

**MELALEUCA FOREST HABITAT IN TRA SU MELALEUCA
FOREST LANDSCAPE CONSERVATION AREA,
TINH BIEN DISTRICT, AN GIANG PROVINCE**

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Abstract

Tra Su Melaleuca forest conservation area is one of typical flooded forests in the Mekong Delta of Vietnam. Located at the upstream part of Mekong Delta, Tra Su Melaleuca forest is home to many species of animals and plants under the Special Use Forest Management System of Vietnam. The diversity and abundance of natural resources make Tra Su cajeput forests become an ideal destination for researchers and enthusiasts to discover the wild nature. Study and understanding on Melaleuca habitat could help conserve the Tra Su forest in sustainable way.

Keywords: *Melaleuca plant, Tra Su Melaleuca forest conservation area*

INTRODUCTION

Tra Su Melaleuca forest is located in Van Giao commune, Tinh Bien district, An Giang province with an area of 845 ha, which is one of the existing natural and semi-natural habitats in the Mekong Delta (An Giang's Forest Protection Department, 2004). Tra Su Melaleuca forest has a significant environmental significance such as regulating climate, maintaining soil stability and fertility, limiting floods, droughts, preserving water sources and habitats for many species of plants and animals (Le Quoc Tuan *et al.*). Especially in the situation of abnormal climate change, there are increasingly negative impacts on the Mekong Delta, the role of forests becomes more and more important. There is a correlation between Melaleuca and other plant communities, but they can both support each other and affect each other. For example, more reeds, ferns will grow, they will form a dense community, put a pressure on the growth and development of Melaleuca and will take away the habitat of birds, bees, etc... (Lam Binh Loi, Nguyen Van Thon, 1972). This study is carried out to assess the status of habitat types at Tra Su Melaleuca forest landscape conservation area, Tinh Bien District, An Giang Province; thus providing better forest management solutions, contributing to the sustainable development of this landscape conservation area.

STUDY METHOD

The study is conducted at Tra Su Melaleuca forest landscape conservation area, Tinh Bien District, An Giang Province from August 2016 to December 2016.

Secondary data collection

The data is based on the analysis and synthesis of relevant sources of material, data and information (existing maps such as maps of land use status and other material and data).

Collecting basic information, material and data that have been researched related to the topic and study area at Tra Su Melaleuca forest landscape conservation area, website, etc.

Field survey method

Based on the current land use status map of Tra Su Melaleuca forest landscape conservation area, 20 sample cells of 10,000 m² (100 m × 100 m) are set up for the survey.

In each sample cell, 1 central cell of 100 m² (10 m × 10 m) and 2 random cells of the same size so that the distance between cells ≥ 30 m and the distance between cells with the edges of the standard cell ≥ 20 m (Le Minh Loc, 2005).

The survey locations are shown in Figure 1.

Figure 1. Survey location map of Tra Su Melaleuca forest

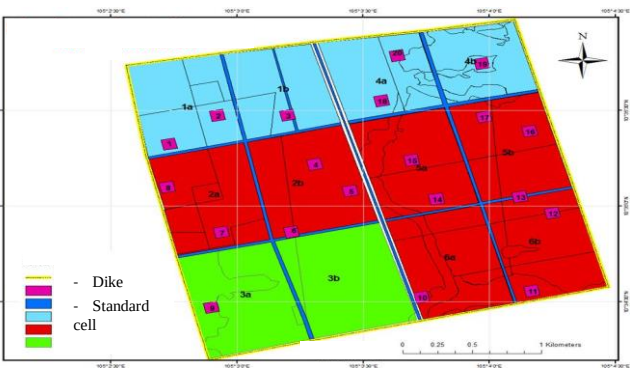
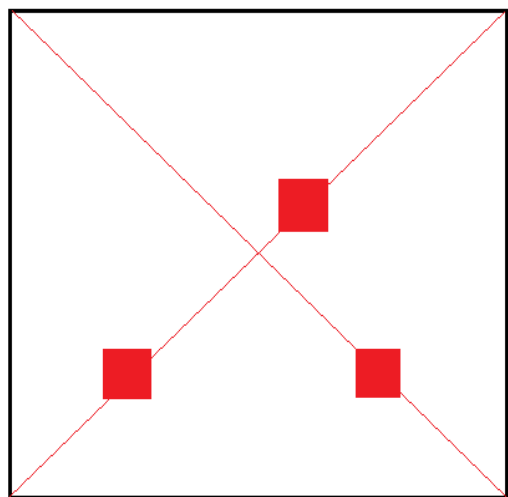


