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Technical Report 70

**Vegetation of American Memorial Park
Saipan, Mariana Islands**

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Abstract

This inventory of the botanical resources at American Memorial Park comprised a general survey of the plants present, the preparation of a vegetation map, and the establishment of four permanent transects in the wetland. One hundred and twenty eight vascular plants including 13 ferns and fern allies were located. None are endangered nor are there any noxious species present. The vegetation types within the natural area include mangrove swamps, marshes, strand, coastal scrub and weedy scrub. Twelve plant communities are identified and mapped. Management recommendations include garbage control, controlling vehicle access to the shoreline and programs to introduce or enhance the growth of kamani (*Calophyllum inophyllum*), gago (*Casuarina equisetifolia*), and temple grass (*Zoysia matrella*).

Introduction

American Memorial Park (AMME) is a subunit of War in the Pacific National Historical Park located in Garapan on the island of Saipan, Northern Marianas (Fig.1). The park, established in 1978, commemorates American soldiers who lost their lives in the campaign on Saipan during the Second World War.

The park is a small area, 133 acres (54 ha). It is a coastal area located just north of Garapan on a raised reef (Fig. 2). The focus of AMME is the modest memorial which is surrounded by a substantial recreational area. There is a small wetland within the Park's boundaries which has been manipulated over the years. Since the war, bulldozing and use of the area as a dump continued until 1978. The waste material was covered over and the area left untouched since then. A dense vegetation has taken over the area which is now the habitat of the endangered Marianas gallinule and a large number of other birds.

In 1982, the Northern Marianas government requested the U.S. Army Corps of Engineers to develop a flood control program for Garapan. Three of the options presented would directly affect the wetland area. The National Park Service became

concerned about the impact of the preferred flood control option on the stability of the endangered gallinule habitat. They requested an inventory of the botanical resources of AMME with some detailed quantitative measurements of the vegetation within the wetland area.

Methods and Materials

General plant survey.

Plants were collected from all areas of the site during the initial survey of the wetland in 1986 and the subsequent survey in 1988 (Table 1). Voucher specimens were collected for each plant species and have been curated at the University of Guam Herbarium. Some duplicates are deposited at Bishop Museum, Honolulu, and the National Museum of Natural History (Smithsonian Institute), Washington, D.C.

Transect.

Quantitative measurements of the vegetation were collected using the line intercept method (Mueller-Dombois and Ellenberg 1974, Brower and Zar 1984; Table 2) along four transects (Fig. 3) in the wetland area

Vegetation Map.

The vegetation map (Fig. 4) was constructed from an aerial photograph of the area taken by the U.S. Geological Survey in 1987. The vegetation units were demarcated on the aerial photograph and ground proofed. The vegetation unit identification follows that of Jacobi (1989).

The Study Area

Saipan is the largest island, and also the capital, of the Commonwealth of the Northern Mariana Islands (CNMI). It is located at 15°12'N latitude and 145°37'E longitude. It is approximately 13 miles (21 km) long and averages 4 miles (6 km) in width, occupying 46.6 square miles (12,070 ha). It lies within the humid

tropics, with an average annual temperature of 81.5°F (27.5°C) and an average relative humidity of 83%. The average wind velocity is 10.5 mph (17 kph); the NE and ENE trade winds are persistent during the January to May dry season whereas winds from various directions are less strong, and sporadic, during the rainy season (Tenorio and Associates 1979).

Saipan is a part of the Mariana Island arc system, and had its beginning about 42 million years ago in an area to the west called the Palau-Kyushu Ridge. Between that time and the present the island has undergone eastward movement, volcanic activity, uplift and subsidence with attendant reef formation, and erosion by wind, rain and movements of the sea. Contained within the rock formations are three volcanic cores, numerous fault lines, and layered volcanic and calcareous rocks (Cloud *et al.* 1956).

The west coast of Saipan south from the Magpi benches consists of an almost continuous lime sand beach backed by a few low limestone ridges and underlain by Tagpochau limestone formed in the early Miocene. The lowest bench and the entire western coastal plain are constructional in origin. The Matansa (Massacre) Fault which runs NNE by SSW and is downfaulted to the west (Cloud *et al.* 1956) passes along the eastern edge of the Park.

AMME is located on the northern boundary of the township of Garapan on the west coast of the island of Saipan (Fig. 5). The park consists of the terrestrial environment only. Coastal waters and islets are not within the park's jurisdiction. It is bounded by Garapan and Tanapag Lagoons from approximately 100m south of Puntan Muchot to Puntan Flores on the north and west, Beach and Middle Roads on the east, and the road to the Hyatt Hotel on the south (Fig. 2). The area is part of a level elevated reef flat and all of it is less than three meters above sea-level. The whole area has been altered by bulldozing and the construction of roads and buildings. The wetland area, except that which lies between Beach Road and Tanapag Lagoon, is also modified so that there are two containment areas one of which is undrained, the other slightly to its south is associated with a small culvert under Beach Road. This area has been designated as a "natural area" by the park administration meaning that it will be managed to protect the natural resources in the area. The passerine birds and the endangered Marianas coot

are significant natural resources of the natural area. An exercise track circles this entire segment of the wetland study site. The two ponding areas are separated by a dirt road raised about one and one half meters above the surrounding terrain. It is now impassable to vehicular traffic but bears along its southern margin a large diameter pipe, possibly an old sewage pipe.

The north-western edge of AMME abutting Tanapag Lagoon consists of artificial coral-fill jetties. The jetties are vegetated with a considerable amount of scrub on either side of the jeep road. The coastal margin of AMME along Tanapag Lagoon is a continuation of the interior mangrove swamp and coastal forest. It contains several dump-sites which are not only unsightly and unhygienic but also disrupt revegetation of the mangrove swamp (Figs. 6, 7, and 8).

Results and Discussion

There are 128 species of vascular plants in the Park (Table 1), thirteen (10%) of which are ferns and fern allies. The remainder are flowering plants; there are no conifers present. Fifty-six species (44%) are indigenous, none endemic to the Marianas. Seventy-two species (56%) are introduced, 67 (78%) of which are naturalized.

There are no federal endangered plant species present. There is no list of endangered plants for CNMI. None of the plants are rare by any consideration. However, the orchid *Zeuxine fritzii* (which was named for a German governor of Saipan) occurs at the swamp edge of the Park and has only been found in one other place in recent times, though perhaps is more common and merely overlooked.

None of the plants present is considered noxious by CNMI.

Importance values are derived from transect data (Table 2, Appendix 1) and relate to a species importance in numbers of specimens (the more numerous, the higher the importance), in frequency of occurrence (the more times a species occurs along a transect, the higher the importance), and in amount of cover (the greater the linear area the species occupies along a transect, the higher is its importance). In this survey, the numbers of

specimens often could not be counted, so that portion of the usual importance value was omitted. Importance values were calculated for each stratum (less than 1m, 1-less than 3m, 3-less than 10m, and greater than 10m), because understory species can be young of the top stratum species, which indicates successful replacement of dominants by themselves and therefore a climax vegetation. Understory species can also be young of the successional generation to follow, or they can be restricted by growth form and will always be small.

Data for Transect 1 indicate a weedy area in which dominance is shared by pago (*Hibiscus tiliaceus*), a native sprawling tree with great environmental tolerance, and tangantangan (*Leucaena leucocephala*), an introduced species common in disturbed habitats on limestone. *Nephrolepis hirsutula* is a terrestrial fern, and most other species are aggressive vines.

Transect 2 extends into an open wetland dominated by the swamp fern langayao (*Acrostichum aureum*); most other dominants are vines, and tangantangan and gago (*Casuarina equisetifolia*) are the only tree species of any importance.

Transect 3 occupies an area dominated by large strand species such as nonag (*Hemandia sonora*), pahong (*Pandanus dubius*) and binalo (*Thespesia populnea*) and ferns in the understory. Weed species are not very significant here, and the understory contains a variety of strand and limestone forest species, and few vines.

The dominant species at most levels of Transect 4 is the mangrove mangle lahi (*Bruguiera gymnorhiza*), but the area along transect four also contains pahong, pago, gago, nonag, and more than 10 other species, only one of which is introduced.

The area of transects 3 and 4 contains native species which are part of a self-replacing, climax vegetation, while that of transects 1 and 2 is weedy and changing, except for the open-water habitats containing ferns. Pago is of importance to both areas.

Vegetation types within the natural area include mangrove swamps, marshes, strand, coastal scrub and weedy scrub.

Mangrove swamps are wetlands dominated by woody mangrove vegetation, in this case (Fig. 9). It is the

dominant and only Pacific mangrove species in the park (and Saipan) although other species are common to mangrove swamps further south. Pago is always an edge species of almost every ecosystem in the Marianas though it is more abundant around wetland areas. Its abundance results from its ability to take root anywhere along the stem. Therefore, when the tree overextends and falls or when strong winds, such as typhoons, knock it down the tree is not killed, rather a number of new trunks are produced. In a wetland more moisture is available to support these new shoots. Langayao is a typical swamp fern. It tolerates a moderate amount of salinity and thus tends to be a feature of mangrove swamps in the Marianas and elsewhere. Gago, though present in the swamp, is typically confined to sandy areas above standing water.

A small marsh vegetated with saltgrass (*Paspalum distichum*) and edged by *Scirpus littoralis* and langayao (Figs. 10 and 11) lies at the southwest portion of the interior. Another grassy area along the north and northwest part of the interior is not a marsh, but does get appreciable moisture; the grasses are elephant grass (*Pennisetum purpureum*) and Guinea grass (*Panicum maximum*), which are large but are not wetland species.

Many of the other species, including nonag, banalo, banago (*Jasminum marianum*), pahong (*Pandanus dubius*) and the herbs *Hymenocallis littoralis*, alaihai (*Ipomoea micrantha*) and bayogo dikika (*Mucuna gigantea*) are typical strand species as well. The presence of these strand species in the swamp is simply the result of proximity to the shoreline and the sandy substrates which predominate within the study area because of bulldozing.

There are a number of weed species in the area which indicate that the area has been and is still disturbed. Tangantangan, a dominant woody weed and an important soil stabilizer, has declined significantly now that the psyllid, *Heteropsylla cubana*, has become established. All the vines, such as mile a minute (*Mikania scandens*), fofgu (*Ipomoea indica*) and ahgaga (*Momordica charantia*) (Figs. 12 and 13) tend to climb and provide a dense shade; now that there is dead tangantangan, this will provide a suitable support which will have to be accepted until other shading tree species invade the area.

The coastal scrub is a combination of species which are early colonists, and those which will be later climax vegetation. The jetties where this vegetation type occurs are dominated by brushy plants such as *Eupatorium odoratum* (Fig.14), *Pluchea indica*, *P. symphitifolia*, hunig (*Tournefortia argentea*), nanaso (*Scaevola sericea*), *Indigofera suffruticosa*, *Desmanthus virgatus*, banago and gasoso (*Colubrina asiatica*). There is also an impressive stand of *Dodonaea viscosa* in a place quite unusual for this species. However, it is extending itself and appears to be a successful colonizer although the storms may be detrimental to its continued survival in the area.

Several of the open areas are being taken over by temple grass (*Zoysia matrella*). This species stabilizes the sand yet it is tolerant of such an exposed salty habitat. It should be encouraged and planted in the picnic areas.

