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**AN ECOLOGICAL STUDY OF *MELALEUCA* COMMUNITIES IN  
LITTORAL SWAMPS**

**Kunio SUZUKI**

## AN ECOLOGICAL STUDY OF *MELALEUCA* COMMUNITIES IN LITTORAL SWAMPS

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**Synopsis:** The genus *Melaleuca* is the second largest genus in the family Myrtaceae after *Eucalyptus* in Australia. Species of *Melaleuca* are common and representative in swamps and seasonally waterlogged sites in the coastal areas of Southeast Asia and Australia. In the past 25 years in Asia, large-scale agricultural development of coastal swamps was carried out, introducing many environmental and social problems. Restoration of coastal swampy ecosystem using *Melaleuca* trees is an important issue in Tropical Asia. *Melaleuca* species is one of the main native trees in the ecosystem and details of the ecological characteristics of *Melaleuca* species are not very clear. This paper reviews the ecological studies of *Melaleuca*-dominated forest/woodland in Australia and Tropical Asia, including the floral one.

**Key words:** peat swamp, *Melaleuca*, swampy forest, ecosystem restoration, Tropical Asia

### INTRODUCTION

There are approximately 150 to 250 *Melaleuca* species in the world and only one to eight species have been recorded outside Australia in areas such as New Caledonia, New Guinea, Malaysia, Thailand and Indonesia. Australia is the home of most *Melaleuca* species. The genus *Melaleuca* of the family Myrtaceae is widespread through most plant communities in Australia, from the tropical north through the arid inland to Tasmania. *Melaleuca* is the second largest genus in Myrtaceae after *Eucalyptus* in Australia (BYRNES, 1984).

Species of *Melaleuca* are common and representative in swamps and seasonally waterlogged sites in the coastal areas of Southeast Asia and Australia. *Melaleuca quinquenervia* and *M. leucadendron* are the most widely distributed species in the peat swamps or coastal seasonal wetlands in eastern Australia. Both *Melaleuca quinquenervia* in eastern Australia and *M. leucadendron* in north-eastern Australia develop quite similar habitats to *Melaleuca cajuputi* in Southeast Asia. *Melaleuca cajuputi* is the only dominant tree species in the developed coastal wetlands in tropical Asia. From the phytosociological viewpoint, the forests and woodlands dominated by these tree *Melaleuca*

species have common characteristics: the tree layer forms pure stands of *Melaleuca*, the shrub layer is usually absent or very rare in tree species, and the herbaceous layer is sometimes absent after extended waterlogging. *Melaleuca raphiophylla* and *M. preissiana* in south-western Western Australia occur on sites similar to that of *M. quinquenervia* etc. (BEADLE, 1981).

In the past 25 years in Malaysia and southern Thailand, the areas of *Melaleuca cajuputi* secondary forest have increased because of large-scale agricultural development of coastal peat swamps. However, after the total loss of the peat layer, the soil changed into sulfate soil and agricultural use was impossible. Restoration of coastal forest ecosystem using *Melaleuca cajuputi* and some other trees is an important scientific and social issue in Southeast Asia.

Many floral and vegetational studies of the genus *Melaleuca* in Australia are already available and can provide important information to study tropical swamp vegetation. This paper reviews the ecological studies of *Melaleuca*-dominated forest/woodland in Australia and Tropical Asia, including the floral one.

## GENERAL COMMENTS ON THE GENUS *MELALEUCA* (MYRTACEAE)

Most *Melaleuca* species are evergreen trees or shrubs with papery bark (numerous, thin, paper-like, corky layers) commonly found on alluvial, nutrient-deficient soils, often with a high water table.