Figure 2. Surveyed cell in the standard cell

Table 1. Coordinates of surveyed standard cells

Zone	Survey location	X	Y	Habitat
Ecological restoration zoning	ST257	505832.309	1170784.126	Melaleuca Cajuputi
	ST126	505326.541	1170782.770	Melaleuca Cajuputi
	ST157	504978.921	1170505.873	Melaleuca Cajuputi
	ST164	506511.891	1170923.927	Melaleuca Cajuputi

	ST57	506624.613	1171357.882	Melaleuca Cajuputi
	ST36	507236.408	1171280.263	Eleocharis
Zone of strict protection	NN57	504963.300	1170091.887	Melaleuca Cajuputi
	NN205	505356.369	1169659.271	Melaleuca Cajuputi
	NN239	505862.140	1169660.621	Melaleuca Cajuputi
	NN68	506031.214	1170311.577	Melaleuca Cajuputi
	NN157	506286.475	1170055.994	Melaleuca Cajuputi
	NN104	506731.167	1170352.862	Melaleuca Cajuputi
	NN221	506909.711	1169978.857	Melaleuca Cajuputi
	NN25	507252.576	1170768.200	Melaleuca Cajuputi
	NN84	507584.543	1170631.111	Melaleuca Cajuputi
	NN256	507512.565	1170000.133	Melaleuca Cajuputi
	NN286	507747.452	1169843.060	Melaleuca Cajuputi
	NN384	507598.741	1169093.611	Melaleuca Cajuputi
	NN319	506801.595	1169032.382	Melaleuca Cajuputi
Administrative Services Zoning	HC01	505283.958	1168935.026	Lotus

In each cell of 100 m², the following criteria are studied:

- Counting all Melaleuca in each cell, symbol n (tree)
- Using tape measure to measure the diameter of the stem at a distance of 1.3 m from the ground, symbol D1-3 (Pham Xuan Quy, 2008)
- Measuring the height of tree
- Recognizing variety composition of vegetation, shrubs, exotic plants, tree tier (if there are plants other than Melaleuca).

Data processing method

Formulas of calculation based on Le Minh Loc (2005):

$$\text{Density (trees/ha)} = (n/S) \times 1000$$

in which n: total number of trees

S: cell area (m²)

$$\text{Horizontal cross-section: } G = 3.14 \times d^2 / 4$$

in which G: the cross-section area at a height of 1.3 m from the ground (m²)

d: tree diameter (m)

Microsoft Excel is used to present collected data.

RESULTS AND DISCUSSIONS

Growth criteria of Melaleuca

Total area of Tra Su Melaleuca forest landscape conservation area is 845 hectares. Data is collected in 20 cells (10.000 m²) and Melaleuca is divided into 5 age groups: group I (10 - 15 years), group II (16 - 20 years), group III (21 - 25 years), group IV (26 - 30 years), and group V (over 30 years).

Survey results of *Melaleuca* growth criteria of diameter at breast height, high top and density of the cells are shown in Table 2.

Table 2. Criteria of *Melaleuca* in Tra Su

No	Age group	Sample cell	Melaleuca age	Density (tree/100 m ²)	Average diameter (cm)	Average height (m)
1	Group I (10 - 15 years)	NN57	10	49	18,10	20,13
2		NN205	11	82	15,50	14,93
3		ST126	12	36	17,73	13,29
4		NN319	12	29	19,85	23,68
5	Group II (16 - 20 years)	NN157	17	25	21,19	10,27
6		NN239	17	39	19,85	14,60
7		ST157	18	43	19,43	25,66
8		NN221	20	29	18,67	17,48
9		NN104	20	60	15,80	16,04
10		NN25	20	109	14,27	13,27
11	Group III (21 - 25 years)	NN384	21	47	17,09	20,43
12		NN286	21	37	18,26	10,94
13		HC01	23	6	21,44	20,99
14	Group IV (26 - 30 years)	NN68	26	62	17,33	9,27
15		NN256	26	36	18,05	10,50
16		ST57	28	76	16,60	15,48
17		ST36	28	8	19,00	17,19
18	Group V (> 30 years)	NN84	32	59	17,31	15,77
19		ST257	33	66	17,20	16,98
20		ST164	33	50	19,17	16,25