The weedy scrubland occurs on scraped limestone over which there is a veneer of "soil." It is dominated by a variety of grasses, the sedge nutgrass (*Fimbristylis cymosa*) and various herbs such as *Desmodium* spp., *Polygala paniculata*, and hunig tasi (*Heliotropium procumbens*). This area is a highly artificial man-induced environment.

The park has one of only three mangrove sites on Saipan; the other two are at Salt Spring, also called Starch Factory Spring/Sadog Tasi, and along the western edge of Hagoi Susupe (Lake Susupe) where the Japanese-built canal brought in sea water. Mangroves are important land holding systems that buffer the effects of storms from the sea and hold erosion products moving off the land. Thus, they actually increase the size of areas in which they are found. Secondly, they are important nurseries of the young of many marine fishes and provide a sheltered, nutrient rich environment for species such as edible crabs and birdlife in general. As with all wetlands man should encroach with great caution. Any further disturbance to the area is potentially disastrous.

Although the area has obviously been a dump and a dumping site and has had much modification by bulldozing, it nevertheless has a long history of being a wetland and is so indicated on old maps and early references. There are many large structural units within the area. Decisions regarding the removal of smaller structures and concrete foundations will have to be evaluated in the light of the damage that might

occur to the system. There are some concrete bunkers that could be left *in situ*. There are some metal structures that are deteriorating rapidly.

The old roadway could be cleaned up slightly and made into a short nature trail. A short diversion aligned along the axis of transect 2 would provide a good example of typical wetland communities. At least four families of the yellow honeyeater and at least an equal number of the cardinal honeyeaters were seen. Other birds including the white-faced dove, rufous-fronted fantail, and bridled white-eyes use the area and were readily observable.

Transect 4 area has large mangle lahi, gago and langayao (Fig. 3, Table 1). On the ground there are orchid species and a variety of species which would be expected in a climax forest. The diversity of species in this area makes it a particularly valuable area.

Botanically, the park comprises areas of weedy shrubs, strand and mangrove species. The jetty areas have yet to develop into a mature climax ecosystem. They are still in a successional stage.

The mangrove swamp should not be allowed to dry out. If the proposed drainage canal results in loss of water from the system then mitigation must be planned to ensure that the swamp remains as swamp. The swamp is probably a balanced ecosystem of salt and fresh water. If the proposed canal is going to upset that balance then some mitigation must be planned. A prominent fault of the west coast of Saipan, the Matansas (Massacre) Fault occurs along the west coastal plain. Its exact location relative to the swamp and the proposed drainage canal should be ascertained because of the impact of the fault on drainage patterns. It is important to understand that the canal will probably interrupt the sheet water flow that is an important source of fresh water in the swamp.

Recommendations

Garbage control

Stop the dumping of trash along the coastal margin of Tanapag Lagoon. This will allow the mangrove to serve as a buffer between the sea and the main road

preventing storm damage to the road and the rest of the park.

Negotiate the closure or proper management of the dump on Puntan Flores. Not only is the garbage which blows into the park unsightly and probably unhygienic, it also is an impediment to the establishment of many plants. The value of the recreational areas being developed on the jetties will also be impaired.

Introduce kamani to coastline

The park should consider the possibility of planting palo maria (*Calophyllum inophyllum*, Mangosteen family) along the jetty area especially in areas where it is wide enough to make picnic areas. This tree will tolerate salt water and spray and is also a common strand inhabitant in most of the Pacific. It will provide good shade for the picnickers. The root system will stabilize the shoreline yet the trees are very resistant to high winds.

Expand temple grass sward

Temple grass (*Zoysia matrella*) should be transplanted from the areas it now occupies to other picnic areas. It is tolerant of trampling and will serve to stabilize the substratum. It is best transplanted by removing strips from healthy colonies and planting firmly in the desired area during the rainy season. The Park staff should do everything they can to discourage local residents from their current practice of removing segments of the turf for their own use (Fig. 18).

Encourage growth of gago

Encouraging the further establishment of gago (*Casuarina equisetifolia*) along the jetties will also help to stabilize the substratum, but more active intervention will be required to shore up the jetties which are now in a precarious state (Fig. 15).

Control vehicle access to shoreline

The development of roads on the ocean side of Beach Road should be discouraged. These roads can be a focus for storm activity which will be concentrated through these gaps and damage the road. Fishing and other activities in the area are acceptable as long as they do not result in opening the coastal forest.

Acknowledgments

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Table 1. Vascular Plants of American Memorial Park, Saipan

Legend:

Name

Information relates to classification of the plants. Capitalized words show categories as large as FAMILY, or larger. Family names typically end in -CEAE. Italicized words are the scientific names — the genera (genus names) first; species names second. Names/abbreviations after scientific names are the person(s) who named the species. Names below the scientific name are common names, including Chamorro local names.

Growth form

Growth form refers to the appearance of the plants.

H	=	herbaceous; plants with little or no woody growth.
S	=	shrubs; woody plants with several major trunks.
T	=	trees; woody plants with generally one major trunk.
V	=	vines; woody or non-woody plants which can not stand free by themselves.

Habit

Place in community.

T	=	terrestrial; rooted in relatively dry soil.
A	=	aquatic; rooted, floating or emergent in watery situations.
E	=	epiphytic; attached to the surface of another plant, and using that plant for support, only.
P	=	parasitic; unrooted but attached to another plant and utilizing its food as well as support.

Status

The relation of the plant to the site.

Nd	=	indigenous - native to the site; evolved there, or arrived by natural transport.
Nt	=	introduced - brought in, accidentally or deliberately, by man or his agents (planes, canoes, dogs, etc.).
Nt/N	=	introduced/naturalized - behaves as an indigenous species; prospers without the assistance of man.

Relative abundance

Comparative numbers in the communities where the species occur(s). /Cl = Clumped - a modifier used to indicate very uneven spacing species like grasses, etc. For example, a species may occur only one place in a site, but several plants will be close together (R/Cl).

R	=	Rare - less than 5 plants per 100 m ² in sites where they occur.
U	=	Uncommon - more than 5 but less than 20 plants per 100 m ² in sites where they occur.
C	=	Common - more than 20 but less than 50 plants per 100 m ² in sites where they occur.
A	=	Abundant - more than 50 plants per 100 m ² .

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Ferns and Fern Allies				
Ophioglossaceae (Adder tongue fern family)				
<i>Ophioglossum nudicaule</i> L.f.	H	T	Nd	R
Polypodiaceae (Polypod family)				
<i>Acrostichum aureum</i> L. Langayao; Giant swamp fern	H	A	Nd	U/Cl
<i>Antrophyum plantagineum</i> (Cav.) Kaulf.	H	E	Nd	R/Cl
<i>Davallia solida</i> (Forst. f.) Sw. Pugua machena	H	T,E	Nd	U
<i>Nephrolepis hirsutula</i> (Forst.) Presl.	H	T,E	Nd	C
<i>Polypodium punctatum</i> (L.) Sw. Bird's nest fern	H	E	Nd	U
<i>Polypodium scolopendria</i> Burm.f.	H	T,E	Nd	C
<i>Pteris vittata</i> L.	H	T	Nt/N	U
<i>Pyrosia lanceolata</i> (L.) Farw.	H	E	Nd	C
<i>Tectaria crenata</i> Cav.	H	T	Nd	U
<i>Thelypteris opulenta</i> (Kaulf.) Fosb.	H	T	Nd	R
<i>Vittaria incurvata</i> Cav. Shoestring fern	H	E	Nd	R/Cl
Psilotaceae (Psilotum family)				
<i>Psilotum nudum</i> (L.) Grisebach Whisk fern	H	T,E	Nd	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Monocotyledons				
Araceae (Arum family)				
<i>Alocasia macrorrhiza</i> (L.) Schott	H	T/A	Nt	R/U
Arecaceae (Palmae) (Palm family)				
<i>Cocos nucifera</i> L. Niyog; Coconut	T	T	Nt/N	U
Cyperaceae (Sedge family)				
<i>Cyperus brevifolius</i> (Rottb.) Hassk.	H	T	Nt/N	U
<i>Cyperus compressus</i> L.	H	T	Nt/N	U
<i>Cyperus difformis</i> L.	H	A/T	Nt/N	U
<i>Cyperus kyllingia</i> Endl.	H	T,A	Nt/N	U
<i>Cyperus polystachyos</i> Rottb.	H	T,A	Nd	U
<i>Fimbristylis cymosa</i> R. Br.	H	T	Nd	U
<i>Scirpus littoralis</i> var. <i>capensis</i> (Boeck.) Koyama	H	A	Nd	U/Cl
Liliaceae (sensu lato) (Lily family)				
<i>Hymenocallis littoralis</i> (Jacq.) Salisb.	H	T	Nt/N	C
<i>Sansevieria</i> sp. Tigre; Bowstring Hemp	H	T	Nt/N	U/Cl
Orchidaceae (Orchid family)				
<i>Spathoglottis plicata</i> Bl.	H	T/E	Nd	U
<i>Taeniophyllum mariannense</i> Schltr. Kamuke-nanofe; amot-otdon; worm orchid	H	E	Nd	U
<i>Zeuxine fritzii</i> Schltr.	H	T	Nd	U/Cl
Pandanaceae (Pandanus family)				
<i>Pandanus dubius</i> Spreng. Pahong; Screw Pine	T	T	Nd	U
<i>Pandanus tectorius</i> Park. Kafu; Screw Pine	T	T	Nd	C

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Poaceae (Gramineae) (Grass family)				
<i>Cenchrus echinatus</i> L. Bur-grass; Sandspur	H	T	Nt/N	U
<i>Chloris inflata</i> Link Fingergrass	H	T	Nt/N	C
<i>Chrysopogon aciculatus</i> (Retz.) Trin. Inifuk; Palaïi	H	T	Nd	U
<i>Cynodon dactylon</i> (L.) Pers. Bermuda Grass	H	T	Nt/N	C
<i>Dactyloctenium aegyptium</i> (L.) Beauv.	H	T	Nt/N	U
<i>Dichanthium blahdii</i> (Retz.) Clayton	H	T	Nt/N	U/Cl
<i>Echinochloa colonum</i> (L.) Link Chaguan-Agaga; Jungle-Rice	H	T/A	Nd	U
<i>Eleusine indica</i> Gaertn. Umog; Goose Grass	H	T	Nt/N	C
<i>Eragrostis ciliaris</i> (L.) R. Br.	H	T	Nt/N	C
<i>Eragrostis amabilis</i> (L.) W. & A. . Lovegrass	H	T	Nt/N	C
<i>Eragrostis</i> sp.	H	T	Nt/N	U
<i>Eustachys petraea</i> (Sw.) Desv.	H	T	Nt/N	U/Cl
<i>Imperata conferta</i> (J.S. Presl) Ohwi	H	T	Nt/N	U
<i>Ischaemum</i> sp.	H	T	Nt	R
<i>Lepturus repens</i> R. Br. Lesaga	H	T	Nd	C
<i>Panicum maximum</i> Jacq. Gunica grass	H	T	Nt/N	C
<i>Panicum muticum</i> Forssk.	H	T	Nt/N	C
<i>Paspalum conjugatum</i> Berg. Hilo grass	H	T	Nt/N	U
<i>Paspalum distichum</i> L. (<i>P. vaginalis</i> Sis.) Saltgrass; Knotgrass; Couchgrass	H	T	Nd	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Poaceae (Gramineae) (Grass family) (Cont'd)				
<i>Pennisetum purpureum</i> Schumach. Elephant grass				
<i>Sporobolus fertilis</i> (Steud.) Clayton Wiregrass	H	T	Nt/N	C
<i>Thuarea involuta</i> (Forst) R. Br. Ex R. J. S. Las-aga	H	T	Nd	C
<i>Zoysia matrella</i> var. <i>pacifica</i> Goudsew. Templegrass	H	T	Nd	C