The genus *Melaleuca* was defined in the eighteenth century by Carolus Linnaeus and named from the Greek "melas", meaning black, and "leucos", meaning white, because of the tree's black trunk (probably charred by fire) and white-barked upper branches (HOLLIDAY, 1989). Common names for *Melaleuca* species include "paperbark", "honey-myrtle" and "tea-tree". "Paperbark" refers to the papery bark common to larger tree species. "Tea-tree" refers to the tea-coloured water of the *Melaleuca* swamps and to its use as a substitute for tea. The name is also used for the genus *Leptospermum*. The name "tea tree" was first used by Captain Cook, whose sailors used the leaves of a species of *Leptospermum* as a substitute for tea (DRURY, 1989).

*Melaleuca* as a Gondwanan genus: The present geographic distribution of the genus *Melaleuca* is of particular interest with respect to the postulated events of the Miocene collision between the Australian and Sundaland plates (BARLOW, 1988). Whilst *Melaleuca leucadendron* occurs in the Moluccas and the Vogelkop and Aru Islands, it is still effectively confined to putatively Gondwanan land surfaces. *Melaleuca cajuputi* occurs in tropical Asia (Indonesia, Malaysia, Thailand and Vietnam). *Melaleuca cajuputi* has been colonising across Wallace's Line from the east. Because of the wide cultivation of *Melaleuca cajuputi* over some centuries for its oil, the natural distribution is difficult to assess.

**Species:** Census of Australian Vascular Plants (HNATIUK, 1990) gives 190 species and 14 varieties of *Melaleuca*. *Flora of New South Wales* Vol. 2 (ed. HARDEN, 1991), gives around 220 species of *Melaleuca* in the world and around 215 species in Australia (around 210 endemic species). BYRNES (1984-86) gives at least 150 species in Australia. That includes 61 species in northern and southern

Australia (BYRNES 1984-86).

**Leaves:** *Melaleuca* leaves yield several useful oils which are used commercially. These include cineole and the valuable components of nerolidol (up to 90%), and linalool (up to 30%) used in the perfume industry (HOLLIDAY, 1989). *Melaleuca linariifolia*, a small to medium-sized tree in damp situations, has received considerable attention as yielding valuable essential oils (ANDERSON, 1968). Oil from *Melaleuca bracteata* is a phenolic ether type, and that from *Melaleuca alternifolia* is a terpenic type, valued for its germicidal activity. In "Plants of the World: the higher plants II", H.C.D. de WIT (1965) states that leaves of *Melaleuca leucadendron*, a tree or shrub which is the only species in its genus to grow wild outside Australia (extending as far as Indonesia), yield Cajaput oil which is used medicinally and in perfumery.

**Habitat:** Many trees and shrubs of *Melaleuca* grow in swamps and estuaries near water, along stream banks or in coastal habitats. They often grow in dry streams, which are occasionally subjected to inundation in the arid inland. *Melaleuca* is an old Australian genus which had its origins in seasonally drowned areas at the margins of tropical rainforests in the north of the continent. Early Tertiary divergence resulted in widespread colonisation of other habitats, and in notable radiation in temperate sites with Mediterranean climates (BARLOW, 1988). Today, *Melaleuca quinquenervia* is classified as a weed in parts of the United States where it has invaded everglade communities (GOMES & KOZLOWSKI, 1980).

## ECOLOGY OF *MELALEUCA* VEGETATION IN AUSTRALIA

### Characteristics of *Melaleuca* trees in wetlands

*Melaleuca*-dominated forests and woodlands have been developing on swamps, floodplains, river banks and even seasonally-dry streambeds in Australia. They are the habitats of a series of forested wetlands. In view of the plant ecology, the *Melaleuca*-dominated forest is one of the main types of forested wetland in Australia. The largest area of forested wetland in Australia is on the floodplain of

the Murray River, where over 60,000 hectares of river red gum (*Eucalyptus camaldulensis*) forest is found (DEXTER, 1978).

SPECHT (1990) listed the main tree species of Australian forested wetlands as follows: two species of *Casuarina*, nine species of *Eucalyptus* and ten species of *Melaleuca*.

