

### Relative Dominance

$$= \frac{\text{basal area of each species}}{\text{total basal area of all species}} \times 100$$

where the *basal area* is defined as the cross sectional area of the stem at breast height (1.30 meters from the ground). For trees with multiple trunks, it is the sum of the basal area at breast height, of all stems.

### Relative Density

$$= \frac{\text{number of individual plant of each species}}{\text{total number of individual plant of all species}} \times 100$$

## (b) Results

Figures 11.3.8 - 11.3.10 shows the plant vegetation maps at the three sites. Tables 11.3.6 - 11.3.11 show the list of flora found therein.

### ① Rainy Season

#### i Site A

Most abundant plants in site A is the para rubber (*Hevea brasiliensis* (Willd. ex A. Juss.) Muell. Arg.), which have been cultivated in a vast area along both northern and southern sides of the existing airport. There are coconut (*Cocos nucifera* Linn.) plantations and a small swampy area covered with various types of grass; the dominant tree species in this swampy zone is the wattle tree (*Acacia auriculaeformis* Cunn.) which appeared to have been cultivated. Along the west coast, there is no significant flora species except some 40 mao trees (*Eugenia grandis* Wight.) near the coast which may be the remainders of beach vegetation in the past. Planted common ironwoods (*Casuarina equisetifolia* J.R. & G. Forst) are also found near the coast.

On the east coast, there is a small area of mangrove, supposedly at least second generation. It was noted that the inner zone (further from the sea) is dominated by kongkaang bailek (*Rhizophora apiculata* Bl.); while nearer to the sea, the more *Sonneratia* spp. and olive mangrove (*Avicennia marina* Vierh.) were dominant. The olive mangrove were found only in the sampling plots adjacent to the sea (see Table 11.3.7 - 11.3.8). Hardly any ground cover was found in this particular mangrove zone.

ii Site B

Almost the whole area in site B is covered by para rubber plantation. This large area of para rubber plantation there are homestead gardens containing various types of fruit-trees such as durian (*Durio zebethinus* Linn.) and champedak (*Artocarpus integar* Meer.). Both eastern and western sides find large areas of post-mined land sparsely covered with secondary vegetation, dominated by wattle (*Acacia auriculaeformis* Cunn.), malabar melastome (*Melastoma malabathricum* Linn.), and chon (*Dicranopteris linearis* Andrew).

iii Site C

There is also a large area of para rubber plantation in site C, especially in the western side. The plantation also has patches of homestead garden containing various types of fruit-trees such as rambutan (*Nephelium lappaceum* Linn.) and durain (*Durio zebethinus* Linn.), etc. In the southwestern side, there is large paddy field and small built-up area.

The southeast coast is covered with reasonably healthy mangrove. It is believed to have been left undisturbed for some time. As compared with site A, mangrove species in site C is much more diversified. *Rhizophora* spp. also dominates this mangrove (see **Table 11.3.11**: Plot C2, C3, C4). It is gathered from the general survey--although not clearly demonstrated from the actual plot data--that there is distinct zonation in mangrove here: nearer to the sea, more *Sonneratia* spp. are found. At the back mangrove, there are lot of *Xylocarpus* spp. and *Excoecaria agallocha* Linn. (see **Table 11.3.11**: Plot C1, C2, C3). There is reasonable amount of ground cover in this mangrove zone such as sea holly (*Acanthus ebracteatus* Vahl.), prong thale (*Acrostichum aureum* Linn.), prong nuu (*A. speciosum* Willd.), lep mue nang (*Aegicerus corniculatum* (L.) Blanco). The mangrove forest in this site has recently been encroached upon to make way for shrimp farms.

② Dry Season

The results of the studies during the two periods were not significantly different, since the plants in this area are perennial plants, not to mention the fact that the two study periods were not significantly different. Essentially, the dry season data only confirmed the rainy season data, rather than representing the different sets of data; the more data, the better statistical representation of the whole. The findings in the dry season site visit are presented in **Table 11.3.8**.

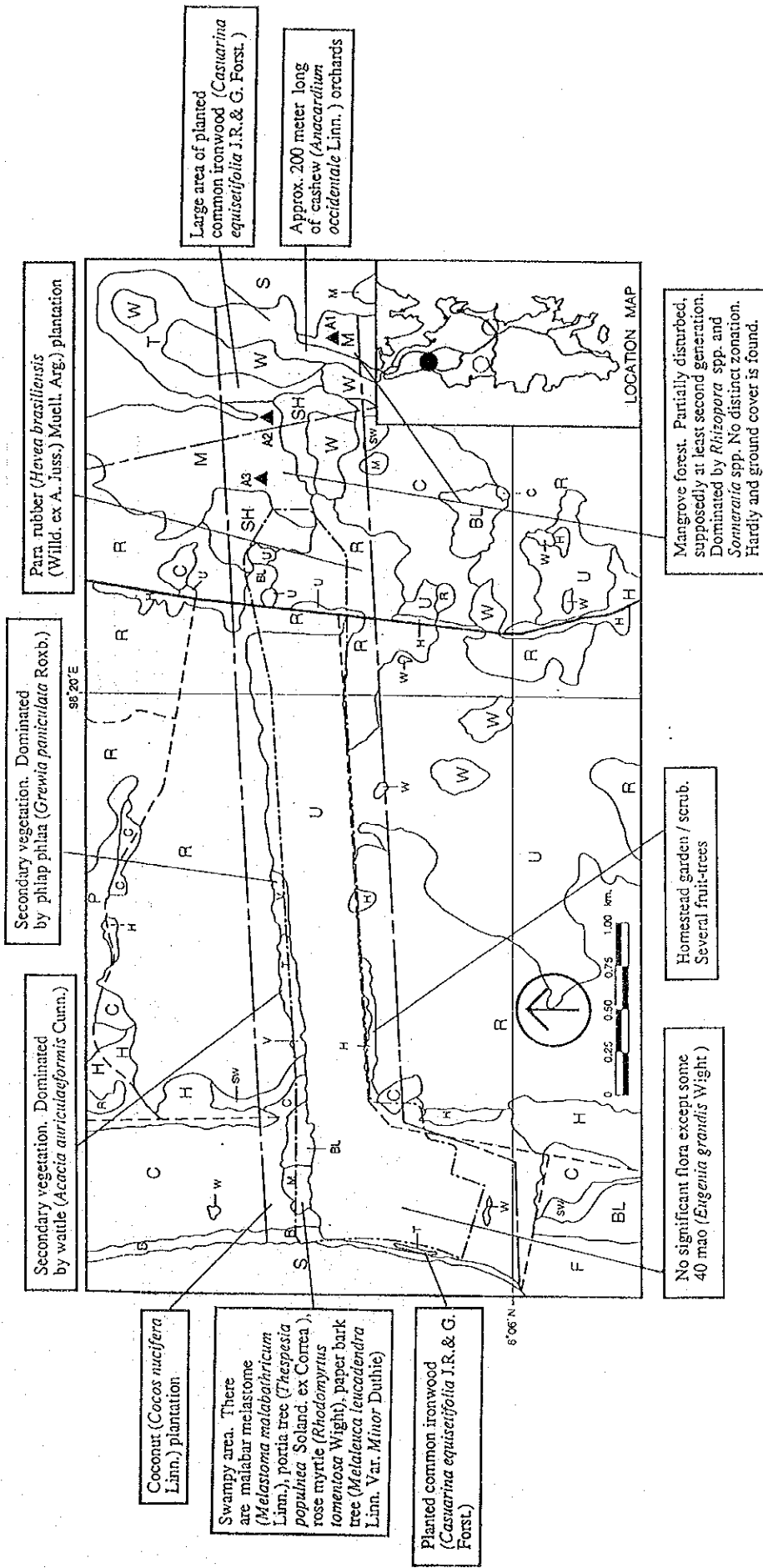


Figure 11.3.8 Vegetation Map at Site A

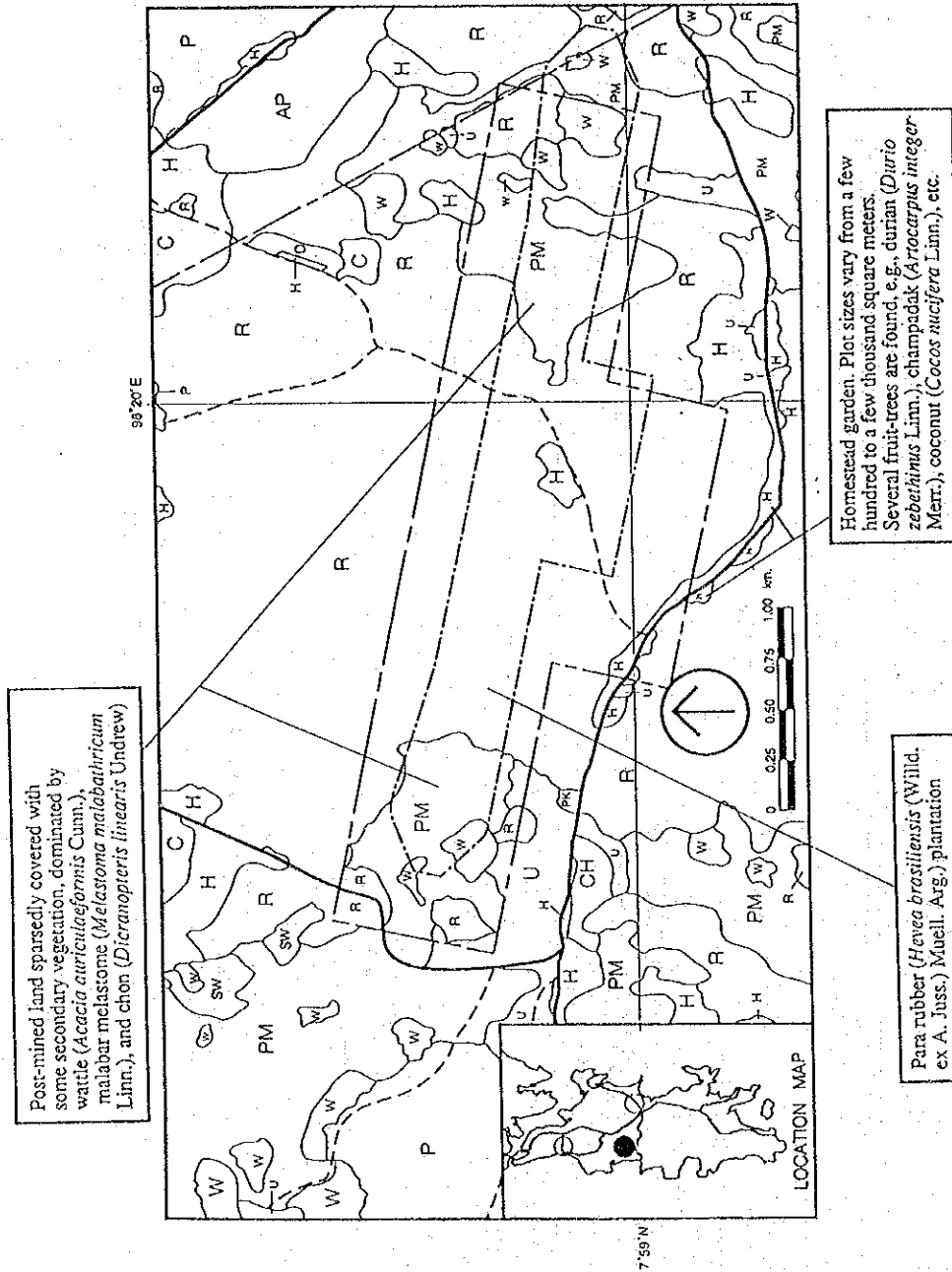


Figure 11.3.9 Vegetation Map at Site B

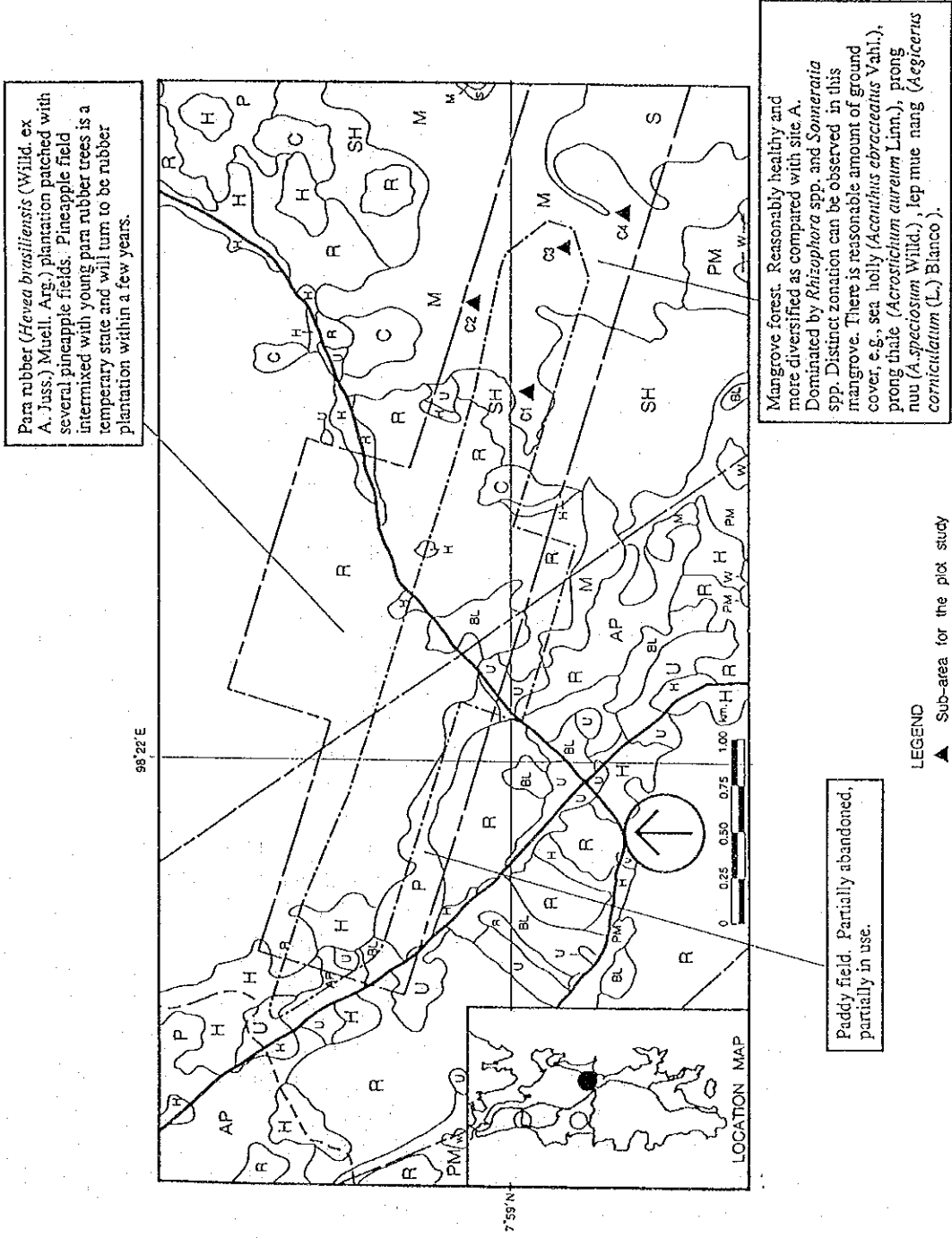


Figure 11.3.10 Vegetation Map at Site C

Table 11.3.6 List of Flora at Site A (General Study)

