Chempedocarpus manillana</i> Merr. (Opiliaceae) H+, <i>Litsea gracilis</i> Hook.f. (Lauraceae) H+, no. 8: <i>Streptocaulon wallichii</i> Wight (Pariplotaceae) S+, <i>Abrus precatorius</i> L. (Leg.-Papilionatae) S+, no. 9: <i>Psychotria serpens</i> L. (Rubiaceae) S+, <i>Micromelum minutum</i> Wight & Arn. (Rutaceae) S+, <i>Sclerarchea curvisi</i> King & Gamble (Apocynaceae) H+, <i>Cassytha filiformis</i> L. (Santalaceae) H+, <i>Imperata cylindrica</i> Beauv. (Gramineae) H+, no. 10: <i>Calophyllum calaba</i> L. var. <i>bracteata</i> (Wight) Stevens (Guttiferaceae) S+, <i>Pearsea membranacea</i> Kosterm. (Lauraceae) S+.										

Location & date : B,C,D: Ban Pa Wai (Narathiwat, Thailand) at 7. August 1987, H-1,2: Ban Pa Wai (Narathiwat, Thailand) at 8. August 1987, M-1,2,3,2-2,3: Khok Mairuea (Narathiwat, Thailand) at 11. August 1987.

suckers and coppice shoots, grows even after repeated burning.

The main species of the tree and shrub layers are *Melaleuca cajuputi*, *Ardisia littoralis*, *Ilex cymosa* (Aquifoliaceae), *Melastoma malabathricum* (Melastomaceae), *Eugenia spicata* and *Rhodomyrtus tomentosa* (Myrtaceae). The *Melaleuca cajuputi* forest is popular along the coastal area of tropical Asia where condition of the (peat) soil is poor similar to soil cultivated for agriculture (shifting cultivation).

From the phytosociological view point, the *Melaleuca cajuputi* forests are divided into two communities: a) the *Lygodium microphyllum-Melaleuca cajuputi*-community and b) the *Evodia roxburghiana-Melaleuca cajuputi*-community.

The *Lygodium microphyllum-Melaleuca cajuputi*-community is characterized by the dominant climbing fern: *Lygodium micorphyllum* (Schizaeaceae) and *Scleria sumatrensis* (Cyperaceae), and can be observed in acid-sulfate soil areas where peat have vanished. The water level rises up to 0.5-2 meters in rainy season (2-3 months per year). This community occupies the habitats in depressions with flooding and drying up. The community is composed by 3 layers. The tree layer has a height of 6-11 meters. The total number of species is 13-20.

The *Evodia roxburghiana-Melaleuca cajuputi*-community, on the other hand, is characterized by *Evodia roxburghiana* (Rutaceae), *Rhodomyrtus tomentosa*, *Eupatorium odoratum* (Compositae), *Tetracera loureiri* (Dilleniaceae), *Chaetocarpus castanocarpus* (Euphorbiaceae) and *Dioscorea glabra* (Dioscoreaceae). The tree layer has a height of 9-20 meters. The total number of species is 18-26. The ground herb layer of the *Evodia roxburghiana-Melaleuca cajuputi*-community is not so rich in species number and cover as that of the *Lygodium microphyllum-Melaleuca cajuputi*-community. The community occurs in the dry habitat such as sandy or sulfate soils after drainage of the peat swamps. The community can be observed in the non-flooded or slightly flooded conditions during the rainy season.

SHRUB VEGETATION

Shrub vegetation in the peat swamp area at Narathiwat are palm-shrubs and Melastomataceae-shrubs. The palm-shrubs are distributed so widely on the Narathiwat peat swamps that each stand of the shrubs are smaller than the other vegetation. The Melastomataceae-shrubs grow widely on roadside and developed peat swamps but occupies only small areas.

5. *Eleiodoxa conferta-Licuala longecalycata*-community (Table 5)

In tropical Asia, palm communities are popular. In Narathiwat province, the palm *Licuala longecalycata*-community which is 4-5 m high, can be found in and along the swamp forest edges of the area. In the survey, the phytosociological data of the *Licuala longecalycata*-palm vegetation were collected at Ban Pa Wai, Narathiwat (3 stands) and the vegetation was summarized into the *Eleiodoxa conferta-Licuala longecalycata*-community. The differential and dominant palm species is *Licuala longecalycata*. *Stenochlaena palustris*, *Lygodium microphyllum* and *Scleria sumatrensis* (Cyperaceae) are also very common.

6. *Eleiodoxa conferta-Metroxylon sagu*-community (Table 5)

In the peat swamp area of Southeast Asia, the sago-palm occurs commonly. The sago-palm; *Metroxylon sagu* also occurs on the peat swamps at Ban Pa Wai, Narathiwat and summarized into the *Eleiodoxa conferta-Metroxylon sagu*-community. The differential and dominant palm species is *Metroxylon sagu*. The community is 5 meters in height and has a total number of species of 10. The sago palm, *Metroxylon sagu* is cultivated widely on swampy habitat and

Table 5. Palm-vegetation

1-3: *Eleiodoxa conferta*-*Licuala longecalycata*-community
4: *Eleiodoxa conferta*-*Metroxylon sagus*-community

Relieve no.:	1	2	3	4
Field no.:	J-1	PH-8	PW-9	T-4
Area of releve(qm):	25	30	30	25
Height of shrub layer(m):	4	5	4	5
Cover of shrub layer(%):	80	40	70	80
Height of herb layer(m):	3	2	1.2	4
Cover of herb layer(%):	20	15	80	40
Total no. of species:	10	10	10	10

Differential species of community:

<i>Licuala longecalycata</i> Furt. (Palmae)	S	5.4	3.3	4.3	.
<i>Metroxylon sagus</i> Retrb. (Palmae)	S	.	1.2	.	5.5

Other species:

<i>Stenochlaena palustris</i> Bodd. (Pteridaceae)	H	2.2	+	+	+2
<i>Lygodium microphyllum</i> R.Br. (Schizaceae)	S	+	+2	+	+2
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	S	1.2	+2	4.4	.
<i>Macaranga pruinosa</i> (Miq.) M.A. (Euphorbiaceae)	S	H	.	.	1.2
<i>Uncaria jasminiflora</i> Hook.f. (Rubiaceae)	S	H	+2	.	.
<i>Eleiodoxa conferta</i> Burr. (Palmae)	S	H	1.2	.	+2
<i>Nephrolepis biserrata</i> Schott var. furcans Hort. (Oleandraceae)	H	+	2.	.	1.2
<i>Leea indica</i> Merr. (Laeaceae)	H	.	.	.	+
<i>Blechnum serratum</i> A. Rich. (Blechnaceae)	H	.	+2	.	+
<i>Eugenia niphoria</i> K. & V. (Myrtaceae)	H	.	.	.	.
<i>Erythra vitis-idaea</i> Fisher (Euphorbiaceae)	S	1.1	.	.	.
<i>Baccouria</i> sp. (Euphorbiaceae)	S	.	+2	.	.
<i>Mikania micrantha</i> H.B.K. (Compositae)	H	.	.	.	.
<i>Ficus</i> sp. 1 (Moraceae)	S	.	.	.	.
<i>Eugenia spicata</i> Lank. (Myrtaceae)	S	.	.	.	.
<i>Melastoma malabathricum</i> L. (Melastomataceae)	H	.	.	+2	.
<i>Tetracera indica</i> Merr. (Dilleniaceae)	H	.	.	.	.
<i>Alpinia nutica</i> Roxb. (Zingiberaceae)	H	.	.	.	2.3
<i>Flagellaria indica</i> L. (Flagellariaceae)	H	.	.	.	.
<i>Ficus</i> sp. 2 (Moraceae)	H	.	.	.	+

Location & date: J-1,P'a Wai(Narathiwat, Thailand) at 8. August 1987,
PH-8,P'a Wai (Narathiwat, Thailand) at 22. August 1988,
PW-9,P'a Wai(Narathiwat, Thailand) at 22. August 1988,
T-4,P'a Wai(Narathiwat, Thailand) at 23. March 1987.

Table 6. *Lygodium microphyllum*-*Melastoma malabathricum*-community

Relieve no.:	1	2	3	4	5	6	7
Field no.:	P-4	P-2	J-2	J-3	P-1	G-12	G-11
Area of releve(qm):	9	14	15	15	12	8	12
Height of vegetation(m):	2	2.2	4	4.5	2	2	1.8
Cover of vegetation(%):	100	100	100	100	95	90	100
Total no. of species:	6	8	8	8	9	11	14

Differential species of community:

<i>Melastoma malabathricum</i> L. (Melastomataceae)	5.5	5.4	5.4	5.4	5.5	5.4	5.4
<i>Lygodium microphyllum</i> R.Br. (Schizaceae)	+2	.	3.3	1.2	.	+2	+2
<i>Uncaria roxburghiana</i> Korth. (Rubiaceae)	.	+1.2	.	.	.	1.2	+2

Other species:

<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	+	.	.	+1.2	.	.	+
<i>Nephrolepis biserrata</i> Schott var. furcans Hort. (Oleandraceae)	.	+	+2	.	.	1.2	+
<i>Mikania micrantha</i> H.B.K. (Compositae)	.	+	2.2	.	.	+2	1.2
<i>Barringtonia racemosa</i> Roxb. (Barringtoniaceae)	.	+	2.2	1.1	1.1	.	.
<i>Fanum camogines</i> Balansa (Gramineae)	.	+	2.	.	.	.	+2
<i>Leea indica</i> Merr. (Laeaceae)	.	+	1.1	.	.	.	.
<i>Stenochlaena palustris</i> Bodd. (Pteridaceae)	.	.	.	1.2	.	.	.
<i>Cleus repens</i> Lank. (Vitidaceae)	.	.	.	.	+	+2	.
<i>Mimosa pudica</i> L. (Mimosaceae)	.	.	.	.	.	.	+2
<i>Ficus</i> species (Moraceae)	.	.	.	+	2.	.	.
<i>Combretum tetralophum</i> Clarke (Combretaceae)	.	.	.	.	1.1	.	.
<i>Eugenia spicata</i> Lank. (Myrtaceae)	.	.	.	.	.	.	.
<i>Inora javanica</i> DC. (Rubiaceae)	.	.	.	.	.	.	.
<i>Cantocroea pubescens</i> Benth. (Leg.-Papilionatae)	.	.	.	.	.	.	+2
<i>Colocasia esculenta</i> Schott (Araceae)	.	.	.	.	.	.	1.1
<i>Pternandra caeruleasans</i> Jack (Melastomataceae)	.	.	.	.	.	.	1.1
<i>Imperata cylindrica</i> Beauv. (Gramineae)	.	.	.	.	.	.	.
<i>Scirpodendron ghaeri</i> Merr. (Cyperaceae)	.	.	.	.	.	.	.
<i>Potkilloperum subtrinervium</i> Miq. (Moraceae)	.	.	.	.	.	.	.
<i>Dioscorea glabra</i> Roxb. (Dioscoreaceae)	.	.	.	.	.	.	.
<i>Cynochloa subulancolata</i> Miq. (Rubiaceae)	.	.	.	.	.	.	.
<i>Polygonum molle</i> D.Don. (Polygonaceae)	.	.	.	.	.	.	.
<i>Anigma martinicensis</i> Choisy (Convolvulaceae)	.	.	.	.	.	.	.
<i>Gynochloa ghaesbilla</i> Gaertn. (Scitagiaceae)	.	.	.	.	.	.	.
<i>Paspalum acrobiculatum</i> L. (Gramineae)	.	.	.	.	.	.	.
<i>Polyalthia curtisii</i> Ridl. (Annonaceae)	.	.	.	.	.	.	.