**Casuarina:** *C. cunninghamiana* (river oak), *C. glauca* (swamp she-oak)

**Eucalyptus:** *E. alba* (white gum), *E. camaldulensis* (river red gum), *E. largiflorens* (black box), *E. microtheca* (coolibah), *E. ochrophloia* (napunyah), *E. ovata* (swamp gum), *E. robusta* (swamp mahogany), *E. tereticornis* (forest red gum), *E. rudis* (Western Australian flooded gum)

**Melaleuca:** *M. argentea*, *M. bracteata*, *M. cajuputi*, *M. dealbata*, *M. leucadendron*, *M. preissiana*, *M. quinquenervia*, *M. raphiophylla*, *M. stenostachya*, *M. viridiflora*

SPECHT (1990) has pointed out the following characteristics of the representative *Melaleuca* trees in Australian wetlands:

1. *M. argentea*, a tree 5 to 25m tall, is a characteristic rheophyte of sandy or gravelly stream banks and beds in northern Australia, sometimes occurring as a belt of trees behind the fringing *M. leucadendron* forest.
2. *M. bracteata* is one of the most widely spread species of the genus in Australia. It is found as a tree, up to 15m tall, along streams in eastern Queensland. In contrast it forms a low shrub, about 2m tall, in depressions on heavy black soil and on rocky places of inland Australia.
3. *M. cajuputi*, a tree up to 25m tall, sometimes forms pure forest communities on water-logged soils in northern Australia.
4. *M. dealbata* is found as a tall tree up to 24m in height in waterlogged soils, rarely far from the coast, from Maryborough, Queensland northwards into southern Papua New Guinea.
5. *M. leucadendron* is widely spread in northern and northeastern Australia, southern Papua New Guinea and thence northwest to Amboina. In Australia it is commonly found as a rheophyte on sandy or gravelly river banks, often forming a nearly pure fringing forest up to 25m high.

6. *M. preissiana* is a paperbark tree, 8 to 10m tall, restricted to southwestern Australia. The species commonly forms pure stands on sandy sites subjects to seasonal flooding.

7. *M. quinquenervia*, a tree up to 25m tall, is widely spread in eastern Australia near the coast from Sydney northwards, in New Caledonia and southern Papua New Guinea. It commonly occurs in pure communities on waterlogged soils, but may extend to hillsides, where groundwater is close to the surface. In some areas, the species appears to tolerate mildly saline conditions.

8. *M. raphiophylla* is a paperbark tree, 3 to 7m tall, forming pure stands on sandy sites subject to seasonal flooding in southwestern Australia.

9. *M. stenostachya*, a tree 4 to 25m high, is common on seasonally waterlogged soil in northern Queensland.

10. *M. viridiflora*, a tree up to 18m tall growing on seasonally swampy ground forms pure forest communities. The species is also found as a small crooked tree, 6 to 8m tall, on poorly drained slopes and flats over most of its distribution.

*Melaleuca quinquenervia* forests have developed widely on swamps/seasonal wetlands in tropical and subtropical areas of eastern coastal Australia. BLAKE (1968), STICK & LERGESSNER (1969) and GOMES & KOZLOWSKI (1980) have pointed out the characteristics of *Melaleuca quinquenervia* as follows:

1. *Melaleuca quinquenervia* (Cav.) S. T. Blake (paperbarked tea tree) is a wetland species with a natural range extending from coastal northern New South Wales to west New Guinea (BLAKE, 1968).
2. Historically, forests of *Melaleuca quinquenervia* have been cleared and planted to sugar cane or to improved pastures for cattle grazing (STICK & LERGESSNER, 1969).