***Melaleuca* age**

Melaleuca at Tra Su *Melaleuca* forest landscape conservation area are 10 years or more. Based on the age of *Melaleuca*, there are five age groups of survey:

- Group I: 10 - 15 age (NN57, NN205, ST126, NN319)
- Group II: 16 - 20 age (NN157, NN239, ST157, NN221, NN104, NN25)
- Group III: 21 - 25 age (NN384, NN286, HC01, NN68, NN256)
- Group IV: 26 - 30 age (ST57, ST36, NN84, ST257, ST164)
- Group V: > 30 age (NN84, ST257, ST164)

Melaleuca at Tra Su *Melaleuca* forest landscape conservation area are at high age with an average age of 20, the highest one is 33 years (grown in 1983) and the lowest one is 9 years (grown in 2007). In the last 12 years, green area of *Melaleuca* are relatively low, concentrated in cells ST126 (1a), NN205 and NN57 (lot 2a), NN319 (lot 6a) and on *Eleocharis* habitat in lot 4b.

Melaleuca trees are from 16 - 20 and 21 - 25 years covering the largest area and distributed in cells NN157, NN239, ST157, NN221, NN104, NN25, NN384, NN286, HC01. *Melaleuca* trees are planted here are quite thick, especially cell HC01 belongs to lotus habitat so the density is quite thin.

Melaleuca forests are from 26 - 30 and over 30 years covering small area are distributed in cells NN68, NN256, ST57, ST36, NN84, ST257, ST164. This is the area of *Melaleuca* grown from 1983 - 1984 (cells NN84, ST257, ST164). According to observation, the *Melaleuca* have quite large fall phenomenon.

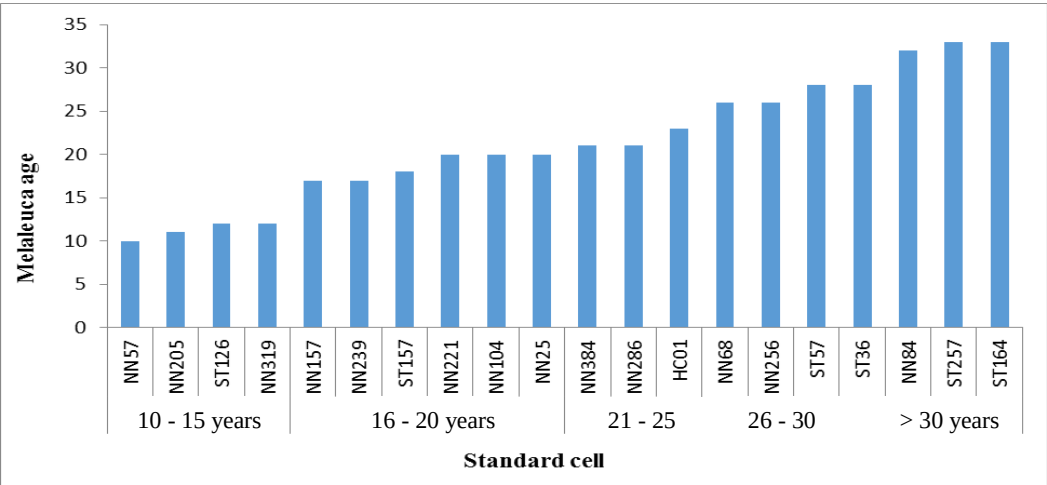


Figure 3. Melaleuca age in sample cells

Melaleuca density

Forest tree density is calculated by counting all alive trees in each survey cell (100 m²), then calculating unit of tree per hectare. The average density of Melaleuca in age group is shown in Figure 4.