Loc. & date: G-11,12:Ban Pa Wai(Narathiwat, Thailand) at 7. August 1987,
J-2,3:Ban Pa Wai(Narathiwat, Thailand) at 8. August 1987,
P-1,2,4:Ban Pa Wai(Narathiwat, Thailand) at 19. August 1988.

Table 7. *Rhodomyrtus tomentosa*-community

Relieve no.:	1	2	3	4	5	6
Field no.:	KK21	KK22	KK23	KK24	41	62
Height of Shrub layer(m):	1.5	1.4	2	1.2	1.2	1.4
Cover of Shrub layer(%):	90	80	100	70	100	95
Height of herb layer(m):	0.5	.	0.5	0.5	.	.
Cover of herb layer(%):	5	.	.	5	.	.
Total no. of species:	6	6	6	6	6	5

Differential species of community:

<i>Rhodomyrtus tomentosa</i> Wight (Melastomataceae)	S	5.4	5.5	4.4	4.4	5.4	5.4
<i>Melastoma malabathricum</i> L. (Melastomataceae)	H	.	+2	.	.	.	.
<i>Lygodium microphyllum</i> R.Br. (Schizaceae)	S	1.2	1.2	1.2	.	2.2	1.2

Other species:

<i>Eugenia spicata</i> Lank. (Myrtaceae)	H	.	.	+	1.2	.	.
<i>Evoidia latifolia</i> (Rutaceae)	H	.	.	.	.	.	.
<i>Eragrostis malayana</i> Stapf (Gramineae)	H	.	.	.	.	.	.
<i>Paspalum longifolium</i> Roxb. (Gramineae)	H	.	.	.	.	.	.
<i>Fimbristylis pauciflora</i> R.Br. (Cyperaceae)	H	.	.	.	.	.	.
<i>Fragaria fragrans</i> Roxb. (Potalliaceae)	H	.	.	.	.	.	.
<i>Axonopus compressus</i> (Sw.) Beauv. (Gramineae)	H	.	.	.	.	.	.
<i>Ardisia littoralis</i> Andr. (Myrsinaceae)	H	.	.	.	.	.	.
<i>Billacaceae</i> sp.	S	.	.	.	.	.	.
<i>Olea maritima</i> Wall. (Oleaceae)	S	.	.	.	.	.	.
<i>Henslowia buxifolia</i> Bl. (Santalaceae)	S	.	.	.	.	.	.
<i>Melaleuca cajuputi</i> Powell (Myrtaceae)	H	.	.	.	.	.	.
<i>Mikania micrantha</i> H.B.K. (Compositae)	H	.	.	.	.	.	.
<i>Lindernia crustacea</i> F.Muell. (Scrophulariaceae)	H	.	.	.	.	.	.
<i>Xyris complanata</i> R.Br. (Xyridaceae)	H	.	.	.	.	.	.
<i>Eleocharis</i> species (Cyperaceae)	H	.	.	.	.	.	.

Location & date: KK-21,22,23,24:Kok Chun Bet (Narathiwat, Thailand) at 26. August 1989, 41,62:Kok Chun Bet (Narathiwat, Thailand) at 19. August 1988.

Table 8. Grassland Vegetation (1)

1-7: *Eleocharis congesta*-community, 8-12: *Echinochloa stagnina*-community
13-15: *Chrysopogon aciculatus*-*Rottboellia exaltata*-community

Relieve no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Field no.:	KK28	KK22	KK36	KK39	KK27	G8	G7	KK35	KK34	KK33	KK32	KK31	K1	K2	K3
Area of releve(qm):	9	9	12	9	12	9	12	12	14	12	12	9	12	9	8
Height of vegetation(cm):	20	20	30	30	20	80	80	50	50	70	40	40	15	10	15
Cover of vegetation(%):	90	90	95	95	90	90	98	90	90	95	95	90	90	90	90
Total no. of species:	2	3	3	3	4	2	3	3	4	3	3	4	4	4	3

Differential species of community:

<i>Eleocharis congesta</i> D.Don (Cyperaceae)	5.4	5.5	5.5	5.4	4.4	5.4	5.5	+2	.	.	.	.	.	.	.
<i>Echinochloa stagnina</i> Beauv. (Gramineae)	.	.	.	.	.	.	.	2.3	2.2	5.5	5.4	5.5	.	.	.
<i>Rottboellia exaltata</i> L. (Gramineae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.4
<i>Chrysopogon aciculatus</i> Trin. (Gramineae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2

Other species:

<i>Cyperus hasepa</i> L. (Cyperaceae)	2.2	+2	+	+	2.3	.	.	5.4	5.4	1.2	2.2	1.2	3.3	4.4	3.3
<i>Lindernia pierrenoides</i> Yamazaki (Scrophulariaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fimbristylis umbellaris</i> (Lamk.) Vahl (Cyperaceae)	.	+	2.	2.2	+	.	.	.	.	.	.	.	.	.	.
<i>Polygonum molle</i> D. Don (Polygonaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ludwigia hyssopifolia</i> (G.Don) Exell (Onagraceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lygodium microphyllum</i> R.Br. (Schizaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Blechnum serratum</i> A. Rich. (Blechnaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lindernia crustacea</i> F. Muell. (Scrophulariaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Melastoma dodecandrum</i> Roxb. (Melastomataceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Xyris complanata</i> R.Br. (Xyridaceae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Location & date: KK-22,27,28,31,32,33,34,35,36,39:Kok Chun Bet (Narathiwat, Thailand) at 22. August 1988, G-7,R:Ban Pa Wai (Narathiwat, Thailand) at 10. August, 1987, K-1,2,3:Kok Chun Bet (Narathiwat, Thailand) at 9. August 1987.

becomes spontaneous.