Scientific name	Common name	Abundance
(1) <i>Acacia auriculaeformis</i> Cunn.	wattle	+++
(2) <i>Anacardium occidentale</i> Linn.	cashew	+++
(3) <i>Ananas comosus</i> Merr.	pineapple	+++
(4) <i>Avicennia marina</i> Vierh.	olive mangrove	+
(5) <i>Borassus flabellifer</i> Linn.	brab palm	++
(6) <i>Cannarus</i> sp.	thop thaep (*)	+++
(7) <i>Cassia alata</i> Linn.	candlebra bush	+++
(8) <i>Casuarina equisetifolia</i> J.R. & G. Forst.	common ironwood	+++
(9) <i>Citrus maxima</i> Merr.	pummelo	+
(10) <i>Cocos nucifera</i> Linn.	coconut	++++
(11) <i>Erythrina variegata</i> Linn.	coral tree	++
(12) <i>Eugenia grandis</i> Wight	mao (*)	++
(13) <i>Excoecaria agallocha</i> Linn.	taatum (*)	++
(14) <i>Grewia paniculata</i> Roxb.	phlap phlaa (*)	+++
(15) <i>Hevea brasiliensis</i> (Willd. ex A. Juss.) Muell. Arg.	para rubber	*****
(16) <i>Licuala</i> sp.	ka pho (*)	++
(17) <i>Lithocarpus</i> sp.	ko (*)	+
(18) <i>Melaleuca leucadendra</i> Linn. Var. <i>Minor</i> Duthie	paper bark tree	++
(19) <i>Melastoma malabathricum</i> Linn.	malabar melastome	+++
(20) <i>Morinda elliptica</i> Ridl.	yo paa (*)	+++
(21) <i>Muntigia calabura</i> Linn.	manila cherry	+++
(22) <i>Musa</i> spp.	banana	+++
(23) <i>Nypa fruticans</i> Wurm.	atap palm	++
(24) <i>Pandanus odoratissimus</i> Linn. f.	lam chiak (*)	++
(25) <i>Parkia speciosa</i> Hassk.	sato (*)	++
(26) <i>Phoenix paludosa</i> Roxb.	mangrove date palm	++
(27) <i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	++++
(28) <i>R. mucronata</i> Poir.	red magrove	+++
(29) <i>Rhodomyrtus tomentosa</i> Wight	rose myrtle	++
(30) <i>Sonneratia alba</i> Smith	lam phaen (*)	++
(31) <i>S. caseolaris</i> Engler	lam phuu (*)	++
(32) <i>Tamarindus indica</i> Linn.	tamarind	++
(33) <i>Terminalia catappa</i> Linn.	bangal almond	++
(34) <i>Thespesia populnea</i> Soland. ex Correa	portia tree	+

Note: (\*) = English names are not available. Flora names are herein given in Thai.

Abundance are categorized as follows:

- \*\*\*\*\* highly abundant (dominant species in the area)
- ++++ very common
- +++ common
- ++ quite rare
- + rare

**Table 11.3.7 List of Flora at Site A  
(Specific Study during the Rainy Season) <sup>⊙</sup>**

Scientific name	Common name	Relative dominance (%)	Relative density (%)
Sub-area A1 (two 10x10 sq.m.)			
(1) <i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	86.0	93.6
(2) <i>R. mucronata</i> Poir.	red mangrove	1.6	3.2
(3) <i>Sonneratia alba</i> Smith	lam phaen (*)	12.4	3.2
Sub-area A2 (two 10x10 sq.m.)			
(1) <i>Avicennia marina</i> Vierh.	olive mangrove	8.1	11.2
(2) <i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	3.2	16.7
(3) <i>R. mucronata</i> Poir.	red mangrove	3.1	16.7
(4) <i>Sonneratia alba</i> Smith	lam phaen (*)	43.3	27.7
(5) <i>S. caseolaris</i> Engler	lam phuu (*)	42.3	27.7
Sub-area A3 (one 25x25 sq.m.)			
(1) <i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	58.9	58.8
(2) <i>R. mucronata</i> Poir.	red mangrove	39.0	38.8
(3) <i>Sonneratia alba</i> Smith	lam phaen (*)	2.1	2.4

Note: ⊙ = Data were collected during late September 1992  
 (\*) = English names are not available. Flora names are herein given in Thai.

**Table 11.3.8** List of Flora at Site A  
(Specific Study during the Dry Season) <sup>⊗</sup>

	Scientific name	Common name	Relative dominance (%)	Relative density (%)
Sub-area A1 (two 10x10 sq.m.)				
(1)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	74.7	69.3
(2)	<i>R. mucronata</i> Poir.	red mangrove	1.5	23.0
(3)	<i>Sonneratia alba</i> Smith	lam phaen (*)	23.8	7.7
Sub-area A2 (two 10x10 sq.m.)				
(1)	<i>Avicennia marina</i> Vierh.	olive mangrove	12.8	9.4
(2)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	43.3	62.4
(3)	<i>R. mucronata</i> Poir.	red mangrove	29.3	18.8
(4)	<i>Sonneratia alba</i> Smith	lam phaen (*)	14.6	9.4
Sub-area A3 (one 25x25 sq.m.)				
(1)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	93.5	88.8
(2)	<i>R. mucronata</i> Poir.	red mangrove	1.8	4.8
(3)	<i>Sonneratia alba</i> Smith	lam phaen (*)	4.7	6.4

Note: ⊗ = Data were collected during late November 1992

(\*) = English names are not available. Flora names are herein given in Thai.  
Study plots in each sub-area are adjacent to those plots in Table 6.



**Table 11.3.9 List of Flora at Site B (General Study)**

	Scientific name	Common name	Abundance
(1)	<i>Acacia auriculaeformis</i> Cunn.	wattle	+++
(2)	<i>Ananas comosus</i> Merr.	pineapple	+++
(3)	<i>Artocarpus altilis</i> Fosberg	saa ke (*)	++
(4)	<i>A. heterophyllus</i> Lamk.	jack fruit tree	+++
(5)	<i>A. integer</i> Merr.	champedak	++
(6)	<i>Areca catchu</i> Linn.	betelnut palm	++
(7)	<i>Borrassus flabelifer</i> Linn.	brab palm	+
(8)	<i>Caesalpinia crista</i> Linn.	grey nickers	+++
(9)	<i>C. digyna</i> Rottler	kamchai (*)	+++
(10)	<i>Citrus maxima</i> Merr.	pummelo	+
(11)	<i>Cocos nucifera</i> Linn.	coconut	++++
(12)	<i>Connarus</i> sp.	thop theap (*)	++
(13)	<i>Dicranopteris linearis</i> Undrew	chon (*)	+++
(14)	<i>Durio zebethinus</i> Linn.	durian	+++
(15)	<i>Garcinia mangostana</i> Linn.	mangosteen	++
(16)	<i>Gmelina arborea</i> Roxb.	so (*)	++
(17)	<i>Grewia paniculata</i> Roxb.	phlap phlaa (*)	++
(18)	<i>Hevea brasiliensis</i> (Willd. ex A. Juss.) Muell. Arg.	para rubber	*****
(19)	<i>Largerstroemia floribunda</i> Jack	tabaek naa (*)	++
(20)	<i>Lycopodium cernuum</i> Linn.	samm roi yod (*)	+++
(21)	<i>Macaranga</i> sp.		+++
(22)	<i>Mangifera indica</i> Linn.	mango tree	++
(23)	<i>Melastoma malabathricum</i> Linn.	malabar melastome	+++
(24)	<i>Morinda elliptica</i> Ridl.	yo paa (*)	++
(25)	<i>Musa</i> spp.	banana	+++
(26)	<i>Nephelium lappaceum</i> Linn.	rambutan	++
(27)	<i>Parkia speciosa</i> Hassk.	saa to (*)	++
(28)	<i>Pandanus odoratissimus</i> Linn. f.	paanae	++
(29)	<i>Salacca rumphii</i> Wall.	rakam (*)	+
(30)	<i>Tamarindus indica</i> Linn.	tamarind	++

Note: (\*) = English names are not available. Flora names are herein given in Thai.

Abundance are categorized as follows:

- \*\*\*\*\* highly abundant (dominant species in the area)
- ++++ very common
- +++ common
- ++ quite rare
- + rare

Table 11.3.10 List of Flora at Site C (General Study)

Scientific name	Common name	abundance
(1) <i>Acanthus ebracteatus</i> Vahl.	sea holly	+++
(2) <i>Acrostichum aureum</i> Linn.	prong thale (*)	+++
(3) <i>A. speciosum</i> Willd.	prong nuu (*)	+
(4) <i>Aegicerus corniculatum</i> (L.) Blanco	lep mue nang (*)	+++
(5) <i>Ananas comosus</i> Merr.	pineapple	+++
(6) <i>Areca catechu</i> Linn.	betelnut plam	+++
(7) <i>Artocarpus altilis</i> Forberg	saa ke (*)	+
(8) <i>A. heterophyllus</i> Lamk.	jackfruit	++
(9) <i>A. integer</i> Merr.	champadak	++
(10) <i>Avecinnia</i> sp.	samae (*)	++
(11) <i>Bauhinia</i> sp.		+++
(12) <i>Borrassus flabelifer</i> Linn.	brab palm	+
(13) <i>Bruquiera cylindrica</i> Bl.	thua khao (*)	+++
(14) <i>Casuarina equisetifolia</i> J.R. & G. Forst.	common iron wood	++
(15) <i>Ceriops tagal</i> C. B. Robinson	prong daeng (*)	+++
(16) <i>Citrus maxima</i> Merr.	pummelo	+
(17) <i>Cocos nucifera</i> Linn.	coconut	+++++
(18) <i>Dipterocarpus alatus</i> Roxb.	yang (*)	+
(19) <i>Durio zebethinus</i> Linn.	durian	++
(20) <i>Eugenia jambos</i> Linn.	rose apple	+++
(21) <i>Excoecaria agallocha</i> Linn.	taatum thale (*)	+++
(22) <i>Grewia paniculata</i> Roxb.	phlap phlaa (*)	+++
(23) <i>Hevea brasiliensis</i> (Willd. ex A. Juss.) Muell. Arg.	para rubber	*****
(24) <i>Lagerstroemia floribunda</i> Jack	tabaek naa (*)	++
(25) <i>Marcaranga</i> sp.		+++
(26) <i>Michelia alba</i> D.C.	white chempaka	+
(27) <i>Morinda elliptica</i> Ridl.	yo paa (*)	+++
(28) <i>Muntigia calabura</i> Linn.	rnanila cherry	+++
(29) <i>Musa</i> spp.	banana	+++
(30) <i>Nephelium leppaceum</i> Linn.	rambutan	+++
(31) <i>Nypa fruticans</i> Wurm.	atap palm	+++
(32) <i>Pandonus odoratissimus</i> Linn. f.	lam chiak (*)	++
(33) <i>Parkia speciosa</i> Hassk.	saa to (*)	+
(34) <i>Phoenix paludosa</i> Roxb.	mangrove date palm	++
(35) <i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	+++++
(36) <i>R. micronata</i> Poir.	red mangrove	+++
(37) <i>Salacca rumphii</i> Wall.	rakam (*)	++
(38) <i>Sandoricum koetiape</i> Merr.	sentul	+
(39) <i>Scoevola taccada</i> Roxb.	rak thale (*)	++
(40) <i>Sonneratia alba</i> Smith	lam phaen (*)	+++

Table 11.3.10 List of Flora at Site C (General Study) (Cont'd)

	Scientific name	Common name	abundance
(41)	<i>Sonneratia alba</i> Smith	lam phaen (*)	++
(42)	<i>S. caseolaris</i> Engler	lam phuu (*)	+++
(43)	<i>Tamarindus indica</i> Linn.	tamarind	++
(44)	<i>Thespesia populnea</i> Soland. ex Correa	portia tree	++
(45)	<i>Xylocarpus granatum</i> Koen.	taa buun (*)	+++
(46)	<i>X. moluccensis</i> Roem.	taa buun dam (*)	+++

Note: (\*) = English names are not available. Flora names are herein given in Thai.

Abundance are categorized as follows:

- \*\*\*\*\* highly abundant (dominant species in the area)
- +++++ very common
- +++ common
- ++ quite rare
- + rare

**Table 11.3.11 List of Flora at Site C  
(Specific Study during the Rainy Season)**

	Scientific name	Common name	Relative Dominance (%)	Relative Density (%)
Sub-area C1 (two 10x10 sq.m.)				
(1)	<i>Excoecaria agallocha</i> Linn.	taatum thale (*)	10.7	6.7
(2)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	4.2	26.7
(3)	<i>R. mucronata</i> Poir.	red mangrove	3.0	13.3
(4)	<i>Xylocarpus granatum</i> Koen.	tabuun (*)	6.8	40.0
(5)	<i>X. moluccensis</i> Roem.	tabuun dam (*)	75.3	13.3
Sub-area C2 (two 10x10 sq.m.)				
(1)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	45.5	74.1
(2)	<i>R. mucronata</i> Poir.	red mangrove	10.7	7.4
(3)	<i>Xylocarpus granatum</i> Koen.	tabuun (*)	6.3	11.1
(4)	<i>X. moluccensis</i> Roem.	tabuun dam (*)	37.5	7.4
Sub-area C3 (two 10x10 sq.m.)				
(1)	<i>Bruquiera cylindrica</i> Bl.	thua khaao (*)	3.9	6.8
(2)	<i>Ceriops tagal</i> C. B. Robinson	prong daeng (*)	19.2	15.0
(3)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	38.8	68.5
(4)	<i>R. mucronata</i> Poir.	red mangrove	13.9	2.8
(5)	<i>Xylocarpus granatum</i> Koen.	tabuun (*)	9.7	2.8
(6)	<i>X. moluccensis</i> Roem.	tabuun dam (*)	14.5	4.1
Sub-area C4 (two 10x10 sq.m.)				
(1)	<i>Bruquiera cylindrica</i> Bl.	thua khaao (*)	16.6	21.1
(2)	<i>Ceriops tagal</i> C.B. Robinson	prong daeng (*)	7.0	26.3
(3)	<i>Rhizophora apiculata</i> Bl.	kongkaang bailek (*)	61.1	42.1
(4)	<i>Sonneratia alba</i> Smith	lam phaen (*)	15.3	10.5

Note: (\*) = English names are not available. Flora names are herein given in Thai.

c. Birds

(a) Methodology

In the rainy season, general studies were conducted at the three sites (A, B, C). The specific study was repeated at site A during the dry season.

