

# Ecological Survey Report : Flora

## Annex D-6

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### 1. BIOLOGICAL ENVIRONMENT

#### 1.1 FLORA

##### 1.1.1. AIMS AND OBJECTIVES

1. To collect, identify and list the plant species in the area.
2. To record the dominant tree species and evaluate the forest types.
3. To identify the threats and environmental impact in the area.
4. To collect the ecological data and evaluate the existing ecosystem.

##### 1.1.2. MATERIALS AND METHODS

###### 1.1.2.1 Method

The floristic data and ecological data collection was conducted by the following methods in the Thilawa POL Storage and Port Facilities Project Area.

###### 1.1.2.1.1 Sample Plotting

The Global Positioning System was used to navigate and mark the coordinates of the sample plots. In order to obtain essential data for predicting of tree species composition in the forest and vegetation types, 30x30 meter quadrants, were set up and tree species in the plot were collected and population of each species were also counted. The species identification was carried out by using key to families of flowering plants and appropriate literature and confirmed by matching with herbarium specimens of Department of Botany, University of Yangon.

###### 1.1.2.1.2 Random Transecting

To get representative checklists of the mangrove species, plant collection was also carried out by random transect lines along the river bank in the patches of mangrove wherever possible. Specimen collection was made within 10 meter on either sides of the transect line.

###### 1.1.2.1.3 Mapping

Vegetation Map base on satellite imagery product (landsat7 ETM, 2006) download from internet (L71132049\_04920061210 and L71132048\_04820060225). NDVI is calculated from ETM band, the red waveband and the near-infrared waveband.

$$\text{NDVI (Normalized Difference Vegetation Index)} = \frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$$

NDVI show as a high value for denser vegetation, while the NDVI is very low in desert or non-vegetation regions

Using UTM map (Sheet No.1696\_01,02,05,06) and Google Earth map to draw mangrove & mangrove associated species patch in project area.

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#### 1.1.2.1.4 Vegetation Profile Drawing

Mangrove vegetations were surveyed at direct impact zones and indirect impact zones according to the method of Whittaker plots (Stohlgren et. al. 1995), for assessing the types of vegetation.

#### Profiles

A profile pro-forma is used to sketch a cross section of the vegetation along the bio-hotspot mangrove area of the construction sites but site's representative plot may be common one and types of species composition in each and every site are same. From the edge of the lowest tide water to the place where maximum reach of the mangrove species. Transect lines were conducted along the area. Sketching profile enables the stature and stem distribution to be visualized, and different canopy level.

In every site, GPS locations were recorded and 30m transects were made except construction sites because vegetation areas of the sites were sufficient for making 60m transect line, according to the maximum reach of mangrove vegetation. Each and every plant was recorded and stumps and all stem of multi-stemmed trees were also measured. Heights of the plants were estimated by measuring the height of human who standing under sample tree.

Mangroves were found in limited areas such as the bank of the creeks and near river only. So the creeks were surveyed by boat at high tide and low tide times and measured the plants on their bank. The profiles of the creeks were sketched 30m crossing including wide of the creeks and until maximum reach of the mangrove and associate. Photographs were taken on each transect and every species compositions.

#### 1.1.2.2 Materials

Materials used for recording are strings for sample plotting and transecting, digital camera for recording, GPS, maps, heavy duty plastic bags, newspapers, alcohol, spray jug (for fixing specimens), 10x lens, permanent marker, field note books, field press, drying press and dryers.

#### 1.1.2.3 Data Analysis

After field survey, data entry was carried out in excel work sheet. Analysis of population per hectare percentage was conducted using excel work 2007 to identify and record the endangered species in the studied area.

#### Population of Individual Species (per hectare)

The population of species will show not only the composition of species but also the richness of the species in the study area. According to R.He'dl, M Sva'tek, M. Dancak, Rodzay A.W., M. Salleh A.B., Kamariah A.S.(2009), population of individual species (per hectare) is determined by following formula.

$$\text{Population of Individual Species} = \frac{\text{Total Individual species}}{\text{Total Plots Area (m}^2\text{)}} \times 10000 \text{ m}^2(1\text{ha})$$

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#### Relative Density of Tree species

The density of a species refers to the numerical representation of its individual and the availability of space in a unit area. The density index shows not only the richness of the taxa but also the relative distribution of the individuals. According to Curtis (1959), the density index is determined by the following formula.

$$\text{Relative Density of Tree species} = \frac{\text{No. of Individual species}}{\text{Total no. of all individual Species}} \times 100$$

#### Relative frequency of Tree species

The relative frequency of a species refers to the percentage occurrence of its individuals and shows the frequency of different species growing in the study area. The species which fall in high frequency class can be considered as the most common species in the study area. According to Curtis (1959), the relative frequency is determined by the following formula.

$$\text{Relative frequency of Tree species} = \frac{\text{No. of sample plot occurs}}{\text{Total no. of all species occur}} \times 100$$

#### Species distribution by frequency class

According to Raunkiaer's Law of frequency (1934), each species was grouped into one of five frequency class (FC); Frequency range (1-20%) represents rare species, (20 - 40%) represents seldom species, (40 - 60%) represents often species, (60 - 80%) represents mostly species, and (80 - 100%) represents constantly present species. This frequency class will also clarify the homogeneity or heterogeneity of the floristic distribution in the study area.

#### Tree species in DBH class interval

Tree species in DBH class interval is calculated by

$$\text{Population of DBH class interval} = \frac{\text{No. of species}}{\text{Total no. of all species}} \times 100$$

Low DBH class interval shows the degraded and secondary forest and high DBH class interval shows the primary forest.

#### Tree species in Height class interval

Tree species in Height class interval is calculated by

$$\text{Population of Height class interval} = \frac{\text{No. of species}}{\text{Total no. of all species}} \times 100$$

Low height class interval shows the degraded and secondary forest and high height class interval shows the primary forest.

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#### 1.1.3 Participants

- (1) U Nyo Maung (Retired Professor), Taxonomist
- (2) Dr. Win Myint (Associated Professor, ex.), Ecologist
- (3) Dr. Ei Ei Phyoe (Taxonomist)
- (4) U Tun Thura (Botanist& GIS/RS)

#### 1.1.4 Overview of Flora

The flora in the project area belongs to Asia tropical coastal tidal region. According to WWF Eco-regions, the study area is situated in the Myanmar coastal mangroves and Myanmar coastal rain forest. (Map I). Mangrove species grow only in the saline water and are sensitive to the changes of ecosystem. The mangrove forests are subject to severe degradation because there is no clear-cut land-use system in the past. Forest lands have been converted to agriculture and other development activities. That is why the mangroves are found in small patches to-day.

##### 1.1.4.1 Regional Vegetation

The region of the study area is in the Thanlyin Township and Kyauktan Township, Yangon Regional Division. Since the studied area is situated in the coastal mangroves and Myanmar coastal rain forest, the coastal area are dominant with mangrove species mixed with mangrove associated species. (Map II). Dominant mangrove species are *Avicennia officinalis*, *Ceriops decandra*, *Excoecaria agallocha*, *Excoecaria agallocha* and *Sonneratia caseolaris* which are named Irrawaddy mangroves according to WWF. These species are growing wild in patches along the coastal area in this region.

##### 1.1.4.2 Present Vegetation

Since the land use change in the study area the vegetation was mostly degraded. The mangroves remain in patches in the area concerned. (Map III & IV). Only 7 mangrove species and 29 associate species are growing in patches in the direct impact zone and indirect impact zone.



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#### List of Species in the Thilawa Petroleum, Oil and Lubricants (POL) Storage and Port Facilities Area

