

Plant community structure of the coastal vegetation of peninsular Thailand

CHUKIAT LAONGPOL¹, KUNIO SUZUKI², KLAUS KATZENSTEINER³ & KITICHATE SRIDITH¹

ABSTRACT. Vegetation study on the natural vegetation along the sandy coasts of peninsular Thailand was conducted from October 2006 to May 2008. Thirteen sites along the sandy coast were selected as representatives of each subtype. The coastal vegetation on the sandy ground can be divided into two groups: I. sandbar vegetation due to the sedimentation from sea current comprising three categories: 1) dune grassland 2) dune scrub and 3) dune woodland communities. II. sandbar vegetation due to strong wind. Only one site of the latter type in the northernmost part of the peninsula is recognized, comprising two categories: 1) dune grassland and 2) dune scrub communities. The profiles of the actual and natural vegetation on the sandbars and dunes along the sandy coast are proposed.

KEY WORDS: Peninsular Thailand, Plant community, Sandy coast, Sandbars.

INTRODUCTION

Peninsular Thailand lies in the northern part of the peninsular Malaysia, extending from the Kra Isthmus in Thailand to the Malaysian border. The Thai part of the peninsula is bordered by the Gulf of Thailand (Pacific Ocean) to the east and the Andaman Sea (Indian Ocean) to the west. Peninsular Thailand is subdivided into three topographic landscapes: the mountain ranges, the Gulf coastal plain and the Andaman coastal plain. There are three mountain ranges in the peninsular region: in Phuket, Nakhon Si Thammarat and the Sankala Khiri. There is a wide coastal plain stretching along the eastern coast of the peninsula, which is characterized by an emergent shoreline. Sediments deposited along this shoreline have created many sandbars and offshore bars (Pongsaputra, 1991). In contrast, the Andaman coast is dominated by a submergent shoreline. Most of the coastal plain on the western coast is narrow, flanked by steep slopes. There are comparatively few rivers running towards the Gulf coastal plain and many short rivers towards the Andaman coastal plain. As a result of the variation in and unique nature of the topographic features of peninsular Thailand, diverse plant communities that have developed in these habitats can be encountered. However, among the diverse plant communities in the various habitats of peninsular Thailand, the terrestrial vegetation developed on the sandbars is one of the characteristic communities in terms of floristic composition and physiognomy. Very limited information on such vegetation in peninsular Thailand has been published comparing it with other types of coastal vegetation i.e. mangrove, peat swamp, moist-

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evergreen forests etc. During the past two decades, most of the natural terrestrial vegetation on sandbars along the coasts of Thailand has been depleted or modified by human activities, especially urban development and tourism. Unfortunately, most of the plant communities on sandbars are not located in protected areas such as national parks or wildlife sanctuaries. Nowadays, most of the natural vegetation on the sandy coast has been fragmented into isolated large and small patches representing the once luxuriant coastal vegetation on sandbars of peninsular Thailand. It is likely that these remnant patches of coastal vegetation with significant ecological and economic value will be totally wiped out in the near future unless the effective conservation measures are implemented.

The purpose of the study is to systematically classify the diverse vegetation on sandbars along the coasts of peninsular Thailand, and to account all the remnant patches left as the corridor vegetation.

Study areas

Peninsular Thailand extends southward from the Kra Isthmus (latitude ca 10°N) toward the Malaysian border (latitude ca 6°N), comprising 14 provinces with a total area of about 70,705 sq.km.

The study areas were located on the eastern coast of the peninsula comprising four provinces (Chumphon, Surat Thani, Nakhon Si Thammarat and Songkhla) and six provinces (Ranong, Phangnga, Phuket, Krabi, Trang and Satun) along the western coast of the peninsula.

The climate of the area is tropical rain forest (Af) according to Köppen's classification (Carter & Mather, 1966). They defined this climate type through the mean temperature being 23–31 °C and the average annual rainfall is 1,600–2,400 mm. The relative humidity ranges from 72 to 83 %.

METHODOLOGY

Selected study sites

Thirteen study sites along the sandy coasts of peninsular Thailand, both on the Gulf of Thailand and the Andaman Sea were marked as the research study sites as follows:

Gulf of Thailand (Nos. 1-10): Study sites 1-4, Chumphon: no.1: Ban Bangboet, Pathio district (UTM 47P 553235 E, 1213774 N); no.2: Ao Phanang Tak, Mueang Chumphon district (UTM 47P 526443 E, 1161688 N); no.3: Ban Pak Nam Tako, Thung Tako district (UTM 47P 514587 E, 1116976 N); no.4: Ban Laem Santi, Lamae district (UTM 47P 515385 E, 1077929 N); Study sites 5-9, Surat Thani, Chaiya district: no.5: Ban Takrop (UTM 47P 528536 E, 1044394 N); no.6: Forest reserve at Ban Plongmai (UTM 47P 528877 E, 1043970 N); no.7: Ban Laem Pho 1 (UTM 47P 530370 E, 1038346 N); no.8: Ban Laem Pho 2 (UTM 47P 530396 E, 1037905 N); no.9: Ban Nuea (UTM 47P 528815 E, 1036563 N); Study site 10: Ban Na Thap, Chana district, Songkhla (UTM 47N 685627 E, 779003 N) (Fig. 1).

Andaman Sea (Nos.11-13): Study site no 11: Hat Thai Mueang, Khao Lampi-Hat Thai Mueang National Park, Thai Mueang district, Phangnga (UTM 47N 413271 E, 943898 N); no.12: Hat Thung Thale, Thung Tale Non-hunting Areas, Ko Lanta district, Krabi (UTM 47P 504874 E, 855453 N); no.13: Hat Yong Ling, Hat Chao Mai National Park, Sikao district, Trang (UTM 47P 540944 E, 812158 N) (Fig. 1).

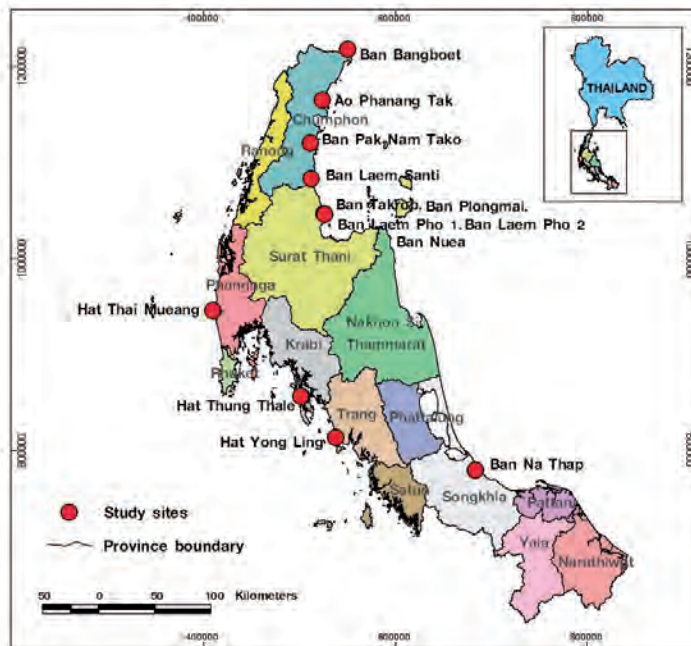


Figure 1. Map of peninsular Thailand showing the 13 study sites.

Inventory

During this research we set out to explore selected remnant patches of terrestrial vegetation along the sandy coast of peninsular Thailand.

Data collecting and analysis

1.1 Plant collection

Herbarium specimens were collected from all study sites for taxonomic identification. Field notes on plants and their habitats with photographs were made.

1.2 Vegetation data

Vegetation and supporting data such as forest profiles, geo-reference position and geology were recorded. Photographs showing structural characteristics of the study sites were taken. Comparative analyses of species composition in the representative plots were undertaken and compared with the vegetation profiles.