The salinity and water-logging tolerance of *Melaleuca ericifolia* has been pointed out by LADIGES *et al.* (1981) as follows:

*Melaleuca ericifolia* Smith (swamp paperbark) is a wetland species found in Tasmania, some of the Bass Strait Islands, Victoria, New South Wales and southern Queensland (WILLIS, 1972). It is a shrub or

small tree which forms dense stands (LADIGES *et al.*, 1981). *Melaleuca ericifolia* may be associated with fresh water of inland swamps or brackish water when fringing the landward limit of coastal salt marsh (PATTON, 1942). Germination is totally inhibited at salinity of 14‰ and a population which naturally occurs adjacent to coastal salt marsh was inhibited more by salinity of 6–12‰ than two other populations from freshwater habitats (LADIGES *et al.*, 1981).

As to the structural characteristics of forested wetlands, SPECHT (1990) has pointed out: usually, shrubs were rare or absent in these forested wetlands. A ground layer of grasses, sedges and herbaceous plants is always predominant, although, in the more arid areas, this stratum may be seasonal or ephemeral. On infertile soils, the graminoid layer is replaced by low sclerophyllous (heathland) plants; in the tropics and subtropics, this sclerophyllous stratum may be predominantly members of the node-sedge family Restionaceae.

## MELALEUCA COMMUNITIES IN AUSTRALIA

Many vegetational studies of *Melaleuca* in Australia are already available. In particular, The Vegetation of Australia (BEADLE, 1981) describes *Melaleuca* communities in detail.

*Melaleuca* communities in fresh or brackish water, mainly on the coastal lowlands, were noted by BEADLE (1981) in "The Vegetation of Australia". A list of the alliances dominated by *Melaleuca* in fresh or brackish water was shown by BEADLE (1981).

### 1. Communities in the tropics:

#### –*Melaleuca leucadendron* Alliance

occupies the climatically wettest sites along the coast line

mainly on the Arnhem Peninsula

#### –*Melaleuca viridiflora* Alliance

in the Tropics with a mean annual rainfall of 500 to 700mm

on yellow earths waterlogged for a few weeks during the summer

#### –*Melaleuca minutiflora* Alliance



Photo 1. *Melaleuca quinquenervia* forest at Ballina, NSW, Australia.

in the Ord River area and westward into the Kimberleys

2. Communities in south-eastern Western Australia  
–*Melaleuca rhapsiophylla* Alliance

on the western coastal plain in Western Australia  
–*Melaleuca preissiana* Alliance  
on the wetter parts of the south coast in Western Australia

The *Melaleuca quinquenervia* community of coastal, brackish lakes and estuaries in the east was described by BEADLE (1981) in "The Vegetation of Australia". *M. quinquenervia* is dominant north of Sydney, sometimes with *M. glomerata* forming a shrub layer. The herbaceous layer contains many species from adjacent sedgeland, including *Baumea juncea*, *Schoenus brevifolius* and *Restio* spp. Other species dominating scrubs or thickets in the east are *Melaleuca decora* and *M. linearifolia* (clay soils), *M. glomerata*, *M. armillaris*, *M. genistifolia*, *M. squamea*, *M. styphelioides*, *M. ericifolia* and, towards the south, *M. squares*. The last is the common species in Victoria, South Australia and Tasmania, where it forms impenetrable thickets with only fragile, scattered herbs below (usually *Drosera* and *Utricularia* spp.).

PEDLEY & ISBELL (1971) and CLARKSON (1982) have described the *Melaleuca* communities of north Queensland. The most widespread formations of Cape York Peninsula are eucalyptus open-forests and woodlands, with large areas of *Melaleuca* low open-woodland and low woodland (PEDLEY & ISBELL, 1971). The following communities of Cape York Peninsula were described by PEDLEY & ISBELL (1971). In their paper, communities with *Melaleuca* were discussed as follows:

1. *Melaleuca viridiflora*–*Acacia brassii* low open-forest

**Distribution:** north and north-east of Coen in the Lockhart River area, and south of Princess Charlotte Bay (small occurrence)

The *Melaleuca* canopy is moderately dense, 5 to 10 m tall. There is a rather open layer up to 3 m and a moderately dense ground cover. *Grevillea glauca* and *Acacia brassii* are common. *Jacksonia thesioides* and *Xanthorrhoea johnsonii* are the commonest shrubs with *Petalostigma banksii* and *Pandanus* spp. common in some stands. *Eriachne glauca*,

*Schizachyrium fragile* and *Thaumastochloa* spp., *Ectrosia leporina*, *Schoenus sparteus*, *Leptocarpus spathaceus* and *Rhynchospora longisetis* occur in the ground layer.