No.	Scientific Name	Vernacular Name	Family Name	Habit
1	<i>Acanthus ilicifolius</i> L.	Kha-yar	Acanthaceae	H
2	<i>Alocasia</i> sp.	Pein-yaing	Araceae	S
3	<i>Achyranthes aspera</i> L.	Kyet-mauk-su-pyan	Amaranthaceae	H
4	<i>Acmella calva</i> (DC.)R.K.Jansen	Pe-lae-nyin	Asteraceae	CL
5	<i>Acrocephalus axillaris</i> Benth.	Sein-na-get	Lamiaceae	S
6	<i>Acrostichum speciosum</i> Willd.	Nget-kyi-taung	Pteridaceae	F
7	<i>Aegiceras coniculatum</i> (L.)Blanco	Ye-kha-yar	Myrsinaceae	ST
8	<i>Aeschynomene indica</i> L.	Not known	Fabaceae	S
9	<i>Albizia procera</i> (Roxb.) Benth.	Sit	Mimosaceae	ST
10	<i>Alternanthera sessilis</i> (L.)R.Br.	Pa-zun-sa-yaing	Amaranthaceae	H
11	<i>Alysicarpus vaginalis</i> (L.)DC.	Than-ma-naing-kyauk-ma-naing	Fabaceae	CL
12	<i>Amaranthus gracilis</i> Desf.	Hin-nu-nwe-yaing	Amaranthaceae	H
13	<i>Avicennia officinalis</i> L.	Tha-mae	Avicenniaceae	ST
14	<i>Azadirachta indica</i> A.Juss.	Ta-ma	Meliaceae	ST
15	<i>Borreria distans</i> (H.B.K.)Cham.& Schlecht.	Not known	Rubiaceae	H
16	<i>Caesalpinia crista</i> L.	A-lo-lay	Caesalpiniaceae	CL
17	<i>Calotropis gigantea</i> (L.)Dryand.ex W.T. Aiton	Ma-yo-gyi	Asclepiadaceae	S
18	<i>Canavalia cathartica</i>	Khwe-la-yar	Fabaceae	CL
19	<i>Cassytha filiformis</i> L.	Shwe-nwee	Lauraceae	CL
20	<i>Cayratia trifolia</i> (L.) Domin	Taw-sa-byit	Vitaceae	CL
21	<i>Centrosema pubescens</i> L.	Not known	Fabaceae	CL
22	<i>Ceriops decandra</i> (Griff.)Ding Hou	Ma-da-ma	Rhizophoraceae	ST
23	<i>Chloris barbata</i> Sw.	Laygwa-myet	Poaceae	G
24	<i>Chromolaena odorata</i> L.	Bi-zet	Asteraceae	S
25	<i>Cleome burmanii</i> Wight & Arn.	Taw-hin-galar	Capparaceae	H
26	<i>Clerodendrum inerme</i> Gaertn. f.	Taw-kyau-pan	Verbenaceae	CL
27	<i>Corchorus capsularis</i> L.	Gon-shaw-yaing	Tiliaceae	S
28	<i>Crinum asiaticum</i> L.	Ko-yan-gyi	Amaryllidaceae	H
29	<i>Crinum</i> sp.	Not known	Amaryllidaceae	H
30	<i>Crotalaria mucronata</i> L.	Taw-paik-san	Fabaceae	S
31	<i>Crotalaria multiflora</i> L.	Not known	Fabaceae	H
32	<i>Cynodon dactylon</i> Pers.	Myay-sar-myet	Poaceae	G
33	<i>Cyperus exaltatus</i> Retz	Myet-thon-dauk	Cyperaceae	H
34	<i>Dalbergia spinosa</i> Roxb.	Byaik	Fabaceae	S
35	<i>Derris trifoliata</i> Lour.	Mi-chaung-nwee	Fabaceae	CL
36	<i>Desmodium polycarpum</i> (Poir)DC.	Myay-pe-htwe	Fabaceae	S
37	<i>Desmodium triflorum</i> DC.	Not known	Fabaceae	CL

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38	<i>Dolichandrone spathacea</i> (L. f.) K. Schum.	Tha-khut	Bignoniaceae	ST
39	<i>Eclipta alba</i> (L.) Hassk.	Kyeik-hman	Asteraceae	H
40	<i>Eichhornia crassipes</i> (Mart.) Solms	Bae-da	Pontederiaceae	H
41	<i>Eleusine indica</i> Gaertn.	Sin-ngo-myet	Poaceae	G
42	<i>Enhydra fluctuans</i> Lour.	Ka-na-phaw	Asteraceae	H
43	<i>Epaltes divaricata</i> (L.) Cass.	Not known	Asteraceae	H
44	<i>Erythrina</i> sp.	Ka-thit	Fabaceae	ST
45	<i>Euphorbia hypericifolia</i> L.	Kywe-kyau-g-hmin-sae	Euphorbiaceae	H
46	<i>Excoecaria agallocha</i> L.	Tha-yaw	Euphorbiaceae	ST
47	<i>Ficus hispida</i> L.	Kha-aung	Moraceae	S
48	<i>Ficus religiosa</i> L.	Baw-di--nyaung	Moraceae	ST
49	<i>Fimbristylis ferruginea</i> Vahl.	Not known	Cyperaceae	H
50	<i>Flagellaria indica</i> L.	Myauk-kyein	Flagellariaceae	CL
51	<i>Flueggea leucopyrus</i> Willd	Ye-chin-ya	Euphorbiaceae	S
52	<i>Glochidion coccineum</i> Muell.Arg.	Hta-min-soke	Euphorbiaceae	S
53	<i>Grangea maderaspatana</i> Poir	Taw-ma-nyo-lon	Asteraceae	H
54	<i>Heliotropium indicum</i> L.	Sin-hna-maung	Boraginaceae	H
55	<i>Hibiscus ficulneus</i> L.	Taw-yon-pa-di	Malvaceae	S
56	<i>Hibiscus tiliaceus</i> L.	Thin-ban	Malvaceae	S
57	<i>Hoya burmanica</i> Rolfe	Ka-mon	Asclepiadaceae	CL
58	<i>Hygrophila phlomoides</i> Nees	Mi-chaung-kun-bat	Acanthaceae	S
59	<i>Hyptis rhomboidea</i> Mart	Not known	Lamiaceae	S
60	<i>Imperata cylindrica</i> var. <i>koenigii</i> Retz.	Thet-ke-kyet-hmi	Poaceae	G
61	<i>Indigofera tinctoria</i>	Me-yaing	Fabaceae	S
62	<i>Ipomoea aquatica</i> Forssk.	Ye-ka-zun	Convolvulaceae	H
63	<i>Ipomoea pes-caprae</i> (L.) Sweet	Pinle-ka-zun	Convolvulaceae	CL
64	<i>Ipomoea pilosa</i> Sweet	Ka-zun-nwee	Convolvulaceae	CL
65	<i>Ipomoea sagittata</i> Poir.	Kon-ka-zun	Convolvulaceae	H
66	<i>Ipomoea violacea</i>	Kyet-thon-pin	Convolvulaceae	CL
67	<i>Jasminum pubescens</i> Willd.	Taw-sa-bae	Oleaceae	CL
68	<i>Jussiaea suffruticosa</i> L.	Lay-nyin	Onagraceae	H
69	<i>Leucaena leucocephala</i> (Lam.) De. Wit	Baw-za-gaing	Mimosaceae	ST
70	<i>Limnophila chinensis</i> (Osbeck) Merr.	Ye-thayet-kin	Scrophulariaceae	H
71	<i>Ludwigia adscendens</i> (L.) H. Hara	Ka-nyut	Onagraceae	H
72	<i>Luffa aegyptiaca</i> Mill.	Tha-but-kha	Cucurbitaceae	CL
73	<i>Malachra capitata</i> L.	Sin-ma-hmwe-soke	Malvaceae	S
74	<i>Melanthera biflora</i> (L.) Wild	Not known	Asteraceae	CL
75	<i>Merremia hederacea</i> Hallier f.	Nwe-shoke	Convolvulaceae	CL
76	<i>Microcos tomentosa</i> J.E. Smith	Mya-ya	Tiliaceae	ST
77	<i>Mikania micrantha</i> H.B.K.	Bi-zet-nwee	Asteraceae	CL
78	<i>Mimosa diplotricha</i> C.	Hti-ka-yone-phyu	Mimosaceae	H
79	<i>Mimosa pudica</i> L.	Hti-ka-yone-ni	Mimosaceae	H

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80	<i>Moghania strobilifera</i> (L.) Aiton f.	Not known	Fabaceae	S
81	<i>Musa</i> sp.	Nget-pyaw	Musaceae	H
82	<i>Nypa fruticans</i> Wurmb	Da-ni	Arecaceae	ST
83	<i>Oldenlandia corymbosa</i> L.	Gant-ga-lar	Rubiaceae	H
84	<i>Oldenlandia diffusa</i> (Willd.) Roxb.	Su-lar-na-pha	Rubiaceae	H
85	<i>Operculina turpethum</i> (L.) Silva Mansa	Kyar-hin-nwee	Convolvulaceae	CL
86	<i>Pandanus foetidus</i> Roxb.	Tha-baw	Pandanaceae	S
87	<i>Phaseolus calcaratus</i> Roxb.	Pe-yin	Fabaceae	CL
88	<i>Phoenix paludosa</i> Roxb.	Thin-baung	Arecaceae	S
89	<i>Physalis minima</i> L.	Bauk-thi	Solanaceae	H
90	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Kala-magyi	Mimosaceae	ST
91	<i>Pluchea indica</i> (L.) Less.	Kha-ru	Asteraceae	S
92	<i>Polygonum barbatum</i> L.	Kywe-hna-khaung-gate	Polygonaceae	H
93	<i>Pongamia pinnata</i> Pierre	Thin-winbyu	Fabaceae	ST
94	<i>Pontederia</i> sp.	Not known	Pontederiaceae	H
95	<i>Portulaca oleracea</i> L.	Myay-byit	Portulacaceae	H
96	<i>Saccharum spontaneum</i> L.	Kaing	Poaceae	G
97	<i>Samanea saman</i> (Jacq.) Merr.	Thin-baw-kokko	Mimosaceae	ST
98	<i>Scoparia dulcis</i> L.	Dana-thu-kha	Scrophulariaceae	H
99	<i>Senna tora</i> (L.) Roxb.	Dant-gywe	Caesalpiniaceae	S
100	<i>Sesbania grandiflora</i> (L.) Poir.	Pauk-pan-phyu	Fabaceae	S
101	<i>Sesbania paludosa</i> Roxb.	Nyan	Fabaceae	S
102	<i>Sesuvium portulacastrum</i> (L.) L.	Not known	Aizoaceae	H
103	<i>Setaria lutescens</i> Hubb.	Yon-sar-myet	Poaceae	G
104	<i>Sida acuta</i> Burm f.	Ta-byet-si-ywet-chon	Malvaceae	H
105	<i>Sonneratia apetala</i> Buch.-Ham	Kant-ba-lar	Sonneratiaceae	ST
106	<i>Sonneratia caseolaris</i> (L.) Engl.	La-mu	Sonneratiaceae	ST
107	<i>Spermocoe hispida</i> L.	Gant-ga-lar-ni	Rubiaceae	H
108	<i>Sphaeranthus africanus</i> L.	Not known	Asteraceae	H
109	<i>Sphenoclea zeylanica</i> Gaertn.	Le-pa-du	Sphenocleaceae	H
110	<i>Tadehagi triquetrum</i> (L.) H. Ohashi	Lauk-thay	Fabaceae	S
111	<i>Tamarindus indica</i> L.	Ma-gyi	Caesalpiniaceae	ST
112	<i>Trema orientalis</i> (L.) Blume	Khwe-sha	Ulmaceae	S
113	<i>Triumfetta bartramia</i> L.	Kat-si-nae-thay	Tiliaceae	S
114	<i>Urena lobata</i> L.	Kat-si-nae-gyi	Malvaceae	S
115	<i>Xanthium strumarium</i> L.	Nwa-hmi-kat	Asteraceae	S
116	<i>Ziziphus jujuba</i> Lam.	Zi	Rhamnaceae	ST