RESULTS AND DISCUSSION

Species composition of the coastal plant communities on sandbars in peninsular Thailand

The remnant patches of the peninsular natural plant communities on sandbars can be expected more on the Gulf of Thailand coast than on the Andaman Sea coast because of the wider coastal plain of the former characterized by emergent shoreline from Chumphon to Narathiwat. The shoreline along the Gulf of Thailand is rather straight and smooth deposited sediments form many sandbars and offshore bars (Pongsaputra, 1991). On these long sandbars parallel to the coastline, unique plant communities have developed in a continuous strip from Chumphon to Narathiwat. However, most of these unique vegetation communities have been much depleted and modified by human activities. As a consequence, many fragmentary remnant patches of those plant communities can be encountered scattering along the peninsular coastline.

Unlike the eastern coast, the Andaman Sea coast is a submergent shoreline characterized by narrow coastal plains flanked by steep slopes, and in certain parts, sea cliffs are common in the landscape (Pongsaputra, 1991). However, the unique plant communities on the narrow coastal plains of the Andaman Sea are highly threatened or have even disappeared as a result of human activities, especially tourism and urban development. Only a few healthy or less disturbed remnant patches of the natural coastal vegetation can be witnessed in some protected areas along the Andaman coast, either in national parks, wildlife sanctuaries or non-hunting areas.

The species composition at the selected sites varies slightly from site to site according to local factors and the topography of shoreline (Table 1). However, all of the selected sites have quite a number of plant species in common. The most common species characterising the plant communities on the coastal sandbars are tree species of the family Myrtaceae i.e. *Syzygium grande* and *S. gratum* (Table 1, where authors of taxa are given except those given below). These two dominant species of the coastal vegetation on sandbars have also been reported by Congdon (1982), Sridith (2002), Sridith & Laongpol (2002), and Laongpol et al. (2005). The characteristically xeromorphic features of these plant species, such as sclerophyllous succulent thick leaves, render them able to withstand the unfavourable coastal environment. In addition, there are some other common plant species, e.g. trees: *Chaetocarpus castanocarpus*, *Olea brachiata*, *Shorea roxburghii*; shrubs: *Melastoma malabathricum*, *Rhodomyrtus tomentosa*; climbers: *Aganosma marginata*, *Hoya parasitica*, *Psychotria sarmentosa*, *Tetracera indica*; herbs: *Dianella ensifolia*; orchids: *Dendrobium crumenatum*, *Doritis pulcherima*, *Cymbidium findlaysonianum*; and ferns: *Davallia denticulata*; *Drynaria sparsisora* (Table 1). The term coastal heath forest mentioned by Congdon (1982) and Whitmore (1985) can also be applied to this coastal vegetation type. There is no doubt that this type of vegetation once occurred luxuriantly in a continuous strip along the coastal sandbars. Though all the remnant patches of the plant community on sandbars of the peninsular coasts harbour many plant species in common, only a few are distributed on just one coast. *Hydrophylax maritima* (Rubiaceae) and *Styphelia malayana* (Epacridaceae), a Malesian element, for example, are distributed along the western coast of Thai-Malay peninsula to the

northernmost limit in Thai Mueang beach, Phangnga. On the eastern coast of peninsular Thailand, some Indo-Chinese elements have a southernmost limit at Bangboet, Pathio district, Chumphon, such as *Sindora siamensis* (Fabaceae). *Podocarpus neriifolia* (Podocarpaceae), a rare gymnosperm species which is normally found in Thailand as a lower montane element above 600 m elevation, is for the first time recorded near sea level on the coastal sandbar at Thai Mueang beach, Phangnga.

Vegetation profiles along the coastal sandbars in peninsular Thailand

The profiles of actual plant communities on the coastal sandbars in the study areas (Figs. 2–8) clearly exhibit various structural characteristics and typical floristic composition. The vegetation can be divided into two main categories according to the topographic features of sandbars.

1. Vegetation on coastal sandbars due to sedimentation from sea currents

Twelve selected sites (nos. 2–13) fall into this category. The vegetation of this kind, in general, can be subdivided into three main zones in accordance with previous studies of such vegetation on the eastern coast of peninsular Thailand (Suzuki et al., 2005), i.e.: dune grassland communities (Plate 1A); dune scrub communities (Plate 1B) and dune woodland communities (Plate 1C, D). However, some features represent the transition between various vegetation zones on the western coast and the eastern coast of the peninsula.

1.1 Natural vegetation on sandbars along the eastern coast of peninsular Thailand (Figs. 2–4; Plate 1A, C, D)

Natural vegetation on the coastal sandbars of the east is likely to have extended from the North of the peninsula in Chumphon and run continually throughout peninsular Malaysia. However, most of natural vegetation on the eastern coast of peninsular Thailand has been depleted for a long time. Only the fragmented remnants of natural vegetation left in isolated patches along the sandy coast can be recognized in some places. The remnants of such vegetation at “Chaiya sandbar” in Surat Thani are typical of natural sandbar vegetation. In Chaiya district, quite a few remnants of natural sandbar vegetation can be seen in fragmented patches along the Chaiya sandy coast from Ban Takrop to Ban Nuea.

The dune grassland communities, adjoining shoreline consist of *Sesuvium portulacastrum*, *Ipomoea imperati*, *Ipomoea pes-caprae*, *Remirea maritima*, *Chrysopogon orientalis*, *Ischaemum muticum*, *Spinifex littoreus*, *Zoysia matrella*, *Vitex rotundifolia*, *Canavalia rosea* and *Vigna marina*. The zone next to the dune grassland is dune scrub communities (Fig. 2) (site 7, Ban Laem Pho 1) which characteristically comprise many stunted, shrubby tree species about 5–8 m high, e.g. *Vatica harmandiana*, *Syzygium gratum*., *Eurycoma longifolia*, *Chaetocarpus castanocarpus*, *Lanea coromendelica*, *Rapanea porteriiana*, *Olea brachiata*, *Acronychia pedunculata* and *Pouteria obovata*; shrub species such as *Salacia chinensis*, *Breynia racemosa*, *Suregada multiflorum*, *Melastoma malabathricum*, *Rhodomyrtus tomentosa*, *Catunaregam tomentosa*, *Atalantia monophylla* and *Micromelum minutum*. The ground cover consists of *Dianella ensifolia*, *Wikstroemia ridleyi*, orchids such as *Doritis pulcherrima*, ferns like *Davallia denticulata* and *Drynaria sparsisora*, and vines such as *Cansjera rheedei*, *Psychotria sarmentosa*, *Dischidia major* and *Hoya parasitica* are rather scattered. The dune woodland communities in the innermost

zone (Figs. 3–4; Plate 1C, D) (site 8, Ban Laem Pho 2) (Fig. 3) are characterized by three storeys in profile. The canopy layer of about 15–18 m high is mainly represented by *Shorea roxburghii*. The lower storey of about 10–12 m high is constituted by smaller trees such as *Vatica harmandiana* and *Vitex pinnata*. The undergrowth layer is composed of shrubs and saplings such as *Eurycoma longifolia*, *Pouteria obovata*, *Rapanea porteriana*, *Ochna integerrima*, *Ardisia crenata*, *Olea brachiata*, *Champereia manillana*, *Carallia brachiata*, *Ixora javanica*, *Micromelum minutum*, *Microcos tomentosa*; climbers such as *Tetracera indica*, *Ancistrocladus tectorius*, *Dischidia major*, *Hoya parasitica*, *Cansjera rheedei*, *Psychotria sarmentosa*; and ferns such as *Davallia denticulata*, *Drynaria sparsisora*. Herbs such as *Dianella ensifolia* are also abundant on the ground floor. However, the woodland communities in the inland sand dunes at Ban Nuea (site 9) (Fig. 4), are also characterized by three layers, but differ slightly from the above. The topmost storey of about 25–30 m high consists of *Dipterocarpus chartaceus* and *D. alatus*. The lower layer of about 15–20 m high comprises of *Mangifera indica* and *Shorea roxburghii*. The undergrowth layer often disturbed by human activities, but there are some native species such as *Memecylon ovatum*, *Ardisia crenata*, *Ochna integerrima*, *Champereia manillana*, *Morinda elliptica* and *Eurycoma longifolia*.