2. *M. viridiflora*–*Petalostigma banksii* low open-forest

**Distribution:** north-west of Laura (small areas)

There is an upper stratum 5 to 7 m tall though some emergent trees (eucalyptus) to 12 m tall are found and a very open to moderately dense ground layer. *Melaleuca viridiflora* forms almost pure stands. The important species are *Petalostigma banksii*, *Arundinella setosa*, *Chrysopogon fallax*, *Pseudopogonanthemum contortum*, *Eriachne glauca*, *Sacciolepis myosuroides*, *Themeda australis*, *Rhynchospora longisetis* and *Schoenus sparteus*.

3. *E. leptophleba*–*E. polycarpa*–*E. alba*–*Melaleuca* spp. woodland

**Distribution:** north and south-west of Laura and the coast south-east of Cape Melville (relatively small areas)

There is an upper tree layer 10 to 15 m tall and a well developed lower tree layer up to about 8 m tall. Of the low trees, *Melaleuca viridiflora* and *M. nervosa* form dense stands.

4. Dune woodland

The composition of the community varies from site to site. In the upper layer *Erythrina vespertilio*, *E. papuana*, *E. polycarpa*, and in the north, *Melaleuca leucadendron* and *Leptospermum fabricia* are most common.

5. *Melaleuca viridiflora*–*Petalostigma banksii* low woodland

**Distribution:** Extensive areas occur on the alluvial outwash plains forming the western and south-western margins of Princess Charlotte Bay. *Melaleuca viridiflora* predominates in the upper stratum (in some places with *M. foliolosa*), and *Petalostigma banksii* in the shrub layer.

6. *Melaleuca viridiflora*–*Petalostigma banksii* low open-woodland

**Distribution:** on wide alluvial plains in the south-west part of the Peninsula.

The tree layer commonly consists entirely of *Melaleuca viridiflora* but other species of *Melaleuca* (*M. foliolosa* and *M. acacioides*) as well as *Hakea persiehana* and *Grevillea striata* are found.

*Melaleuca* vegetation at Aurukun, north Queensland has been noted by CLARKSON (1982) as

follows:

**1. *Melaleuca cajuputi* shrubland or tall shrubland (swamp complex)**

**Location:** Aurukun (Special Bauxite Mining Lease No. 9)

This community is both structurally and floristically simple. It occupies broad shallow depressions which are flooded for a large part of the year. Low and often gnarled *Melaleuca cajuputi* 1.5 to 3m high form an open canopy over a dense ground layer of *Isachne confesta*. *Nepenthes mirabilis* is often locally common, particularly near the margin.

**2. *Melaleuca viridiflora* low open-forest or low woodland**

**Location:** Aurukun (SBML9)

This unit occurs on the lower slopes of the shallow valleys. The canopy is 6 to 8m tall, mid-dense or occasionally sparse. *Melaleuca viridiflora* is the most common tree often overtopped by scattered *Eucalyptus polycarpa*. *Petalostigma banksii* is the principal species in an open shrub layer about 3m high. The ground layer is short, sparse to very

sparse, about 30cm high and commonly contains *Schizachyrium fragile* and *Ectrosia leporina* mixed with *Schoenus sparteus* and *Leptocarpus spathaceus*.