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Dicotyledons				
Acanthaceae (Acanthus family)				
<i>Blechum brownei</i> Juss. var. <i>puberulum</i> Yerbas babui	H	T	Nt/N	U/Cl
<i>Pseuderanthemum carruthersii</i> (Seem.) Guill. var. <i>carruthersii</i>	S	T	NT	U
Amaranthaceae (Amaranth family)				
<i>Achyranthes aspera</i> L. Chichitum; Lasogado	H	T	Nt/N	U
<i>Deeringia amaranthoides</i> (Lam.) Merr.	V/S	T	Nd	U/Cl
Araliaceae (Panax family)				
<i>Polyscias fruticosa</i> (L.) Harms Papua	S/T	T	Nd	R
Asteraceae (Compositae) (Daisy family)				
<i>Bidens alba</i> (L.) DC. Daisy	H	T	Nt/N	C
<i>Eupatorium odoratum</i> L.	H	T	Nt/N	C
<i>Mikania scandens</i> (L.) Willd. Mile-a-minute	V	T	Nt/N	C
<i>Pluchea indica</i> (L.) Less.	S	T	Nt/N	C/Cl
<i>Pluchea symphitifolia</i> (Mill.) Gillis	S	T	Nt/N	U/Cl
<i>Pluchea x fosbergii</i>	S	T	Nt/N	R
<i>Vernonia cinerea</i> (L.) Less. Chaguan Santa Maria	H	T	Nt/N	U
Boraginaceae (Heliotrope family)				
<i>Heliotropium procumbens</i> var. <i>depressum</i> (Cham.) Fosb. & Sachet Hunig-tasi	H	T	Nt/N	U
<i>Tournefortia argentea</i> L.f. Hunig; Beach Heliotrope	T	T	Nd	U
Caesalpiniaceae (Leguminosae) (Senna family)				
<i>Delonix regia</i> (Bojer) Raf. Royal poinciana; flamboyant	T	T	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Caricaceae (Papaya family)				
<i>Carica papaya</i> L. Papaya	H,T	T	Nt/N	U
Casuarinaceae (Casuarina family)				
<i>Casuarina equisetifolia</i> L. Gago; Ironwood; Australian Pine	T	T	Nd	C
Convolvulaceae (Morning Glory family)				
<i>Ipomoea indica</i> (Burm.) Merr. Fufgu; asa-gao; Japanese Morning-glory	V	T	Nt/N	C
<i>Ipomoea macrantha</i> R. & S. alaihai; Moon flower	V	T	Nd	C
<i>Ipomoea pes-caprae</i> ssp. <i>brasiliensis</i> (L.) v. Ooststr. alalag-tasi; Beach morning-glory	V	T	Nd	C
<i>Ipomoea triloba</i> L. Fofgu-sabana	V	T	Nt/N	C
<i>Operculina ventricosa</i> (Bert.) Peter Alalag; Wood-rose	V	T	Nt/N	U/Cl
<i>Stictocardia tiliaefolia</i> (Desr.) Hall.f. Abubo	V	T	Nt/N	U
Cucurbitaceae (Gourd family)				
<i>Momordica charantia</i> L. Ahgaga; Bitter-melon	V	T	Nt/N	U
Euphorbiaceae (Spurge Family)				
<i>Acalypha indica</i> L. Hierba del cancer; Island Catnip	H	T	Nt/N	U
<i>Euphorbia cyathophora</i> Murr. Dwarf Poinsetta	H	T	Nt/N	U
<i>Euphorbia hirta</i> L. Golondrina	H	T	Nt/N	U
<i>Melanolepis multiglandulosa</i> (Reinw. Ex Bl.) Reichb. f. & Zoll.	S	T	Nt/N	R
<i>Phyllanthus amarus</i> Schum. Maigo-lalo	H	T	Nt/N	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Euphorbiaceae (Spurge Family) (Cont'd)				
<i>Phyllanthus marianus</i> Muell.-Arg. Gaogao-uchan	H	T	Nt/N	U
Fabaceae (Leguminosae) (Bean family)				
<i>Abrus precatorius</i> L. Kolales halomtano; Coral bean	V	T	Nd	U
<i>Alysicarpus vaginalis</i> (L.) DC.	H	T	Nt/N	U
<i>Crotalaria pallida</i> Ait. Pale Rattlebox	H	T	Nt/N	U
<i>Desmodium triflorum</i> (L.) DC.	H	T	Nt/N	U
<i>Indigofera suffruticosa</i> Mill.	S	T	Nd	U/Cl
<i>Mucuna gigantea</i> (Willd.) DC. Bayogo dikike; Gayetan	V	T	Nd	U/Cl
<i>Sesbania cannabina</i> (Retz.) Pers.	H	T	Nt/N	R
Goodeniaceae (Naupaka family)				
<i>Scaevola sericea</i> Vahl. Nanaso; Half-flower	S	T	Nd	U
Hernandiaceae (Hernandia family)				
<i>Hernandia sonora</i> L. Nonag	T	T	Nd	C
Lamiaceae (Labiatae) (Mint family)				
<i>Hyptis</i> sp.	H/S	T	Nd	R/Cl
Lauraceae (Laurel family)				
<i>Cassytha filiformis</i> L. Agasi; Magagas	V	P	Nd	U
Lythraceae (Crape myrtle family)				
<i>Pemphis acidula</i> Forst. Nigas	S	T	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Malvaceae (Hibiscus family)				
<i>Hibiscus tiliaceus</i> L. Pago; Sea-hibiscus	T	T	Nd	A
<i>Malvastrum coromandelianum</i> (L.) Garcke	H	T	Nt/N	U
<i>Sida rhombifolia</i> L. var. <i>rhombifolia</i> Escobilla dalili; Dalili apaka	H	T	Nt/N	U
<i>Thespesia populnea</i> (L.) Sol ex Correa Banalo; Kilulu; Kuluk	S	T	Nd	C/Cl
Mimosaceae (Leguminosae) (Mimosa family)				
<i>Albizia lebbek</i> (L.) Benth. Trongkon-mames; Mamis; Woman's tongue	T	T	Nt/N	U
<i>Desmanthus virgatus</i> (L.) Willd.	S	T	Nt/N	U
<i>Leucaena leucocephala</i> (Lam.) de Wit Tangantangan	T	T	Nt/N	A
<i>Mimosa pudica</i> L. Sleeping Grass; Sensitive plant	V	T	Nt/N	C
<i>Pithecellobium dulce</i> (Roxb.) Beth. Kamachile	T	T	Mt/N	C
Moraceae (Fig family)				
<i>Ficus prolixa</i> var. <i>subcordata</i> Corner Nunu; Taotaomona tree; Strangler Fig	T	T	Nd	R
<i>Ficus tinctoria</i> var. <i>neo-ebudarum</i> (Summerh.) Fosb.	T	T	Nd	R
Myrtaceae (Myrtle family)				
<i>Eugenia palumbis</i> Merr. Agatelang	T	T	Nd	R
Oleaceae (Olive family)				
<i>Jasminum marianum</i> DC. Banago	V	T	Nd	C
Onagraceae (Evening primrose family)				
<i>Ludwigia octovalis</i> (Jacq.) Raven Titimo	H	A	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Oxalidaceae (Oxalis Family)				
<i>Oxalis corniculata</i> L. Apsom; Agsom; Yellow wood-sorrel	H	T	Nt/N	U/Cl
Passifloraceae (Passion flower family)				
<i>Passiflora foetida</i> var. <i>hispida</i> (DC.) Killip Love-in-a-mist	V	T	Nt/N	U
<i>Passiflora suberosa</i> L.	V	T	Nt/N	U
Polygalaceae (Polygala family)				
<i>Polygala paniculata</i> L.	H	T	Nt/N	U
Polygonaceae (Buckwheat family)				
<i>Portulaca oleracea</i> var. <i>granulato-stellulata</i> v. Poelin Botdolagas, Donkulu	H	T	Nd	U/C
Rhamnaceae (Buckthorn family)				
<i>Colubrina asiatica</i> (L.) Brongn. Gasoso	S	T	Nd	U
Rhizophoraceae (Mangrove family)				
<i>Bruguiera gymnorhiza</i> (L.) Lam. Mangle lahi	T	A	Nd	A
Rubiaceae (Coffee family)				
<i>Aidia cochinchinensis</i> Lour. Sumac	T	T	Nd	U
<i>Dentaria repens</i> J.R. & G. Forst. Borduegas	H	T	Nt/N	U
<i>Hedyotis strigulosa</i> (Bartl. ex DC.) Fosb.	H	T	Nd	U
<i>Morinda citrifolia</i> L. Lada	T	T	Nd	U
<i>Psychotria mariana</i> Bartl. ex. DC.	T	T	Nd	U
<i>Spermacoce assurgens</i> R. & P.	H	T	Nt/N	U
Rutaceae (Rue family)				
<i>Citrus</i> sp.	T	T	Nt	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Sapindaceae (Soapberry family)				
<i>Allophylus timorensis</i> (DC.) Bl. Nger	S	T	Nd	R
<i>Dodonaea viscosa</i> (L.) Jacq.	T	T	Nt/N	U/Cl
Sapotaceae (Sapodilla family)				
<i>Pouteria obovata</i> (R. Br.) Baehni	T	T	Nd	U
Scrophulariaceae (Snapdragon family)				
<i>Bacopa monnieri</i> (L.) Wettst. Water hyssop	H	A	Nt/N	U
<i>Bacopa procumbens</i> (Mill.) Greenm.	H	T	Nt/N	U
Solanaceae (Tomato family)				
<i>Physalis</i> sp.	H	T	Nt	R
Tiliaceae (Linden family)				
<i>Muntingia calabura</i> L. Manzanita; Panama Cherry	T	T	Nt/N	U
Urticaceae (Nettle family)				
<i>Pilea microphylla</i> (L.) Liebm. Artillery plant	H	T	Nt/N	U
Verbenaceae (Vervain family)				
<i>Lippia nodiflora</i> (L.) Rich.	H	T	Nt/N	U/Cl
<i>Premna obtusifolia</i> R. Br.	T	T	ND	U
<i>Stachytarpheta jamaicensis</i> (L.) Vahl Jamaica Vervain	H	T	Nt/N	C
<i>Stachytarpheta urticifolia</i> Sims Nettle-leaved vervain	H	T	Nt/N	U