1.2 Natural vegetation on sandbars along the western coast of peninsular Thailand (Figs. 6–8; Plate 1B)

Unlike the eastern coast of peninsular Thailand, the western coast vegetation has developed on narrow sandbars in small fragmented patches in accordance with the topographic features of each coastal sandbar. However, almost all natural vegetation along the western sandy coast of peninsular Thailand had been already diminished or modified as a result of the tourism business, especially sea resorts. There are a few remnants of natural sandbar vegetation left in some protected areas along the coastline, such as Khao Lampi-Hat Thai Mueang National Park (site 11), Thung Thale non-hunting areas (site 12) and Hat Chao Mai National Park (site 13). The profiles of remnant patches at Hat Thai Mueang (site 11) seem to be typical representatives of sandbar vegetation along the western peninsular coast. Though some parts of natural vegetation at Hat Thai Mueang were destroyed by the “Tsunami” tidal waves in 2005, the remaining fragmented patches along the coastal sandbar still exhibit typical sandbar vegetation along the western peninsular coast. The profile diagrams illustrate structure of the plant communities in the areas from the tidal zone towards the innermost zone of the sandbar, i.e. coastal scrub (Fig. 6). The first area of coastal dune scrub community is composed of *Hydrophylax maritima*, *Ischaemum muticum*, *Crinum northianum*, *Scaevola taccada*, *Pandanus odoratissimus*, *Diospyros areolata*, *D. ferrea*, *Calophyllum pulcherrimum*, *Rhodomyrtus tomentosa*, *Atalantia monophylla* and *Pouteria obovata*. The inner dunes coastal scrub community is scattered and separated by small patches of other plant communities (Fig. 7; Plate 1B). They are formed by characteristic species of sandbar vegetation on the western coast that differ from those on the eastern coast. Each small coastal dune scrub community is mainly composed of tree or shrubby tree species, e.g. *Cotylelobium lanceolatum* and *Rapanea porteriana* surrounded by other shrubs or treelets, e.g. *Syzygium gratum*, *Styphelia malayana*, *Rhodamnia cinerea*, *Rhodomyrtus tomentosa*, and some orchids e.g. *Doritis pulcherrima*, *Dendrobium crumenatum*, *Dendrobium indivisum* and *Dendrobium pachyphyllum*. The coastal dune woodland communities (Fig. 8) developed in a continual

narrow strip according to the length of the dune are characterized by three storeys. The canopy layer of about 15–18 m high is dominated by dipterocarp species e.g. *Shorea roxburghii*. The lower tree layer of about 8–10 m high comprises smaller trees and shrubs, e.g. *Vatica harmandiana*, *Acronychia pedunculata*, *Pouteria obovata* and *Syzygium gratum*. The undergrowth layer consists of *Rhodamnia cinerea*, *Rhodomyrtus tomentosa* and *Calophyllum pulcherimum* (for example). Ferns are also frequent, such as *Drynaria sparsisora*, *Davallia denticulata*, *D. heterophylla*, *D. pectinata*, *Pyrrosia piloselloides*, *Schizaea dichotoma* and *S. digitata*.

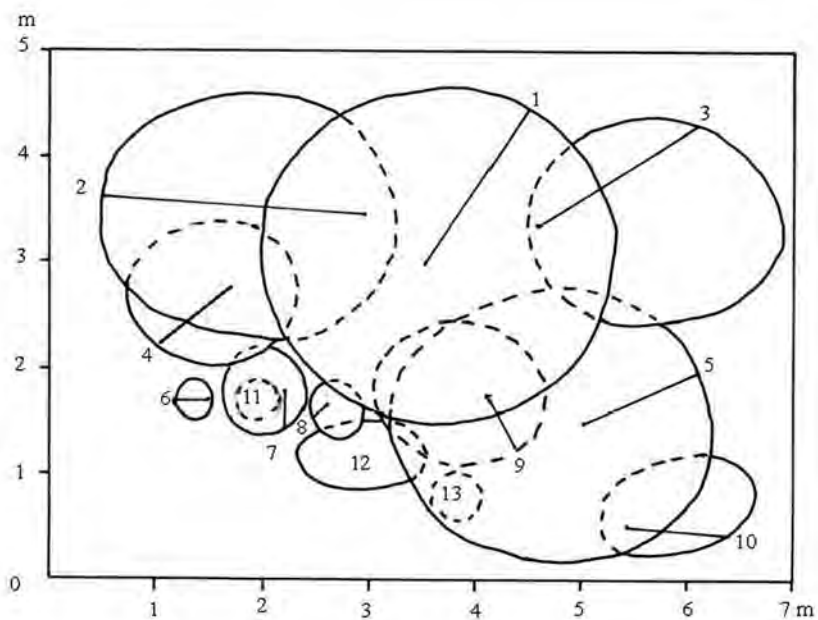
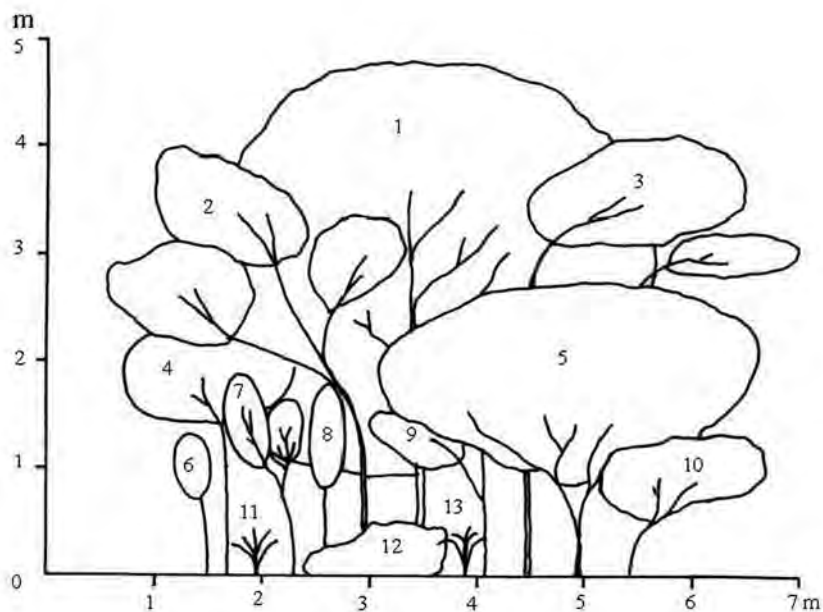
The natural vegetation profiles along the coastal sandbars of peninsular Thailand (Fig. 9) may differ slightly from place to place in some details such as structure of plant communities and floristic composition. The establishment of the coastal dune grassland and coastal shrub communities, apart from edaphic factors, seems to be governed by strong winds from the open sea. Unlike the noticeably changeable zonation of the mangrove swamp community, the development and establishment of coastal sandbar vegetation in terms of species distribution are quite stable. In certain localities, mangrove and coastal sandbar vegetation are interrupted by a secondary swamp community dominated by pure stands of *Melaleuca cajuputi* Powell.

2. Vegetation on the coastal sandbars due to wind storms.

Only one site in the northernmost part of the peninsula is recognized (site 1). This is a characteristic community and unique on the plain of the eastern coast of peninsular Thailand. The site is located at Ban Bangboet, Pathio district, Chumphon (Plate 1E) characterized by the coastal sanddunes resulting from strong winds. The dune features are always subjected to change by strong wind. In some places where the existing dunes are less affected by strong winds, the natural vegetation will develop quickly, as soon as the dunes are stable. There are coastal dune grassland and coastal scrub communities. The coastal dune grassland is composed of *Ipomoea imperati*, *Ipomoea pes-caprae*, *Fimbristylis sericea* and *Cyperus stoloniferus*. Coastal scrub communities (Fig. 5) are composed of shrubby trees and shrubs such as *Syzygium gratum*, *Eurycoma longifolia*, *Pouteria obovata*, *Calophyllum pulcherimum*, *Sindora siamensis*, *Scaevola taccada*, *Pandanus odoratissimus*, *Diospyros ferrea*, *Ardisia crenata*. Some climbers and herbs such as *Tetracera indica*, *Dunbaria bella* and *Dianella ensifolia*, are also presented.