CL=Climber; F= Fern; G=Grass; H=Herbs; S=Shrubs; ST=Small Tree

	Mangrove associate
	Mangrove
	Other terrestrial species

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Out of 36 mangrove and mangrove associate species, 7 mangrove species are ecologically sensitive species.

#### List of Ecologically Sensitive Species

No.	Vernacular Name	Scientific Name	Family Name
1	Da-ni	<i>Nypa fruticans</i> Wurm	Areaceae
2	Kant-ba-lar	<i>Sonneratia apetala</i> Buch.-Ham	Sonneratiaceae
3	La-mu	<i>Sonneratia caseolaris</i> (L.)Engl.	Sonneratiaceae
4	Ma-da-ma	<i>Ceriops decandra</i> (Griff.)Ding Hou	Rhizophoraceae
5	Tha-mae	<i>Avicennia officinalis</i> L.	Avicenniaceae
6	Tha-yaw	<i>Excoecaria agallocha</i> L.	Euphorbiaceae
7	Ye-kha-yar	<i>Aegiceras coniculatum</i> (L.)Blanco	Myrsinaceae

The species distributions in these patches are varied. *Crinum asiaticum* L., *Ipomoea pes-caprae*, and *Pongamia pinnata* are very rare and present only in the indirect impact zone. *Acrostichum speciosum* and *Erythrina* sp. are also rare study area.

#### Distribution of Plant Species in Thilawa Petroleum, Oil and Lubricants (POL) Storage and Port Facilities Area

No.	Scientific Name	Local Name	Common Name	Direct Impact Area					Indirect Impact Area		
				Group A	Group B	Group C	Phalan Creek I	Phalan Creek II	Area between Navy Base and Group A	Thilawa Old Village	Shwe byauk Creek
1	<i>Acanthus ilicifolius</i> L.	Kha-yar	Sea holly	*	*	*	*	*	*	*	*
2	<i>Acrostichum speciosum</i> Willd.	Nget-kyi-taung	-	*	*						
3	<i>Aegiceras coniculatum</i> (L.)Blanco	Ye-kha-yar	Butalet			*	*	*		*	
4	<i>Albizia procera</i> (Roxb.) Benth.	Sit	Vangfek		*		*	*			
5	<i>Avicennia officinalis</i> L.	Tha-mae	Meppin	*	*		*	*	*	*	*
6	<i>Caesalpinia crista</i> L.	A-lo-lay	Fever nut	*	*		*	*			*
7	<i>Canavalia cathartica</i>	Khwe-la-yar	-		*	*	*	*		*	*
8	<i>Cassytha filiformis</i> L.	Shwe-nwee	-	*	*	*	*	*		*	*
9	<i>Cayratia trifolia</i> (L.) Domin	Taw-sa-byit	Fox grape	*	*		*	*			*
10	<i>Ceriops decandra</i> (Griff.)Ding Hou	Ma-da-ma	-			*	*			*	*
11	<i>Clerodendrum inerme</i> Gaertn. f.	Taw-kyau-pan	Garden quinine	*	*	*	*	*	*	*	*
12	<i>Crinum asiaticum</i> L.	Ko-yan-gyi	Poison bulb								*
13	<i>Crinum</i> sp.	Not known	-	*			*	*	*	*	*
14	<i>Cyperus exaltatus</i> Retz	Myet-thon-dauk	-	*	*	*	*	*	*	*	*
15	<i>Dalbergia spinosa</i> Roxb.	Byaik	-	*	*	*	*	*	*	*	*

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16	<i>Derris trifoliata</i> Lour.	Mi-chaung-nwee	Black creeper	*	*	*	*	*	*	*	*
17	<i>Dolichandrone spathacea</i> (L. f.) K. Schum.	Tha-khut	Mangrove trumpet tree	*			*	*			
18	<i>Erythrina</i> sp.	Ka-thit	-				*	*			
19	<i>Excoecaria agallocha</i> L.	Tha-yaw	Kayaw	*	*	*	*	*	*	*	*
20	<i>Fimbristylis ferruginea</i> Vahl.	Not known	-	*	*	*	*	*		*	*
21	<i>Flagellaria indica</i> L.	Myauk-kyein	-		*		*	*	*	*	*
22	<i>Hibiscus tiliaceus</i> L.	Thin-ban	-	*	*	*	*	*	*	*	*
23	<i>Hoya burmanica</i> Rolfe	Ka-mon	-	*	*	*	*	*	*	*	*
24	<i>Ipomoea pes-caprae</i> (L.) Sweet	Pinle-ka-zun	Goat's foot creeper							*	
25	<i>Ipomoea violacea</i>	Kyet-thon-pin	-	*	*	*	*	*	*	*	*
26	<i>Melanthera biflora</i> (L.) Wild	Not known	-	*	*	*	*	*	*	*	*
27	<i>Nypa fruticans</i> Wurm	Da-ni	Toddy palm	*			*	*		*	*
28	<i>Pandanus foetidus</i> Roxb.	Tha-baw	-			*	*				*
29	<i>Phoenix paludosa</i> Roxb.	Thin-baung	-	*	*	*	*	*		*	*
30	<i>Pluchea indica</i> (L.) Less.	Kha-ru	Wabalu	*	*	*	*	*	*	*	*
31	<i>Pongamia pinnata</i> Pierre	Thin-winbyu	-			*					
32	<i>Pontederia</i> sp.	Not known	-	*	*	*	*	*	*	*	*
33	<i>Sesbania paludosa</i> Roxb.	Nyan	-	*	*	*	*	*	*	*	*
34	<i>Sesuvium portulacastrum</i> (L.) L.	Not known	-	*	*	*					
35	<i>Sonneratia apetala</i> Buch.-Ham	Kant-ba-lar	-	*	*		*	*	*	*	*
36	<i>Sonneratia caseolaris</i> (L.) Engl.	La-mu	-	*	*	*	*	*	*	*	*

**Group A**=Myat Myittar Mon, Apex & Shwe Taung; **Group B**=Asia World, Denko, Dagon International & New Day;  
**Group C**=Myanmar Naing Group, Kaung Myanmar Aung, IGE & Shwe Than Lwin; **Phalan Creek II**=No Name creek;  
**Area between Navy Base and Group A**=Group of A Lwam Sut Village

Out of 7 ecologically sensitive species *Excoecaria agallocha*, *Sonneratia caseolaris* are dominant species and are found almost all study area. Thilawa old village and Phalan creek (I) are relatively rich in biodiversity comprising almost all 36 mangroves and mangrove associated species growing wild.

#### Number of ecologically sensitive Species

No.	Name of the Survey Area	No. of Species
1.	Group A	5
2.	Group B	4
3.	Group C	4
4.	Phalan Creek I	7
5.	Phalan Creek II	6
6.	Area between Navy Base and Group A	4
7.	Thilawa Old Village	7
8.	Shwe byauk Creek	6

**Group A**=Myat Myittar Mon, Apex & Shwe Taung; **Group B**=Asia World, Denko, Dagon International & New Day;  
**Group C**=Myanmar Naing Group, Kaung Myanmar Aung, IGE & Shwe Than Lwin; **Phalan Creek II**=No Name creek;  
**Area between Navy Base and Group A**=Group of A Lwam Sut Village

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#### Floristic composition

Total numbers of species collected in the studied area are altogether 36 mangrove and mangrove associate species. However, only four mangrove species belonging to 3 genera are growing in large patches to be collected in 5 representative plots. The dominant mangrove species in this area are *Sonneratia caseolaris* (L.)Engl. (La-mu) followed by *Excoecaria agallocha* L. (Tha-yaw) and *Avicennia officinalis* L. (Tha-mae), *Sonneratia apetala* Buch.-Ham (Kant-ba-lar). The other three species are growing sparsely along the creeks. These species are *Nypa fruticans*, *Ceriops decandra* and *Aegiceras coniculatum*.