Table 2. Importance Values of Dominant Species Along Four Transects

Transect 1. Species and Importance values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
<i>Nephrolepis hirsutula</i>	0.645	<i>Leucaena leucocephala</i>	0.424	<i>Hibiscus tiliaceus</i>	0.901	<i>Leucaena leucocephala</i>	1.019	<i>Hibiscus tiliaceus</i>	1.546
<i>Leucaena leucocephala</i>	0.275	<i>Hibiscus tiliaceus</i>	0.383	<i>Leucaena leucocephala</i>	0.469	<i>Hibiscus tiliaceus</i>	0.391	<i>Leucaena leucocephala</i>	0.528
<i>Eupatorium odoratum</i>	0.223	<i>Ipomoea indica</i>	0.280	<i>Ipomoea indica</i>	0.240	<i>Ipomoea indica</i>	0.205	<i>Ipomoea indica</i>	0.238
<i>Ipomoea indica</i>	0.222	<i>Momordica charantia</i>	0.154	<i>Passiflora suberosa</i>	0.133	<i>Mucuna gigantea</i>	0.139	<i>Nephrolepis hirsutula</i>	0.104
<i>Hibiscus tiliaceus</i>	0.168	<i>Ipomoea macrantha</i>	0.149	7 other species, each < 0.100		4 other species, each < 0.100		19 other species, each < 0.100	
<i>Polypodium scolopendria</i>	0.139	<i>Eupatorium odoratum</i>	0.130						
<i>Momordica charantia</i>	0.135	<i>Ficus tinctoria</i>	0.103						
5 other species, each < 0.100		7 other species, each < 0.100							

Table 2. (Cont'd)

Transect 2. Species and Importance Values

Bottom Stratum	Lower Stratum	Upper Stratum	Top Stratum	All Strata Combined
1m	1-3m	3-10m	10m	
<i>Acrostichum aureum</i> 1.011	<i>Ipomoea indica</i> 0.475	<i>Leucaena leucocephala</i> 1.040	<i>Casuarina equisetifolia</i> 1.618	<i>Acrostichum aureum</i> 0.488
<i>Mikania scandens</i> 0.503	<i>Morinda citrifolia</i> 0.346	<i>Jasminum marianum</i> 0.825	<i>Jasminum marianum</i> 0.382	<i>Leucaena leucocephala</i> 0.242
<i>Ipomoea indica</i> 0.113	<i>Eupatorium odoratum</i> 0.247	<i>Ipomoea macrantha</i> 0.136	No other species	<i>Mikania scandens</i> 0.242
<i>Ipomoea macrantha</i> 0.111	<i>Mucuna gigantea</i> 0.228	No other species.		<i>Jasminum marianum</i> 0.231
<i>Polypodium scolopendria</i> 0.111	<i>Ipomoea macrantha</i> 0.217			<i>Casuarina equisetifolia</i> 0.160
2 other species, each 0.100	<i>Hibiscus tiliaceus</i> 0.189			<i>Ipomoea indica</i> 0.159
	<i>Leucaena leucocephala</i> 0.169			<i>Ipomoea macrantha</i> 0.129
	<i>Jasminum marianum</i> 0.130			<i>Eupatorium odoratum</i> 0.101
	No other species.			5 other species, each < 0.100

Table 2. (Cont'd)

Transect 3. Species and Importance Values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
<i>Acrostichum aureum</i>	0.665	<i>Pandanus dubius</i>	0.579	<i>Hernandia sonora</i>	0.642	<i>Thespesia populnea</i>	0.746	<i>Hernandia sonora</i>	0.502
<i>Polypodium scolopendria</i>	0.381	<i>Hernandia sonora</i>	0.324	<i>Pandanus dubius</i>	0.576	<i>Mikania scandens</i>	0.626	<i>Pandanus dubius</i>	0.324
<i>Hernandia sonora</i>	0.276	<i>Polypodium scolopendria</i>	0.274	<i>Morinda citrifolia</i>	0.190	<i>Hernandia sonora</i>	0.621	<i>Thespesia populnea</i>	0.269
<i>Mikania scandens</i>	0.231	<i>Ficus tinctoria</i>	0.230	<i>Mucuna gigantea</i>	0.141	<i>Pithecellobium dulce</i>	0.228	<i>Polypodium scolopendria</i>	0.135
<i>Eupatorium odoratum</i>	0.173	<i>Leucaena leucocephala</i>	0.218	<i>Melanolepis multiglandulosa</i>	0.115	<i>Pandanus dubius</i>	0.217	<i>Acrostichum aureum</i>	0.130
<i>Thelypteris opulenta</i>	0.127	<i>Eupatorium odoratum</i>	0.106	4 other species, each < 0.100		1 other species < 0.100		<i>Mucuna gigantea</i>	0.104
2 other species, each 0.100		3 other species, each 0.100						12 other species, each < 0.100	

Table 2. (Cont'd)

Transect 4. Species and Importance Values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined
1m		1-3m		3-10m		10m		
<i>Acrostichum aureum</i>	0.664	<i>Pandanus dubius</i>	0.734	<i>Pandanus dubius</i>	1.135	<i>Casuarina equisetifolia</i>	1.558	<i>Bruguiera gymnorrhiza</i> 0.830
<i>Hymenocallis littoralis</i>	0.491	<i>Hibiscus tiliaceus</i>	0.367	<i>Hibiscus tiliaceus</i>	0.229	<i>Hemandia sonora</i>	0.183	<i>Pandanus dubius</i> 0.498
<i>Nephrolepis hirsutula</i>	0.202	<i>Bruguiera gymnorrhiza</i>	0.216	<i>Hemandia sonora</i>	0.221	<i>Bruguiera gymnorrhiza</i>	0.174	<i>Casuarina equisetifolia</i> 0.314
<i>Bruguiera gymnorrhiza</i>	0.140	<i>Hemandia sonora</i>	0.132	<i>Bruguiera gymnorrhiza</i>	0.115	1 other species, < 0.100		<i>Acrostichum aureum</i> 0.181
<i>Pandanus dubius</i>	0.112	<i>Passiflora suberosa</i>	0.126	4 other species, each < 0.100				<i>Hibiscus tiliaceus</i> 0.147
<i>Polypodium scolopendria</i>	0.107	<i>Phyllanthus marianus</i>	0.126					<i>Hymenocallis littoralis</i> 0.137
<i>Eupatorium odoratum</i>	0.101	4 other species, each < 0.100						<i>Hemandia sonora</i> 0.125
2 other species, each < 0.100								12 other species, each < 0.125

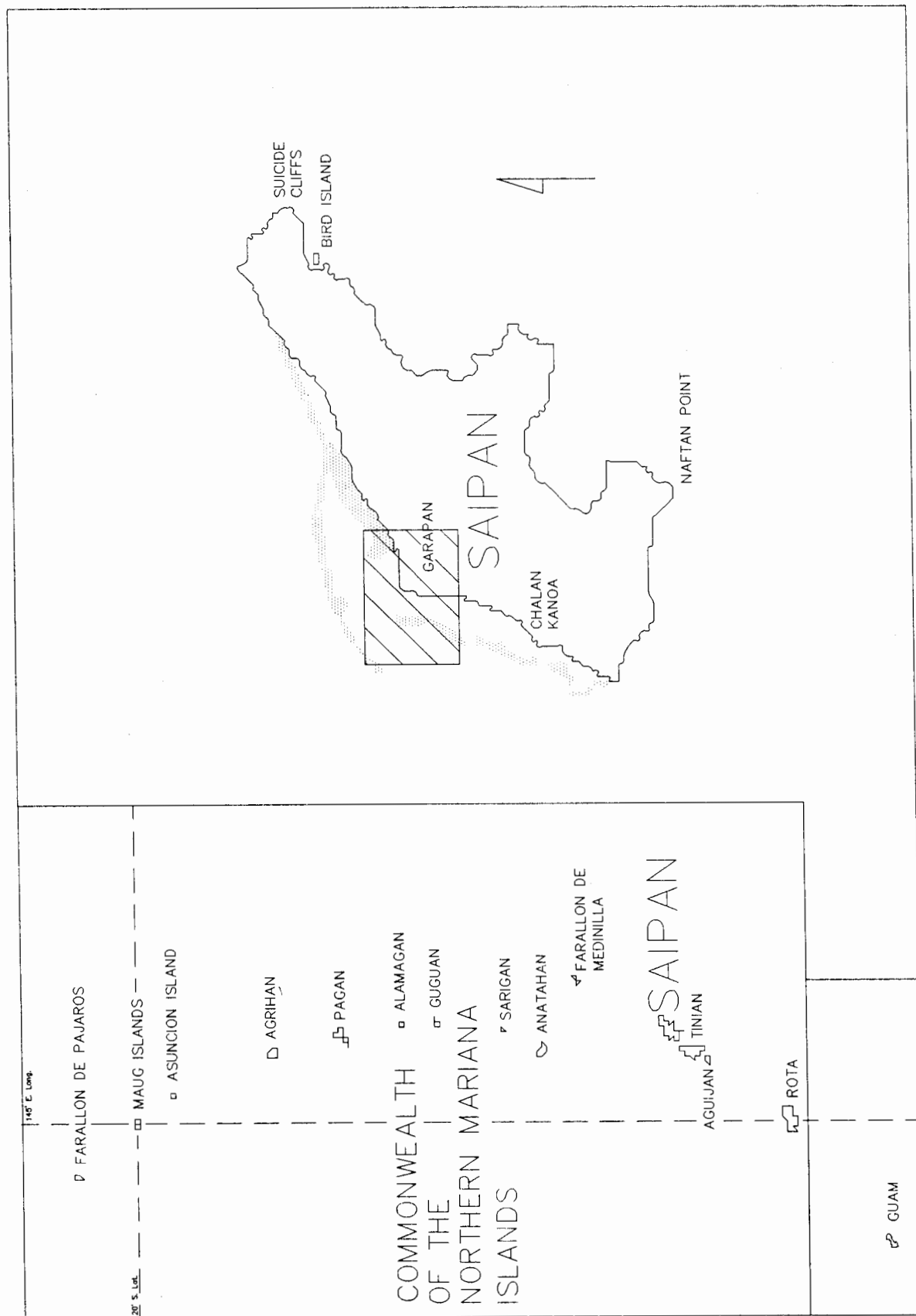


Fig 1. Vicinity Map

American Memorial Park CNMI, Saipan.