① Sampling site selection

The following sub-areas were selected for bird observation (Figure 11.3.11 - 11.3.13).

- Site A
- A1 Rubber plantation including swamp, north of the airport, approx. 80 hectare
  - A2 Rubber plantation on the hill slope, south of the airport, approx. 30 hectare
  - A3 Grassland, east end of the runway, approx. 20 hectare
  - A4 Sandy beach, west end of the runway, approx. 30 hectare
  - A5 Mangrove area including mud-flats, east end of the study area, approx. 30 hectare
- Site B
- B1 Post-mined land, west end of the study area, approx. 80 hectare
  - B2 Rubber plantation at the center of the study area, large part of which are young rubber trees with patches of pineapple fields, approx. 80 hectare
- Site C
- C1 Shrimp farm and mangrove area, approx. 80 hectare
  - C2 Rubber plantation, northwest of the study area, approx. 80 hectare

② General Study

For general study, at least one visit was made to every part of every sub-area and covered all representative samples of habitat. Species of birds were then assigned to one or more habitat types, as described below.

Second growth: new plants (trees and bushes) growing where original plants have been removed, usually following deforestation (A1, A2)

Plantation: primarily rubber and only in some areas there are small patches of fruit trees (A1, A2, B2, C2)

- Pineapple field: patches of pineapple are usually grown inside rubber plantations, creating open-air space (B2, C2)
- Open scrub: cleared areas with mixed species of small woody plants, typical of area within the post-mined land (B1)
- Scrub-grassland: mixed species of small woody plants scattered in cleared areas covered with tall grass (A1, A3, A4, B1)
- Swampy area: open water-logged area, with reeds emerging along the edge (A1)
- Swamp-grassland: water-logged area, with grass, reeds, and small bushes distributed all over the area (B1)
- Mangrove: mangrove tree assemblages (A5, C1)
- Mud-flats: exposed muddy beaches at low tide (A5)
- Sandy beach: sandy beach at west end of the existing runway (A4)
- Open country: open-air environment where birds were seen flying or hovering around (all sub-areas)

Population status in the area was given as *resident* (those that are present in the area all year round and presumed breeding) and *migrant* (those that are absent from the area for at least a few months usually during summer, and present in winter, not breeding).

### ③ Specific Study

Specific study was conducted at sub-areas A1, A3, and A5. Herein, two census procedures were employed: *the interval point counts* and *the instantaneous area counts*. Different procedures were applicable in different habitat types. The relative abundance of the species found in the selected areas were then determined.

#### i Interval point counts

An observer moved along a particular path; paused at regular intervals of 50 meters; surveyed the surrounding area for 15 minutes and recorded the species, number of birds, and distance of birds detected from the observation point. Where the points were not on the straight path, each point was kept 50 meters apart in all directions so that each census area did not overlap. The distance categories were 0-5, 5-10, and 10-25 meters which corresponded to area categories 0-78.5, 78.5-

314.2, and 314.2-1,963.5 square meters, respectively. An attempt was made to avoid counting individual species more than once. Detection was based on sight or sound.

The relative abundance of bird populations in the whole area was approximated for all points based on the detection distances and frequencies.

This procedure was used in the study at sub-area A1.

ii Instantaneous area counts

A stationary observer scanned an area and counted each bird species that were present in the area at a particular instant in time, with an aid of a 20-60 magnification telescope. The scanning was repeated, if necessary. Detection was based on sight only.

The relative abundance of each species was computed as percentage of the total number of birds observed.

This procedure was used in the study at sub-areas A3 and A5.

Relative abundance was estimated as percentage from the total of all bird populations in a particular site and was categorized as abundant (90%-100%), common (65%-89%), moderately common (31%-64%), uncommon (10%-30%), and rare (1%-9%).

The specific study was repeated at site A, following the same procedure, during the rainy season site visit.

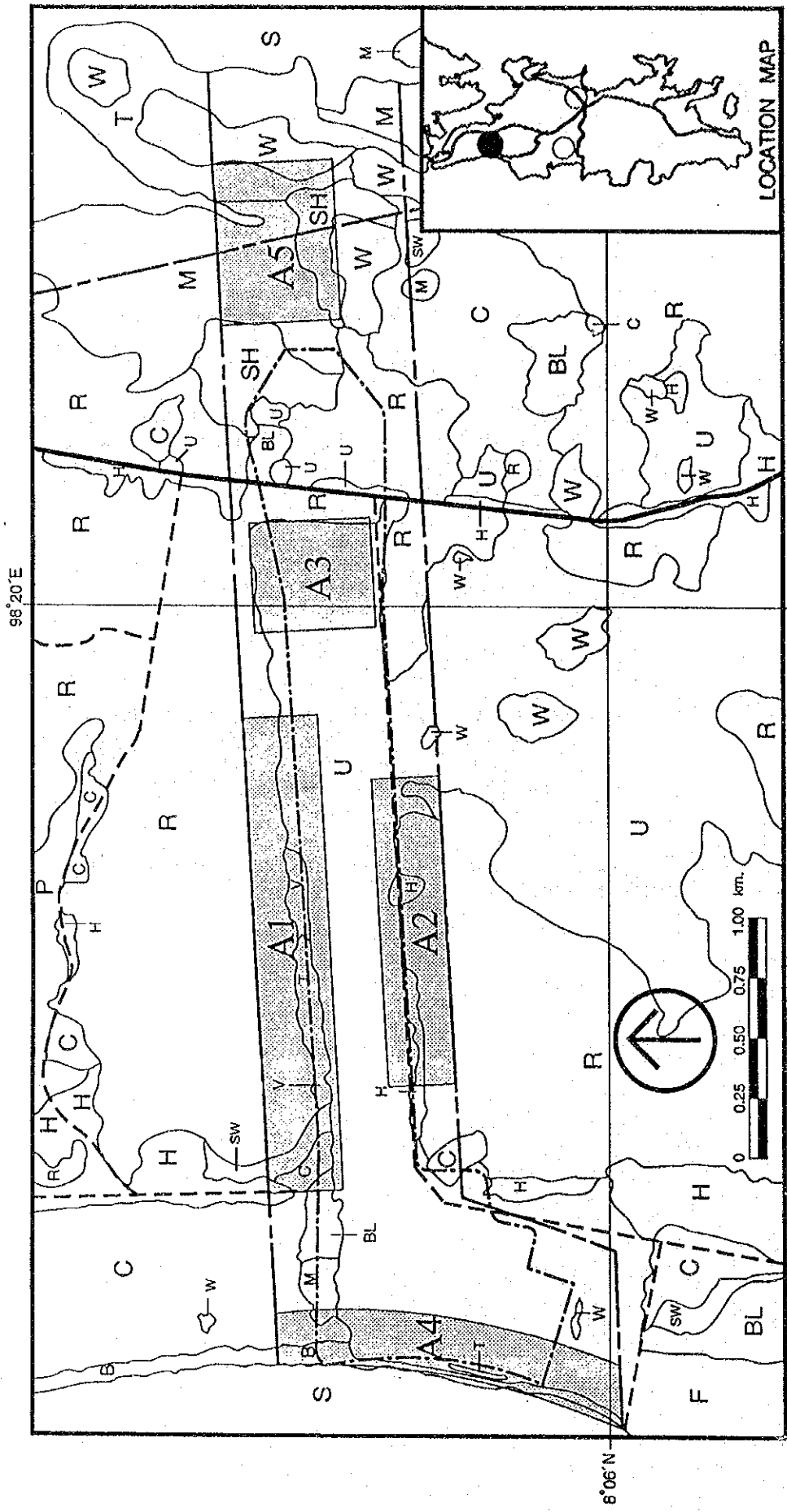
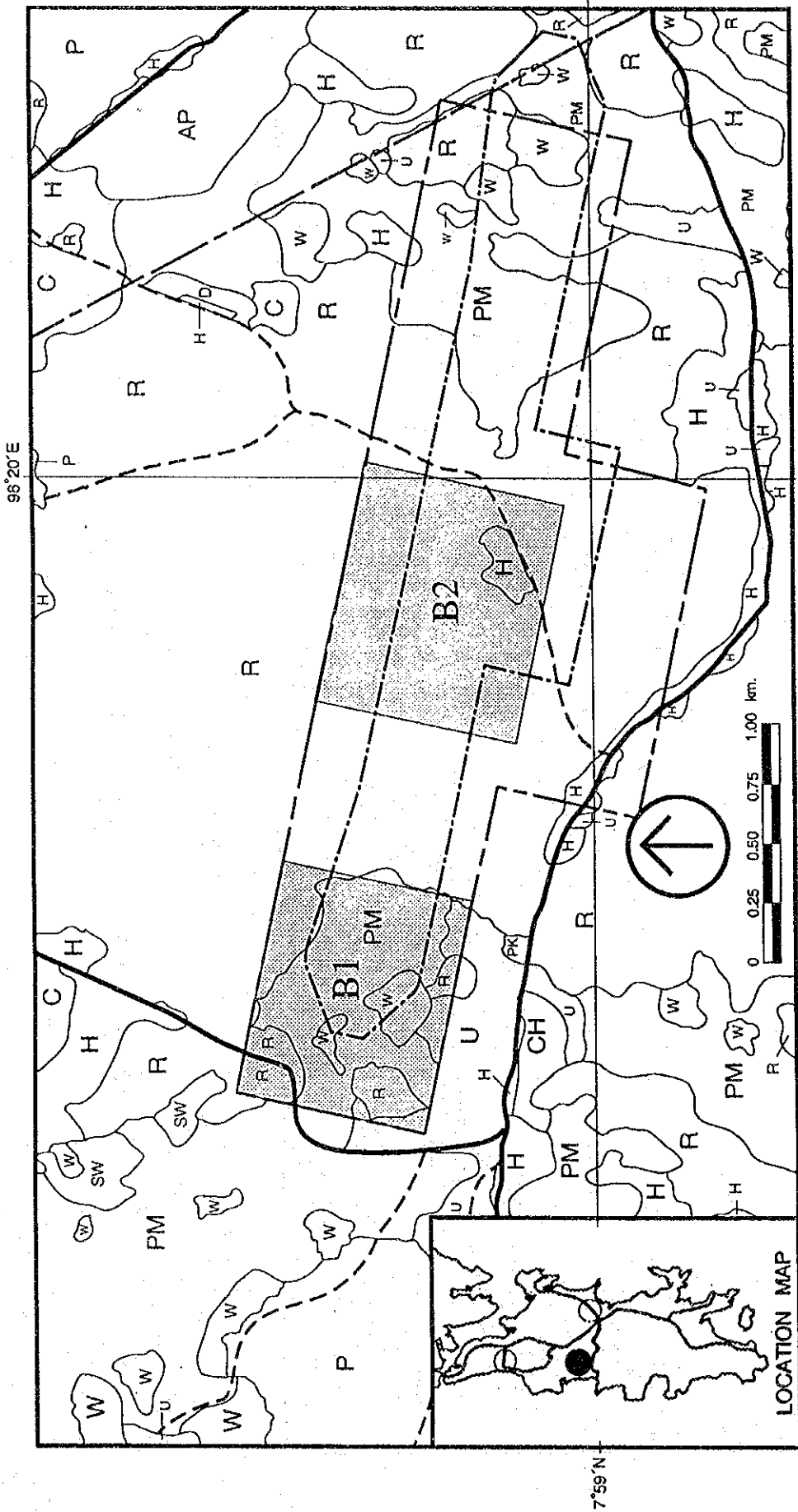