#### Mangrove Species Population

No.	Scientific Name	No. of individual	Total no. of individual(per ha)	Total no. of population(per ha) %
1	<i>Avicennia officinalis</i> L.	26	26.26262626	10.56910569
2	<i>Excoecaria agallocha</i> L.	44	44.44444444	17.88617886
3	<i>Sonneratia apetala</i> Buch.-Ham	16	16.16161616	6.504065041
4	<i>Sonneratia caseolaris</i> (L.)Engl.	160	161.6161616	65.04065041
	<b>Total</b>	<b>246</b>	<b>248.4848485</b>	<b>100</b>

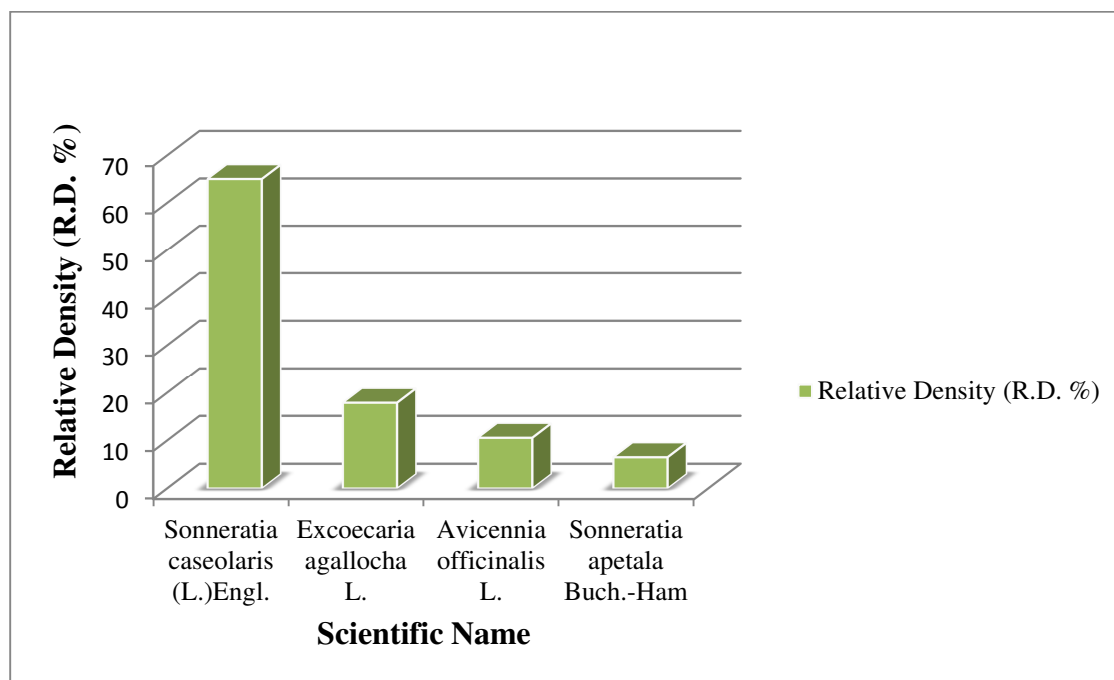
#### Relative Density of Mangrove Species

Among the sample plots species density per hectare varied and the highest density was observed *Sonneratia caseolaris* (L.)Engl.followed by *Excoecaria agallocha* L. and *Avicennia officinalis* L., *Sonneratia apetala* Buch.-Ham. This shows that these four species are abundant in this area.

No.	Scientific Name	Density (D)	Relative Density (R.D. %)
1	<i>Sonneratia caseolaris</i> (L.)Engl.	32	65.04065041
2	<i>Excoecaria agallocha</i> L.	8.8	17.88617886
3	<i>Avicennia officinalis</i> L.	5.2	10.56910569
4	<i>Sonneratia apetala</i> Buch.-Ham	3.2	6.504065041

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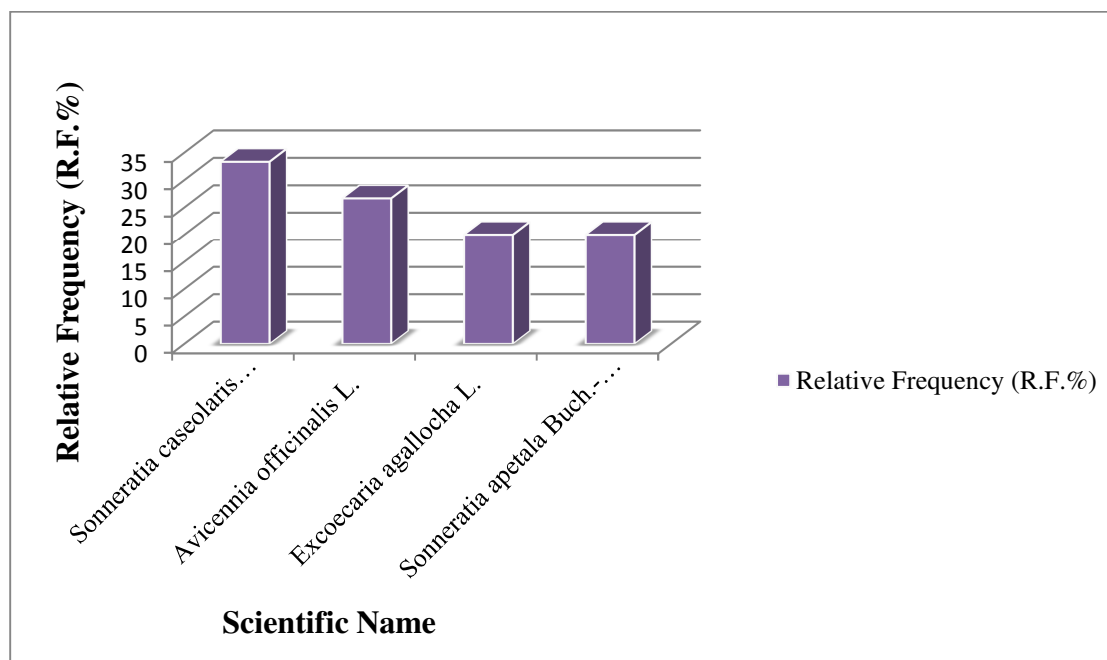
### Relative Frequency of Mangrove Species

Relative frequency is the frequency of one species compared to the total frequency of all the species. According to the results, *Sonneratia caseolaris* (L.)Engl. is high relative frequency value (33.333%) followed by *Avicennia officinalis* L. (26.667%), *Excoecaria agallocha* L. (20.0%) are equal and *Sonneratia apetala* Buch.-Ham (20.0%), respectively. Therefore these species occur everywhere in the study area.

No.	Scientific Name	Frequency (F)	Relative Frequency (R.F.%)
1	<i>Sonneratia caseolaris</i> (L.)Engl.	1	33.33333333
2	<i>Avicennia officinalis</i> L.	0.8	26.66666667
3	<i>Excoecaria agallocha</i> L.	0.6	20
4	<i>Sonneratia apetala</i> Buch.-Ham	0.6	20

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#### Species Distribution by Frequency Class

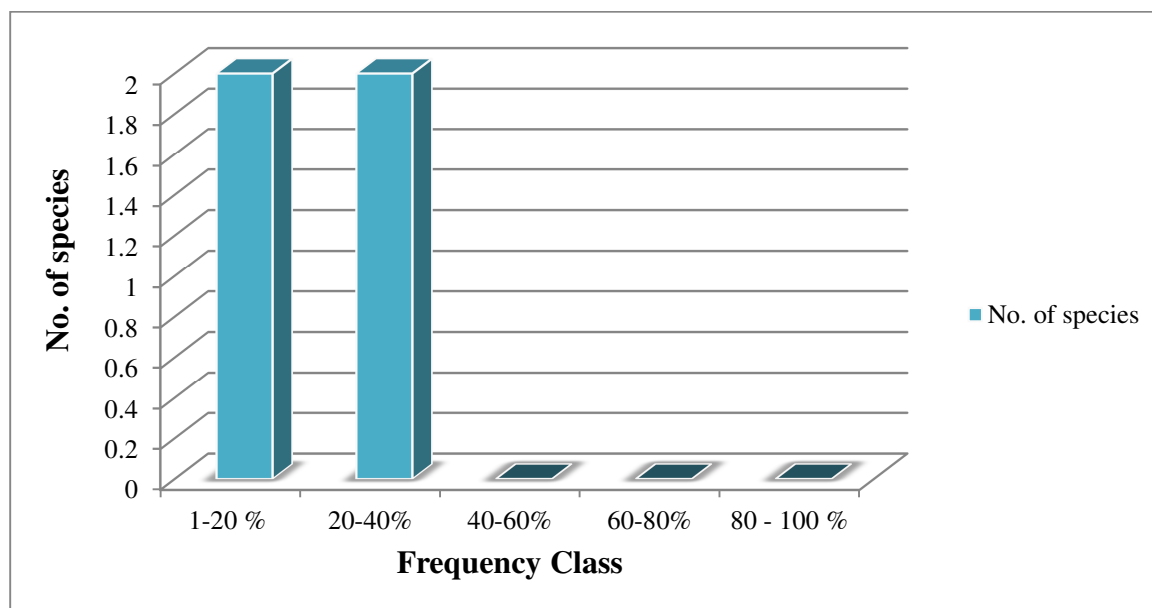
In order to clarify the homogeneity and heterogeneity of the floristic distribution in the area, the species distribution by frequency class was examined. According to the outcome of the frequency classes, only two species are in high frequency class and 4% of the species are in low frequency class. This shows that this area is floristically high degree of heterogeneity.