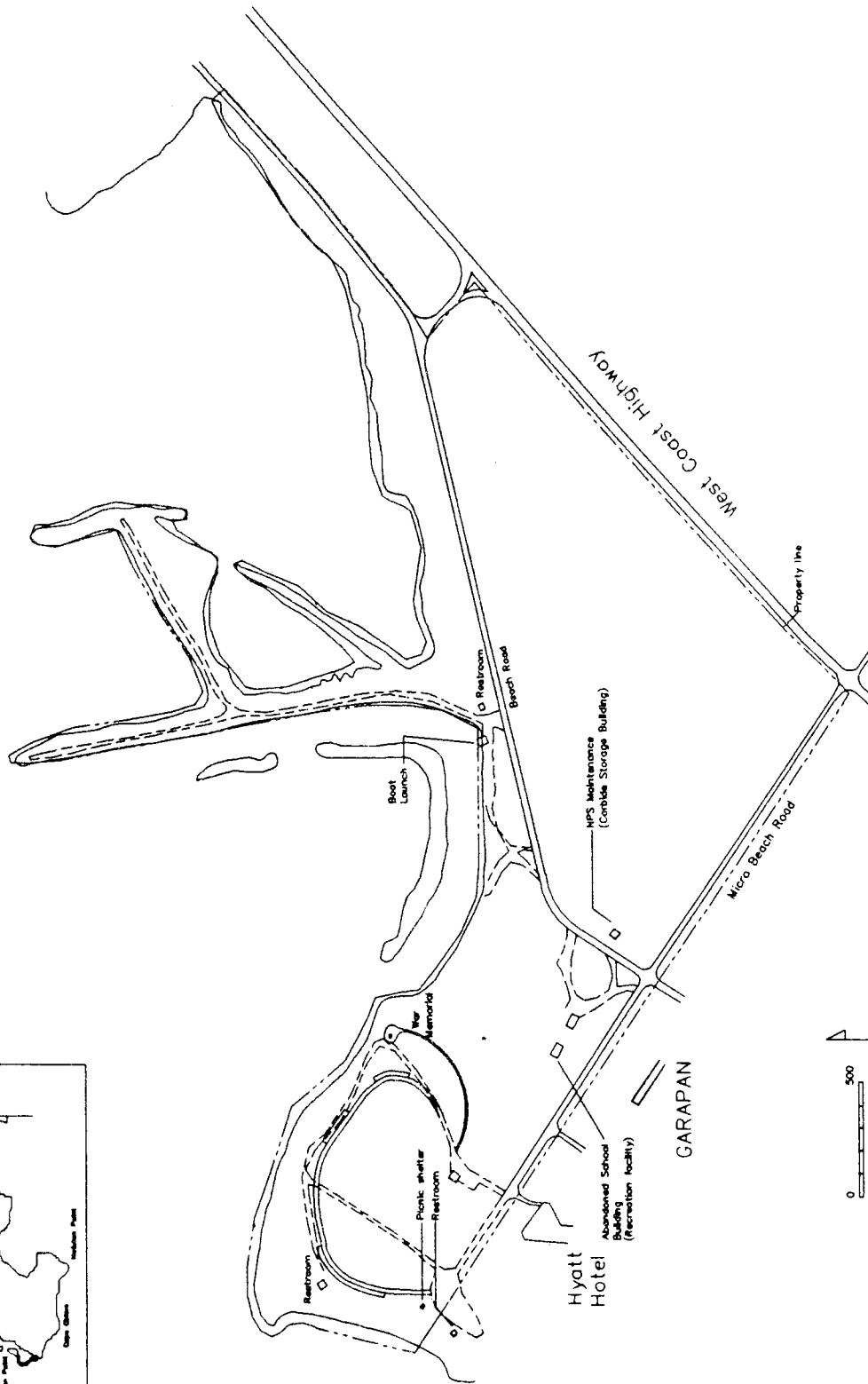
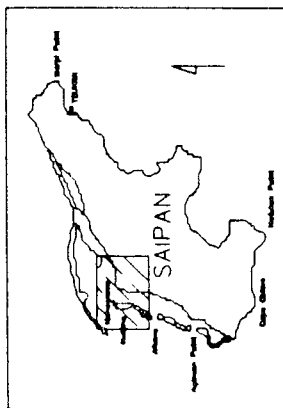


Fig 2. Map of American Memorial Park, Saipan

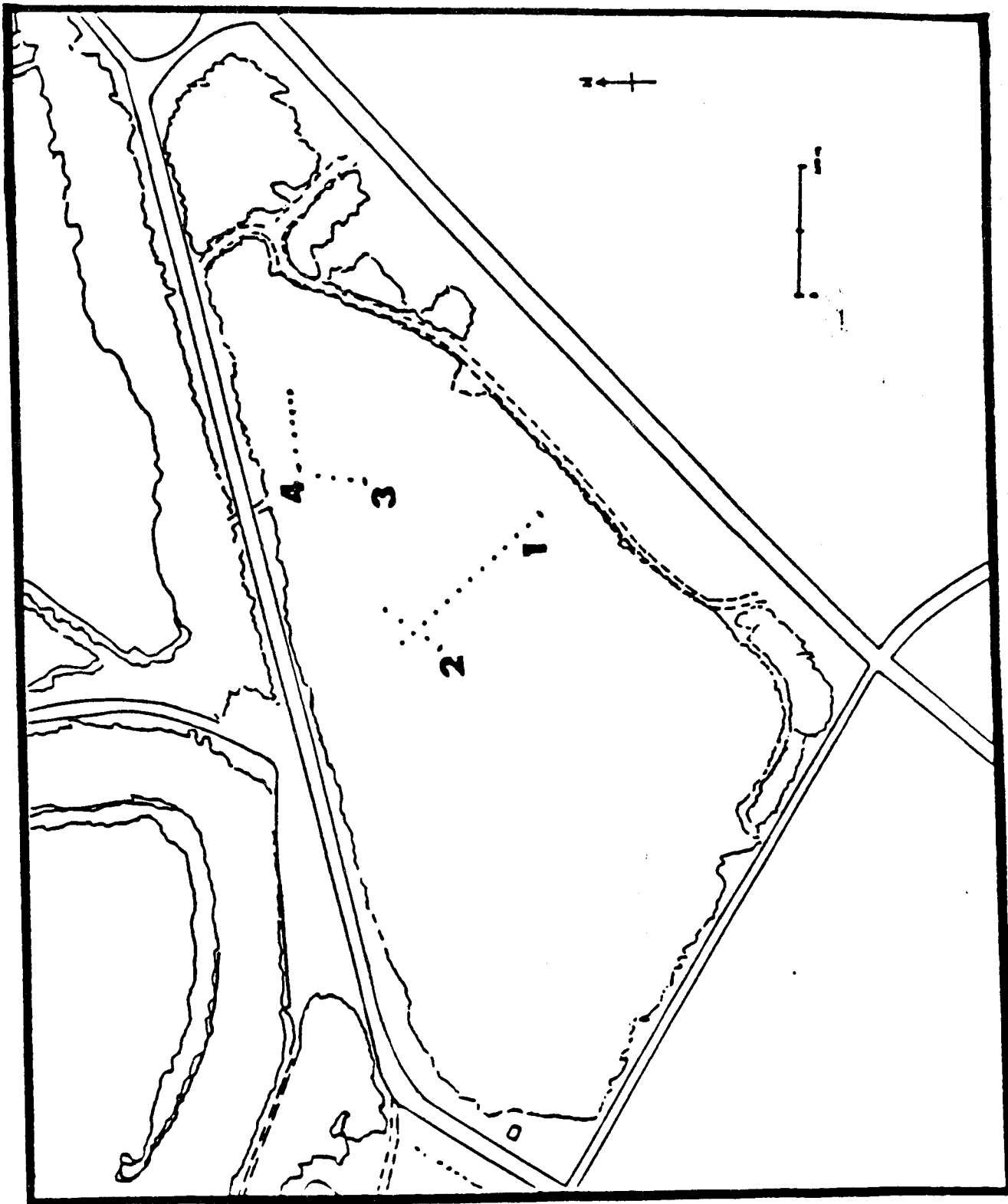


Fig 3. Location of Vegetation transects in American Memorial Park, Saipan

LEGEND

c-M:Cep	Closed mesic Ironwood; kamachile forest
c-M:Li(v)	Closed mesic tangantangan scrub with vines
c-M:ns	Closed mesic native shrubs
c-W:Bg-nt	Closed wet mixed forest with mangroves
c-W:Ht	Closed hibiscus forest
c-M:Ce(v-g)	Open mesic Ironwood forest with grassland and morning glory vine understory
o-M:(g)	Open dry area with mixed grasses (mown areas)
o-M:(v-g)	Open mesic grassland with morning glory vines
o-W:(Aa)	Open wetland with acrostichum aureum
o-W:Ce,nt(Aa)	Open wet Ironwood forest with other native trees and an understory of Acrostichum aureum
o-W:(h)	Open wetland with native herbs
P	Planted ornamentals

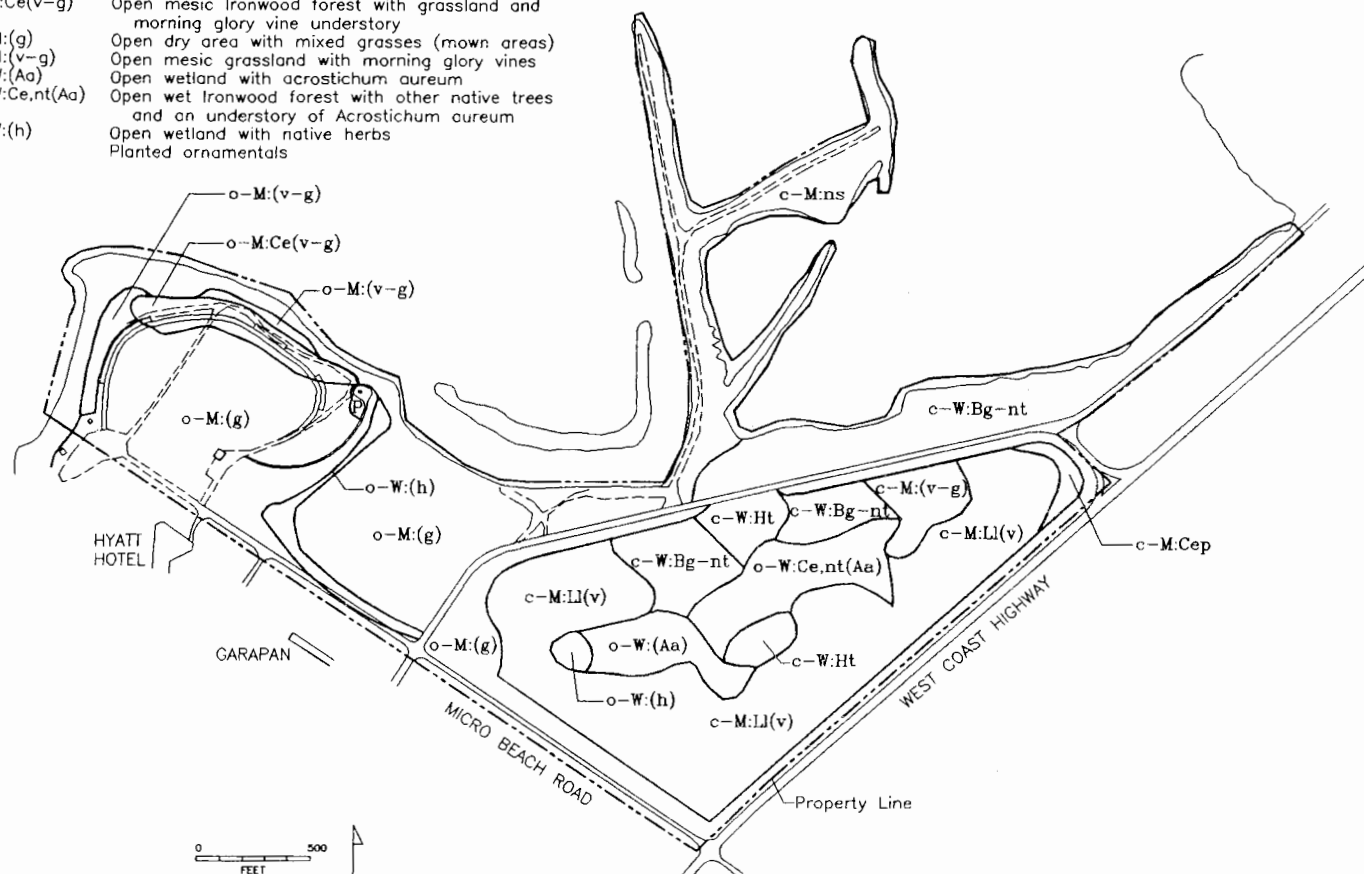


Fig 4. Vegetation Map of American Memorial Park, Saipan



Fig 5. Garapan and the barrier reef with Managaha Island from Mt. Topochau.