Figure 11.3.11 Sampling Site for Birds at Site A






LEGEND  
 Bird observation site

Figure 11.3.12 Sampling Site for Birds at Site B

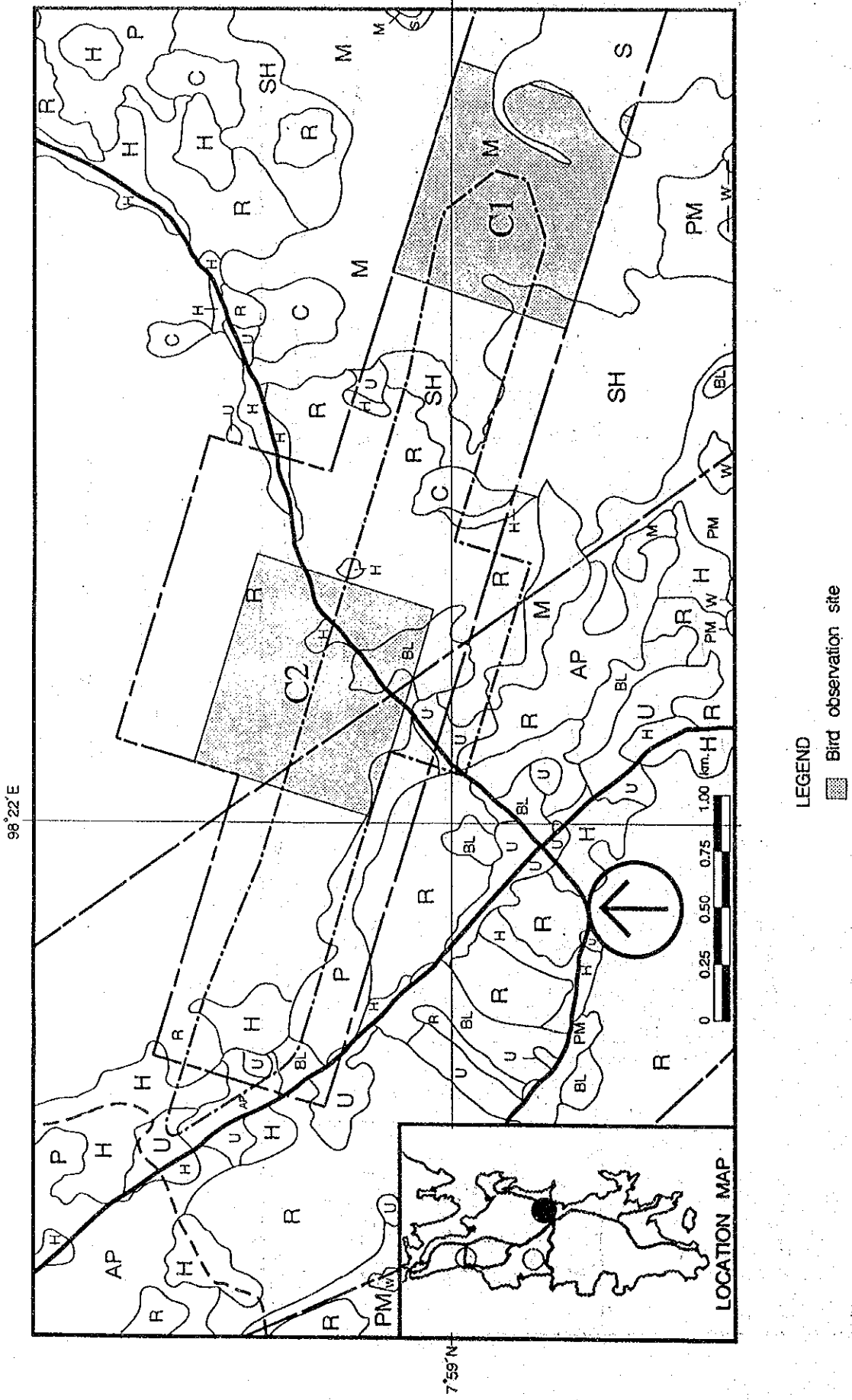


Figure 11.3.13 Sampling Site for Birds at Site C

(b) Results

① Rainy Season

i General Study

List of birds from the three sites are presented in **Table 11.3.12, 11.3.17, 11.3.18**. Common to all sites were the Common Mynas (*Acridotheres tristis*) which are considered semi-urban inhabitants. A large number of the migratory shore-birds feeding on mud-flats were also found (sub-area A5). The Barn Swallows (*Hirundo rustica*) and the Brown Shrikes (*Lanius cristantus*) were also present in most habitats.

ii Specific Study

Relative abundance of bird population in the selected sub-areas (A1, A3, A5) are presented in **Tables 11.3.13 - 11.3.16: Table 11.3.13 - 11.3.15** shows the rainy season data; **Table 11.3.16**, the dry season data.

No species was particularly abundant. Species assemblages were more diversified at sub-area A1 due to various types of habitats covered. The species feeding on mud-flats at low tide were found in sub-area A5.

② Dry Season

The species list and relative abundance of bird population were almost the same as those obtained in the rainy season site visit: very little additional information was obtained. Barn Swallow (*Hirundo rustica*) was slightly higher in number, but remained rare in sub-area A1 and moderately common in sub-area A3.

Three additional species were recorded (**Table 11.3.16**). The Yellow Bitterns (*Ixobrychus sinensis*) and the Barred Cuckoo-Doves (*Macropygia unchall*) were believed to have also been present in the area--A1 and A2, respectively-- during the rainy season site visit, but failed to be recorded because of their very low numbers. The Black Drongos (*Dicrurus macrocercus*) was presumed to have recently moved into site A (A4) from nearby areas.

Table 11.3.12 List of Birds at Site A (General Study)

Common name	Scientific name	Status	Habitat									
			Second-growth	Plantation	Scrub-land	Swamp land	Man-grove	Mud-flat	Sandy beach	Open country		
Purple Heron	<i>Ardea purpurea</i>	R				x						
Little Green Heron	<i>Butorides striatus</i>	R					x					
Javan Pond-Heron	<i>Ardeola speciosa</i>	R				x						
Lesser Treeduck	<i>Dendrocygna javanica</i>	R										
Black-shouldered Kite	<i>Elanus caeruleus</i>	R			x							
Brahminy Kite	<i>Haliastur indus</i>	R			x			x				x
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	R										x
White-browed Crane	<i>Porzana cinerea</i>	R				x						
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	R				x						
Little Buttonquail	<i>Turnix sylvatica</i>	R										
Red-wattled Lapwing	<i>Vanellus indicus</i>	R										
Lesser Golden Plover	<i>Pluvialis dominica</i>	M								x		
Greater Sand-Plover	<i>Charadrius leschenaulti</i>	M								x		
Whimbrel	<i>Numenius phaeopus</i>	M								x		
Common Redshank	<i>Tringa totanus</i>	M								x		
Marsh Sandpiper	<i>Tringa stagnatilis</i>	M								x		
Terek Sandpiper	<i>Xenus cinereus</i>	M								x		
Common Sandpiper	<i>Actitis hypoleucos</i>	M								x		
Orange-breasted Pigeon	<i>Treron bicincta</i>	R	x									
Yellow-footed Pigeon	<i>Treron phoenicoptera</i>	R	x									

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

Table 11.3.12 List of Birds at Site A (General Study) (Cont'd)

Common name	Scientific name	Status	Second-growth	Plantation	Scrub-land	Swamp land	Habitat				
							Man-grove	Mud-flat	Sandy beach	Open country	
Spotted Dove	<i>Streptopelia chinensis</i>	R	x	x	x						
Greater Coucal	<i>Centropus sinensis</i>	R	x	x	x						
Common Kingfisher	<i>Alcedo atthis</i>	R				x					
Blue-eared Kingfisher	<i>Alcedo meninting</i>	R				x					
Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	R			x						
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	R			x						
Black-capped Kingfisher	<i>Halcyon pileata</i>	R			x						
White-collared Kingfisher	<i>Halcyon chloris</i>	R									
Blue-throated Bee-eater	<i>Merops viridis</i>	R	x					x			
Coppersmith Barbet	<i>Megalaima haemacephala</i>	R	x	x							
Common Goldenback	<i>Dinopium javanense</i>	R		x							
Woodpecker											
Barn Swallow	<i>Hirundo rustica</i>	M								x	
Pacific Swallow	<i>Hirundo tahitica</i>	M								x	
Common Iora	<i>Aegithina tiphia</i>	R	x	x				x			
Great Iora	<i>Aegithina lafresnayei</i>	R	x	x				x			
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	R	x	x				x			
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	R	x	x				x			
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	R	x	x				x			
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	R	x	x				x			
Red-eyed Bulbul	<i>Pycnonotus bruneus</i>	R	x	x				x			
Black-naped Oriole	<i>Oriolus chinensis</i>	R	x								

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

Table 11.3.12 List of Birds at Site A (General Study) (Cont'd)

Common name	Scientific name	Status	Habitat							
			Second-growth	Plantation	Scrub-land	Swamp	Man-grove	Mud-flat	Sandy beach	Open country
Large-billed Crow	<i>Corvus macrorhynchos</i>	R		x	x			x		
Striped Tit-Babbler	<i>Macronous gularis</i>	R	x	x						
Magpie Robin	<i>Copsychus saularis</i>	R		x	x			x		
Eastern Crowned Warbler	<i>Phylloscopus coronatus</i>	M			x					
Common Tailorbird	<i>Orthotomus sutorius</i>	R			x					
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	R			x					
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	R			x					
Pied Fantail	<i>Rhipidura javanica</i>	R	x					x		
Yellow Wagtail	<i>Monticilla flava</i>	M							x	
Richard's Pipit	<i>Anthus novaeseelandiae</i>	R			x					
Brown Shrike	<i>Lanius cristatus</i>	M		x	x					
Common Myna	<i>Acridotheres tristis</i>	R		x	x					
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	R	x	x	x			x		
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	R		x	x					
Oriental White-Eye	<i>Zosterops palpebrosa</i>	R		x					x	
Scaly-breasted Munia	<i>Lonchura punctulata</i>	R								x

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

**Table 11.3.13 List of Bird at Sub-area A1  
(Specific Study during the Rainy Season)**

Common name	Scientific name	Proportion(*) in whole bird assemblage %	Relative abundance
Purple Heron	<i>Ardea purpurea</i>	<1	rare
Javan Pond-Heron	<i>Ardeola speciosa</i>	1	rare
Lesser Treeduck	<i>Dendrocygna javanica</i>	1	rare
White-browed Crake	<i>Porzana cinerea</i>	2	rare
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	2	rare
Little Buttonquail	<i>Turnix sylvatica</i>	1	rare
Red-wattled Lapwing	<i>Vanellus indicus</i>	1	rare
Orange-breasted Pigeon	<i>Treron bicincta</i>	1	rare
Yellow-footed Pigeon	<i>Treron phoenicoptera</i>	<1	rare
Spotted Dove	<i>Streptopelia chinensis</i>	5	rare
Greater Coucal	<i>Centropus sinensis</i>	2	rare
Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	<1	rare
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	1	rare
Black-capped Kingfisher	<i>Halcyon pileata</i>	1	rare
Blue-throated Bee-eater	<i>Merops viridis</i>	2	rare
Barn Swallow	<i>Hirundo rustica</i>	<1	rare
Common Iora	<i>Aegithina tiphia</i>	5	rare
Great Iora	<i>Aegithina lafresnayeii</i>	2	rare
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	5	rare
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	6	rare
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	5	rare
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	6	rare
Large-billed Crow	<i>Corvus macrorhynchos</i>	1	rare
Magpie Robin	<i>Copsychus saularis</i>	2	rare
Eastern Crowned Warbler	<i>Phylloscopus coronatus</i>	2	rare
Common Tailorbird	<i>Orthotomus sutorius</i>	5	rare
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	6	rare
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	2	rare
Pied Fantail	<i>Rhipidura javanica</i>	2	rare
Richard's Pipit	<i>Anthus novaeseelandiae</i>	2	rare
Brown Shrike	<i>Lanius cristatus</i>	2	rare
Common Myna	<i>Acridotheres tristis</i>	5	rare
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	5	rare
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	2	rare
Oriental White-Eye	<i>Zosterops palpebrosa</i>	2	rare
Scaly-breasted Munia	<i>Lonchura punctulata</i>	5	rare

Note: (\*) approximate total density = 408 individuals per hectare

**Table 11.3.14 List of Birds at Sub-area A3  
(Specific Study during the Rainy Season)**

Common name	Scientific name	No. of birds observed	Relative Abundance
Spotted Dove	<i>Streptopelia chinensis</i>	2	rare
Greater Coucal	<i>Centropus sinensis</i>	2	rare
Barn Swallow	<i>Hirundo rustica</i>	10	uncommon
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	2	rare
Common Tailorbird	<i>Orthotomus sutorius</i>	4	rare
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	5	rare
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	2	rare
Richard's Pipit	<i>Anthus novaeseelandiae</i>	4	rare
Brown Shrike	<i>Lanius cristatus</i>	2	rare
Common Myna	<i>Acridotheres tristis</i>	4	rare
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	2	rare
Scaly-breasted Munia	<i>Lonchura punctulata</i>	4	rare

**Table 11.3.15 List of Birds at Sub-area A5  
(Specific Study during the Rainy Season)**

Common name	Scientific name	Relative abundance	
Little Green Heron	<i>Butorides striatus</i>	x	R
Lesser Golden Plover	<i>Pluvialis dominica</i>	xx	R
Greater Sand-Plover	<i>Charadrius leschenaulti</i>	xxxxxx	UC
Whimbrel	<i>Numenius phaeopus</i>	x	R
Common Redshank	<i>Tringa totanus</i>	xx	R
Marsh Sandpiper	<i>Tringa stagnatilis</i>	xx	R
Terek Sandpiper	<i>Xenus cinereus</i>	xx	R
Common Sandpiper	<i>Actitis hypoleucos</i>	xxxxxxxxxx	MC
Yellow Wagtail	<i>Motacilla flava</i>	x	R

Note: x denotes 50 individuals or less  
 MC = moderately common  
 UC = uncommon  
 R = rare



Table 11.3.16 Additional Birds found at Site A during the Dry Season

Common name	Scientific name	Status	Habitat							
			Second-growth	Plantation	Scrub-land	Swamp	Man-grove	Mud-flat	Sandy beach	Open country
Yellow Bittern (A1)	<i>Ixobrychus sinensis</i>	R				x				
Barréd Cuckoo-Dove (A2)	<i>Macropygia unchall</i>	R	x							
Black Drongo (A4)	<i>Dicrurus macrocercus</i>	R			x					

Note: (1) M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.  
 (2) Letters in parentheses denote sub-areas where each species was found.  
 (3) Relative abundance of the Yellow Bittern is assessed as "rare".

Table 11.3.17 List of Birds at Site B (General Study)

Common name	Scientific name	Status	Habitat					
			Planta- tion	Pineapple field	Scrub- glassland	Open scrub	Swamp grassland	Open country
Little Green Heron	<i>Butorides striatus</i>	R					x	
Javan Pond-Heron	<i>Ardeola speciosa</i>	R					x	
Lesser Treeduck	<i>Dendrocygna javanica</i>	R					x	
Black-shouldered Kite	<i>Elanus caeruleus</i>	R			x		x	
Brahminy Kite	<i>Haliastur indus</i>	R			x		x	x
White-browed Crane	<i>Porzana cinerea</i>	R					x	
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	R					x	
Little Buttonquail	<i>Turnix sylvatica</i>	R			x			
Red-wattled Lapwing	<i>Vanellus indicus</i>	R					x	
Orange-breasted Pigeon	<i>Treeron bicincta</i>	R					x	
Spotted Dove	<i>Streptopelia chinensis</i>	R	x				x	
Greater Coucal	<i>Centropus sinensis</i>	R	x					
Swiftlet	<i>Collocalia</i> spp.	R						x
White-rumped Swift	<i>Apus pacificus</i>	M						x
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	R					x	
Black-capped Kingfisher	<i>Halcyon pileata</i>	R						x
Blue-tailed Bee-eater	<i>Merops viridis</i>	R					x	
Coppersmith Barbet	<i>Megalaima haemacephala</i>	R	x					

Note: M = presumed migrant or winter visitor, R = presumed resident; x = present in particular habitat.