7. *Lygodium microphyllum*-*Melastoma malabathricum*-community (Table 6)

The Melastomataceae-shrub, commonly found on the roadside or secondary grasslands of tropical Asia, is also found in the survey area. The *Melastoma*-dominated shrub which

belongs to the *Lygodium microphyllum*-*Melastoma malabathricum*-community, is 1-3 m high; and has a total number of species of 8-14. The community is mainly composed of *Melastoma malabathricum* (Melastomataceae), *Lygodium microphyllum*, *Scleria sumatrensis*, *Mikania micrantha* (Compositae), *Nephrolepis biserrata* (Oleandraceae), *Panicum cambogiense* (Gramineae), *Barringtonia racemosa* (Barringtoniaceae), *Stenochlaena palustris* and *Cissus repens* (Vitidaceae). The community grows widely not only on the peat swamps but also on sandy conditions.

8. *Rhodomyrtus tomentosa*-community (Table 7)

This community, characterized by the shrub *Rhodomyrtus tomentosa*, *Melastoma malabathricum* and *Lygodium microphyllum*, occurs on sandy condition of the Narathiwat coastal area. The melastomataceous shrub *Rhodomyrtus tomentosa*; secondary shrub vegetation grows widely on the dry habitat after drainage of peat swamps as same as the shrub *Melastoma* species. The *Rhodomyrtus tomentosa*-community is 0.5 meter in height and has a total number of species of 5-6. *Eugenia spicata* (Myrtaceae) is also very common.

GRASSLAND VEGETATION

The Thai peat is essentially woody in nature and most of the forests were changed to grasslands under many types of human activities. The Narathiwat swampy area is covered widely by secondary grasslands. The secondary grasslands were summarized into 13 types of communities according to types of human impact and micro conditions.

9. *Eleocharis congesta*-community (Table 8)

On the sandy habitat which was covered the thin peat layer before development, many types of secondary grasslands are widely growing. The *Eleocharis congesta*-community, characterized by Cyperaceae species; *Eleocharis congesta* is a typical herb community on the dry sandy habitat. The community is 20-80 cm in height and total number of species ranges 2-4. Other component species are *Cyperus haspan* (Cyperaceae), *Lindernia pierreanoides* (Scrophulariaceae), *Polygonum molle* (Polygonaceae), *Ludwigia hyssopifolia* (Onagraceae) and *Fimbristylis umbellaria* (Cyperaceae).

10. *Echinochloa stagnina*-community (Table 8)

The *Echinochloa stagnina*-community is widely developing on the swampy habitat. The community is 40-70 cm in height and the differential and dominant species is *Echinochloa stagnina* (Gramineae). The total cover of the community is 90-95 per cent; the height is 40-70 cm. The species number are not more than 3-4. In the community, *Echinochloa stagnina* or *Cyperus haspan* is dominant or co-dominant.

11. *Chrysopogon aciculatus*-*Rottboellia exaltata*-community (Table 8)

On the dry sandy habitat after agricultural development and/or drainage, the secondary grassland, characterized by *Rottboellia exaltata* (Gramineae) and *Chrysopogon aciculatus* (Cyperaceae), is growing. The grassland; *Chrysopogon aciculatus*-*Rottboellia exaltata*-community is 10-15 cm in height and with dominated *Cyperus haspan*. The stands of the *Chrysopogon aciculatus*-*Rottboellia exaltata*-community have a cover of 90 per cent. The species number is not more than 4-5.

12. *Axonopus compressus*-*Mimosa pudica*-community (Table 9)

On the roadside, there is a grassland with a prickly grass; *Mimosa pudica*. The community is 20-30 cm in height and is summarized into the *Axonopus compressus*-*Mimosa pudica*-community, characterized by *Axonopus compressus* (Gramineae) and dominated *Mimosa*

Table 9. Grassland Vegetation (2)

1-2: *Axonopus compressus*-*Mimosa pudica*-community, 3-7: *Isachne confusa*-community

Releve no.:		1	2	3	4	5	6
Field no.:		KK63	PW3	PW4	PW5	PW6	PW7
Area of releve(qm):		4	4	6	6	4	6
Height of vegetation(cm):		20	30	80	80	40	40
Cover of vegetation(%):		80	98	98	98	100	100
Total no. of species:		2	4	4	5	3	3

Differential species of community:

<i>Mimosa pudica</i> L. (Mimosaceae)	4.4	5.4	.	+2	.	.	.
<i>Axonopus compressus</i> (Sw.) Beauv. (Gramineae)	+	+2	.	.	.	.	.

Other species:

<i>Isachne confusa</i> Ohwi. (Gramineae)	.	.	5.4	5.5	5.5	5.5	.
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	.	.	2.3	2.2	+	.	.

Location & date: KK-63:Kok Chun Bet (Narathiwat, Thailand) at 19. August 1987, PW-3,4,5,6,7:Ban Pa Wai (Narathiwat, Thailand) at 19. August 1987.