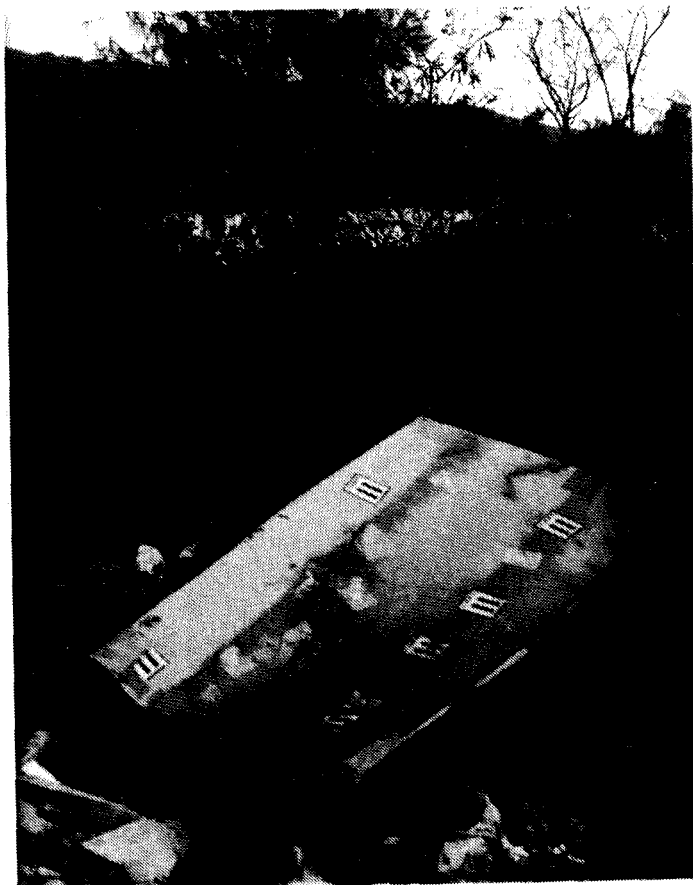


Fig 6. Dumping area.

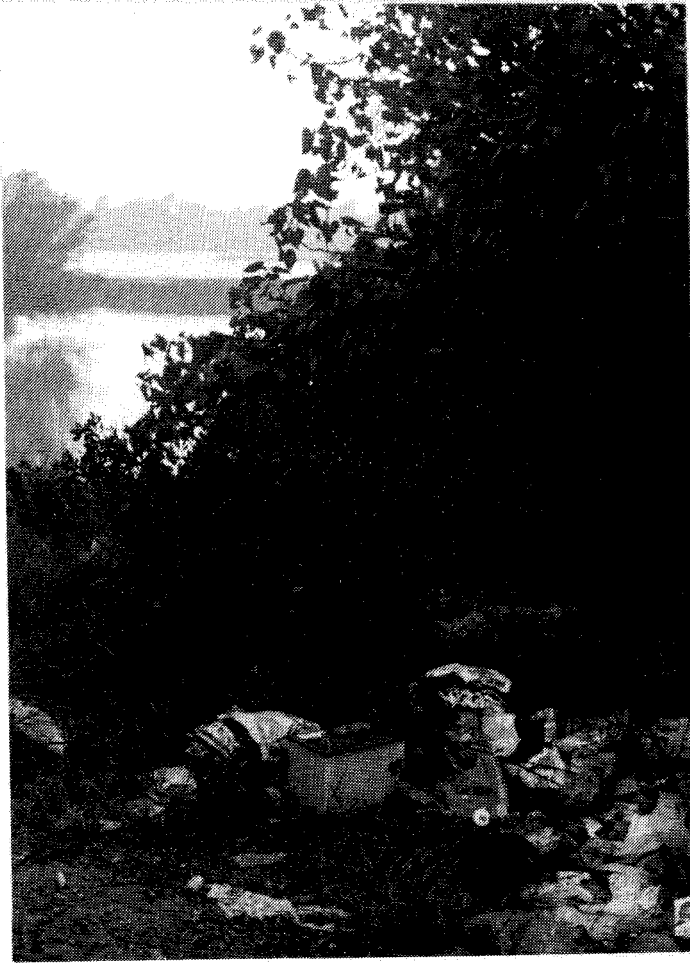


Fig 7. Trash and smoke from the dump.



Fig 8. Trash and smoke from the dump and eroding jetty.



Fig 9. Mangle lahi (*Bruguiera gymnorhiza*). Only Pacific mangrove on Saipan.



Fig 10. *Scirpus littoralis*.



Fig 11. Hilo grass (*Paspalum distichum*), and
Langayao (*Acrostichum aureum*)
in the background.



Fig 12. Fufgu (*Ipomoea indica*)
growing on tangantangan (*Leucaena leucocephala*).



Fig 13. Mile a minute (*Mikania scandens*) and fufgu (*Ipomoea indica*) growing on tangantangan (*Leucaena leucocephala*).



Fig 14. *Eupatorium odoratum*.



Fig 15. Temple grass
(*Zoysia matrella*)
on the jetty.



Fig 16. Trash from the
municipal dump.

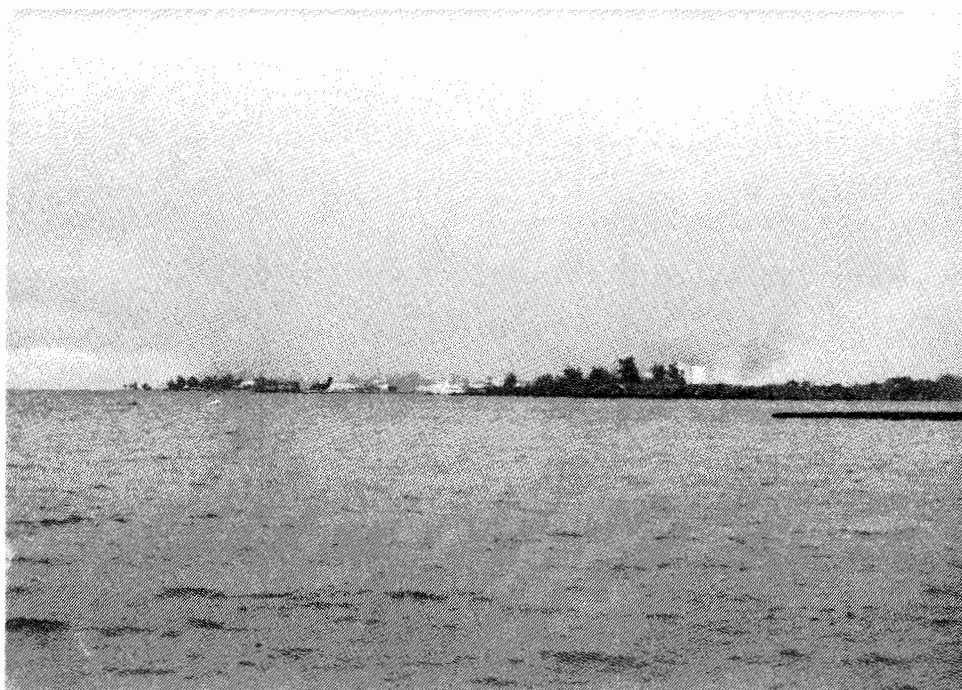


Fig 17. Smoke from the dump.

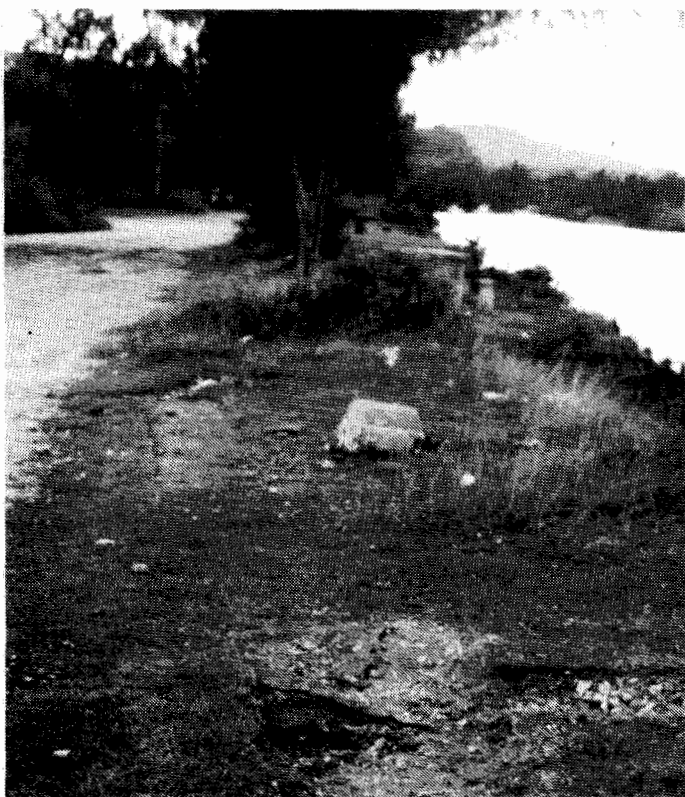


Fig 18. Harvested turf.

Appendix

Raw Data used to calculate Importance Values

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (li)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
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Date : 7 August 1986

Transect #1 - Totals of all 4 Strata

Total transect length (L) 600m Total number of transect intervals 120

<i>Hibiscus tiliaceus</i>	39	0.325	0.209	137.6m	0.229	0.337	1.546
<i>Leucaena leucocephala</i>	42	0.350	0.225	123.7m	0.206	0.303	0.528
<i>Ipomoea indica</i>	27	0.225	0.145	38.1m	0.064	0.093	0.238
<i>Pouteria obovata</i>	3	0.025	0.016	2.6m	0.004	0.006	0.022
<i>Polypodium scolopendria</i>	5	0.042	0.027	7.5m	0.013	0.018	0.045
<i>Momordica charantia</i>	12	0.100	0.064	9.9m	0.017	0.024	0.088
<i>Acalypha indica</i>	1	0.008	0.005	0.2m	0.0003	0.001	0.006
<i>Eupatorium odoratum</i>	8	0.067	0.043	10.4m	0.017	0.026	0.069
<i>Carica papaya</i>	1	0.008	0.005	1.0m	0.002	0.003	0.008
<i>Passiflora suberosa</i>	7	0.058	0.037	11.0m	0.018	0.027	0.064
<i>Desmanthus virgatus</i>	1	0.008	0.005	0.4m	0.001	0.001	0.006
<i>Jasminum marianum</i>	7	0.058	0.037	11.2m	0.019	0.028	0.065
<i>Ficus tinctoria</i>	2	0.017	0.011	4.5m	0.008	0.011	0.022