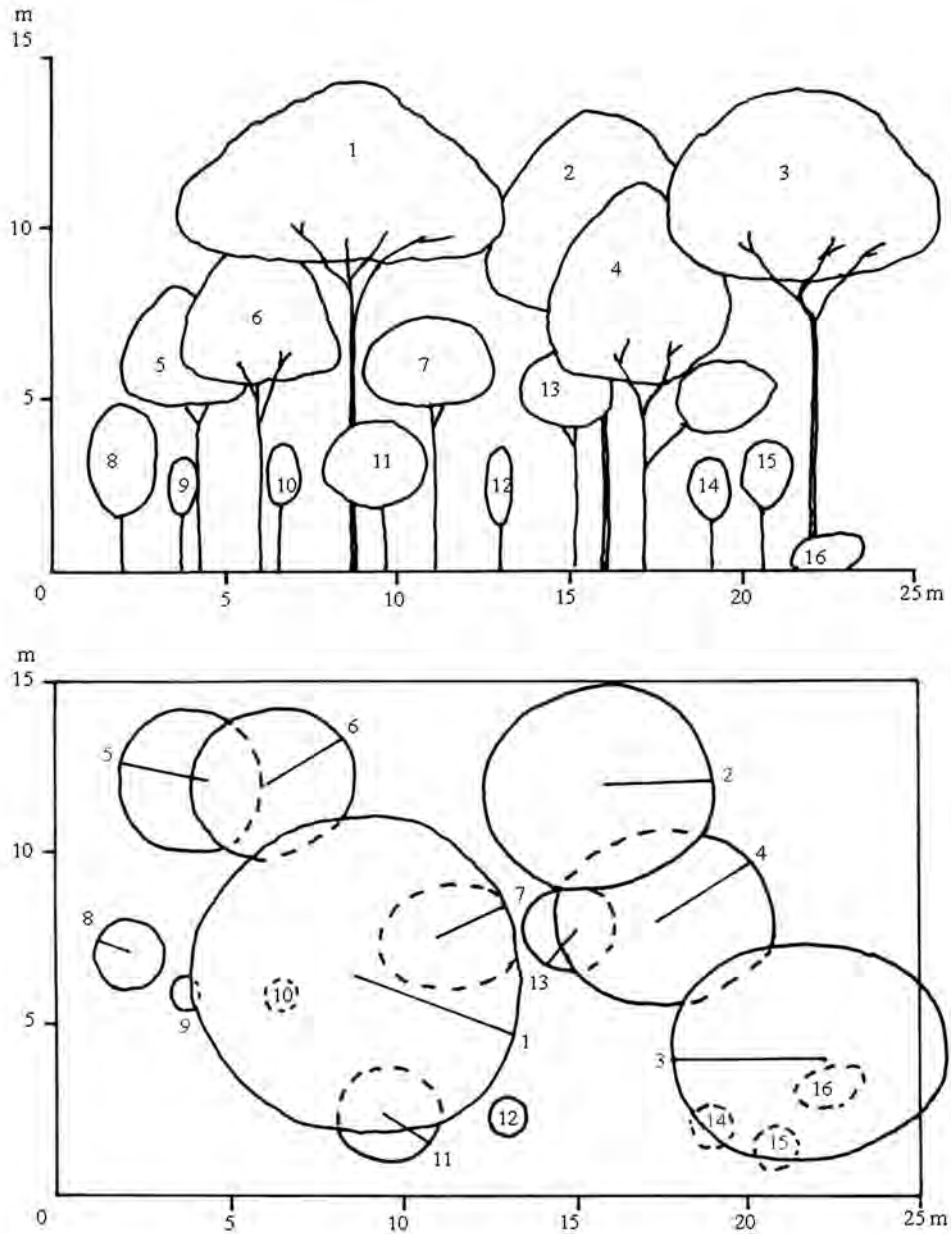
Future work and conservation measures

Vegetation analysis by the qualitative method of Braun-Blanquet (Zurich-Montpellier school) should be undertaken in order to identify all the actual plant community types in the study areas. The relationship between soil types and the actual plant communities should be analyzed and discussed in order to achieve a systematic site classification of the coastal sandbar vegetation of the peninsular Thailand. Almost remnant patches of coastal vegetation on sandbars of peninsular Thailand are substantially threatened in the near future because most of them are not yet protected by law. Various human activities including agriculture (especially oil palm plantations), tourism and monoculture forest plantation using alien species, e.g. *Eucalyptus* spp., *Acacia* spp. and *Casuarina* spp. have entirely altered and modified the remaining natural remnant patches of such vegetation. Unless all remnant patches of such vegetation are systematically identified and protected by law, the natural sandbar vegetation along the peninsular coasts will be completely wiped out in the near future.



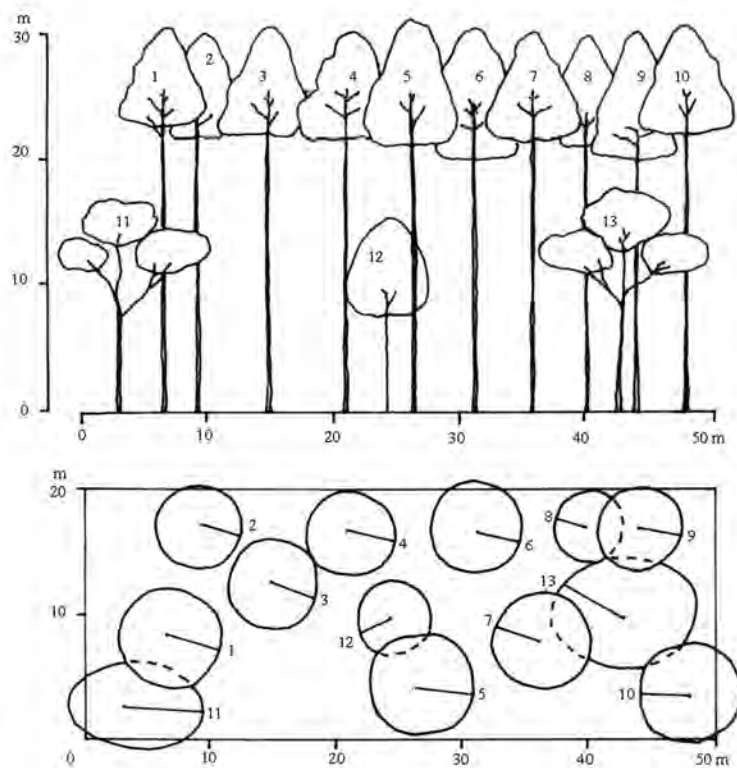
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|-------------|--|---------|---|
| 1, 4, 5, 10 | <i>Vatica harmandiana</i> Pierre | 2, 3, 9 | <i>Syzygium gratum</i> (Wight) S.N.Mitra. |
| 6, 7, 8 | <i>Eurycoma longifolia</i> Jack | 11, 13 | <i>Dianella ensifolia</i> (L.) DC. |
| 12 | <i>Tetracera indica</i> (Christm. & Panz.) Merr. | | |

Figure 2. Profile of coastal scrub vegetation at Ban Laem Pho 1 (study site 7), Chaiya district, Surat Thani.



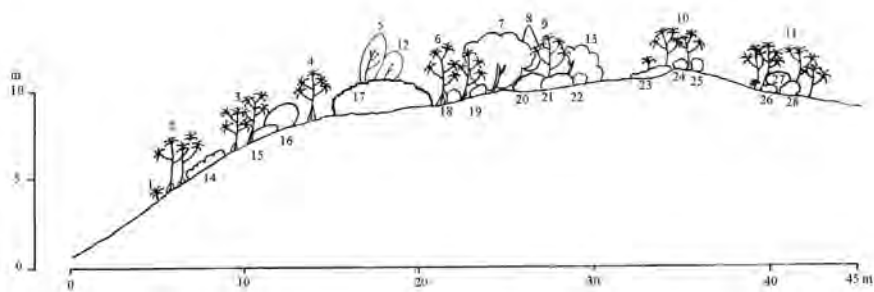
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|-------------------|--|------|----------------------------------|
| 1, 2, 3, 4, 5, 6 | <i>Shorea roxburghii</i> G. Don | 7, 8 | <i>Vatica harmandiana</i> Pierre |
| 9, 10, 12, 14, 15 | <i>Eurycoma longifolia</i> Jack | 13 | <i>Vitex pinnata</i> L. |
| 16 | <i>Tetracera indica</i> (Christm. & Panz.) Merr. | | |
| 11 | <i>Pouteria obovata</i> (R.Br.) Baehni | | |

Figure 3. Profile of coastal woodland vegetation at Laem Pho 2 (study site 8), Chaiya district, Surat Thani.