**3. *Melaleuca acacioides* shrubland or open-shrubland (Littoral marsh and mud flat complex)**

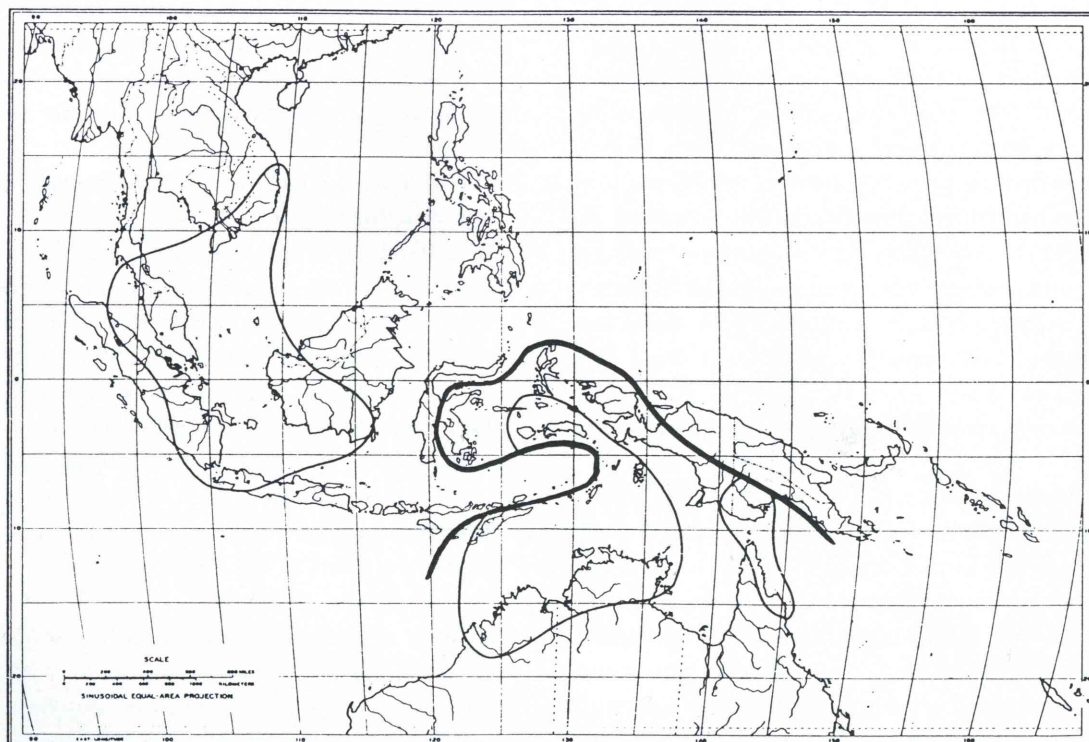
**Location:** Aurukun (SBML9)

Small areas of this shrubland occur on the tidal flats but are nowhere extensive in the area. The shrubs are characteristically gnarled, 1 to 1.5m tall or occasionally somewhat taller, and interspersed with clumps of *Leptocarpus elatior*.

**4. *Melaleuca cajuputi* tall open-scrub**

**Location:** Aurukun (SBML9)

Small areas of this community occur along the lower reaches of the Watson River and are usually associated with fresh water seepages. The canopy is even, dense to mid-dense, with multi-stemmed shrubs reaching 9-10m in height. Stem densities are high with seldom more than 1-2m separating adjacent plants. Stem diameters range from 3.5 to 20cm dbh with slender stems around 7cm being most common. *Melaleuca cajuputi* forms an almost monospecific stand with *M. leucadendron* sometimes occurring on the margins. Understorey layers are



**Fig. 1.** Geographic distribution of *Melaleuca cajuputi*. The heavy line shows the postulated boundary between Australian/Papuan and Sundaland plates (after AUDLEY-CHARLES, 1981; BARLOW, 1998).

generally lacking and the community is flooded for most of the year to a depth of 10 to 20 cm, probably higher during the wet season. Occasional clumps of *Leptocarpus elatior* may occur with *Oryza rufipogon* present in some places. Aquatics such as *Aeschynomene aspera*, *Caldesia oligococca*, *Nymphoides hydrocharoides*, *Philydrum lanuginosum* and *Nymphaea violacea* are sometimes locally common.