Transect # 1 Bottom stratum

Total transect length (L) 150m Total number of transect intervals 30

<i>Hibiscus tiliaceus</i>	4	0.133	0.103	3.7m	0.025	0.065	0.168
<i>Leucaena leucocephala</i>	4	0.133	0.103	9.8m	0.065	0.172	0.275
<i>Ipomoea indica</i>	5	0.167	0.129	5.3m	0.035	0.093	0.222
<i>Pouteria obovata</i>	1	0.033	0.025	1.2m	0.008	0.021	0.046
<i>Momordica charantia</i>	4	0.133	0.103	1.8m	0.012	0.032	0.135
<i>Polypodium scolopendria</i>	3	0.100	0.077	3.5m	0.023	0.062	0.139
<i>Acalypha indica</i>	1	0.033	0.025	0.2m	0.001	0.004	0.029

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (li)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
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Transect # 1 Bottom stratum (Cont'd)

Total transect length (L) 150m Total number of transect intervals 30

<i>Eupatorium odoratum</i>	6	0.200	0.154	3.9m	0.026	0.069	0.223
<i>Passiflora suberosa</i>	1	0.033	0.025	0.3m	0.002	0.005	0.030
<i>Stictocardia tiliaefolia</i>	1	0.033	0.025	0.2m	0.001	0.004	0.029
<i>Mikania scandens</i>	1	0.033	0.025	2m	0.013	0.035	0.060
<i>Nephrolepis hirsutula</i>	8	0.267	0.206	25m	0.167	0.439	0.645
Totals	f = 1.298	Rf = 1.0	I = 56.9m	IC = 0.603	RC = 1.0		

Transect #1 - Lower stratum

Total transect length (L) 150m Total number of transect intervals 30

<i>Hibiscus tiliaceus</i>	7	0.233	0.140	17.5m	0.117	0.243	0.383
<i>Leucaena leucocephala</i>	8	0.267	0.160	19.0m	0.127	0.264	0.424
<i>Ipomoea indica</i>	9	0.300	0.180	7.2m	0.048	0.100	0.280
<i>Pouteria obovata</i>	2	0.067	0.040	1.4m	0.009	0.020	0.060
<i>Polypodium scolopendria</i>	2	0.067	0.040	4.0m	0.027	0.056	0.096
<i>Momordica charantia</i>	5	0.167	0.100	3.9m	0.026	0.054	0.154
<i>Eupatorium odoratum</i>	2	0.067	0.040	6.5m	0.043	0.090	0.130
<i>Passiflora suberosa</i>	1	0.033	0.020	0.3m	0.002	0.004	0.024
<i>Desmanthus virgatus</i>	1	0.033	0.020	0.4m	0.003	0.006	0.026
<i>Jasminum marianum</i>	2	0.067	0.040	3.0m	0.020	0.042	0.082
<i>Ficus tinctoria</i>	2	0.067	0.040	4.5m	0.030	0.063	0.103
<i>Psychotria mariana</i>	2	0.067	0.040	1.7m	0.011	0.024	0.064
<i>Melanolepis multiglandulosa</i>	1	0.033	0.020	0.4m	0.003	0.006	0.026
<i>Ipomoea indica</i>	6	0.200	0.120	2.1m	0.014	0.029	0.149
Totals	f = 1.668	Rf = 1.0	I = 71.9	IC = 0.48	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (li)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
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Transect # 1 Upper stratum

Total transect length (L) 150m Total number of transect intervals 30

<i>Hibiscus tiliaceus</i>	23	0.767	0.354	92.9m	0.619	0.547	0.901
<i>Leucaena leucocephala</i>	15	0.500	0.231	40.4m	0.269	0.238	0.469
<i>Ipomoea indica</i>	10	0.333	0.154	14.6m	0.097	0.086	0.240
<i>Momordica charantica</i>	2	0.067	0.031	0.5m	0.003	0.003	0.034
<i>Carica papaya</i>	1	0.033	0.015	1.0m	0.007	0.006	0.021
<i>Passiflora suberosa</i>	4	0.133	0.061	6.4m	0.043	0.038	0.133
<i>Jasminum marianum</i>	2	0.067	0.031	3.0m	0.020	0.018	0.049
<i>Mucuna gigantea</i>	4	0.133	0.061	4.5m	0.030	0.027	0.088
<i>Mikania scandens</i>	2	0.067	0.031	4.0m	0.027	0.024	0.055
<i>Morinda citrifolia</i>	1	0.033	0.015	2.0m	0.013	0.012	0.027
<i>Pithecellobium dulce</i>	1	0.033	0.015	0.4m	0.003	0.002	0.017
Totals	f = 2.166	Rf = 1.0	I = 169.7	IC = 1.131	RC = 1.0		

Transect #1 Top stratum

Total transect length (L) 150m Total number of transect intervals 30

<i>Hibiscus tiliaceus</i>	5	0.167	0.167	23.5m	0.157	0.224	0.391
<i>Leucaena leucocephala</i>	15	0.500	0.500	54.5m	0.363	0.519	1.019
<i>Ipomoea indica</i>	3	0.100	0.100	11.0m	0.073	0.105	0.205
<i>Momordica charantia</i>	1	0.033	0.033	4.5m	0.030	0.013	0.076
<i>Passiflora suberosa</i>	1	0.033	0.033	4.0m	0.027	0.038	0.071
<i>Stictocardia tiliacifolia</i>	1	0.033	0.033	3.0m	0.020	0.029	0.062
<i>Mucuna gigantea</i>	3	0.100	0.100	4.0m	0.027	0.039	0.139
<i>Pithecellobium dulce</i>	1	0.033	0.033	0.4m	0.003	0.004	0.037
Totals	f = 0.999	Rf = 1.0	I = 105	IC = 0.7	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (li)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
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Transect # 2 - Total for all strata

Total transect length (L) 220m Total number of transect intervals 44

<i>Hibiscus tiliaceus</i>	1	0.023	0.022	2.5m	0.011	0.020	0.042
<i>Acrostichum aureum</i>	9	0.205	0.195	36m	0.164	0.293	0.488
<i>Casuarina equisetifolia</i>	4	0.091	0.087	9m	0.041	0.073	0.160
<i>Mikania scandens</i>	5	0.114	0.109	16.3m	0.074	0.133	0.242
<i>Leucaena leucocephala</i>	6	0.136	0.130	13.8m	0.063	0.112	0.242
<i>Ipomoea indica</i>	3	0.068	0.065	11.5m	0.052	0.094	0.159
<i>Polypodium scolopendria</i>	2	0.046	0.044	0.9m	0.004	0.007	0.051
<i>Jasminum marianum</i>	1	0.023	0.022	3.5m	0.016	0.029	0.051
<i>Passiflora suberosa</i>	1	0.023	0.022	0.8m	0.004	0.007	0.029
<i>Morinda citrifolia</i>	2	0.046	0.044	4.2m	0.019	0.034	0.078
<i>Ipomoea macrantha</i>	5	0.114	0.109	2.4m	0.011	0.020	0.129
<i>Eupatorium odoratum</i>	2	0.046	0.044	7m	0.032	0.057	0.101
Totals	f = 1.049	Rf = 1.0	I = 122.9m	IC = 0.559	RC = 1.0		

Transect #2 - Bottom stratum

Total transect length (L) 55m Total number of transect intervals 11

<i>Acrostichum aureum</i>	9	0.818	0.431	36m	0.655	0.58	1.011
<i>Mikania scandens</i>	5	0.455	0.240	16.5m	0.296	0.263	0.503
<i>Ipomoea indica</i>	1	0.091	0.048	4m	0.073	0.065	0.113
<i>Polypodium scolopendria</i>	2	0.182	0.096	0.9m	0.016	0.015	0.111
<i>Passiflora suberosa</i>	1	0.091	0.048	0.8m	0.015	0.013	0.061
<i>Ipomoea macrantha</i>	2	0.182	0.096	0.9m	0.016	0.015	0.111
<i>Eupatorium odoratum</i>	1	0.091	0.048	3m	0.055	0.049	0.097
Totals	f = 1.900	Rf = 1.0	I = 61.9m	IC = 1.126	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (li)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
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Transect #2 - Lower stratum

Total transect length (L) 55m Total number of transect intervals 11

<i>Hibiscus tiliaceus</i>	1	0.091	0.091	2.5m	0.046	0.098	0.189
<i>Leucaena leucocephala</i>	1	0.091	0.091	2m	0.036	0.078	0.169
<i>Ipomoea indica</i>	2	0.182	0.182	7.5m	0.136	0.293	0.475
<i>Jasminum marianum</i>	1	0.091	0.091	1m	0.018	0.039	0.130
<i>Mucuna gigantea</i>	1	0.091	0.091	3.5m	0.064	0.137	0.228
<i>Morinda citrifolia</i>	2	0.182	0.182	4.2m	0.076	0.164	0.346
<i>Ipomoea macrantha</i>	2	0.182	0.182	0.9m	0.016	0.035	0.217
<i>Eupatorium odoratum</i>	1	0.091	0.091	4m	0.073	0.156	0.247
Totals	f = 1.001	Rf = 1.0	I = 25.6m	IC = 0.465	RC = 1.0		

Transect #2 - Upper stratum

Total transect length (L) 55m Total number of transect intervals 11

<i>Leucaena leucocephala</i>	5	0.455	0.556	11.8m	0.215	0.484	1.04
<i>Jasminum marianum</i>	3	0.273	0.333	12m	0.218	0.492	0.825
<i>Ipomoea macrantha</i>	1	0.091	0.111	0.6m	0.011	0.025	0.136
Totals	f = 0.819	Rf = 1.0	I = 24.4m	IC = 0.444	RC = 1.0		

Transect #2 - Top stratum

Total transect length (L) 150m Total number of transect intervals 30

<i>Casuarina equisetifolia</i>	4	0.364	0.800	9m	0.164	0.818	1.618
<i>Jasminum marianum</i>	1	0.091	0.200	2m	0.036	0.182	0.382
Totals	f = 0.455	Rf = 1.0	I = 11m	IC = 0.2	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #3; Totals for all strata							
Total transect length (L) <u>200m</u> Total number of transect intervals <u>40</u>							
<i>Acrostichum aureum</i>	3	0.075	0.049	10.8m	0.054	0.081	0.130
<i>Pyrrosia lanceolata</i>	1	0.025	0.016	1.0m	0.005	0.008	0.024
<i>Thespesia populnea</i>	5	0.125	0.082	24.8m	0.124	0.187	0.269
<i>Polypodium scolopendria</i>	6	0.150	0.098	4.9m	0.025	0.037	0.135
<i>Morinda citrifolia</i>	3	0.075	0.049	2.8m	0.014	0.021	0.070
<i>Mikania scandens</i>	2	0.050	0.033	6.5m	0.033	0.049	0.082
<i>Mucuna gigantea</i>	4	0.100	0.066	5.0m	0.025	0.038	0.104
<i>Eupatorium odoratum</i>	3	0.075	0.049	1.5m	0.008	0.011	0.060
<i>Pithecellobium dulce</i>	3	0.075	0.049	2m	0.010	0.015	0.064
<i>Hibiscus tiliaceus</i>	1	0.025	0.016	1m	0.005	0.008	0.024
<i>Ipomoea indica</i>	2	0.050	0.033	0.5m	0.003	0.004	0.037
<i>Pandanus dubius</i>	9	0.225	0.148	23.3m	0.117	0.176	0.324
<i>Ficus tinctoria</i>	2	0.050	0.033	3.5m	0.018	0.026	0.059
<i>Hernandia sonora</i>	12	0.300	0.197	40.5m	0.203	0.308	0.502
<i>Leucaena leucocephala</i>	2	0.050	0.033	1.1m	0.006	0.008	0.041
<i>Passiflora suberosa</i>	1	0.025	0.016	0.1m	0.001	0.001	0.017
<i>Thelypteris opulenta</i>	1	0.025	0.016	1.5m	0.008	0.011	0.027
<i>Melanolepis multiglandulosa</i>	1	0.025	0.016	2m	0.01	0.015	0.031
Totals	f = 1.525	Rf = 1.0	I = 132.8m	IC = 0.669	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many traverse Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVI)
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Transect #3 - Bottom stratum