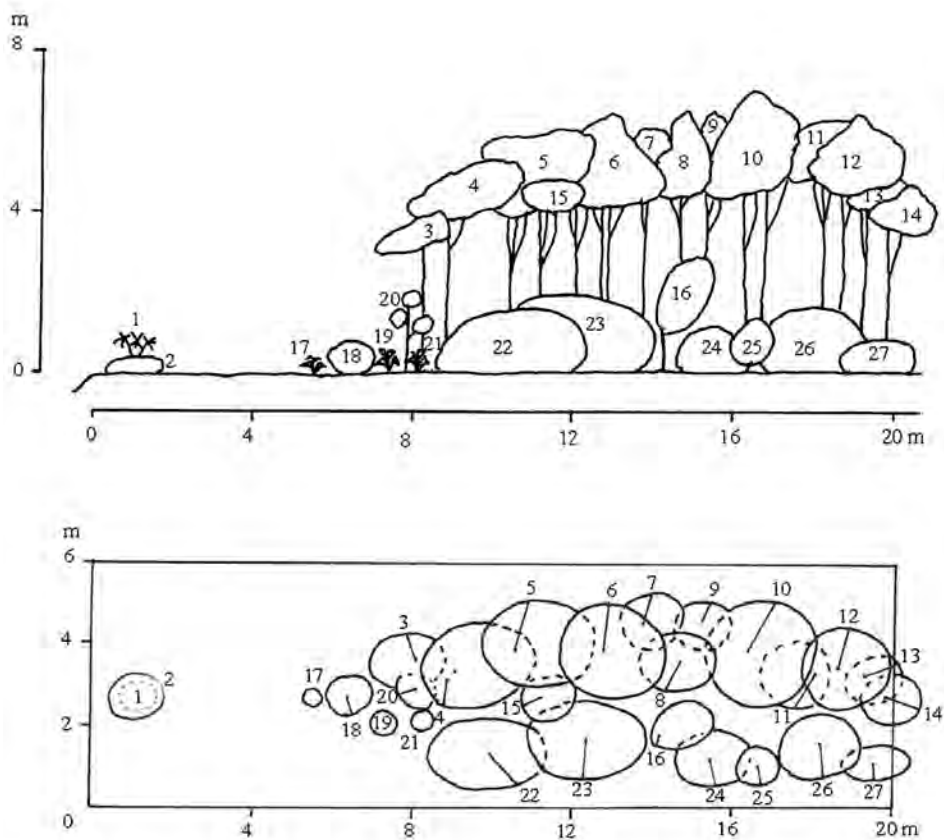
- 1, 3, 4, 5, 6, 7, 8, 9, 10 *Dipterocarpus alatus* Roxb. ex G. Don
 11, 13 *Shorea roxburghii* G. Don
 12 *Mangifera indica* L.
 2 *Dipterocarpus chartaceus* Symington

Figure 4. Profile of coastal woodland vegetation at Ban Nuea (study site 9), Chaiya district, Surat Thani.



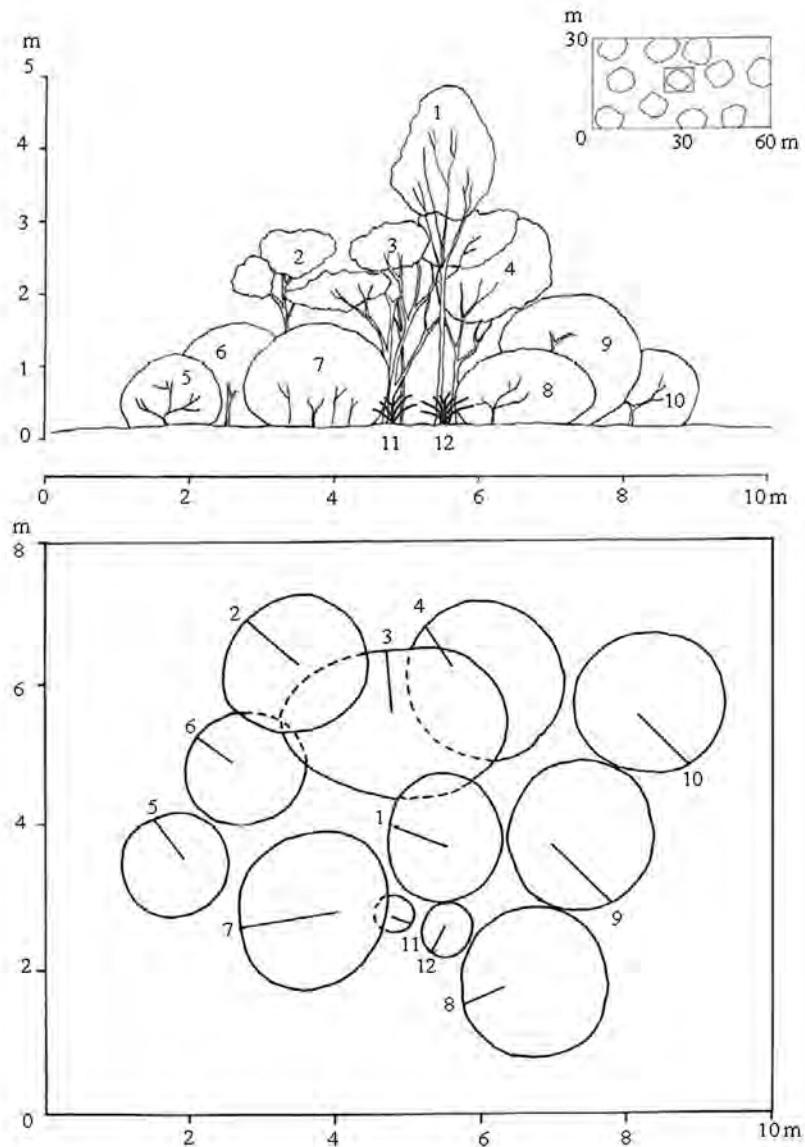
- 1, 2, 3, 4, 6, 9, 10, 11 *Pandanus odoratissimus* L.f.
 5 *Pouteria obovata* (R.Br.) Baeh
 8 *Eurycoma longifolia* Jack
 15, 25, 26 *Diospyros ferrea* (Willd.) Bakh.
 18, 19, 21, 27 *Calophyllum pulcherrimum* Wall.
 7, 13 *Syzygium grande* (Wight) Walp.
 12, 16 *Syzygium gratum* (Wight) S.N.Mitra
 17 *Scaevola taccada* (Gaertn.) Roxb.
 20, 22, 24, 28 *Ardisia crenata* Sims
 14, 23 *Tetracera indica* (Christm. & Panz.) Merr.

Figure 5. Profile of coastal scrub vegetation at Ban Bangboet (study site 1), Pathio district, Chumphon.