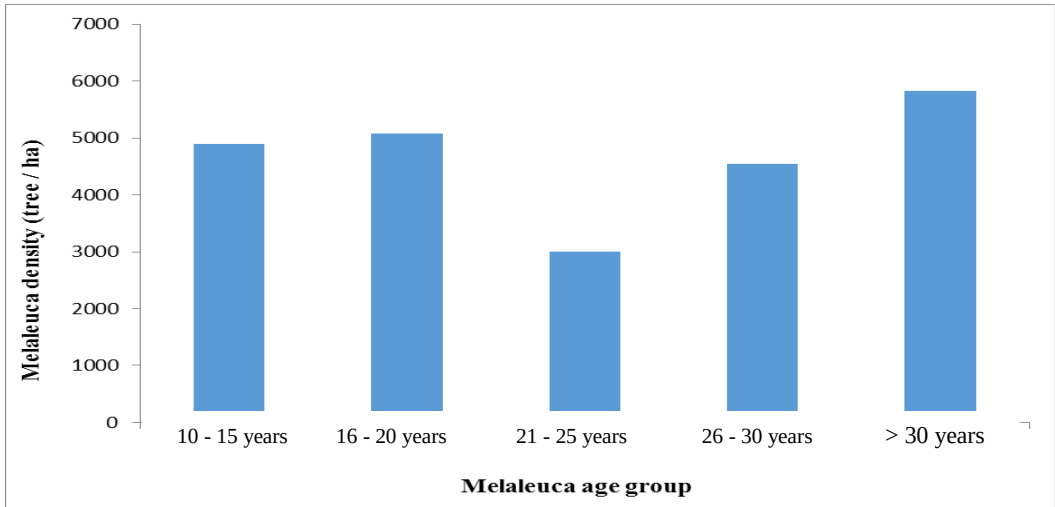


Figure 4. Melaleuca density in age group

Trees in Tra Su Melaleuca forest of all age groups are very dense. Age group III (21 - 25 years) is experienced the lowest density (3,000 trees/ha) and age group V (over 30 years) is experienced the highest density (5,833 trees/ha). The reason is that in cell HC01 of Group III is lotus habitat, so Melaleuca density is very low (average 6 trees/100 m²). Cell NN25 (group II) is experienced the highest average density of 109 trees/100 m².

The density of Melaleuca is not only affected by Melaleuca life-time but also depends on many factors such as flooding, shrubs and vines and the impact of forest fires during the growth and development. Forest fire on August 30th, 2015 destroyed 20ha of forest at lot 4b, thus greatly affecting the density and number of Melaleuca trees here (cell ST36).

According to the Designing Normative on Forest Business (1984), if the forest density is less than 1,000 trees/ha, it is considered as sparse; if the density is between 1,000 and 2,000 trees /ha, the density is considered as averaged; if the density is 2,000 trees/ha, it is considered as thick. With data above, the Melaleuca forest at Tra Su Melaleuca forest landscape conservation area is very thick thanks to Melaleuca plantation.

Melaleuca height

Melaleuca height is measured by a height meter with a precision of 0.1m and the measuring results by age group show that the height is not proportional to Melaleuca age. The highest average height is age group I (18.01m) and the lowest height is group IV (13.11m). Cell NN68 (group IV) is experienced the lowest height in 20 standard cells (9.27m), because cell NN68 (lot 2b) is an old yard of birds, so the density here is very thick (62 trees/100 m²) the height at this cell is not well developed.