Frequency Class	No. of Species
1-20 %	2
20-40%	2
40-60%	0
60-80%	0
80 - 100 %	0



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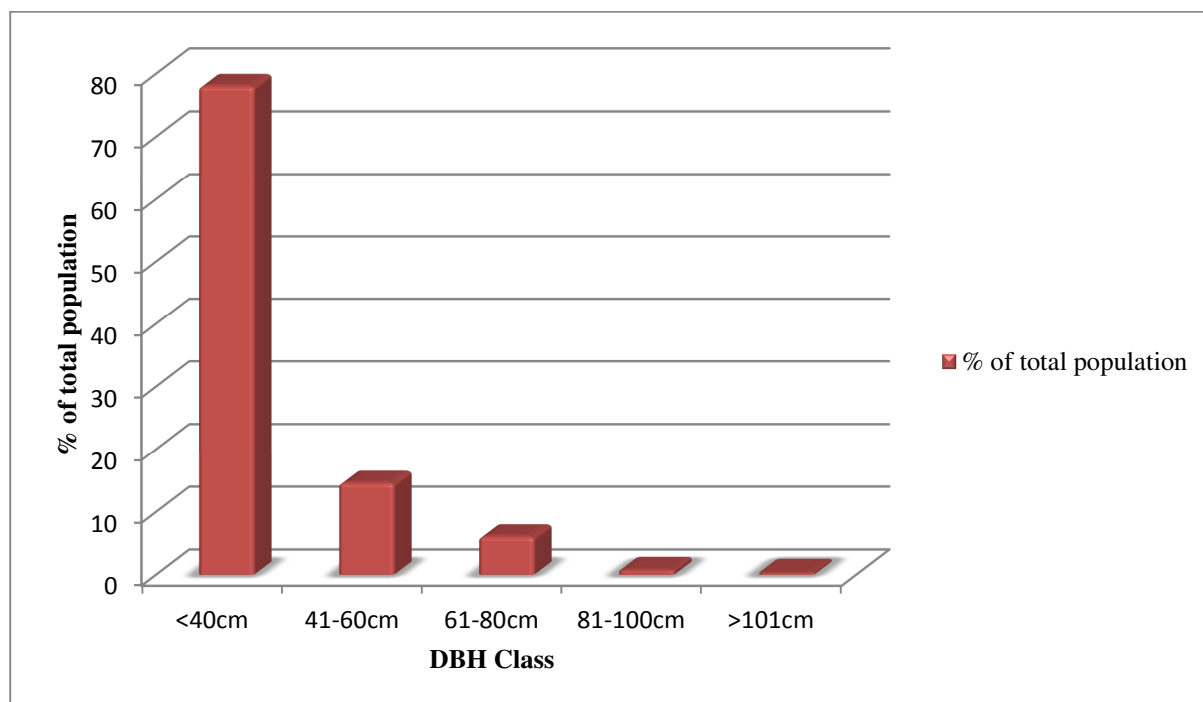
#### Mangrove species in DBH class interval

The distribution of DBH interval class reveals the dominant of small stem individuals in the area. 78.05 % of the mangrove species are less than 40cm DBH. Large stem individuals with DBH more than 80cm are of 7.32 %. Majority of the trees are less than 40cm in diameter, which indicates that the forests are degraded.

DBH Class	No. of species	Total number of individual	% of total population
<40cm	192	193.9393939	78.04878049
41-60cm	36	36.36363636	14.63414634
61-80cm	15	15.15151515	6.097560976
81-100cm	2	2.02020202	0.81300813
>101cm	1	1.01010101	0.406504065
<b>Total</b>	<b>246</b>	<b>248.4848485</b>	<b>100</b>

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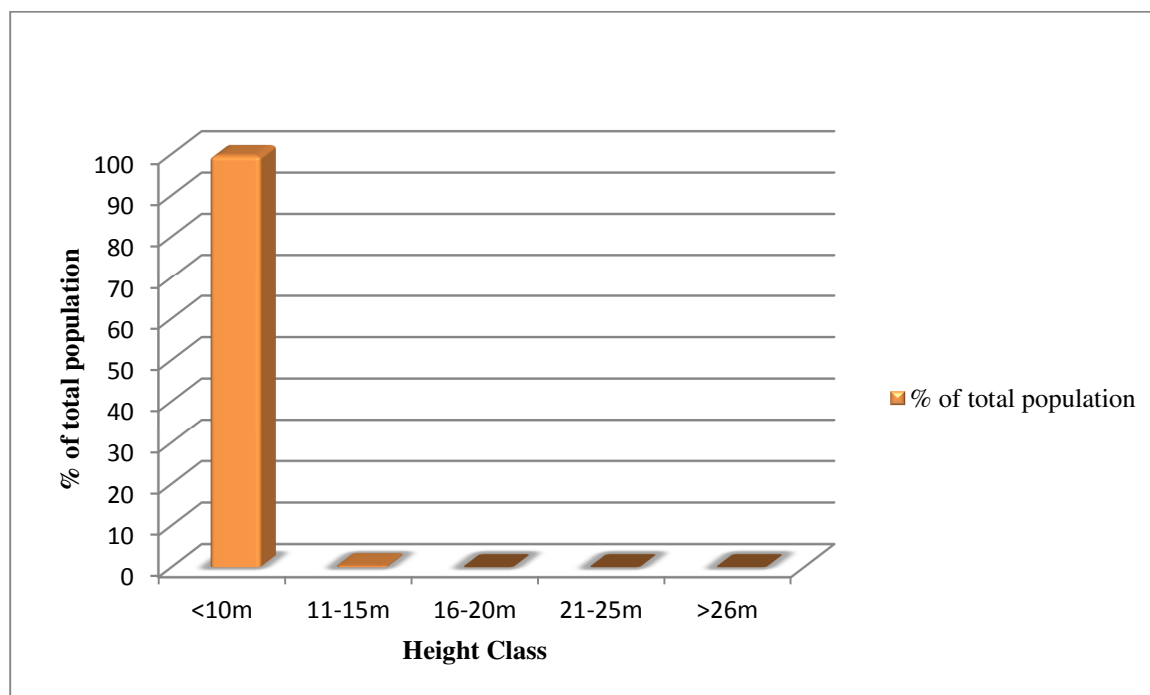
#### Mangrove species in Height class interval

The distribution of Height class shows that 247 individuals are less than 10 meter, comprising 100% and of the total population and 1 individual is more than 15meter, comprising the 0.41%. Since most canopy height classes are not more than 10m.

Height Class	No. of species	Total number of individual	% of total population
<10m	245	247.4747475	99.59349593
11-15m	1	1.01010101	0.406504065
16-20m	0	0	0
21-25m	0	0	0
>26m	0	0	0
<b>Total</b>	<b>246</b>	<b>248.4848485</b>	<b>100</b>

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#### 1.1.5. Vegetation Profile in the Studied Area



According to analysis of the transect survey at the construction sites, there was found high species composition. Which includes six mangrove species and five mangrove associate species but maximum girth of the trees is 10cm and maximum height is 4m. Majorities are bushes and grow in patches. Obvious impact of the area could be predicted as a clearance of

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land for construction. So far, site workers are collecting the mangrove for their kitchen energy.(Profile I)



Species composition on both sides of the Shwe byauk Creek is also high but their distribution widens 10m on both sides of the creek. There are not prominent impacts on them. Four mangrove species and five mangrove associate species are found on both sides of the creek. Maximum height is 3m with 15cm in girth. Prominent vegetation pattern is bushy and continuous on both sides.(Profile II)



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In Phalan Creek, four mangrove and four associate species are growing together. The places which near village have scatter vegetation and the places away from village are dense and bushy. In some places, the prominent *Sonneratia caseolaris* species are dominant. It has 5m maximum height of tree and 15cm in girth. The vegetation grows on 10m wide on both sides of the creek. Impact is only firewood cutting by villagers from nearby village.(Profile III)

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An area between Navy Base and Group A is occupied by temporary fisherman village. So the vegetation is extremely disturbed. The vegetation can find in patch near fisherman huts, species composition is few. The forests compose of only three mangrove and four associate species.(Profile IV)

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Thilawa Creek is flowing through old settlement area and it has been disturbed for long time. That is why, its species composition is a few and growing pattern is also scattered. There are three mangrove species and two associate species only. However the giant *Sonneratia apetala* has 90cm in girth and 6m in height, which might be conserved for longtime in house yard. Recently the prominent disturbance is found as firewood cutting by neighboring people.(Profile V)

No.	Profiles	Mangrove	Associate	Composition	Impacts
I.	Construction sites	6	5	high	high
II.	Shwe byauk Creek	4	5	high	low
III.	Phalan Creek	4	4	high	low
IV.	Between Navy Base & Group A	3	4	low	high
V.	Thilawa Creek	3	2	low	high