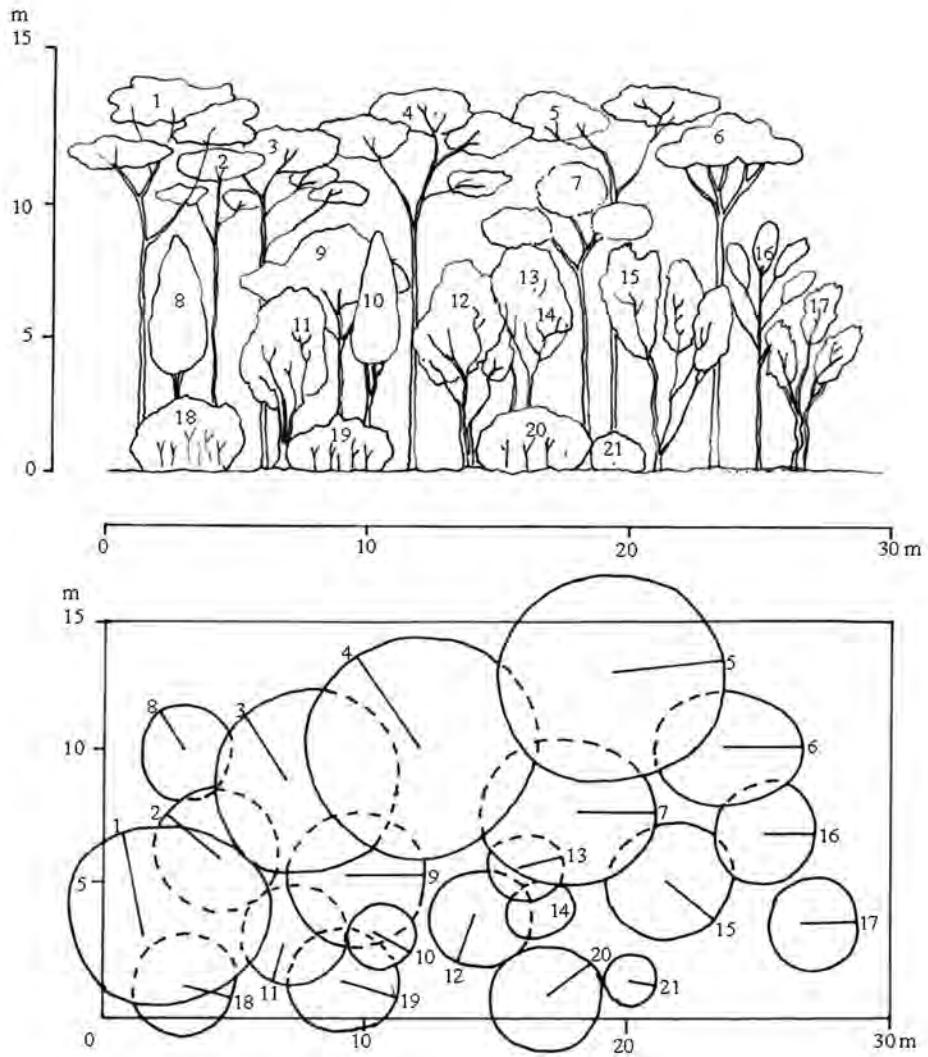
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|---|--|----|---------------------------------------|
| 17, 19, 21 | <i>Crinum northianum</i> Baker | 1 | <i>Pandanus odoratissimus</i> L.f. |
| 16 | <i>Diospyros areolata</i> King & Gamble | 20 | <i>Guettarda speciosa</i> L. |
| 18 | <i>Diospyros ferrea</i> (Willd.) Bakh. | 27 | <i>Calophyllum pulcherrimum</i> Wall. |
| 24 | <i>Rhodomyrtus tomentosa</i> (Aiton) Hassk | | |
| 25 | <i>Atalantia monophylla</i> (DC.) Correa | | |
| 2, 22, 23, 26 | <i>Scaevola taccada</i> (Gaertn.) Roxb | | |
| 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 | <i>Pouteria obovata</i> (R.Br.) Baehni | | |

Figure 6. Profile of coastal scrub vegetation at Hat Thai Mueang (study site 11), Thai Mueang district, Phangnga.



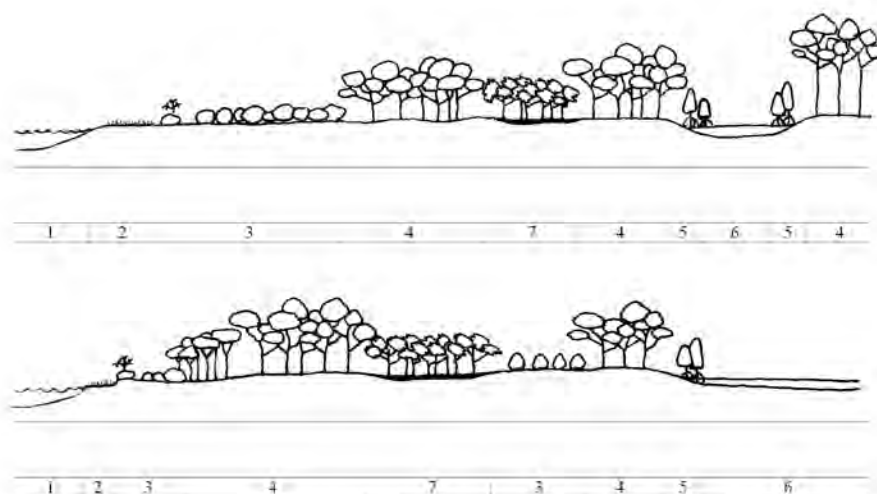
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|----------|---|---------|--|
| 1 | <i>Rapania porteri</i> ana (A.DC.) Mez | 2, 3, 4 | <i>Syzygium gratum</i> (Wight) S.N.Mitra |
| 5, 8 | <i>Styphelia malayana</i> (Jack) Spring | 7 | <i>Rhodammia cinerea</i> Jack |
| 6, 9, 10 | <i>Rhodomyrtus tomentosa</i> (Aiton) Hassk. | | |
| 11, 12 | <i>Dianella ensifolia</i> (L.) DC. | | |

Figure 7. Profile of coastal scrub vegetation at Hat Thai Mueang (study site 11), Thai Mueang district, Phangnga.



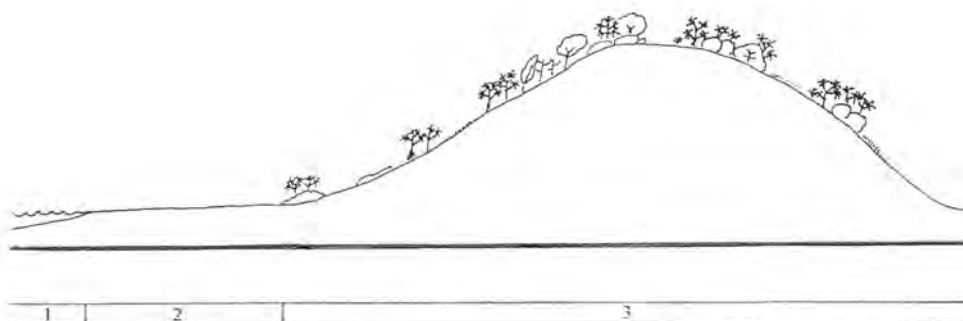
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|----------------------------|---|------------|--------------------------------------|
| 1, 2, 3, 4, 5 | <i>Shorea roxburghii</i> G.Don | 6 | <i>Syzygium grande</i> (Wight) Walp. |
| 7 | <i>Vitex pinnata</i> L. | 8, 10 | <i>Vatica harmandiana</i> Pierre |
| 9 | <i>Acronychia pedunculata</i> (L.) Miq. | 18, 19, 20 | <i>Rhodamnia cinerea</i> Jack |
| 21 | <i>Rhodomirtus tomentosa</i> (Aiton) Hassk. | | |
| 11, 12, 13, 14, 15, 16, 17 | <i>Syzygium gratum</i> (Wight) S.N.Mitra | | |

Figure 8. Profile of coastal woodland vegetation at Hat Thai Mueang (study site 11), Thai Mueang district, Phangnga.



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|---------------------|--|-------------------------------|
| 1 Tidal zone | 4 Woodland vegetation | 7 Melaleuca (swamp) community |
| 2 Coastal grassland | 5 Mangrove forest | |
| 3 Scrub vegetation | 6 Marine swamp (under tidal condition) | |

Figure 9. A; B: Diagram of natural vegetation on the coastal sandbars of peninsular Thailand: A. on the eastern coast at “Chaiya sandbars”, Chaiya district, Surat Thani province; B. on the western coast at Hat Thai Mueang, Thai Mueang district, Phangnga.



- | | | |
|--------------|---------------------|--------------------|
| 1 Tidal zone | 2 Coastal grassland | 3 Scrub vegetation |
|--------------|---------------------|--------------------|

Figure 10. Diagram of natural vegetation on coastal sand dunes at Ban Bangboet, Pathio district, Chumphon.

Table 1. List of plant species found in each study sites⁴.