Table 10. Grassland Vegetation (3)

1-5: *Axonopus compressus*-*Chrysopogon aciculatus*-community, 6-8: *Eragrostis malayana*-community, 9-11: *Chrysopogon orientalis*-*Massia trisetia*-community

Releve no.:		1	2	3	4	5	6	7	8	9	10	11
Field no.:		K14	K15	K16	KU12	KU13	KU11	KU14	KU18	KU15	KU16	KU17
Area of releve(qm):		4	5	2	9	9	2	2	4	6	6	6
Height of vegetation(cm):		30	50	60	40	50	10	10	20	45	45	30
Cover of vegetation(%):		90	80	90	70	70	70	70	80	70	60	70
Total no. of species:		5	4	3	3	5	3	3	3	2	2	3

Differential species of community:

<i>Chrysopogon aciculatus</i> Trin. (Gramineae)	4.4	3.4	3.3	4.4	4.4	(1.1)	.	.	.	.	.	.
<i>Axonopus compressus</i> Beauv. (Gramineae)	2.2	3.3	3.4	.	+	.	.	.	.	.	.	.

Other species:

<i>Eragrostis malayana</i> Stapf (Gramineae)	.	.	.	+2	+2	4.4	4.4	5.4	.	.	.	1.2
<i>Massia trisetia</i> (Nees) Balansa (Gramineae)	.	.	.	.	.	.	.	.	.	4.4	4.4	4.4
<i>Chrysopogon orientalis</i> (Desv.) A. Camus (Gramineae)	.	.	.	.	.	.	.	.	.	2.2	1.2	1.1

Location & date: K-14,15,16:Kok Chun Bet (Narathiwat, Thailand) at 9. August 1987, KU-12,13,14,15,16,17,18:Kuk Rhuk Muu (Narathiwat, Thailand) at 19. August 1988.

Table 11. Grassland Vegetation (4)

1-2: *Monochoria vaginalis*-*Fuirena umbellata*-community, 3-4: *Scirpodendron ghaeri*-community, 5-9: *Rhynchospora corymbosa*-*Rottboellia exaltata*-community, 10-15: *Chrysopogon aciculatus*-community

Releve no.:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Field no.:		E	F	G6	G10	K6	K7	K8	K4	K5	K9	K10	K11	K12	K13	K17
Area of vegetation(qm):		12	12	4	6	6	6	6	16	6	6	6	6	6	6	4
Height of shrub layer(cm)-underline		-	-	-	60	60	70	40	60	-	-	-	-	-	-	-
Cover of shrub layer(%)-underline		-	-	-	30	35	30	15	5	-	-	-	-	-	-	-
Height of herb layer(cm):		100	100	80	200	30	20	10	10	10	10	7	5	10	10	
Cover of herb layer(%):		100	100	90	90	90	90	90	90	80	80	70	60	70	70	
Total no. of species:		5	7	7	5	5	5	6	7	8	4	3	2	3	3	5

Differential species of communities:

<i>Fuirena umbellata</i> Rottb. (Cyperaceae)	5.5	5.3	+2	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Monochoria vaginalis</i> Presl (Pontederiaceae)	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ludwigia hyssopifolia</i> (G. Don) Exell (Onagraceae)	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Other species:

<i>Scirpodendron ghaeri</i> Merr. (Cyperaceae)	.	.	4.4	5.4	.	.	.	.	.	.	.	.	.	.	.	.
<i>Stenochlaena palustris</i> Bedd. (Pteridaceae)	.	.	2.3	+2	.	.	.	.	.	.	.	.	.	.	.	.

Species with presence 1 no. *E. Ipomoea aquatica* Forsk. (Convolvulaceae) +, no. *F. Blechnum serratum* A. Rich. (Blechnaceae) +, *Lygodium microphyllum* R. Br. (Schizaceae) +2, no. *O. Colocasia esculenta* Schott. (Araceae) +2, *Eleocharis congesta* D. Don (Cyperaceae) +2, no. *G10: Scleria sumatrensis* Retz. (Cyperaceae) +2, *Uncaria senophylla* Roxb. (Rubiaceae) +2, no. *K4: Eugenia spicata* Lamk. (Myrtaceae) S+, no. *K17: Imperata cylindrica* Beauv. (Gramineae) +, *Eragrostis malayana* Stapf (Gramineae) +, *Paspalum longifolium* Roxb. (Gramineae) +2.

Location & date: E, F, G-6, 10: Ban Pa Wai (Narathiwat, Thailand) at 10. August 1987, K-4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17: Kok Chun Bet (Narathiwat, Thailand) at 9. August 1987.

Table 12. Grassland Vegetation (5)

Blechnum serratum-*Scleria sumatrensis*-community

Releve no.:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Field no.:		G1	G2	G6	G10	K6	K7	K8	K4	19	20	21	22	23	24	25
Area of vegetation(qm):		12	20	4	6	6	6	6	16	25	25	25	25	25	25	25
Height of herb layer(cm):		150	200	150	150	180	200	150	80	70	80	80	80	60	60	60
Cover of herb layer(%):		95	98	90	98	90	85	80	75	90	95	90	90	90	85	90
Total no. of species:		5	5	3	4	4	3	5	2	3	3	2	2	2	2	2

Differential species of community:

<i>Blechnum serratum</i> A. Rich. (Blechnaceae)	1.2	1.2	1.2	2.2	2.2	2.2	3.3	+	4.4	5.5	5.5	5.5	5.5	5.4	5.4	5.5
<i>Scleria sumatrensis</i> Retz. (Cyperaceae)	5.5	5.4	5.5	5.4	5.4	4.4	4.4	3.3	.	.	.	.	.	.	.	.