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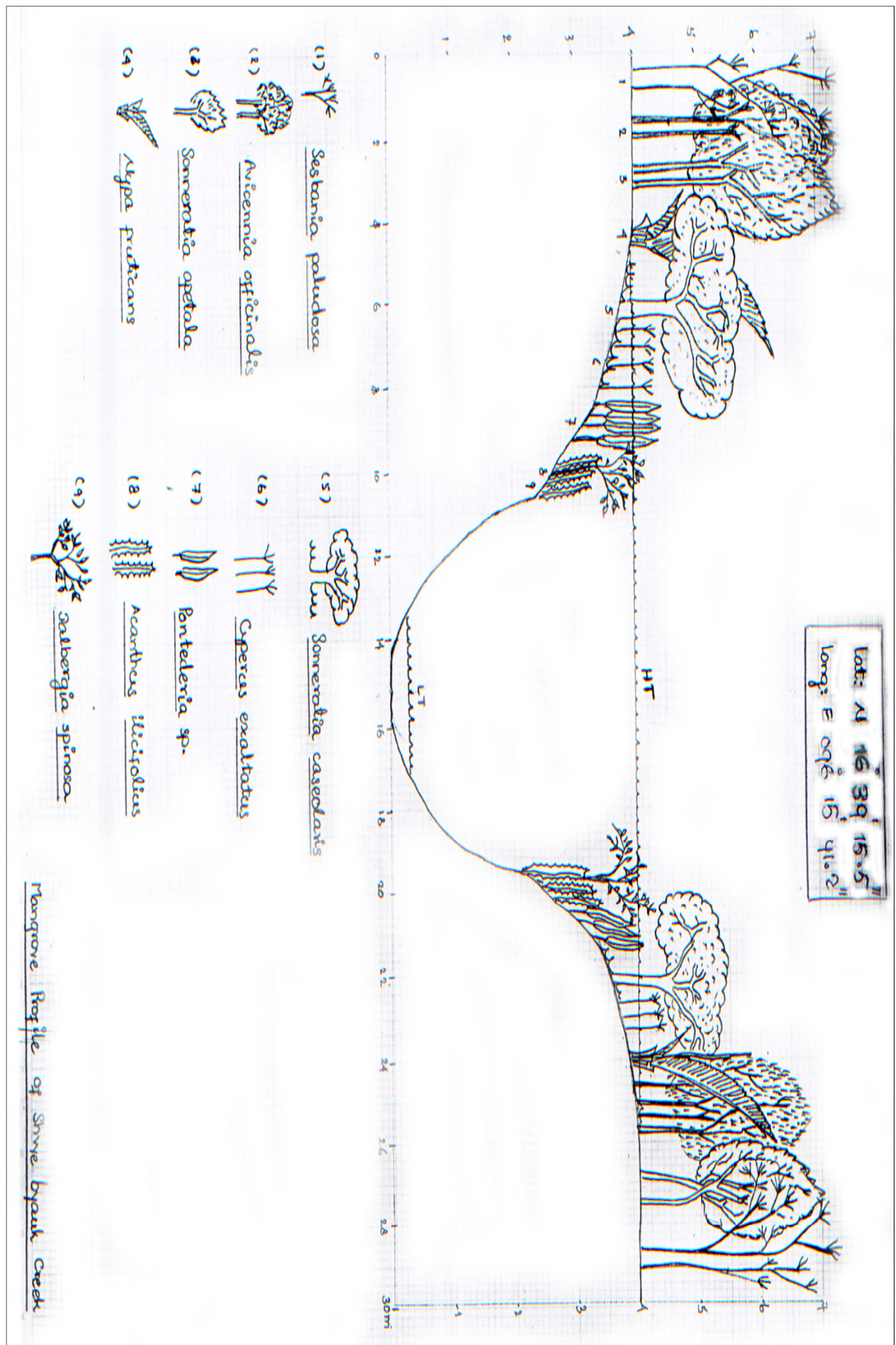
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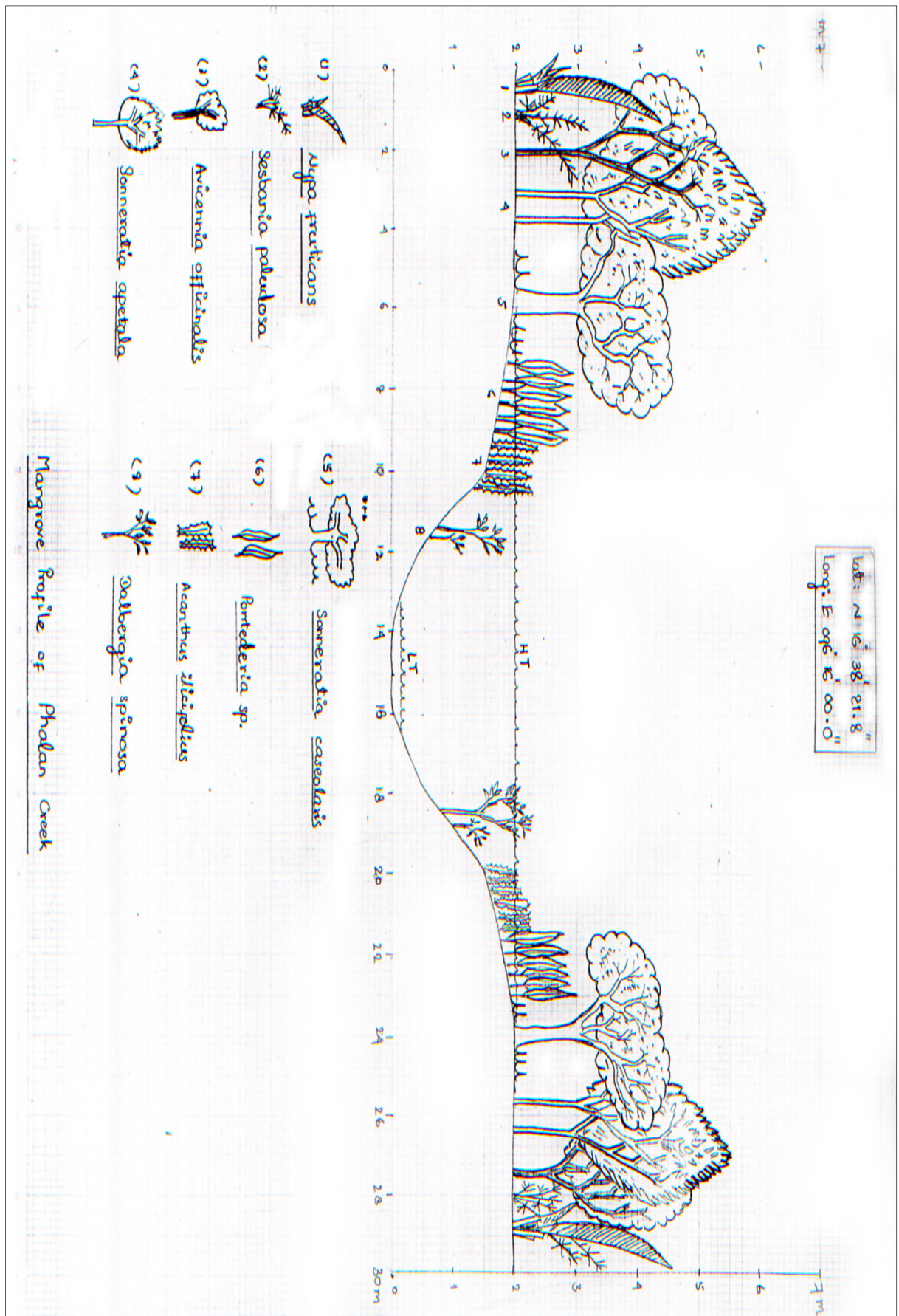
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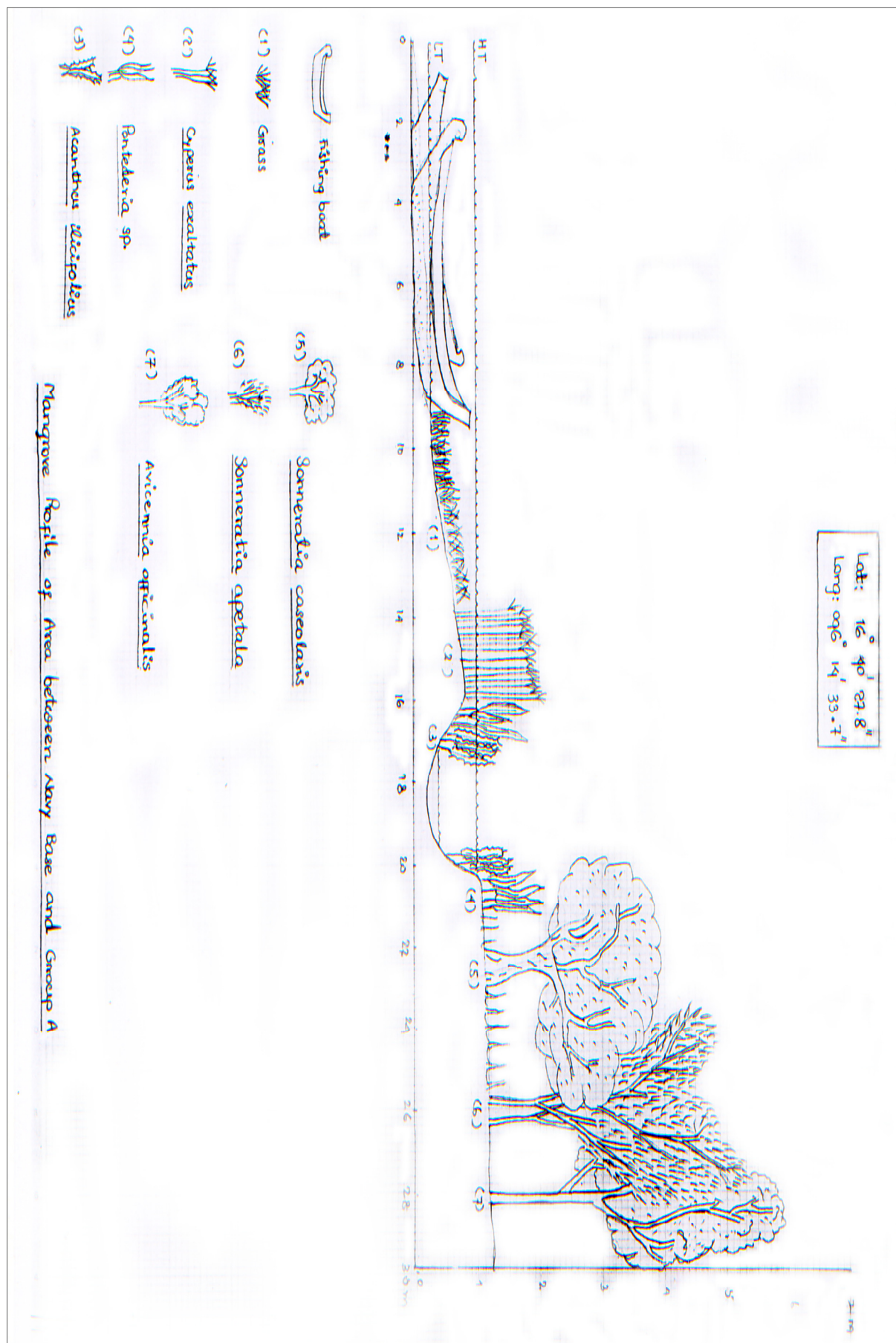