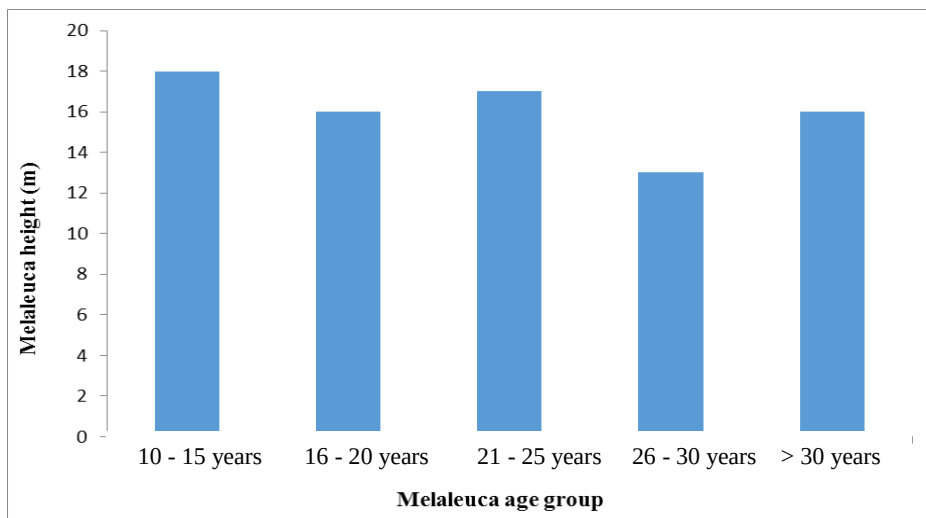


Figure 5. Average height of Melaleuca in age group

In group I, Melaleuca in cells NN57 and NN319 are superior to the age, with average height of 20.13m and 23.68m respectively. These forests are planted by row sowing and thinning up to 4 times, Melaleuca in this zone are growing very well. For NN57, in 2007, Australian Melaleuca were piloted in the plantation which brought business benefits by giving high yields and shortening the planting time. Up to now, Melaleuca has surpassed the surrounding areas. In ST157, NN384 cells, Melaleuca tend to grow in height to compete for light. In cell ST36 of Eleocharis habitat, with a large area of empty land and surrounded by Eleocharis, Melaleuca here are not high to compete the light but tend to grow in diameter.

Diameter at breast height

Average diameter at breast height in the age group of Tra Su Melaleuca forest is proportional to the tree age for age groups I, II and III. Melaleuca under 25 years are able to grow rapidly in stem diameter. The other 2 age groups (more than 26 years) with limited developed diameter due to:

- Below the organic layer of Eleocharis habitat cell ST36 (lot 4b) is sandy clay layer; cells ST164, ST57 (lot 4a) appears jarosite and cells NNR84 and NN256 (lot 5b) as heavy clay so when the older the trees grow and the roots develop to this layer, the development of Melaleuca will be significantly affected (Truong Thi Nga *et al.*, 2009).

- Density of dead trees in cells NN157 and ST164 is quite high, dead density in cells NN157 is 7,033 trees/ha and in cell ST164 is 12,100 trees/ha.

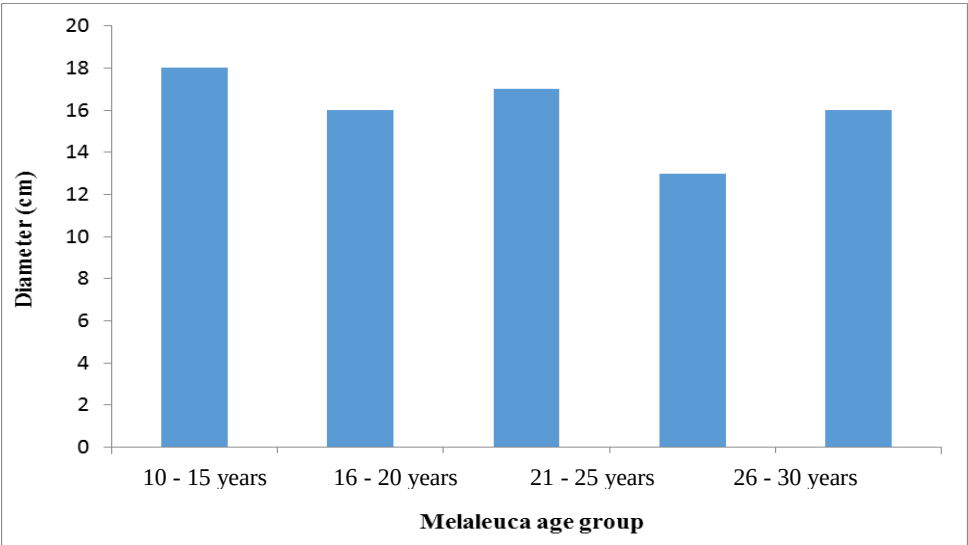


Figure 6. Melaleuca diameter in age group

Status of habitat of Tra Su Melaleuca forest landscape conservation area

Melaleuca forest at Tra Su Melaleuca forest landscape conservation area are stratified by height. The layers are closely related to each other including the composition of trees, the composition of shrubs under Melaleuca canopy, the composition of fresh vegetation and exotic vegetation. However, the habitat of Melaleuca forests, lotus and Eleocharis is very flooded in rainy season (> 1 meter flood), but drought occurs in dry season and forest fire warning at level 5. Therefore, there are only some plants existing in Melaleuca habitat and the diversity of this habitat is not high.

Composition of trees

The composition of timber in Tra Su Melaleuca forest is mainly Melaleuca cajuputi with relatively thick density (4,673 trees/ha) and many different ages. In addition to Melaleuca, there are also *Acacia mangium*, *Eucalyptus alba*, *Acacia auriculaeformis*, etc. They grow mainly on the forest edges.