Family	Species	Habit ⁵	Location ⁶											Voucher ⁷			
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM		LT	SK	
Aizoaceae	<i>Sesuvium portulacastrum</i> (L.) L.	H										X	X	X	X	X	Laongpol 866
Amaranthaceae	<i>Gomphrena celosoides</i> Mart.	H		X	X	X	X	X									Laongpol 703
Amaryllidaceae	<i>Crinum northianum</i> Baker	H	X									X	X	X	X		-
Anacardiaceae	<i>Lannea coronandolica</i> (Houtt.) Merr.	ST	X	X	X	X	X	X	X	X	X	X	X	X	X		-
	<i>Mangifera indica</i> L.	T	X	X	X	X	X	X	X	X	X	X	X	X	X		-
Ancistrocladaceae	<i>Ancistrocladus tectorius</i> (Lour.) Merr.	C	X									X	X	X	X		-
Annonaceae	<i>Polyalthia evecta</i> (Pierre) Finet & Gagnep.	S	X	X	X	X	X	X	X	X	X	X	X	X	X		Laongpol 504
Apocynaceae	<i>Aganostma marginata</i> (Roxb.) G. Don	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 521
	<i>Alyxia reinwardtii</i> Blume	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 718
	<i>Cerbera odollum</i> Gaertn.	ST										X	X	X	X	X	Laongpol 576
	<i>Holarrhena curtisii</i> King & Gamble	S										X	X	X	X	X	Laongpol 727
	<i>Spiranthera cambodianum</i> Baill.	S	X									X	X	X	X	X	Laongpol 535

⁴ Voucher specimens deposited at BKF & PSU

⁵ Habit: C= Climber, CrS= Creeping shrub, F= Fern, G= Grass, H= Herb, HC= Herbaceous climber, O= Orchid, Pa= Parasite, S= Shrub, ST= Shrubby tree, T= Tree, TerO= Terrestrial orchid

⁶ Location: JN= Ban Nuea; CY1= Ban Nuea; CY2= Ban Laem Pho 2; CY3= Ban Laem Pho 1; CY4= Ban Plongmai; CY5= Ban Takrop; Chaiya, Surat Thani; LM = Ban Laem Sarni; Lamae; TK.= Ban Pak Nam Tako, Thung Tako; MU = Ao Phanang Tak, Mueang, Chumphon; PT= Ban Bangboet, Pathio, Chumphon; TM = Hat Thai Mueang, Thai Mueang, Phangnga; LT= Hat Thung Tale, Ko Lanta, Krabi; SK= Hat Yong Ling, Sikao, Trang

⁷ No voucher is available for many plant species due to incomplete collections (sterile material) or damage during transportation or processing. (In such case, photographs were used for reference).

Family	Species	Habit ⁵	Location ⁶													Voucher ⁷	
			Habit ⁵										Location ⁶				
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM	LT	SK		
Asclepiadaceae	<i>Willughbeia coriacea</i> Wall.	C		X	X	X								X	X	X	Laongpol 997
	<i>Dischidia major</i> (Vahl) Merr.	C+H	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
	<i>Hoya parasitica</i> (Roxb.) Wall. ex Traill	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
	<i>Streptocaulon juvenas</i> (Lour.) Merr.	C	X							X							Laongpol 781
Caryophyllaceae	<i>Polycarpaea corymbosa</i> (L.) Lam.	H												X			-
Celastraceae	<i>Etonymus cochinchinensis</i> Pierre	ST	X			X					X				X		-
	<i>Pleurostylia opposita</i> (Wall.) Alston	ST									X			X	X		Laongpol 660, 661
	<i>Salacia chinensis</i> L.	S												X			Laongpol 522, 588
Colchicaceae	<i>Gloriosa superba</i> L.	HC	X				X							X			Laongpol 998
Combretaceae	<i>Terminalia catappa</i> L.	T												X	X	X	-
Connaraceae	<i>Connarus semidecandrus</i> Jack	C												X	X		Laongpol 1001
Convolvulaceae	<i>Ipomoea imperati</i> (Vahl) Griseb.	C+H												X	X	X	Laongpol 994
	<i>Ipomoea pes-caprae</i> (L.) R.Br.	C+H												X	X	X	Laongpol 833
Cyperaceae	<i>Cyperus stoloniferus</i> Retz.	H												X			Laongpol 995
	<i>Fimbristylis sericea</i> R.Br.	H												X	X		Laongpol 638, 771, 854
	<i>Remirea maritima</i> Aubl.	H												X			Laongpol
Davalliaceae	<i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn	F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 557
	<i>Davallia heterophylla</i> Sm.	F												X	X	X	Laongpol 758
	<i>Davallia pectinata</i> Sm.	F												X	X	X	Laongpol 757

Family	Species	Habit ⁵	Location ⁶											Voucher ⁷		
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM		LT	SK
Myrtaceae	<i>Baeckea frutescens</i> L.	S	X											X	X	Laongpol 546
	<i>Rhodammia chinerea</i> Jack	S												X	X	Laongpol 646, 662
	<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	S	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 545, 801
	<i>Syzygium grande</i> (Wight) Walp.	T	X	X	X	X	X	X	X	X	X	X	X	X	X	-
	<i>Syzygium gratum</i> (Wight) S.N.Mitra	ST	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 559, 847
Orchidaeeae	<i>Acrotopsis riddlei</i> Hook.f.	O	X													Laongpol 539
	<i>Acrotopsis indica</i> C.Wright	O												X	X	Pattarakulpisutti 25
	<i>Arachnis floxaeris</i> (L.) Rehb.f.	O												X		Laongpol 738
	<i>Bromheadia finlaysonianana</i> (Lindl.) Rehb.f.	TerO												X		-
	<i>Bulbophyllum planibulbe</i> (Ridl.) Ridl.	O												X		-
	<i>Cleisomeria lanatum</i> (Lindl.) Lindl. ex G.Don	O												X		Laongpol 458
	<i>Cymbidium finlaysonianum</i> Lindl.	O	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 720
	<i>Dendrobium crumenatum</i> Sw.	O	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 805
	<i>Dendrobium indivisum</i> (Blume) Miq.	O												X	X	Laongpol 739, 806, 810
	<i>Dendrobium pachyphyllum</i> (Kuntze) Bakh.f.	O												X		Laongpol 744, 753
<i>Doritis pulcherrima</i> Lindl.	TerO	X											X	X	Laongpol 751	
<i>Eria affinis</i> Griff.	O												X		-	
<i>Eria lasiopetala</i> (Willd.) Ormerod	O												X		Pattarakulpisutti 26	
<i>Eulophia andamanensis</i> Rehb.f.	TerO												X	X	Pattarakulpisutti 1,16	

Family	Species	Habit ⁵	Location ⁶													Voucher ⁷	
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM	LT	SK		
	<i>Zoysia matrella</i> (L.) Merr.	G											X				Laongpol 581
	<i>Liparis downii</i> Ridl.	O													X		Laongpol 750
Podocarpaceae	<i>Podocarpus nerifolius</i> D.Don.	T												X			Laongpol 930
	<i>Oxystophyllum carnosum</i> Blume	O												X			Laongpol 740, 808
Polypodiaceae	<i>Drynaria sparsisora</i> (Desv.) S.Moore	F	X	X	X	X	X	X	X	X	X	X	X	X	X		-
	<i>Microsorium scolopendria</i> (Burm.f.) Copel.	F	X			X	X								X	X	Laongpol 552
	<i>Pyrrosia adnascens</i> (G.Forst.) Ching	F	X														Laongpol 556
	<i>Pyrrosia piloselloides</i> (L.) M.G.Price	F	X	X	X	X	X	X	X						X	X	Laongpol 561, 674
Rhizophoraceae	<i>Carallia brachiata</i> (Lour.) Merr.	ST	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 494
	<i>Brackenridgea palustris</i> Bartell.	S											X				Laongpol 848
Rubiaceae	<i>Catunaregam tomentosa</i> (Blume ex DC.) Tirveng.	S	X			X	X	X						X	X	X	Laongpol 543, 568
	<i>Chassalia curviflora</i> (Wall.) Thwaites	S	X											X			Laongpol 531, 555
	<i>Guetarda spectosa</i> L.	S												X			Laongpol 577
	<i>Gynochthodes sublanceolata</i> Miq.	C	X											X	X		Laongpol 564
	<i>Hydrophytum formicarum</i> Jack	H		X										X			-
	<i>Hydrophyllax maritima</i> L.f.	H												X			Laongpol 755, 832
	<i>Ixora javanica</i> (Blume) DC.	S	X	X	X	X	X	X	X	X	X	X	X	X	X		Laongpol 816
	<i>Ixora cibdela</i> Craib	S													X		Laongpol 1000
	<i>Morinda elliptica</i> Ridl.	S	X										X	X	X		-