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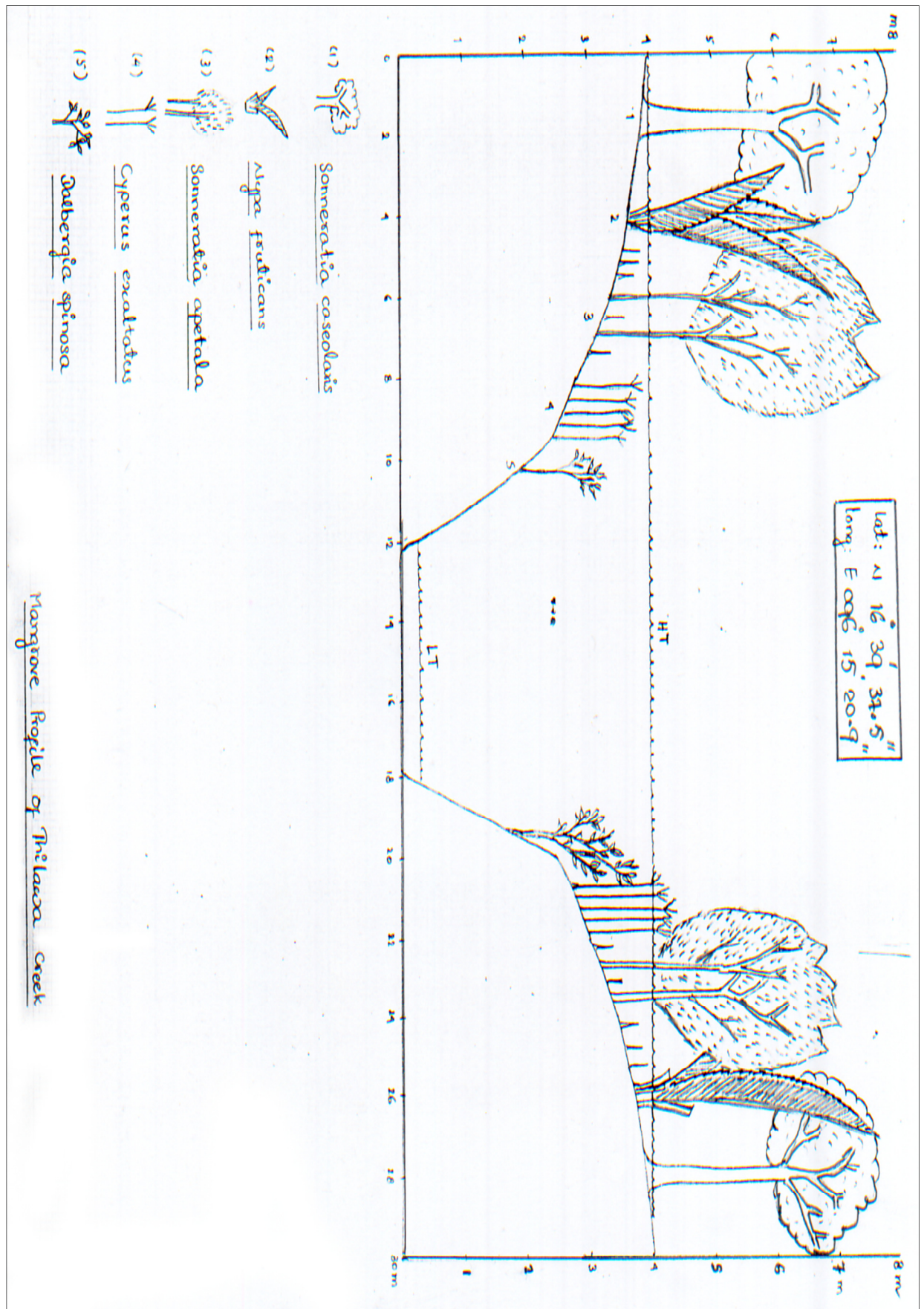
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#### 1.1.6. Introduced Species found in the study Area

No.	Vernacular Name	Scientific Name	Family Name	Remark	Sites
1.	Ma-lay-sha-padauk	<i>Acacia auriculiformis</i> A.Cunn	Mimosaceae	Cultivated Since the time of cultivated land	G A, G B&G C
2.	Ban-da	<i>Terminalia catappa</i> L.	Combretaceae	Cultivated as landscape in project sites	GC
3.	Kha-yae	<i>Mimusops elengi</i> L.	Sapotaceae	"	G B, G C
4.	Korea-ban-da	<i>Bucida</i> sp.	Combretaceae	"	G A
5.	Pinle-kabwe	<i>Casuarina equisetifolia</i> Forst.	Casuarinaceae	"	G A
6.	Lan-ta-ma	<i>Polyalthia longifolia</i> (Lam.)Benth. & Hook.f.	Annonaceae	"	G A
7.	Eu-ca-lit	<i>Eucalyptus ovate</i> Labill.	Myrtaceae	"	G B