Table 11.3.17 List of Birds at Site B (General Study) (Cont'd)

Common name	Scientific name	Status	Habitat						
			Planta- tion	Pineapple field	Scrub- glassland	Open scrub	Swamp grassland	Open country	
Barn Swallow	<i>Hirundo rustica</i>	M							x
Common Iora	<i>Aegithina tiphia</i>	R	x		x				
Black-headed Bulbul	<i>Merops philippinus</i>	R	x						
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	R			x				
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	R	x		x				
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	R	x		x				
Lesser Racket-tailed Drongo	<i>Dicrurus remifer</i>	R	x						
Black-naped Oriole	<i>Oriolus chinensis</i>	R	x						
Large-billed Crow	<i>Corvus macrorhynchos</i>	R	x		x				x
Magpie Robin	<i>Copsychus saularis</i>	R	x		x				
Eastern Crowned Warbler	<i>Phylloscopus coronatus</i>	M	x		x				
Common Tailorbird	<i>Orthotomus sutorius</i>	R	x		x				
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	R			x				x
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	R			x				
Pied Fantail	<i>Rhipidura javanica</i>	R	x						
Richard's Pipit	<i>Anthus novaeseelandiae</i>	R			x				
Brown Shrike	<i>Lanius cristatus</i>	M	x	x	x				x
Common Myna	<i>Acridotheres tristis</i>	R	x	x	x				x
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	R	x		x				
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	R	x		x				x
Plain-backed Sparrow	<i>Passer flaveolus</i>	R			x				x
House Sparrow	<i>Passer domesticus</i>	R			x				x
Scaly-breasted Munia	<i>Lonchura punctulata</i>	R		x	x				x

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

Table 11.3.18 List of Birds at Site C (General Study)

Common name	Scientific name	Status	Habitat				
			Plantation	Pineapple field	Shrimp farm	Mangrove	Open country
Little Green Heron	<i>Butorides striatus</i>	R				x	
Black-shouldered Kite	<i>Elanus caeruleus</i>	R					x
Brahminy Kite	<i>Haliastur indus</i>	R					x
Red-wattled Lapwing	<i>Vanellus indicus</i>	R			x		
Common Sandpiper	<i>Actitis hypoleucos</i>	M			x		
Spotted Dove	<i>Streptopelia chinensis</i>	R	x				
Greater Coucal	<i>Centropus sinensis</i>	R	x				
Common Kingfisher	<i>Alcedo atthis</i>	R				x	
Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	R				x	
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	R				x	
Black-capped Kingfisher	<i>Halcyon pileata</i>	R				x	
White-collared Kingfisher	<i>Halcyon chloris</i>	R				x	
Blue-tailed Bee-eater	<i>Merops philippinus</i>	R				x	
Coppersmith Barbet	<i>Megalaima haemacephala</i>	R	x				
Barn Swallow	<i>Hirundo rustica</i>	M					x
Common Iora	<i>Aegithina tiphia</i>	R	x				
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	R	x				
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	R	x				
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	R	x				
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	R	x				
Large-billed Crow	<i>Corvus macrorhynchos</i>	R	x				x
Striped Tit-Babbler	<i>Macronous gularis</i>	R	x				

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

Table 11.3.18 List of Birds at Site C (General Study) (Cont'd)

Common name	Scientific name	Status	Habitat					
			Plantation	Pineapple field	Shrimp farm	Mangrove	Open country	
Magpie Robin	<i>Copsychus saularis</i>	R	x				x	
Common Tailorbird	<i>Orthotomus sutorius</i>	R		x			x	
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	R		x			x	
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	R		x				
Pied Fantail	<i>Rhipidura javanica</i>	R	x					x
Yellow Wagtail	<i>Motacilla flava</i>	M				x		
Forest Wagtail	<i>Dendronanthus indicus</i>	M	x					
Richard's Pipit	<i>Anthus novaeseelandiae</i>	R		x				
Brown Shrike	<i>Lanius cristatus</i>	M	x					
Common Myna	<i>Acridotheres tristis</i>	R	x					x
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	R	x					x
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	R	x					x
Oriental White-Eye	<i>Zosterops palpebrosa</i>	R	x					
Scaly-breasted Munia	<i>Lonchura punctulata</i>	R					x	

Note: M = presumed migrant or winter visitor; R = presumed resident; x = present in particular habitat.

d. Fish & Benthic Fauna

(a) Methodology

The marine ecological survey was conducted only at Site A, by means of sampling, observation through snorkeling, observation at fishing boats and interviews. Snorkeling was performed only in the dry period. Other missions were conducted twice, once in the rainy season and another in the dry season.

① Sampling Stations

**Figure 11.3.14** displays the study area for the marine ecology which lies along the coast at the western end of the airport at Site A, and extends approximately 1 kilometer into the sea. Fish and benthic fauna samples were collected at three sampling stations, at approximately 500 meters intervals; all three stations were approximately 500 meters from the coast.

② Sampling Procedure & Species Identification

i Fish

Fish was caught at three sampling stations with an encircling gill net of 2 x 2 centimeters mesh size. The net was 210 meters long and 16 meters deep. Fish catching time was 30 minutes at each station. The fish caught was fixed and preserved with 10% formalin.

Fish species were identified in accordance with the methods developed by Day, 1878; Smith, 1965; Munro, 1967; Fischer and Whitened, 1974; and Nelson, 1984.

ii Benthic Fauna

The benthic fauna samples were collected at three sampling stations with a modified van Veen grab. The grabbing area was 0.05 square meters. At each sampling station, the samples were collected in 4 replicates. Samples were filtered through a sieve of 1 millimeter mesh size to remove fine sediment. The benthic fauna was then fixed and preserved with 10% formalin, and colored with Rose Bengal.

Benthic fauna species were identified in accordance with the methods developed by Day, 1967; Clark and Rowe, 1971; Fauchald, 1977; and Barnes, 1980.

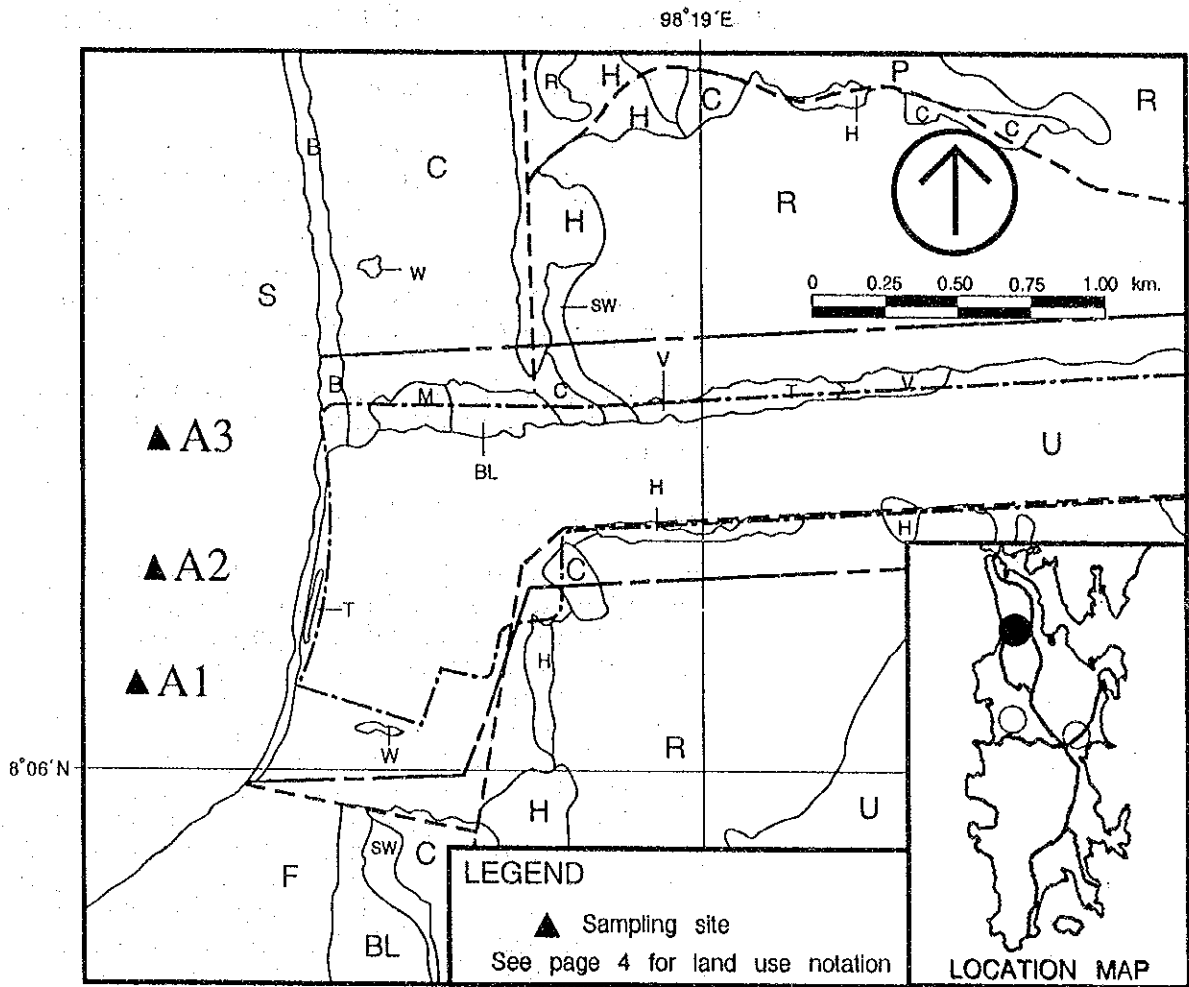


Figure 11.3.14 Sampling Stations for Fish and Benthic Fauna at Site A

(b) Results

① Fish

**Table 11.3.19** shows a list of fishes which have been present, or are believed to be present, in the study area. The list--as many as 146 species-- has been compiled as results of (1) sampling by the study team during the field reconnaissance; (2) observation through snorkeling; (3) observation at fishing boats and (4) interviewing fishermen.

i. Sampling by the Study Team

Ten and eight fish species were caught by the study team during the two reconnaissance studies in the rainy season and the dry season, respectively (**Table 11.3.19**). All fishes caught by the study team were pelagic fishes, most of which belonged to the Leiognathidae family. The species compositions of fish samples caught during the two seasons were not significantly different.

Fish catch from the sampling, however, comprised very few species as compared with those obtained by other means.

ii. Observation through Snorkeling

Forty-eight fish species were observed by the investigator snorkeling around the coral reef at the south side of the study area, during the dry season site visit (see **Table 11.3.19**).

iii. Observation at fishing boats

Fifty-seven fish species were identified by observing the fishing boats when they ran ashore. These fishing boats operated in the vicinities, mainly around the coral reef. **Photo 11.3.1** displays some of the fishes observed at the fishing boats during the study teams field visits. They are coastal fishes which live within a few kilometers from the coast.

iv. Interviewing Fishermen

The study team interviewed 15 fishermen within the area (there were about 25 fishermen that fish around this area). The fishermen generally employ either encircling gill net, bottom gill net or fish-hooks for catching fish. Fish catching is generally operated approximately 6 months within the year. During this period, two trips were made daily: 04:00 - 08:00 and 16:00 - 20:00 hours. Average fish catch per trip was 30 kilograms.

The study showed that, during the monsoon, fish catch was highly unpredictable. Fishermen (who have no



secondary occupation) some times had to wait for weeks only to find a lucky day when they could catch several hundred kilograms of fish within a few hours' trip, near the coast. It was not merely because of storm that prevented them from catching fish, but rather, because of unpredictable arrival of fish. Fish catch was generally more near the coral southwards of the study area. Thirty-five fish species were identified from the interview results.

② Benthic Fauna

**Table 11.3.20** displays a list of benthic fauna collected during the field surveys in both the rainy season and the dry season: a compilation of 34 groups of organisms. There were no significant difference in densities and composition between the benthic fauna collected in the two seasons. On the average, 767 individuals per square meter was present in the rainy season: and 698 in the dry season.

The benthic fauna which were most often found, and found in very high densities, was Gammaridean amphipoda: 345 individuals per square meter was found in the rainy season; and 248 in the dry season. Next in order was Spionid polychaete: 42 and 138 in the rainy season and the dry season, respectively. These two groups of organisms, especially the latter, were capable of burying themselves in the sand thus able to prevent themselves from external threats including storms.

③ Other Marine Biota

It was gathered from the interview survey that fish catch often included Spiny lobster and Cuttle fish, both of which were highly priced commodities.

It was also noted that when gill nets were employed, Green turtles were often caught. The coast in the study area has been known to be the nesting ground for Green turtles and Leathery turtles. They usually lay eggs twice a year: once during February, another between October and December. Five turtle nests were observed during the field visit in October 1992. Both Green turtles and Leathery turtles are registered by the International Union for Conservation of Nature and Natural Resources (IUCN) as endangered species.