The following formations and associations, dominated by *Melaleuca* spp. have been pointed out in South Australia by SPECHT (1972):

### 1. Low open-forest formation

*Melaleuca halmaturorum* association, found around saline, coastal swamps.

### 2. Closed-scrub formation

*Leptospermum pubescens*-*Melaleuca squarrosa* association. Lower south-east (recorded from the Eight Mile Creek area).

The association is dominated by a densely-packed assemblage of shrubs (70% to 100% foliage cover, 2 to 8 m tall) and is restricted to a few swampy, often peaty, sites in the high-rainfall areas of the Lower South East.

## MELALEUCA VEGETATION IN SOUTHEAST ASIA

Only one species of the genus *Melaleuca*, *Melaleuca cajuputi*, is found in Southeast Asia. However, *Melaleuca cajuputi*-dominated vegetation is a typical secondary woodland on the coastal wetlands.

In Southeast Asian coastal areas along the Malaysian Peninsula, the eastern part of Sumatra and the northern part of Borneo are vast areas of swamps composed of peat soil. Most of the present forests in the peat swamps are *Melaleuca cajuputi*-dominated vegetation.

### *Melaleuca cajuputi* forest in Thailand

Natural coastal peat swamp ecosystems can be found at Narathiwat in southern Thailand. The area of natural peat swamp forest is decreasing every year due to burning and draining, and most of the present forests in the peat swamps are secondary

forests, such as *Macaranga pruinosa*-forest and *Melaleuca cajuputi*-forest.

The *Melaleuca cajuputi* forest is widely distributed and often occupies very large areas, from peat swamp to sandy conditions. The habitat of the *Melaleuca cajuputi* forest is directly or indirectly influenced by artificial drainage and seasonal flooding and burning. *Melaleuca cajuputi* forest, which has root suckers and coppice shoots, grows well after burning. The main component species of the *Melaleuca cajuputi* forest are *Melaleuca cajuputi*, *Ardisia littoralis* (Myrsinaceae), *Ilex cymosa* (Aquifoliaceae), *Melastoma malathricum* (Melastomaceae), and *Eugenia spicata* (Myrtaceae). From the phytosociological viewpoint, the *Melaleuca cajuputi* forests are divided into two communities: *Lygodium microphyllum*-*Melaleuca cajuputi* community and *Evodia roxburghiana*-*Melaleuca cajuputi* community (SUZUKI *et al.*, 1992).

The *Lygodium microphyllum*-*Melaleuca cajuputi* community is characterised by the dominant climbing ferns *Lygodium microphyllum* (Schizaeaceae)

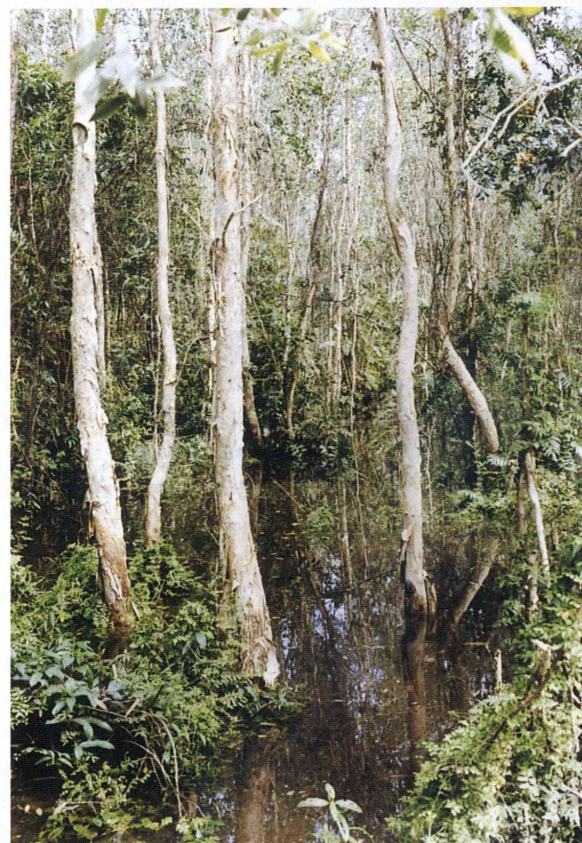


Photo 2. *Melaleuca cajuputi* forest at Narathiwat, Thailand.