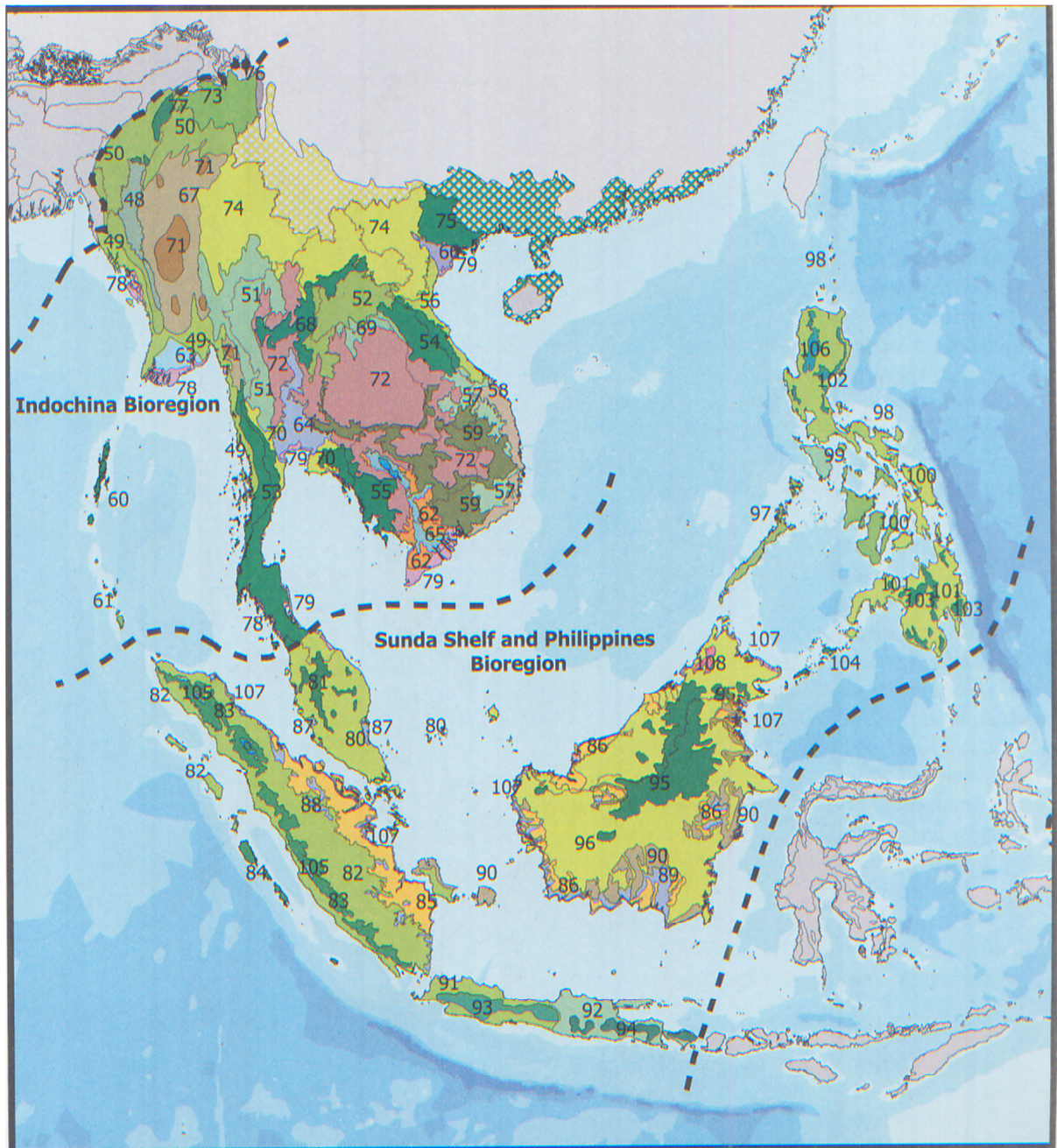
G=Group



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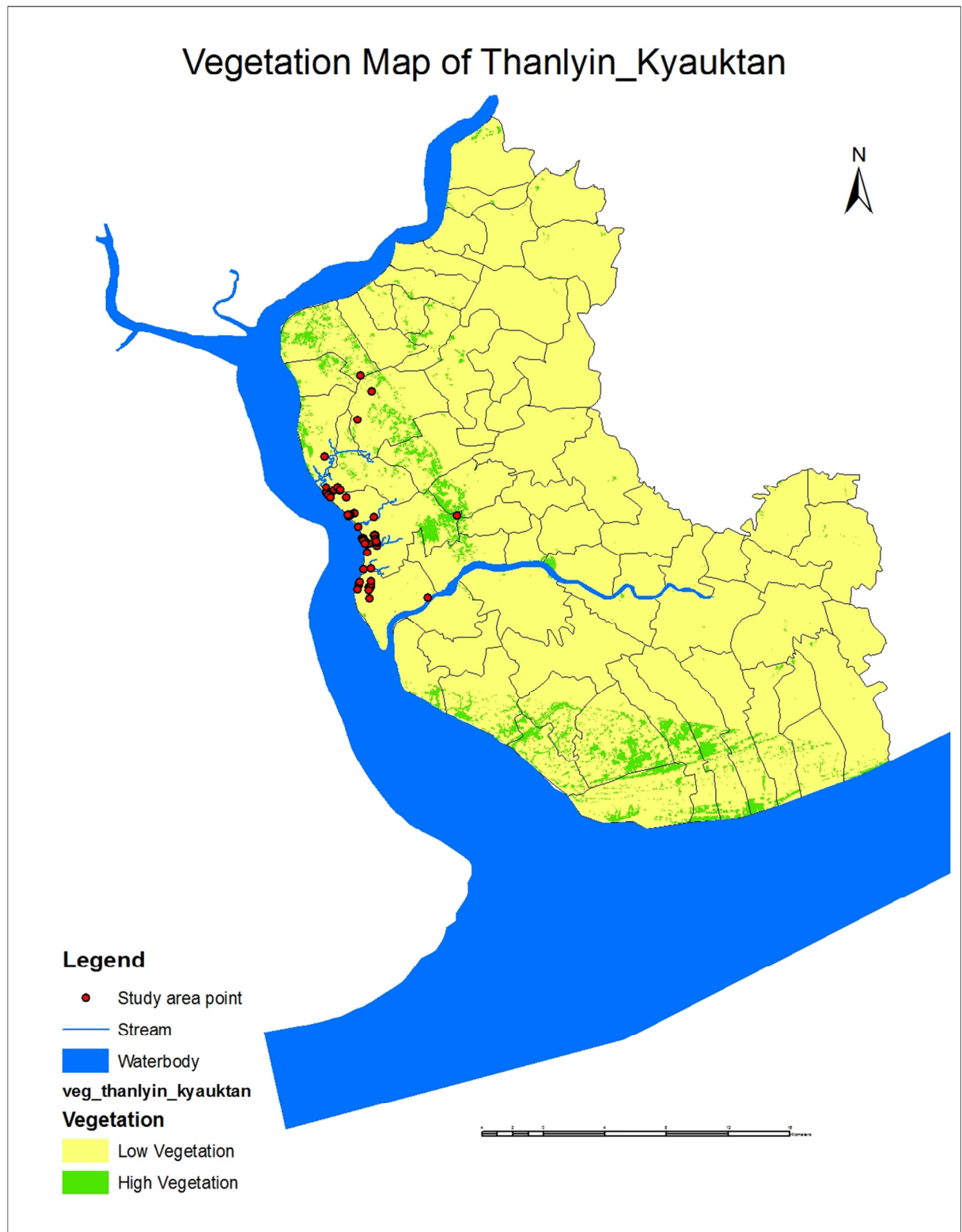
Map I



Terrestrial Ecoregions of the Indochina and Sunda Shelf and Philippines bioregions

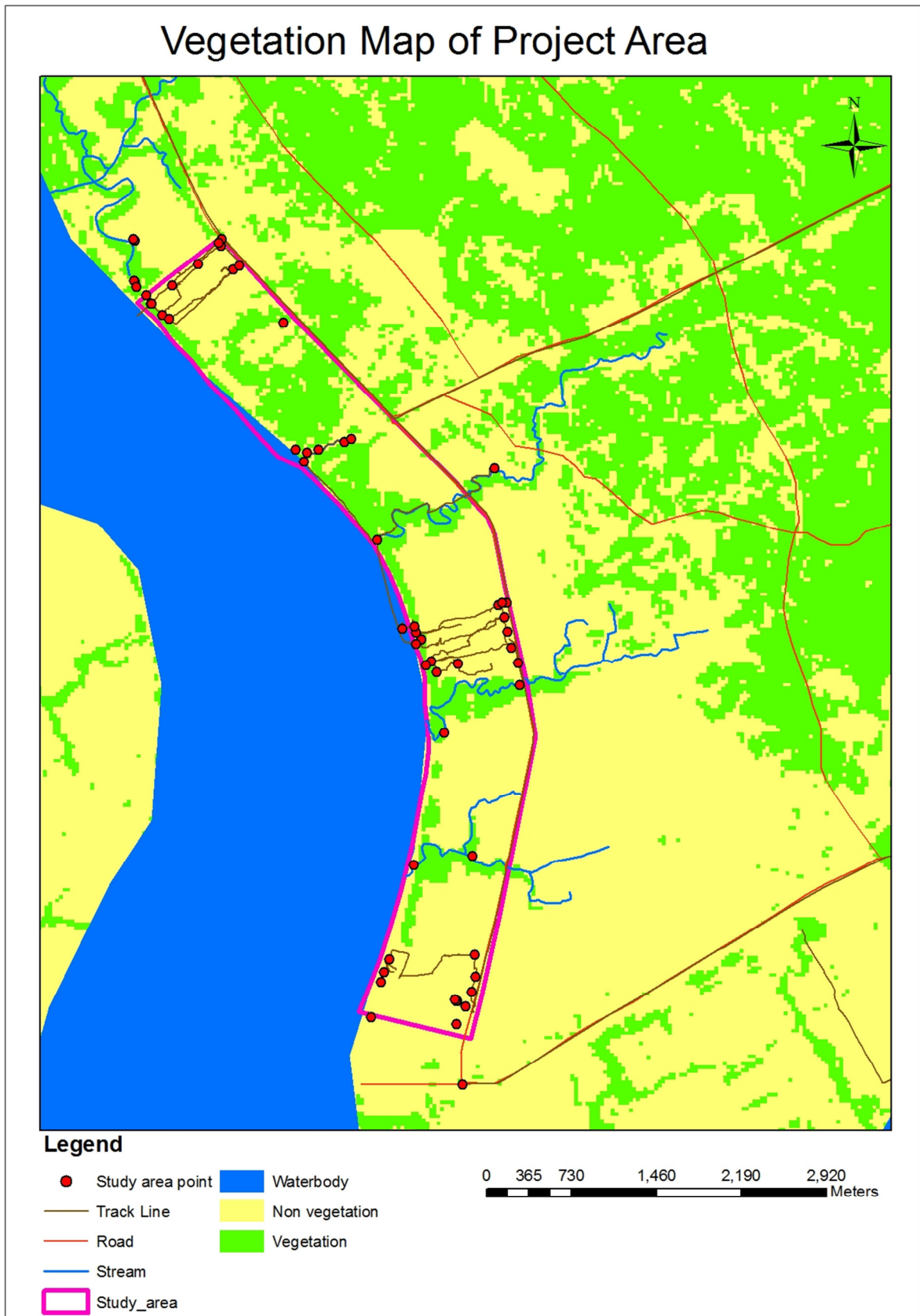
Source-Terrestrial Ecoregions of the Indo-Pacific

Map II





Map III





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Map IV

#### Project Area Mangrove and Mangrove Associated Species Map Using Google Earth



#### Legend

- Study area point
- Mangrove & Mangrove Associated Species

0.4 0.2 0 0.4 0.8 1.2 1.6  
Kilometers