Figure 7. Compositions of timber

Compositions of shrubs under Melaleuca canopy

The compositions of main shrubs are found in the forest edge habitat. In addition, some varieties are found in forest habitat and lotus habitats such as *Sesbania sesban*, *Mimosa pigra*, *Phragmites australis*, etc. They grow right under the forest canopy with low and scattered densities, growing in small clusters.

The composition of shrubs contributes to the diversity of habitat in the forest, which is home to many species of animals and insects such as ants, birds, worms, etc. However, the strong development of shrubs also leads to bad influences, causing loss of paths in the forest canopy. Thriving shrubs will use more organic matters in the soil, affecting the growth and development of Melaleuca forest.

Composition of fresh vegetation

Fresh vegetation in the forest includes herbaceous plants (without wood structure), mainly distributed in forest edge habitats. In addition, some plants are found in:

- Forest habitat and lotus habitat: *Brachiara mutica*, *Eclipta prostrata*, *Cyclosorus parasiticus*, *Glinus oppositifolius*.
- Melaleuca forest habitat: *Scoparia dulcis*, *Ceratopteris thalictroides*, *Axonopus compressus*, *Struchium sparganophorum*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Ludwigia adscendens*, *Heliotropium indicum*.
- Lotus habitat: *Acalypha brachystachya*, *Panicum repens*, *Commelina paludaso*, *Euphorbia atoto*, *Cyperus digitatus*
- Eleocharis habitat: *Eleocharis dulcis*



Figure 8. Some plants of fresh vegetation

The role of fresh vegetation as well as shrubs, many plants bring highly economic benefits. From an ecological point of view, layers of shrubs and fresh vegetation are important, and they contribute to soil protection, erosion prevention, soil moisture retention, and soil formation and improvement. However, they may also be obstacles to regeneration, which causes difficulties in reforestation and rehabilitation.

Exotic plants

The major exotic plants are vines found in the forest edge habitat. In addition, some plants are found in:

- Forest landscape habitat and lotus habitat: *Lygodium japonicum*, *Pueraria phaseoloides*, *Stenochiaena palustris*, *Zehneria indica*, *Passiflora foetida*, *Ipomoea aquatica*.
- Melaleuca forest habitat: *Lygodium japonicum*, *Cayratia trifolia*.



Figure 9. *Exotic plants*

Vine plants contribute to the increase in biodiversity in the forest, and they are also home to insects such as ants, insects, etc. Excessive exotic vegetation affects the growth and development process of Melaleuca forest: their supporters are Melaleuca stems. The vines living on to Melaleuca's stem will damage the Melaleuca, they absorb nutrients from the Melaleuca and make them develop slowly, etc.

In addition, in the lotus habitat and some Melaleuca of permanent flood, such as ST164 (slot 4a), there is also the presence of aquatic plants such as Lemnoideae, Pistia stratiotes.

CONCLUSION AND RECOMMENDATION

Conclusion

Melaleuca in Tra Su Melaleuca forest conservation area is quite large, mainly over 20 years, the density of Melaleuca is very thick to very thick: from 3,000 trees/ha with Melaleuca in age group from 21 to 25 years to age group from 26 - 30 years, 10 - 15 years and 16 - 20 years are 4,550 trees/ha, 4,900 trees/ha and 5,083 trees/ha, respectively, with the highest number of trees in the age group of 30 years with 5,833 trees/ha.

The average height is lowest in the 26 - 30 age group with the height of 13.11 m, the highest average height group is the age group 10 - 15 years with the height of 18.01 m.

The highest average diameter in the 21 - 25 age group is 18.93 cm and the lowest is the 26 - 30 age group at 17.75 cm.

The criteria of height, diameter at chest height, the density show that the growth and development of Melaleuca in Tra Su forest depend not only entirely on the age of Melaleuca forest

but also depends on factors such as flooding, soil, shrubs and vines, etc Degraded forest area is the survey cells NN25, NN239 and ST164 respectively of cells 5b, 2b, 4a. It should be planted in degraded and dead areas.

Melaleuca forest is stratified at the height, including the composition of timber, the composition of shrubs under Melaleuca canopy, the composition of fresh vegetation and exotic plants, but the effect is negligible.

Recommendation

Further research on (fresh and dry) biomass and carbon reserves of Melaleuca forest, subterranean elements and organic layer of Melaleuca should be continued to be done.

It is necessary to consider and study solutions to overcome the overcrowding of Melaleuca forest, to grow trees on bare land and in dead Melaleuca forest.

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