Other species:

<i>Stenochlaena palustris</i> Bedd. (Pteridaceae) +	2.2	1.2	+2	2.2	.	.	2.3	.	.	.	.	.	.	.	.	.
<i>Helaleuca cajuputi</i> Powell (Myrtaceae)	.	.	.	.	.	.	.	.	.	+	+	.	+2	.	.	+
<i>Uncaria longiflora</i> Merr. (Rubiaceae)	1.2	+2	.	1.1	.	1.1	.	.	.	.	.	.	.	.	.	.

Location & date: G-1,2:Ban Pa Wai(Narathiwat, Thailand) at 10. Aug. 1987, 19-27:Pru Baocho(Narathiwat, Thailand) at 20. December 1990.

pudica (Leguminosae). The stands of the *Axonopus compressus-Mimosa pudica*-community have a cover of 80-98 per cent. The community distributes in roadside and wastelands in tropics. *Mimosa pudica* is a perennial herb with shaped spines.

13. *Isachne confusa*-community (Table 9)

The *Isachne confusa*-community is characterized by dominated Compositae; *Isachne confusa* and *Scleria sumatrensis* (Cyperaceae). The data were collected at Ban Pa Wai, Narathiwat. The stands of the *Isachne confusa*-community have a cover of 98-100 per cent and a height of 40-80 cm. *Mikania cordata* (Compositae) is also common. The community distributes in roadside and wastelands. The habitat is not so dry and the nourishment is not poor.

14. *Axonopus compressus-Chrysopogon aciculatus*-community (Table 10)

The *Axonopus compressus-Chrysopogon aciculatus*-community is a common secondary herbaceous vegetation on the sandy dry conditions. The data of the community were collected at Kok Chun Bet and Kuk Rhuk Muu, Narathiwat. The community is differentiated by *Chrysopogon aciculatus* (Gramineae) and *Axonopus compressus* (Gramineae), and is 60-70 cm high. The cover of the community is 60-70 per cent.

15. *Eragrostis malayana*-community (Table 10)

On the sandy habitat after development of the peat swamps, the *Eragrostis malayana*-community is growing. The data of the community were collected at Kuk Rhuk Muu, Narathiwat. The community, characterized by dominated *Eragrostis malayana* (Gramineae), have a height of 10-20 cm and a cover of 70-80 per cent. The total number of species is 3. *Hedyotis auricularia* (Rubiaceae) is also common.

16. *Chrysopogon orientalis-Massia trisetata*-community (Table 10)

The grasslands with dominated *Massia trisetata* develop widely on the sandy habitat. The grasslands is dominated and characterized by *Massia trisetata* (Gramineae) and *Chrysopogon orientalis* (Gramineae). The stands of the *Chrysopogon orientalis-Massia trisetata*-community have a cover of 60-70 per cent and a height of 30-45 cm. The total number of species is 2-3.

17. *Monochoria vaginalis-Fuirena umbellata*-community (Table 11)

The *Monochoria vaginalis-Fuirena umbellata*-community is summarized by *Fuirena umbellata* (Cyperaceae), *Monochoria vaginalis* (Pontederiaceae) and *Ludwigia hyssopifolia* (Onagraceae). The data were collected at Ban Pa Wai, Narathiwat. The species number is not more than 5-7. The community grows on aquatic and wet conditions.

18. *Scirpodendron ghaeri*-community (Table 11)

The grassland with dominated *Scirpodendron ghaeri* (Cyperaceae) is a common swamp vegetation. The differential and dominant species of the *Scirpodendron ghaeri*-community are *Scirpodendron ghaeri* and *Stenochlaena palustris*. The species number is not more than 5-7.

19. *Rhynchospora corymbosa-Rottboellia exaltata*-community (Table 11)

The *Rhynchospora corymbosa-Rottboellia exaltata*-community is 40-60 cm high and is characterized by *Rottboellia exaltata* (Gramineae), *Mitrasacme pygmaea* (Loganiaceae), *Rhynchospora corymbosa* (Cyperaceae), *Melastoma malabathricum* and *Melaleuca cajuputi*. Total number of species is 5-7. *Melastoma malabathricum* and *Melaleuca cajuputi* are shrub or tree species. In the sandy wet soil condition, the stand of this community is distributed together with some peat layer.

20. *Chrysopogon aciculatus*-community (Table 11)

The diagnostic and dominant species is *Chrysopogon aciculatus* (Gramineae) and *Polygonum*

molle (Polygonaceae). The species number is not more than 2-5. The data were collected at Kok Chun Bet, Narathiwat. The stands of the community are influenced by pastage. The total cover is 60-80 per cent; the height of the community is 5-10 cm. The community is distributed on the sandy condition with shallow peat soils which was originally covered by thin peat soils before the development of the place 5-10 years ago.

21. *Blechnum serratum*-*Scleria sumatrensis*-community (Table 12)

The *Blechnum serratum*-*Scleria sumatrensis*-community is a quite common grassland on the peat swamps at Narathiwat. The community is 60-200 cm in height and is dominated by *Scleria sumatrensis*, *Blechnum serratum* (Blechnaceae) and *Stenochlaena palustris*. *Melaleuca cajuputi*, *Uncaria longiflora* (Rubiaceae) and *Evodia roxburghiana* are also common. The species number is 2-5.

THE COMMUNITY RINGS OF THE PEAT SWAMPY AREAS AT NARATHIWAT

The community rings (see Fig. 3) are the relationships between the natural and substitutional vegetation in the coastal wetlands of Narathiwat, Thailand, which are being covered by peat/acid sulfate soils.