Table 11.3.19 List of Fish at Site A

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
<b>ACANTHURIDAE</b>										
<i>Acanthurus grammoptilus</i> Richardson, 1843	Ring-tailed surgeon fish							★		
A. spp.	Surgeon fish									★
<i>Ctenochaetus strigosus</i> (Bennett)	Slender-toothed surgeon fish							★		
<b>APOGONIDAE</b>										
<i>Apogon novemfasciatus</i> Cuvier, 1828	Seven-striped cardinal fish							★		
A. spp.	Cardinal fish									★
<i>Cheilodipterus quinquelineata</i> (Cuvier, 1828)	Five-lined cardinal fish							★		
<b>ARIIDAE</b>										
<i>Arius thalassinus</i> (Ruppell, 1837)	Giant salmon catfish									★
<b>BELONIDAE</b>										
<i>Strongylura incisa</i> (Valenciennes, 1846)	Reef needle fish								★	
S. spp.	Needle fish									★
<i>Tylosurus crocodilis crocodili</i> (Lesueur, 1821)	Crocodile needle fish				★		★			
T. spp.	Needle fish									★
<b>BLENNIIDAE</b>										
<i>Istiblennius lineatus</i>	Lined rockskipper							★		
<i>I. periophthalmus</i> (Valenciennes)	Blue-dashed rockskipper							★		
<i>Selarias fasciatus</i>	Jeweled blenny							★		
<b>BOTHIDAE</b>										
<i>Pseudorhombus duplucicellatus</i> Regan, 1905	Three twin-spot flounder								★	
<b>CAESIONIDAE</b>										
<i>Caesio caeruleus</i> Lacepede, 1802	Blue & gold fusilier							★		
C. spp.	Yellow-tailed caesio									★
<i>Pterocaesio lunaris</i> Cuvier, 1830	Lunar fusilier							★		
<b>CARANGIDAE</b>										
<i>Alepes</i> sp.	Small-mouthed scad								★	
<i>Atule mate</i> (Cuvier, 1833)	Yellow-tailed scad								★	
<i>Carangoides armatus</i> (Ruppell, 1830)	Long finned trevally								★	
<i>C. malabaricus</i> (Bloch & Schneider, 1801)	Trevally		★							
C. spp.	Trevally									★
<i>Caranx sexfasciatus</i> Quoy & Gaimard, 1824	Big-eyed trevally								★	

Table 11.3.19 List of Fish at Site A (Cont'd)

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
<b>CARANGIDAE (cont'd)</b>										
<i>Caranx</i> spp.	Scad									★
<i>Elagatis bipinnulata</i> (Quoy & Gaimard, 1824)	Rainbow-runner									★
<i>Megalaspis cordyla</i> (Linn., 1758)	Finny scad									★
<i>Scomberoides tol</i> (Cuvier, 1831)	Needle-scaled queen fish									★
<i>S.</i> spp.	Queen fish									★
<i>Selaroides leptolepis</i> (Cuvier, 1833)	Yellow-striped trevally						★			★
<i>Seriolina nigrofasciata</i> (Ruppell, 1828)	Black-banded kingfish									★
<b>CARCHARHINIDAE</b>										
<i>Carcharhinus dussumieri</i> (Muller & Henle, 1841)	Wide-mouthed black spot shark									★
<i>C.</i> spp.	Black-finned gray shark									★
<b>CHAETODONTIDAE</b>										
<i>Chaetodon auriga</i> Forsskal, 1775	Thread fin butterfly fish							★		
<i>C. barronense</i> Cuvier, 1831	Eastern triangular butterfly fish							★		
<i>C. collaris</i> Day	White-collared butterfly fish							★		
<i>C. lineolatus</i> Cuvier, 1831	Lined butterfly fish							★		
<i>C. vagabundus</i> Linn., 1758	Vagabond butterfly fish							★		
<i>C.</i> spp.	Butterfly fish									★
<b>CHIROCENTRIDAE</b>										
<i>Chirocentrus dorab</i> (Forsskal, 1775)	Wolf-herring									★
<b>CLUPEIDAE</b>										
<i>Clupeoides</i> spp.	White sardine									★
<i>Dussumieria acuta</i> Valenciennes	Rainbow sardine									★
<i>Ilisha</i> spp.	Long-tailed herring									★
<i>Sardinella gibbosa</i> (Bleeker, 1849)	Gold-striped sardine									★
<i>S.</i> spp.	Sardine, shad, herring									★
<b>CYNOGLOSSIDAE</b>										
<i>Cynoglossus cynoglossus</i> (Ham-Butch, 1882)	Long tongue-sole									★
<i>C.</i> spp.	Tongue-sole									★
<b>DASYATIDIDAE</b>										
<i>Dasyatis kuhlii</i> (Muller & Henle, 1841)	Blue-spotted string ray									★
<i>Taeniura melanospilos</i> Bleeker, 1853	Black-spotted string ray									★

Table 11.3.19 List of Fish at Site A (Cont'd)

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
<b>ECHENEIDIDAE</b> <i>Echeneis naucrates</i> Linn., 1758	Shark sucker								★	
<b>ENGRAULIDAE</b> <i>Stolephorus indicus</i> (van Hasselt, 1823)	Indian anchovy	★								★
<b>EPHIPPIDAE</b> <i>Platax teira</i> (Forsskal, 1775)	Long-finned spadefish								★	
<b>GERREIDAE</b> <i>Pentaprion longimanus</i> (Cantor, 1849)	Long-finned silver-biddy							★		
<b>GOBIIDAE</b> <i>Cryptocentrus cinctus</i> (Herre, 1936)	Banded prawn-goby							★		
<i>C. singaporensis</i> (Harre, 1936)	Singapore prawn-goby							★		
<i>Gobiodon albofasciatus</i> Sawada & Arai, 1972	Whitelined coral goby							★		
<i>Istigobius decoratus</i> (Herre, 1927)	Decorated goby							★		
<i>Ptereleotris</i> spp.	Dartfish							★		
<b>HAEMULIDAE</b> <i>Diagramma pictum</i> (Thunberg, 1792)	Painted sweetlip								★	
<i>Pomadyus striatus</i> (Ghenrist & Thompson)	Striped sweetlip								★	
<b>HOLOCENTRIDAE</b> <i>Sargocentron melanospilos</i> (Bleeker, 1858)	Black-spotted squirrelfish								★	
<b>LABRIDAE</b> <i>Anampses caeruleopunctatus</i> Ruppell, 1828	Blue-spotted wrasse							★		
<i>Cheilinus chlorourus</i> (Bloch, 1791)	Floral wrasse							★		
<i>C. digrammus</i> (Lacepede, 1801)	Bandcheek wrasse							★		
<i>Choerodon vitta</i> Ogilby, 1910	Red-spot tuskfish							★		
<i>Helichoeres scapularis</i> (Bennett, 1831)	Zigzag wrasse							★		
<i>H. sp.</i>	Wrasse							★		
<i>Labroides dimidiatus</i> (Valenciennes, 1839)	Bluestreak cleaner wrasse							★		
<i>Thalassoma amblycephalum</i> (Bleeker, 1856)	Twotone wrasse							★		
<i>T. lurare</i> (Linn., 1758)	Crescent wrasse							★		
<i>T. lutescens</i> (Lay & Bennett, 1839)	Sunset wrasse							★		

Table 11.3.19 List of Fish at Site A (Cont'd)

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
<b>LACTARIIDAE</b>										
<i>Lactarius lactarius</i> (Bloch & Schneider, 1801)	White fish									★
<b>LEIOGNATHIDAE</b>										
<i>Gazza minuta</i> (Bloch, 1797)	Toothed ponyfish			★					★	
<i>Leiognathus elongatus</i> (Gunther, 1874)	Elongated ponyfish			★						
<i>L. equulus</i> (Forsskal, 1775)	Narrow-banded ponyfish								★	
<i>L. leuciscus</i> (Gunther, 1860)	Whipfin ponyfish		★	★		★				
<i>L. splendens</i> (Cuvier, 1829)	Black-tipped ponyfish		★	★			★			
<i>L. spp.</i>	Ponyfish									★
<b>LETHRINIDAE</b>										
<i>Lethrinus choerorynchus</i> (Bloch & Schneider, 1801)	Lesser spangled emperor								★	
<i>L. elongatus</i> Valenciennes, 1830	Long-nosed emperor								★	
<i>L. lentjan</i> Lacepede, 1802	Red spot emperor								★	
<i>L. mahseni</i> (Forsskal, 1775)	Yellow-tailed emperor								★	
<i>L. microdon</i> Valenciennes, 1830	Small tooth emperor								★	
<i>L. nebulosus</i> (Forsskal, 1775)	Spangled emperor								★	
<b>LUTJANIDAE</b>										
<i>Lutjanus argentimaculatus</i> (Forsskal, 1775)	River snapper								★	
<i>L. biguttatus</i> (Valenciennes, 1830)	Two-spot snapper								★	
<i>L. bohar</i> (Forsskal, 1775)	Twinspot red snapper								★	
<i>L. fluviflamma</i>	Black-spot snapper								★	
<i>L. gibbus</i> (Forsskal, 1775)	Humpback red snapper								★	
<i>L. johni</i> (Bloch, 1792)	John's sea perch								★	
<i>L. lutjanus</i> Bloch, 1790	Big-eye sea perch								★	
<i>L. rivulatus</i> (Cuvier, 1838)	Scribbled snapper								★	
<b>MUGILIDAE</b>										
<i>Liza vaigiensis</i> (Quoy & Gaimard, 1824)	Squartetail mullet							★		
<i>Valamugil seheli</i> (Forsskal, 1775)	Blue spot mullet							★		
<b>MULLIDAE</b>										
<i>Parupeneus barberinus</i> (Lacepede, 1801)	Dash-and-dot goatfish							★		
<i>P. cyclostomus</i> (Lacepede, 1801)	Yellow saddle goatfish								★	
<i>P. indicus</i> (Shaw, 1803)	Indian goatfish							★		
<i>Upeneus tragula</i> Richardson, 1846	Black striped goatfish								★	

Table 11.3.19 List of Fish at Site A (Cont'd)

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
MYLIOBATIDIDAE <i>Aetomyleus narinari</i> (Euphrasen, 1790)	Spotted eagle ray								★	
NEMIPYTERIDAE <i>Scolopsis affinis</i> Peters, 1877	Spinecheek							★		
<i>S. ciliatus</i> (Lacepede, 1802)	Ciliate spinecheek							★		
<i>S. lineatus</i> Quoy & Gaimard, 1824	Black-and-white spinecheek							★		
<i>S. monogramma</i> (Cuvier, 1830)	Threadfin monocle-bream							★		
<i>S. vosmeri</i> (Bloch, 1792)	White-cheeked monocle-bream							★		
ORECTOLOBIDAE <i>Chiloscyllium punctatum</i> Muller & Henle, 1841	Brown-spotted catshark								★	
PEMPHERIDAE <i>Pempheris ovalensis</i> Cuvier, 1831	Bronze sweeper							★		
PLATYCEPHALIDAE <i>Platycephalus</i> spp.	Flathead fish								★	
POMACENTRIDAE <i>Abudefduf sexfasciatus</i> (Lacepede, 1801)	Scissor-tail sergeant						★			
<i>Chromis atripectoralis</i> Welanders & Schultz, 1951	Black-axil chromis						★			
<i>C. ternatensis</i> (Bleeker, 1856)	Ternate chromis						★			
<i>C. xanthura</i> (Bleeker, 1854)	Black chromis						★			
<i>Dascyllus trimaculatus</i> (Ruppell, 1828)	Three-spot dascyllus						★			
<i>Dischistodus perspicillatus</i> (Cuvier, 1830)	White damsel						★			
<i>Hemiglyphidodon plagiometapon</i> (Bleeker, 1852)	Giant farmer fish						★			
<i>Pomacentrus grammorhynchus</i> Fowler, 1918	Blue-spot damsel						★			
<i>P. tripunctatus</i> Cuv. & Val., 1830	Three-spot damsel						★			
RACHYCENTRIDAE <i>Rachycentron canadus</i> (Linn., 1758)	Black kingfish							★		
RHYNCHOBATIDAE <i>Rhynchobatus djiddensis</i> (Forsskal, 1775)	White-spotted shovelnose-ray								★	

Table 11.3.19 List of Fish at Site A (Cont'd)

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
<b>SCARIDAE</b>										
<i>Scarus dussumieri</i> (Cuv. & Valenciennes, 1839)	Dussumier's parrot fish								★	
<i>S. frenatus</i> Lacepede, 1802	Vermiculate parrot fish								★	
<i>S. ghobban</i> Forsskal, 1775	Blue-barred parrot fish								★	
<i>S. niger</i> Forsskal, 1775	Black parrot fish								★	
<i>S. tricolor</i> Bleeker	Tricolor parrot fish								★	
<i>S. spp.</i>	Parrot fish									★
<b>SCIAENIDAE</b>										
<i>Johnius amblycephalus</i> (Bleeker, 1855)	Green-backed croaker									★
<i>J. vogleri</i> (Bleeker, 1853)	Sharp-toothed hammer croaker									★
<b>SCOMBRIDAE</b>										
<i>Rastrelliger kanagurta</i> (Cuvier, 1829)	Indian mackerel								★	
<i>Scomberomorus commerson</i> (Lacepede, 1800)	Narrow-barred king mackerel								★	
<b>SCORPAENIDAE</b>										
<i>Pterois volitans</i> (Linn., 1758)	Lionfish, Stingfish	⊙						★		
<b>SERRANIDAE</b>										
<i>Cephalopholis argus</i> (Schneider, 1801)	Peacock grouper, Blue-spotted grouper							★	★	
<i>C. boenak</i> (Bloch, 1790)	Brown-barred grouper							★	★	
<i>Cromileptes altivelis</i> (Val., 1828)	Pantherfish, Polkadot grouper									★
<i>Epinephelus aereolatus</i> (Ruppell, 1830)	Yellow-spotted rock-cod								★	
<i>E. megachir</i> (Richardson)	Long-finned rock-cod								★	
<i>E. ongus</i> (Bloch, 1790)	Wavy-lined grouper								★	
<i>E. suillus</i> (Valenciennes, 1828)	Red-spotted rock-cod								★	
<i>E. summana</i> (Forsskal, 1775)	Summana grouper									
<i>E. spp.</i>	Reef-cod, Grouper									★
<b>SIGANIDAE</b>										
<i>Siganus canaliculatus</i> (Park, 1797)	Seagrass rabbitfish					⊙	⊙			
<b>SILLAGINIDAE</b>										
<i>Sillago sihama</i> (Forsskal, 1775)	Common sand-whiting									★
<b>SPHYRAENIDAE</b>										
<i>Sphyrna obtusata</i> Cuvier, 1829	Pygmy barracuda									★
<b>SPHYRNIDAE</b>										
<i>Sphyrna lewini</i> (Griffith & Smith, 1834)	Scalloped hammerhead shark									★

**Table 11.3.19 List of Fish at Site A (Cont'd)**

Scientific name	Common name	Sampled by the study team						Seen through snorkeling	Seen at fishing boats	Interview
		Wet season			Dry season					
		A1	A2	A3	A1	A2	A3			
SYNGNATHIDAE <i>Corythoichthys intestinalis</i> (Ramsey, 1881)	Scribbled pipefish							★		
TERAPONIDAE <i>Terapon jarbua</i> (Forsskal, 1775)	Crescent grunter-perch								★	
TRICHIURIDAE <i>Trichiurus lepturus</i> Linn., 1758	Large-headed hairtail									★
URANOSCOPIDAE <i>Uranoscopus cognatus</i> Canter, 1849	Two-spined yellow-tail stargazer				⊕					
ZANCLIDAE <i>Zanclus cornutus</i> (Linn., 1758)	Moorish idol							★		
Total		2	3	5	2	2	4	48	57	35





↙ *Lutjanus rivulatus*  
caught by fish-hook



*Lutjanus lutjanus*  
*Epinephelus onges*  
*Cephalopholis boenak*  
↙  
caught by fish-hook



↙ *Alepes* sp.  
*Rastrelliger kanagurta*  
*Gazza minuta*  
caught by encircling gill net

**Photo 11.3.1** Fish Observed at Fishing Boats

Table 11.3.20 List of Benthic Fauna at Site A (individuals/square meter)