and *Scleria sumatrensis* (Cyperaceae), and can be found in sandy or acid-sulfate soil habitats where peat has vanished. The community occupies the habitat in depressions with alternate flooding and drying up.

The *Evodia roxburghiana*-*Melaleuca cajuputi* community, on the other hand, is characterised by *Evodia roxburghiana* (Rutaceae), *Rhodomyrtus tomentosa* (Myrtaceae), *Eupatorium odoratum* (Compositae), *Tetracera loureiri* (Dilleniaceae), *Chaetocarpus castanocarpus* (Euphorbiaceae) and *Dioscorea glabra* (Dioscoreaceae). The ground herb layer of the community is not so rich in species and cover as that of the *Lygodium microphyllum*-*Melaleuca cajuputi* community. The community occurs in dry habitats such as sandy or sulfate soils after drainage of the peat swamps. The community flourished in non-flooded or slightly flooded conditions during any season.

### ***Melaleuca cajuputi* forest in Malaysia**

In Malaysia, SUZUKI *et al.* (1992) has pointed out that the *Melaleuca cajuputi* forest at Kanpong Kenangan, Muar was categorised as an *Alstonia angustifolia*-*Melaleuca cajuputi* community. The *Alstonia angustifolia*-*Melaleuca cajuputi* community was the common secondary forest among the coastal peat swamps, where most of the peat layer has been lost. The height was about 12 metres, the tree layer cover ranged from 30 to 85% and the total number of species ranged from 12 to 22. The main component species were *Melaleuca cajuputi*, *Ixonanthes reticulata* (Ixonanthaceae), *Canthium confertum* (Rubiaceae), *Eugenia papillosa* (Myrtaceae), *Elaeocarpus mastersii* (Elaeocarpaceae), *Gynotroches axillaris* (Rhizophoraceae) and *Nepenthes* species (Nepenthaceae).

### **DISCUSSIONS**

On the Malaysian peninsula and neighbouring islands, large areas of natural peat swamp forests remained in their natural form until the 1960s. One of the main reasons for the natural forests remaining was that the local populations efforts to develop agriculture in peat swamp areas were thwarted by low productivity and difficulties in supervision. Consequently, agricultural activities in

peat swamp lands generally ceased after a period of time and the land was abandoned. From the 1970s, however, development activities in these areas began to increase, introducing many environmental and social problems.

The restoration of tropical ecosystem, and in particular tropical peat swamp forest, is an important social and scientific issue. *Melaleuca cajuputi* is one of the main native trees in acid peat swampy areas. However, details of the ecological characteristics of *Melaleuca cajuputi* are not very clear. This is the first introductory paper on the ecology of *Melaleuca* vegetation.

### **ACKNOWLEDGEMENTS**

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### **SUMMARY**

1. Most *Melaleuca* species are evergreen trees or shrubs with papery bark commonly found on alluvial, nutrient-deficient soils, often a high water table.
2. The 4 alliances dominated by *Melaleuca* in fresh or brackish water in Australia was shown by BEADLE (1981).
3. Only one species of the genus *Melaleuca*, *Melaleuca cajuputi*, is found in Southeast Asia. *Melaleuca cajuputi*-dominated vegetation is a typical secondary woodland on the coastal wetlands.
4. The *Melaleuca cajuputi* forest at Muar in Malaysia was categorised as an *Alstonia angustifolia*-*Melaleuca cajuputi* community.

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