The upper categories of the figure are less influenced by human activities. Direction of the arrows indicate succession (vegetation changes).

The original vegetation in the peat swamp area of Narathiwat is of the *Baccauria bracteata*-*Endiandra macrophylla*-community. The structure of the two kinds of peat swamp forests can be noticed: the natural *Baccauria bracteata*-*Endiandra macrophylla*-community and the secondary *Macaranga pruinosa*-community; the physiognomy and component species of these two communities are similar. However due to forest cutting, cultivation, burning, and pasturage, most of the peat soil disappeared within a short time. The traditional culture which is burning for agriculture, have extensively degraded the primary forests and the habitat to openwood or treeless grassland and the problem habitat. The secondary *Melaleuca*-dominated forests; the *Lygodium microphyllum*-*Melaleuca cajuputi*-community and the *Evodia roxburghiana*-*Melaleuca cajuputi*-community, can be observed in sandy or acid-sulfate soil areas where peat have vanished.

When peat layer was still present, cultivation of rice was possible. But after the loss of the peat layer, ground level went down and the soil changed into sulfate soil, the main recovery or reconstruction of original vegetation is impossible. Potential natural vegetation was alternated by the change of soil condition under the influence of human activities. The community is a kerangas forest (heath forest) on the silica-sandy habitat.

DISCUSSIONS

The researches of the coastal wetland of the Southeast Asia were mostly limited to the mangroves because of the following constraints: deep water, heavy rainfall, and the difficult terrain under severe climatic condition, which made difficult the conduct of research. This paper is the first detailed description of the Thai peat swamp vegetation which contains community table with complete flora list, and it will be useful for phytosociologists and environmental scientists.

About 90 per cent of the population in Thailand is engaged in certain forms of agriculture,

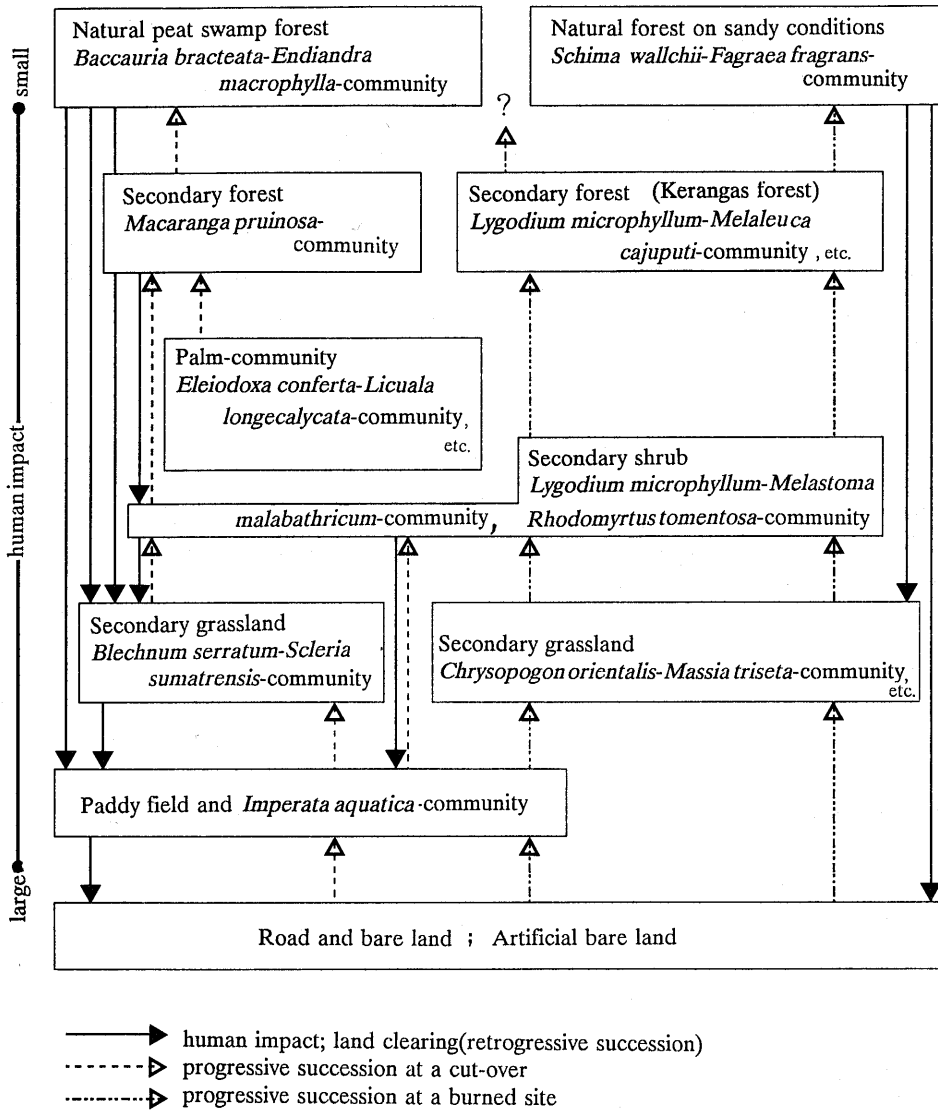


Fig. 3. Community ring on peat swampy area at Narathiwat, Thailand.
(Principal interrelationships between natural and secondary vegetation).

predominantly rice farming. Due to the increasing need for agricultural land created by population growth, the careless utilization of such original swamps had introduced many adverse conditions.

Lowering of the water table leads to oxidation of surface peat which is followed by humification (decomposition) and loss of volume (shrinkage). This can have severe consequences in the tropics where peat lands are located mainly in lowland, sub-coastal areas at or only slightly above sea level. In the last few decades, the sulfate soil areas which were originally peat swamp have been increasing in tropical Asia because of burning and irrigation. Sulfate soil area is impossible for use of cultivation. Thus, for this problem, this ecological research project would be important and useful in consideration.