Taxa	Common name	Rainy season				Dry season			
		A1	A2	A3	Avg.	A1	A2	A3	Avg.
<b>POLYCHAETA</b>									
Aphroditid polychaete	Scale worm	5	0	0	1.7	0	0	0	0
Capitellid polychaete	Polychaete worm	15	25	0	13.3	0	0	15	5
Glycerid polychaete		30	45	5	26.7	10	15	30	18.3
Hesionid polychaete	Bamboo worm	0	5	0	1.7	5	0	15	6.7
Maldanid polychaete		20	0	0	6.7	5	0	10	5
Magelonid polychaete	Polychaete worm	0	0	0	0	0	25	0	8.3
Nephtyid polychaete		10	10	15	11.7	10	0	35	15
Nereid polychaete		10	15	10	11.7	40	0	35	25
Onuphid polychaete		15	10	15	11.7	15	120	20	51.7
Orbinid polychaete	Tube worm	15	5	0	6.7	5	0	0	1.7
Pectinariid polychaete		0	25	35	20	15	5	15	11.7
Polydontid polychaete	Scale worm	10	5	0	5	0	0	0	0
Spionid polychaete	Polychaete worm	50	55	20	41.7	80	20	315	138.3
Trichobranchid polychaete		5	55	105	55	30	0	35	21.7
<b>CRUSTACEANA</b>									
Ostracoda	Seed shrimp	60	20	45	41.7	85	0	15	33.3
Cumacea	Sand hopper	25	0	15	13.3	45	5	30	26.7
Gammaridian amphipoda		450	255	330	345	475	60	210	248
Hyperidean amphipoda	Marine isopod	25	10	80	38.3	0	0	15	5
Anthuridean isopoda		0	0	25	8.3	35	5	0	13.3
Euphausiidae		0	0	0	0	5	0	0	1.7
<i>Callinasa</i> sp.	Mud lobster	0	0	5	1.7	0	0	5	1.7
<b>BIVALVIA</b>									
<i>Corbula erythrodon</i> (Lamarck, 1818)	Red toothed corbula	10	10	5	8.3	0	5	0	1.7
<i>Cuculaea</i> sp.	Ark shell	0	0	5	1.7	15	0	5	6.7
<i>Donax</i> sp.	Surf clam	5	15	50	23.3	0	35	0	11.7
Lucinidae	Lucina clam	5	5	0	3.3	10	0	5	5
<i>Siliqua radiata</i> (Linn., 1758)	Sunset siliqua	15	20	5	13.3	0	0	30	10
<b>GASTROPODA</b>									
<i>Mitra</i> sp.	Miter	0	0	0	0	5	0	0	1.7
<i>Oliva tigrina</i> (Lamarck, 1818)	Olive shell	5	5	0	3.3	0	0	10	3.3
<i>Umbonium</i> sp.	Button top	0	0	0	0	0	10	0	3.3
<b>OPHIUROIDEA</b>									
Amphiuridae	Bristle star, serpent star	45	35	10	30	5	0	5	3.3
Ophiocomidae		5	30	0	11.7	5	0	5	3.3
<b>ECHINOIDEA</b>									
<i>Laganum laganum</i> (Leske)	Sand dollar	5	25	25	18.3	15	0	0	5
<b>HOLOTHUROIDEA</b>									
<i>Holothurea</i> sp.	Sea cucumber	0	0	0	0	0	5	0	1.7
<b>CEPHALOCHORDATA</b>									
<i>Amphioxus</i> sp.	Amphioxus	0	0	0	0	0	10	0	3.3
Total		840	685	805	767	925	320	850	698

## 11.4 ENVIRONMENTAL EVALUATION

### 11.4.1 Selection of Environmental Items

#### (1) Activities which may cause impacts

The activities which may cause impacts are divided into the followings.

##### - Construction Stage

- Reclamation and spatial occupancy
- Operation of construction equipment and vehicles

##### - Operation Stage

- Spatial occupancy
- Operation of vehicles
- Operation of aircraft
- Operation of facilities

The relationships of these activities and environmental items are shown in **Table 11.4.1.**

#### a. Reclamation and Spatial Occupancy

It could be anticipated that resettlement and waste as social environment, topography and geology, hydrological situation, flora and fauna and meteorology as natural environment, and water pollution as pollution may be generated by the reclamation and spatial occupancy at the construction stage.

#### b. Operation of Construction Equipment and Vehicles

It is anticipated that air pollution, and noise and vibration may be generated by the operation of construction equipment and vehicles at the construction stage.

#### c. Spatial Occupancy

Split of communities and land use as the social environment, and hydrological situation and aesthetics as the natural environment may be generated by the spatial occupancy at the operation stage.

#### d. Operation of Vehicles

It could be anticipated that noise and vibration as the sources of pollution may be generated by the operation of vehicles at the operation stage.

**Table 11.4.1 The Relationship of Activities and Environmental Items**

Activities which may cause impacts Environmental Items		Overall Evaluation	Construction Stage		Operation Stage			
			Reclamation and Spatial Occupancy	Operation of Construction Equipment and Vehicles	Spatial Occupancy	Operation of Vehicles	Operation of Aircrafts	Operation of Facilities
Social Environment	1 Resettlement	⊙	⊙					
	2 Economic Activity	△	△		△			△
	3 Traffic / Public Facility	△			△	△	△	
	4 Split of Communities	○			○			
	5 Cultural Property	△	△				△	
	6 Land Use	○			○		△	
	7 Public Health Condition							
	8 Waste	○	○					○
	9 Hazards ( Risk )	○	△				○	
Natural Environment	10 Topography /Geology	○	○					
	11 Soil Erosion	△	△					
	12 Groundwater							
	13 Hydrological Situation	○	○		○			△
	14 Coastal Zone	△	△					
	15 Fauna/Flora	⊙	⊙	△	△	△	○	○
	16 Meteorology	○	○					
17 Aesthetics	○	△		○				
Pollution	18 Air Pollution	○		○		△	○	
	19 Water pollution	○	○					○
	20 Soil Contamination							
	21 Noise/Vibration	⊙		○		○	⊙	
	22 Land Subsidence							
	23 Offensive Odor							

Note: ⊙ : The environmental items to which special attention has to be paid, because they might cause serious impacts that may affect the project formulation, depending on the magnitude of the impacts and the possibility of the measures.

○ : The environmental items which may give a remarkable impact depending upon the scale of project and site conditions.

△ : The environmental items which may give no impact in case of the scale and site conditions of this project.

No mark: The environmental items which require no impact assessment since the anticipated impacts are not significant.

e. Operation of Aircraft

Hazards as the social environment, flora and fauna as the natural environment, and air pollution and noise and vibration as a source of pollution may be generated by the operation of aircraft at the operation stage.

f. Operation of Facilities

Waste as the social environment, flora and fauna as the natural environment, and water pollution as the source of pollution may be generated by the operation of facilities at the operation stage.

(2) Selection of Environmental Items

The following environmental items are selected by taking into the consideration the environmental items and activities which may cause impacts.

-Social Environment

- Resettlement
- Split of Communities
- Land Use
- Waste
- Hazards

-Natural Environment

- Topography / Geology
- Hydrological Situation
- Flora / Fauna
- Meteorology
- Aesthetics

-Pollution

- Air Pollution
- Water Pollution
- Noise / Vibration

11.4.2 Evaluation of New Airport Sites

(1) Nine New Airport Site

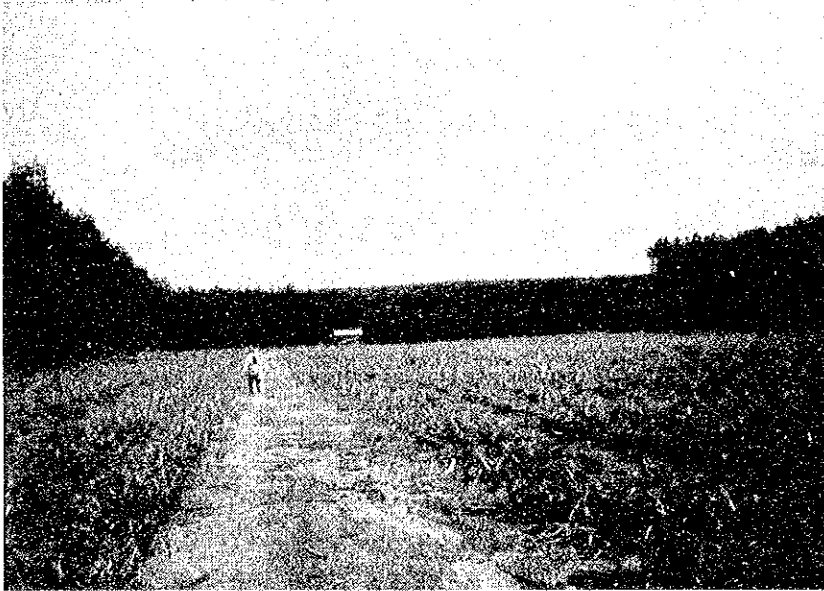
Evaluation of the sites in terms of environmental conditions will be carried out from the selected 13 environmental items.

Results of evaluation are outlined in **Table 11.4.2.**

Table 11.4.2 Outline of Each Site

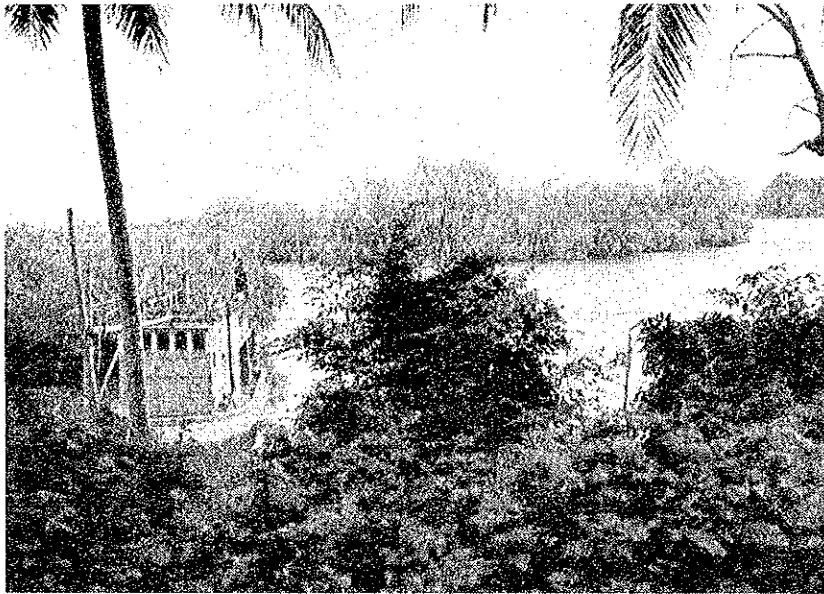
Environmental Items	I-1	I-2	I-3	I-4	M-1	M-2	C-1	C-2	C-3
<b>Social Environment</b>									
Resettlement	muslim villages	small villages	a few	muslim villages	pearl farm/ bungalows	bungalows	a few	small villages	small villages
Split of Communities	none	none	across	isolated area	none	isolated area	none	none	none
Land Use	near muslim villages/hotels	proposed park	main road	next to industrial park	pearl farm/ bungalows	famous viewpoint	near sea gypsy village	proposed resort area	none
Waste	none	none	none	none	none	none	none	none	none
Hazard	none	none	none	none	a little	a little	a little	a little	a little
<b>Natural Environment</b>									
Topography/Geography	flat area	flat area	wetland	flat area	island and sea	island and sea	hill area	flat area	lowland
Hydrological Situation	none	none	wetland	none	island and sea	change of current	none	coastal area	lowland
Flora and Fauna	rubber plantation	mangrove	mangrove	mangrove	marine area	marine area	next to mangrove	rubber plantation	mangrove
Meteorology	none	none	none	none	none	none	none	none	none
Aesthetics	near big hotels	proposed park	none	none	change of shape	change of shape	change of shape	proposed resort area	none
<b>Quality of Life</b>									
Air Pollution	none	none	none	none	none	none	none	none	none
Water Pollution	none	next to mangrove	mangrove	mangrove	reclamation	reclamation	next to mangrove	none	ruined mangrove
Noise and Vibration	near muslim villages/hotels	proposed park	none	next to Phuket Town	none	none	near Phuket Town	proposed resort area	near villages
<b>Total evaluation</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>C</b>	<b>B</b>	<b>C</b>	<b>B</b>	<b>A</b>	<b>B</b>

\*A:No significant effect B:Small significant effect C:moderate significant effect D:Major significant effect



**Photo 11.4.1**

The flat area  
at I-1 Site.



**Photo 11.4.2**

The mangrove forest  
in good condition  
at I-2 Site.



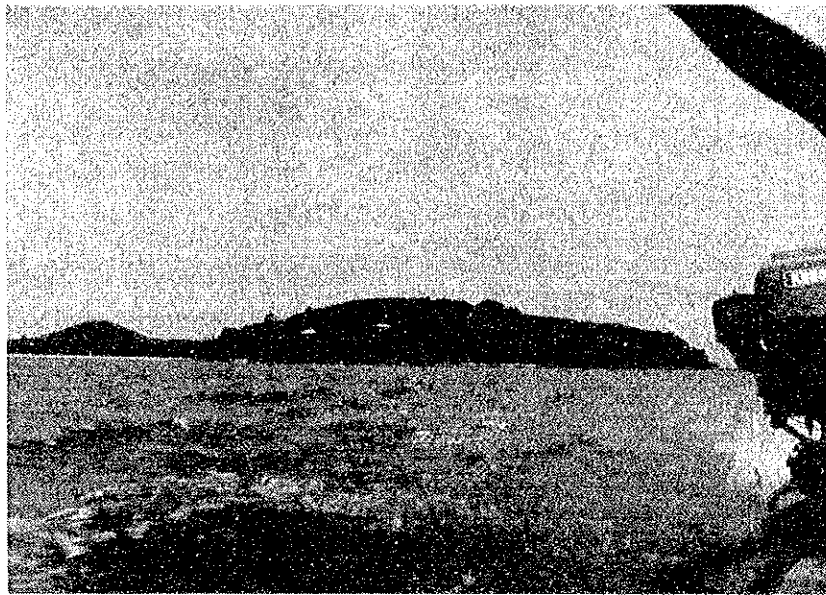
**Photo 11.4.3**

The flat area  
at I-3 Site.



**Photo 11.4.4**

The proposed industrial park near I-4 Site.