Total transect length (L) 50m Total number of transect intervals 10

<i>Acrostichum aureum</i>	3	0.333	0.217	10.8m	0.216	0.448	0.665
<i>Polypodium scolopendria</i>	4	0.40	0.261	2.9m	0.058	0.120	0.381
<i>Mikana scandens</i>	1	0.10	0.065	4.0m	0.080	0.166	0.231
<i>Mucunia gigantea</i>	1	0.10	0.065	0.2m	0.004	0.008	0.073
<i>Eupatorium odoratum</i>	2	0.20	0.131	1.0m	0.020	0.042	0.173
<i>Ipomoea indica</i>	1	0.10	0.065	0.2m	0.004	0.008	0.073
<i>Hernandia sonora</i>	2	0.20	0.131	3.5m	0.070	0.145	0.276
<i>Thelypteris opulenta</i>	1	0.10	0.065	1.5m	0.030	0.062	0.127
Totals	f = 1.533	Rf = 1.0	I = 24.1m	IC =	RC = 1.0		

Transect #3 Lower stratum

Total transect length (L) 50m Total number of transect intervals 10

<i>Polypodium scolopendria</i>	2	0.2	0.150	2m	0.04	0.124	0.274
<i>Morinda citrifolia</i>	1	0.1	0.075	0.2m	0.006	0.019	0.094
<i>Mucuna gigantea</i>	1	0.1	0.075	0.3m	0.006	0.019	0.094
<i>Eupatorium odoratum</i>	1	0.1	0.075	0.5m	0.010	0.031	0.106
<i>Pandanus dubius</i>	3	0.333	0.250	5.3m	0.106	0.329	0.579
<i>Ficus tinctoria</i>	1	0.1	0.075	2.5m	0.050	0.155	0.230
<i>Hernandia sonora</i>	1	0.1	0.075	4m	0.080	0.249	0.324
<i>Leucaena leucocephala</i>	2	0.2	0.150	1.1m	0.022	0.068	0.218
<i>Passiflora suberosa</i>	1	0.1	0.075	0.1m	0.002	0.006	0.081
Totals	f = 1.333	Rf = 1.0	I = 16.1m	IC = 0.375	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVI)
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Transect #3 - Upper stratum

Total transect length (L) 50m Total number of transect intervals 10

<i>Pyrrosia lanceolata</i>	1	0.1	0.063	1.0m	0.020	0.026	0.089
<i>Morinda citrifolia</i>	2	0.2	0.125	2.5m	0.050	0.065	0.190
<i>Mucuna gigantea</i>	1	0.1	0.063	3.0m	0.060	0.078	0.141
<i>Hibiscus tiliaceus</i>	1	0.1	0.063	1.0m	0.020	0.026	0.089
<i>Ipomoea indica</i>	1	0.1	0.063	0.3m	0.006	0.008	0.071
<i>Pandanus dubius</i>	4	0.4	0.250	12.5m	0.250	0.326	0.576
<i>Ficus tinctoria</i>	1	0.1	0.063	1m	0.020	0.026	0.089
<i>Hernandia sonora</i>	4	0.4	0.250	15.0m	0.300	0.392	0.642
<i>Melanolepis multiqlandulosa</i>	14	0.1	0.063	2m	0.040	0.052	0.115
Totals	f = 1.60	Rf = 1.0	I = 38.3m	IC = 0.766	RC = 1.0		

Transect #3 - Top stratum

Total transect length (L) 50m Total number of transect intervals 10

<i>Thespesia populnea</i>	5	0.5	0.289	24.8m	0.496	0.457	0.746
<i>Mikania scandens</i>	1	0.1	0.058	2.5m	0.050	0.046	0.626
<i>Mucuna gigantea</i>	1	0.1	0.058	1.5m	0.030	0.028	0.086
<i>Pithecellobium dulce</i>	3	0.33	0.191	2.0m	0.040	0.037	0.228
<i>Pandanus dubius</i>	2	0.2	0.116	5.5m	0.110	0.101	0.217
<i>Hernandia sonora</i>	5	0.5	0.289	18.0m	0.360	0.330	0.621
Totals	f = 1.73	Rf = 1.0	I = 54.3m	IC = 1.086	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #4; total all 4 strata							
Total transect length (L) <u>240m</u> Total number of transect intervals <u>48</u>							
<i>Carica papaya</i>	3	0.063	0.038	3.3m	0.014	0.017	0.055
<i>Imperata conferta</i>	2	0.042	0.025	0.8m	0.003	0.004	0.029
<i>Phyllanthus marianus</i>	2	0.042	0.025	1.4m	0.006	0.007	0.032
<i>Hemandia sonora</i>	4	0.083	0.050	15m	0.063	0.075	0.125
<i>Polypodium scolopendria</i>	3	0.063	0.038	2.2m	0.009	0.011	0.049
<i>Leucaena leucocephala</i>	2	0.042	0.025	1.3m	0.005	0.007	0.032
<i>Casuarina equisetifolia</i>	9	0.188	0.113	40m	0.167	0.201	0.314
<i>Pandanus dubius</i>	16	0.333	0.199	59.5	0.248	0.299	0.498
<i>Mucuna gigantea</i>	4	0.083	0.050	4.1m	0.017	0.021	0.071
<i>Hymenocallis littoralis</i>	6	0.125	0.075	12.3m	0.051	0.062	0.137
<i>Acrostichum aureum</i>	7	0.146	0.087	18.7m	0.078	0.094	0.181
<i>Morinda citrifolia</i>	1	0.021	0.013	0.5m	0.002	0.003	0.016
<i>Mikania scandens</i>	2	0.042	0.025	0.9m	0.004	0.005	0.030
<i>Eupatorium odoratum</i>	1	0.021	0.013	3m	0.013	0.015	0.028
<i>Hibiscus tiliaceus</i>	6	0.125	0.075	14.4m	0.060	0.072	0.147
<i>Bruguiera gymnorhiza</i>	6	0.125	0.75	16m	0.067	0.080	0.830
<i>Nephrolepis hirsutula</i>	3	0.063	0.038	4.1m	0.017	0.021	0.059
<i>Pyrrosia lanceolata</i>	1	0.021	0.013	0.4m	0.002	0.002	0.015
<i>Passiflora suberosa</i>	2	0.042	0.025	1.4m	0.006	0.007	0.032
Totals	f = 1.670	Rf = 1.0	I = 199.3m			RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVI)
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Transect #4 Swamp, swamp forest & associates; bottom (0-1m) stratum

Total transect length (L) 60m Total number of transect intervals 12

<i>Imperata conferta</i>	2	0.167	0.077	0.8m	0.01	0.017	0.094
<i>Polypodium scolopendria</i>	2	0.167	0.077	1.4m	0.02	0.030	0.107
<i>Mucuna gigantea</i>	1	0.083	0.038	0.6m	0.01	0.017	0.055
<i>Hymenocallis littoralis</i>	6	0.5	0.231	12.3m	0.205	0.260	0.491
<i>Acrostichum aureum</i>	7	0.583	0.269	18.7m	0.312	0.395	0.664
<i>Eupatorium odoratum</i>	1	0.083	0.038	3m	0.05	0.063	0.1401
<i>Bruguiera gymnorrhiza</i>	2	0.167	0.077	3m	0.05	0.063	0.140
<i>Nephrolepis hirsutula</i>	3	0.25	0.115	4.1m	0.068	0.087	0.202
<i>Pandanus dubius</i>	1	0.083	0.038	3.5m	0.058	0.074	0.112
Totals	f = 2.166	Rf = 1.0	I = 47.4m	IC = 0.783	RC = 1.0		

Transect #4; Lower stratum

Total transect length (L) 60m Total number of transect intervals 12

<i>Carica papaya</i>	2	0.167	0.091	1.3m	0.022	0.032	0.123
<i>Phyllanthus marianus</i>	2	0.167	0.091	1.4m	0.023	0.035	0.126
<i>Hernandia sonora</i>	1	0.083	0.045	3.5m	0.058	0.087	0.132
<i>Leucaena leucocephala</i>	1	0.083	0.045	0.3m	0.005	0.008	0.053
<i>Pandanus dubius</i>	6	0.5	0.273	18.5m	0.308	0.461	0.734
<i>Morinda citrifolia</i>	1	0.083	0.045	0.5m	0.008	0.012	0.057
<i>Mikania scandens</i>	1	0.083	0.045	0.8m	0.013	0.020	0.065
<i>Hibiscus tiliaceus</i>	4	0.333	0.182	7.4m	0.123	0.185	0.367
<i>Bruguiera gymnorrhiza</i>	2	0.167	0.091	5m	0.083	0.125	0.216
<i>Passiflora suberosa</i>	2	0.167	0.091	1.4m	0.023	0.035	0.126
Totals	f = 1.833	Rf = 1.0	I = 40.1m	IC = 0.666	RC = 1.0		

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVI)
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Transect #4 Upper stratum

Total transect length (L) 60m Total number of transect intervals 12

<i>Carica papaya</i>	1	0.083	0.055	2m	0.033	0.034	0.089
<i>Hernandia sonora</i>	2	0.167	0.111	6.5m	0.108	0.110	0.221
<i>Polypodium scolopendria</i>	1	0.083	0.055	0.8m	0.013	0.014	0.069
<i>Leucaena leucocephala</i>	1	0.083	0.055	1m	0.017	0.017	0.072
<i>Pandanus dubius</i>	9	0.750	0.500	37.5m	0.625	0.635	1.135
<i>Mucuna gigantea</i>	1	0.083	0.055	0.8m	0.013	0.014	0.069
<i>Hibiscus tiliaceus</i>	2	0.167	0.111	7m	0.117	0.118	0.229
<i>Bruguiera gymnorhiza</i>	1	0.083	0.055	3.5	0.058	0.606	0.115
Totals	f = 1.499	Rf = 1.0	I = 59.1m	IC = 0.984	RC = 1.0		

Transect #4 - Top stratum

Total transect length (L) 60m Total number of transect intervals 12

<i>Hernandia sonora</i>	1	0.083	0.083	5m	0.083	0.100	0.183
<i>Casuarina equisetifolia</i>	9	0.75	0.751	40m	0.667	0.807	1.558
<i>Mikania scandens</i>	1	0.083	0.083	0.1m	0.002	0.002	0.085
<i>Bruguiera gymnorhiza</i>	1	0.083	0.083	4.5m	0.075	0.091	0.174
Totals	f = 0.999	Rf = 1.0	I = 49.6m	IC = 0.827	RC = 1.0		