SUMMARY

In Thailand, the natural peat swamp forest can be only found at Narathiwat province. Now, the natural swamp forest and many types of the secondary vegetation are decreasing every year due to burning and draining. In 1986-1990, ecological and phytosociological investigations on the vegetation of the peat swampy area were carried out by the field survey. As a result of the investigation and the classification, it is possible to establish 22 communities as follows:

A. Forest Vegetation: 1. *Baccauria bracteata-Endiandra macrophylla*-community, 2. *Macaranga pruinosa*-community, 3. *Schima wallichii-Fagraea fragrans*-community, 4. *Lygodium microphyllum-Melaleuca cajuputi*-community, 5. *Evodia roxburghiana-Melaleuca cajuputi*-community

B. Shrub Vegetation: 6. *Eleiodoxa conferta-Licuala longecalycata*-community, 7. *Eleiodoxa conferta-Metroxylon sagus*-community, 8. *Lygodium microphyllum-Melastoma malabathricum*-community, 9. *Rhodomyrtus tomentosa*-community

C. Grassland vegetation: 10. *Eleocharis congesta*-community, 11. *Echinochloa stagnina*-community, 12. *Chrysopogon aciculatus-Rottboellia exaltata*-community, 13. *Axonopus compressus-Mimosa pudica*-community, 14. *Isachne confusa*-community, 15. *Axonopus compressus-Chrysopogon aciculatus*-community, 16. *Eragrostis malayana*-community, 17. *Chrysopogon orientalis-Massia trisetata*-community, 18. *Monochoria vaginalis-Fuirena umbellata*-community, 19. *Scirpodendron ghaeri*-community, 20. *Rhynchospora corymbosa-Rottboellia exaltata*-community, 21. *Chrysopogon aciculatus*-community, 22. *Blechnum serratum-Scleria sumatrensis*-community

The peat soil of the tropical wetlands in Asia has disappeared within a short time due to human activities such as the clear cutting and burning of the natural forest, draining the area for the reclamation of land-use in cultivation. Then most of the vegetation in the peat swamp area can not everlastingly be restored to the original vegetation.

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鈴木邦雄, C. NIYOMDHAM 熱帯泥炭湿地の植物社会学的研究 1. タイ国ナラチワ地区の植生区分

湿潤熱帯特に東南アジアの低地には、200 万haともいわれる広大な泥炭湿地がある。筆者らは、1987 年以来、タイ、マレーシア、インドネシアを中心とする熱帯アジアの泥炭湿地を対象とした植物社会学的研究を進めてきている。本報告では、その第1報として、タイ国南部ナラチワ地区の泥炭湿地の植生区分および植生相互の関係をまとめている。現地踏査によって得られた植生調査資料を基に群落単位の区分を行い、森林植生から低木植生、草本植生まで、以下に示している22群落認められた。

A. 森林植生: 1. *Baccauria bracteata-Endiandra macrophylla* 群落 (泥炭湿地に生育している典型的な自然林・高さ 40 m 前後の高木林), 2. *Macaranga pruinosa* 群落 (自然林内のギャップなどに繁茂している高木林), 3. *Schima wallichii-Fagraea fragrans* 群落 (泥炭層が薄いケランガスの立地に生育する自然林), 4. *Lygodium microphyllum-Melaleuca cajuputi* 群落 (火入れの影響を受けている泥炭湿地に成立する二次林), 5. *Evodia roxburghiana-Melaleuca cajuputi* 群落 (泥炭層が失われ、乾燥しやすい立地に成立する二次林)。

B. 低木植生: 6. *Eleiodoxa conferta-Licuala longecalycata* 群落 (ヤシ林), 7. *Eleiodoxa conferta-Metroxylon sagus* 群落 (サゴヤシ林), 8. *Lygodium microphyllum-Melastoma malabathricum* 群落 (泥炭湿地に限らず広範囲に生育する低木林), 9. *Rhodomyrtus tomentosa* 群落 (生育面積は限られている低木林)。

C. 草本植生: 10. *Eleocharis congesta* 群落, 11. *Echinochloa stagnina* 群落, 12. *Chrysopogon aciculatus-Rottboellia exaltata* 群落 (ケランガスの立地の草原), 13. *Axonopus compressus-Mimosa pudica* 群落, 14. *Isachne confusa* 群落, 15. *Axonopus compressus-Chrysopogon aciculatus* 群落, 16. *Eragrostis malayana* 群落 (ケランガスの立地の草原), 17. *Chrysopogon orientalis-Massia trisepta* 群落, 18. *Monochoria vaginalis-Fuirena umbellata* 群落 (年間を通じて冠水している立地の草原), 19. *Scirpodendron ghaeri* 群落 (年間を通じて冠水している立地の草原), 20. *Rhynchospora corymbosa-Rottboellia exaltata* 群落, 21. *Chrysopogon aciculatus* 群落, 22. *Blechnum serratum-Scleria sumatrensis* 群落 (泥炭湿地で最も典型的な二次草原)。

本報告では、区分した植生単位によって、現在までほとんど報告の行われていない熱帯泥炭湿地の自然植生と代償植生の関係について群落環をまとめ (図3), 植物社会学的考察を行った。タイ国ナラチワでは、排水・火入れという人間活動の影響を受けることによって、森林 (自然林) 伐採とは異なった系列での植生の遷移が進行し、原 (始) 植生への復元が極めて困難となっていることが明らかになった。