**Photo 11.4.5**

The M-1 Site on the sea.



**Photo 11.4.6**

The famous viewpoint at M-2 Site.





**Photo 11.4.7**

The hill area  
at C-1 Site.



**Photo 11.4.8**

The C-2 Site  
near the coast.



**Photo 11.4.9**

The C-3 Site  
along the coast.

(2) Selected Two New Airport Sites

a. I-1 Site (Site B)

(a) Social Environment

i) Resettlement

There are a few residents in this site, but the Muslim village is located in this site. Muslim people have an attachment to their native land. Therefore the problem of resettlement will arise because of the difficulty of land acquisition.

ii) Split of Communities

This site does not span the main road, and there are a few communities around this site. There are no problems on the split of communities at this site.

iii) Land Use

The land use in this site is mainly rubber plantation (**Figure 11.3.5**), but the Muslim villages are located around this site. Muslim people place a religious value in regard to this area and it will not be so easy because of a movement against the development. There are no protected areas such as national park, wildlife park and reservation forest (**Figure 11.2.1**).

iv) Waste

The protective facilities and measures to cope with wastes which will be generated from construction works at the construction stage, and the utilization of airport facilities at the operation stage will be provided. Therefore there will be no problems concerning waste.

v) Hazards

This site is located on Island, and the land use of this area is mainly rubber plantations. The bird species which are confirmed by field reconnaissance are not so many. Therefore the problem of bird hazards will not be generated at this site.

(b) Natural Environment

i) Topography and Geology

This area is relatively flat with maximum level difference of about 20 meters. The land use in this site is mainly rubber plantations and post - mined land, and there are no big rivers nor wetlands. Therefore, there will be no problems on topography and geology, because there are no large scale excavations and embankments.

ii) Hydrological Situation

There are no big rivers nor ponds, therefore there will be no problems on hydrological situation in this site.

iii) Flora and Fauna

In this area the rubber plantations and post - mined lands are located mainly, and there are no vulnerable environment areas. The existing condition on flora and fauna is not so good, therefore there will be no problems on flora and fauna in this site.

iv) Meteorology

The construction works in this site do not include large scale excavations nor embankment, therefore there will be no problems on meteorology.

v) Aesthetics

The Ban Thao Beach which has many big hotels is located near this site, so this resort area is listed as the viewpoint in terms of aesthetics. But the main view direction of these viewpoints is in the direction of the sea and seashore, therefore the problems on aesthetics will not be so large.

(c) Pollution

i) Air Pollution

The traffic volumes to be added to the present traffic by the material transportation at the construction stage will not be so large.

The frequency of aircraft operation will not be so large, and the volume is not expected to bring about air pollution in large amounts.

In the operation stage, exhaust gases emitted from airport facilities and vehicles at the airport are not expected to be so much.

From the above, it is not expected to cause problems on air pollution.

ii) Water Pollution

Muddy waters will be generated from the earth works at the construction stage, especially during heavy rains in the rainy season, but temporary flood control ponds will be provided.

In the operation stage, sewage will be generated from airport facilities, for which sewage treatment system will be provided.

From the above, it is not expected that there will be problems on water pollution.

iii) Noise and Vibration

Material transportation and construction equipment will generate noise and vibration at the construction stage. And vehicles for access to the airport will generate noise and vibration at the operation stage. The volume of vehicles and construction equipment are not expected to be so many, therefore there will be no problems for these cases.

On the aircraft noise problem, there are big hotels and many villages near the airport, therefore the problem of aircraft noise will occur.

b. I-3 site (Site C)

(a) Social Environment

i) Resettlement

There are a few residents in this site, therefore the problem of resettlement are not expected to occur at this site. But there is a school at this site, so the removal of the school will be required.

ii) Split of Communities

This site will cross the main road, a replacement road will be constructed. The distance for the detour will be only 3~4 km, and some schools are located on both sides of this site. Therefore there will be no problems on the split of communities at this site.

iii) Land Use

The land use surrounding this area is mainly rubber plantations, and the east side of this area is used as a fish or shrimp pond. And there are few Muslims residing in this area. But the east side of this area may include the Klong Tha Rua mangrove reservation forest (**Figure 11.2.2** and **Appendix 11.4.1**). Therefore detail reconnaissance on rights of common will be required at feasibility study stage.

iv) Waste

The east side of this site is located on the mangrove forest, so it is anticipated that waste water will be discharged into the forest. But by providing protective facilities and measures for wastes will be provided, therefore there will be no problems on wastes discharged at this site.

v) Hazards

The east side of this site is located in the mangrove forest. In general, the mangrove forest has a diversified bird species, but the forests of this site has been changed to the fish or shrimp ponds. The number of birds which are counted by the field reconnaissance at this site is less than that of the existing airport site. Therefore, the problem of bird hazards will not be generated at this site.

(b) Natural Environment

i) Topography and Geology

This area is relatively flat, and there are no big rivers. And large scale excavation and embankment will not be generated, therefore there are no problems on topography and geology at this site.

ii) Hydrological Situation

There will be no problems on the hydrological situation similar to the I-1 Site.

iii) Flora and Fauna

The mangrove forest has recently been encroached so it has become a scarce resource of Phuket Island.

The east side of this site is located in the mangrove forest. The inland portion of this forest will be occupied with fish or shrimp ponds, but at the portion near the sea the mangrove forest is in relatively good condition according to field reconnaissance, therefore the environmental consideration will be required such that the development area will be kept to the absolute minimum, the inflow of sea water will cause no disturbances, and mitigating countermeasures will be taken.

iv) Meteorology

There will be no problems on meteorology similar to I-1 Site

v) Aesthetics

There are no scenic view point on aesthetics around this site, therefore there will be no problems on aesthetics at this site.

(c) Pollution

i) Air Pollution

There will be no problems of air pollution similar to I-1 Site.

ii) Water Pollution

Water pollution can be caused by muddy waters and sewage discharge, so flood control pond and sewage drainage treatment system will be provided.

The east side of this site has a mangrove forest, therefore the protective measures will be required.

iii) Noise and Vibration

There will be no problems on noise and vibration by material transportation, construction equipment and vehicles to the airport, similar to I-1 Site.

The aircraft noise problem will not be so large, because there are only a few villages.

(3) Existing Airport Site (Site A)

a. Alt-1 Site and Alt-2 Site

(a) Social Environment

i) Resettlement

Land acquisition will not be so large, so the number of resettlement is not expected to be so large. The land cost around the existing airport is very high, therefore there will be some problems on land acquisition.

ii) Split of Communities

The site will cross the main road (**Photo 11.4.10**), so a replacement road will be constructed. But the distance for the detour will be very little, therefore there will be no problems on the split of communities.

iii) Land Use

The land use surrounding this area is mainly rubber plantations (**Figure 11.2.1, 11.3.4**). The construction of a golf course and resort facilities at the south-east side of the existing airport (**Photo 11.4.11**), and the existence of National Park at the south-west side of this airport will affect the future expansion of the airport in this direction. The west side of this area may include the Klong Ta Maphrao mangrove reservation forest and Mai Phok and Maikaew reservation forest (**Figure 11.2.2 and Appendix 11.4.2 and 11.4.3**). Therefore detail reconnaissance will be required at the feasibility stage.

There will be problems for the non-establishment of land use policies and development plan around the airport. The land use plan around the airport will be established by the authority concerned so as to avoid the occurrence of environmental problems in the future, and to control the development around the airport vicinity. On the other hand, if the new airport plan is adopted in the long-term master plan, it will be necessary to consider how the site can be restored its original condition after the existing airport has left.

iv) Waste

There will be no problems of waste similar to I-3 Site.

v) Hazards

The west side of the existing airport faces the Andaman Sea and the east side is located in the mangrove forest, so there are many sea birds around this area. But accidents by bird hazards have not occurred at the existing airport, therefore there will be no problems on hazards.

(b) Natural Environment

i) Topography and Geology

There will be no problems of topography and geology similar to I-3 Site at Alt-1.

But at Alt-2 there is large scale excavation and embankment, therefore detail investigation on topography and geology will be required at the feasibility study stage.

ii) Hydrological Situation

There will be no problems of the hydrological situation similar to I-1 Site and I-3 Site.

iii) Flora and Fauna

The east side of this area is located in the mangrove forest. But this forest is not in good condition, and the forest has been changing to other land use, mainly for ponds for fish, prawn or shrimp (**Photo 11.4.12**). Therefore some problems on flora and fauna can not be anticipated.

Nai Yang National Park is located at the west side of the existing airport. This coast is famous for nesting of Green Turtles and Leathery Turtles, therefore this marine area is prohibited for any development projects.

iv) Meteorology

There will be no problems of meteorology similar to I-1 Site and I-3 Site.

v) Aesthetics

The national park faces the southeast side of the existing airport. But from the scenic viewpoint in the park, airport buildings are not able to see this fine view. Therefore, there will be no problems on aesthetics.

(c) Pollution

i) Air Pollution

There will be no problems on air pollution similar to I-1 Site.

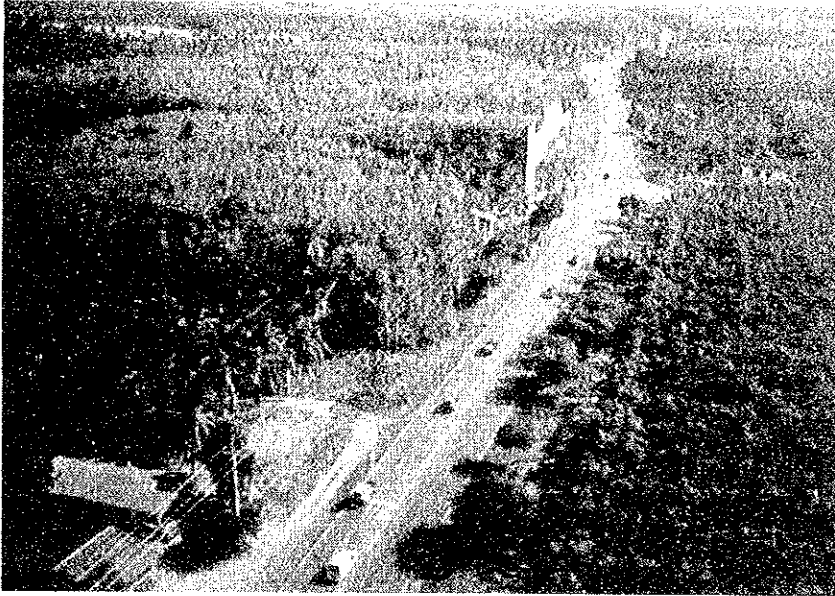
ii) Water Pollution

Careful protective measures will be required similar to I-3 Site.

iii) Noise and Vibration

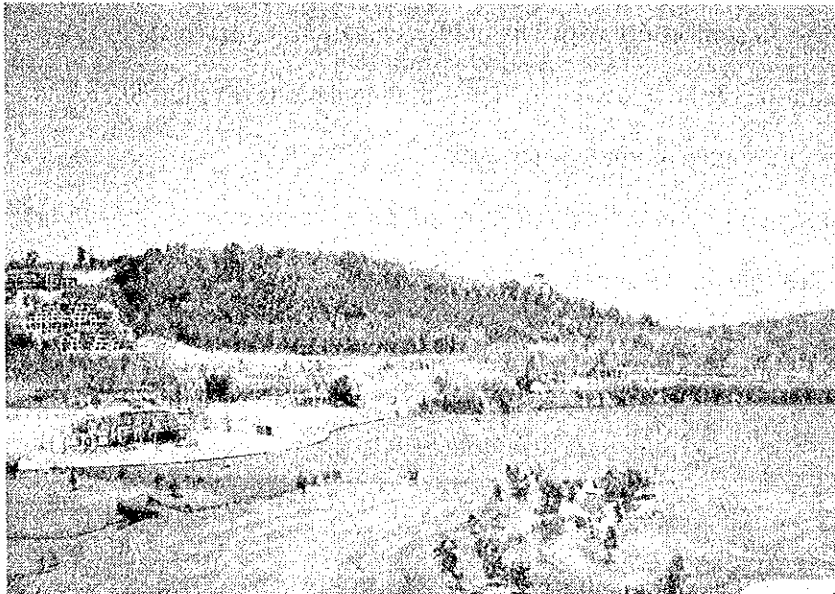
There will be no problems on noise and vibration similar to I-3 Site.





**Photo 11.4.10**

The road which will be replaced.



**Photo 11.4.11**

The golf course and resort facilities at the south-east side of the existing airport.



**Photo 11.4.12**

The shrimp pond which was changed from the mangrove forest.

(4) Conclusion

- a. The inhabited natural resources to be considered is the following
  - Mangrove Reservation Forest
  - Nai Yang National Park
- b. The following items should be considered to make the master plan
  - Resettlement
  - Flora/fauna
  - Aircraft Noise
- c. Preparation of Environmental Impact Assessment is required as soon as possible in conformity with Thailand's regulations concerned.
- d. Preparation of the following policies and regulations is required.
  - Land-use plan around the airports
  - Drainage system at Phuket Town and beach resort area
  - Collecting and treatment system of waste disposal

## CHAPTER 12

### AIRCRAFT NOISE ANALYSIS



## CHAPTER 12 AIRCRAFT NOISE ANALYSIS

### 12.1 GENERAL

This chapter examines the aircraft noise influence on the surrounding area of the existing Phuket International Airport and the new airport site.

### 12.2 AIRCRAFT NOISE CONTOURS

The level of aircraft noise is estimated by use of WECPNL (Weighted Equivalent Continuous Perceived Noise Level), which is one of the ICAO standard indices for aircraft noise, and noise contours are drawn on the existing topographic maps.

The contours are calculated for the year 2010 (the long-term development) at the existing airport and the new airport site as shown in **Figures. 12.2.1, 12.2.2 and 12.2.3.**

**Table 12.2.1** shows the assumption when the contours were calculated.

**Table 12.2.1 Assumptions for the Calculation of Aircraft Noise Contour**

Item	Assumption
Target Year	Year 2010 (Master Plan)
Traffic Pattern	Straight - in / Straight - out
Ratio of Runway Use	RWY 09 : 20 % RWY 27 : 80 %
Runway Length	3,500 m
Glide Slope Angle	RWY 09 : 3.0 ° degree RWY 27 : 3.0 ° degree
Number of Daily Frights	B - 747                    23.10 B - 777 / A - 330        37.20 A - 300 / B - 767        20.60 B - 737                    9.70 ATR - 42                    8.90 Total                        99.50