Family	Species	Habit ⁵	Location ⁶													Voucher ⁷	
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM	LT	SK		
	<i>Zoysia matrella</i> (L.) Merr.	G										X					Laongpol 581
	<i>Liparis downii</i> Ridl.	O													X		Laongpol 750
Podocarpaceae	<i>Podocarpus nerifolius</i> D.Don	T												X			Laongpol 930
	<i>Oxystylidium carnosum</i> Blume	O												X			Laongpol 740, 808
Polypodiaceae	<i>Drynaria sparsisora</i> (Desv.) S.Moore	F	X	X	X	X	X	X	X	X	X	X	X	X	X		-
	<i>Microsorium scolopendria</i> (Burm.f.) Copel.	F	X				X								X	X	Laongpol 552
	<i>Pyrosia adnascens</i> (G.Forst.) Ching	F	X														Laongpol 556
	<i>Pyrosia piloselloides</i> (L.) M.G.Price	F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 561, 674
Rhizophoraceae	<i>Carallia brachyiata</i> (Lour.) Merr.	ST	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 494
	<i>Brackenridgea palustris</i> Bartell.	S											X				Laongpol 848
Rubiaceae	<i>Catunaregam tomentosa</i> (Blume ex DC.) Tirveng.	S	X				X	X	X	X	X	X	X	X	X	X	Laongpol 543, 568
	<i>Chassalia curviflora</i> (Wall.) Thwaites	S	X							X					X		Laongpol 531, 555
	<i>Guettarda speciosa</i> L.	S								X				X	X	X	Laongpol 577
	<i>Gynochthodes sublancoota</i> Miq.	C	X											X	X		Laongpol 564
	<i>Hydrophyllum formicarum</i> Jack	H								X				X			-
	<i>Hydrophyllum maritima</i> L.f.	H												X			Laongpol 755, 832
	<i>Ixora javanica</i> (Blume) DC.	S	X	X	X	X	X	X	X	X	X	X	X	X	X		Laongpol 816
	<i>Ixora cibdela</i> Craib	S													X		Laongpol 1000
	<i>Morinda elliptica</i> Ridl.	S	X								X	X	X	X	X		-

Family	Species	Habit ⁵	Location ⁶											Voucher ⁷				
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM		LT	SK		
	<i>Oxyceros longiflora</i> (Lam.) T.Yamaz.	S									X						X	-
	<i>Prismatomeris tetrandra</i> (Roxb.) K.Schum.	S	X				X	X			X						X	Laongpol 533, 602, 636
	<i>Psychotria sarmentosa</i> Blume	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 547
	<i>Psychax niida</i> (Craib) K.M.Wong	S													X	X	X	Laongpol 586
	<i>Drynaria sparsisora</i> (Desv.) S.Moore	F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
	<i>Tarenna wallichii</i> (Hook.f.) Ridl.	S														X		Laongpol 587
Rutaceae	<i>Acronychia pedunculata</i> (L.) Miq.	ST	X				X								X	X	X	Laongpol 551
	<i>Atalantia monophylla</i> (DC.) Correa	ST	X	X	X										X			Laongpol 840
	<i>Micromelum minutum</i> (G.Forst.) Wight & Arn.	ST	X							X					X			Laongpol 583
	<i>Brackenridgea palustris</i> Bartell.	S											X					Laongpol 848
Sapindaceae	<i>Allophylus cobbe</i> (L.) Raeusch	S												X	X	X	X	Laongpol 488
	<i>Guioa pleuropteris</i> (Blume) Radlk.	ST	X	X	X	X								X				-
	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	ST																-
	<i>Mischocarpus sundaicus</i> Blume	ST	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 553
	<i>Dodonaea viscosa</i> Jacq.	S												X			X	Laongpol 379
	<i>Hydrophylax maritima</i> L.f.	H														X		Laongpol 755, 832
	<i>Ixora javanica</i> (Blume) DC.	S	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Laongpol 816
	<i>Ixora cibdela</i> Craib	S															X	Laongpol 1000
	<i>Morinda elliptica</i> Ridl.	S	X										X	X	X	X		-

Family	Species	Habit ⁵	Location ⁶											Voucher ⁷			
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM		LT	SK	
	<i>Oxycceros longiflora</i> (Lam.) T. Yamaz. K.Schum.	S					X	X	X	X				X			-
	<i>Prismatomeris tetrandra</i> (Roxb.) Blume	S	X					X	X	X				X			Laongpol 533, 602, 636
	<i>Psychotria sarmentosa</i> Blume	C	X	X	X	X	X	X	X	X				X	X	X	Laongpol 547
	<i>Psydrax nitida</i> (Craib) K.M. Wong	S												X	X	X	Laongpol 586
	<i>Drynaria sparsisora</i> (Desv.) S. Moore	F	X	X	X	X	X	X	X	X				X	X	X	-
	<i>Tarenna wallichii</i> (Hook.f.) Ridl.	S												X			Laongpol 587
Rutaceae	<i>Acronychia pedunculata</i> (L.) Miq.	ST	X				X	X	X	X				X	X	X	Laongpol 551
	<i>Atalantia monophylla</i> (DC.) Correa	ST	X		X									X			Laongpol 840
	<i>Micromelum minutum</i> (G.Forst.) Wight & Arn.	ST	X						X					X			Laongpol 583
	<i>Brackenridgea palustris</i> Bartell.	S										X					Laongpol 848
Sapindaceae	<i>Allophylus cobbe</i> (L.) Raeusch	S										X	X	X	X		Laongpol 488
	<i>Gutia pleuropteris</i> (Blume) Radlk. Leenh.	ST	X		X							X		X			-
	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	ST															-
	<i>Mischocarpus sundaicus</i> Blume	ST	X	X	X	X	X	X	X	X				X	X	X	Laongpol 553
	<i>Dodonaea viscosa</i> Jacq.	S												X	X	X	Laongpol 379
Sapotaceae	<i>Pouteria obovata</i> (R.Br.) Baehni	ST	X		X									X	X	X	Laongpol 653
Schizaeaceae	<i>Schizaea dichotoma</i> (L.) Sm.	F	X											X			Laongpol 575
	<i>Schizaea digitata</i> (L.) Sw.	F	X											X	X		Laongpol 574
Simaroubaceae	<i>Eurycoma longifolia</i> Jack	S	X	X	X	X	X	X	X	X				X	X	X	Laongpol 563
Stemonaceae	<i>Stemona tuberosa</i> Lour.	C												X			Laongpol 503, 592

Family	Species	Habit ⁵	Location ⁶											Voucher ⁷			
			JN	CY1	CY2	CY3	CY4	CY5	LM	TK	MU	PT	TM		LT	SK	
Taccaceae	<i>Tacca integrifolia</i> Ker Gawl.	H										X			X		<i>Laongpol 702</i>
Theaceae	<i>Schinus molle</i> (DC.) Korth.	ST		X	X	X	X	X	X	X	X	X			X		-
Thymelaeaceae	<i>Wikstroemia ridleyi</i> Gamble	S	X						X						X	X	<i>Laongpol 747</i>
Tiliaceae	<i>Microcos tomentosa</i> Sm.	ST	X	X	X	X	X	X	X	X	X	X			X		-
Viscaceae	<i>Viscum articulatum</i> Burm.f.	Pa	X										X		X		-



Plate 1. A.-E. Coastal vegetation on sandy grounds in peninsular Thailand: A. coastal grassland at Ao Phanang Tak, Mueang district, Chumphon; B. scrub vegetation at Hat Thai Mueang, Thai Mueang district, Phangnga; C. woodland vegetation at Ban Laem Pho, Chaiya district, Surat Thani; D. woodland vegetation at Ban Nuea, Chaiya district, Surat Thani. E. scrub vegetation at Ban Bangboet, Pathio district, Chumphon.

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