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Vegetation Survey of Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands

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The vegetation of Rota, Tinian, and Saipan in the Commonwealth of the Northern Mariana Islands is described and mapped. The survey, intended for land-use planning and forest resource management, is based on vegetation types identified on 1976 aerial photographs. Descriptions emphasize native limestone forest types and are based on field reconnaissance. The maps indicate that native forest and introduced trees cover approximately 29,278 acres (11,848 ha), secondary vegetation covers an estimated 24,986 acres (10,111 ha), and some 16,500 acres (6,678 ha) are unforested.

Retrieval Terms: vegetation survey, vegetation maps, forest resources, Rota, Tinian, Saipan, Commonwealth of the Northern Mariana Islands

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INTRODUCTION

The islands of Rota, Tinian, and Saipan are the largest and southernmost islands in the Commonwealth of the Northern Mariana Islands (CNMI). Knowledge of the extent and composition of their vegetation, including forest land, is needed for land-use planning. To fill this need, cooperative agreements were drawn up between the CNMI, the U.S. Fish and Wildlife Service, and the Forest Service, U.S. Department of Agriculture, to map the vegetation of the three islands. The vegetation maps were prepared by the Forest Service in cooperation with the Commonwealth Government and are intended to serve as a working tool for land-use planning and forest resource management.

This bulletin presents 13 vegetation maps for Rota, Tinian, and Saipan, and describes the various vegetation types, their ecological function, and uses. A breakdown of nonforest types is also provided.

GEOGRAPHY AND CLIMATE

Rota, Tinian, and Saipan are located in the Mariana Islands (lat. 14°01' to 15°20' N., long. 145°00' to 145°50' E), between Guam and Farallon de Medinilla (*fig. 1*). In general, the islands are raised limestone terraces on extinct volcanic peaks and slopes, with limited areas of volcanic soils protruding through limestone. The smallest of the three islands is Rota, which is approximately 33 mi² (86 km²) and has a maximum elevation of 1612 ft (490 m). Saipan, the largest of the islands, is 47 mi² (122 km²) and has an elevation of 1554 ft (472 m). Tinian, the least mountainous of the islands, has a maximum elevation of 557 ft (169 m) and is 39 mi² (102 km²) in total area (Douglas 1969).

The climate of the CNMI is warm and humid throughout the year. Data collected for the island of Saipan gives a mean temperature of 78 °F (25.6 °C) with a mean annual relative humidity of 82 percent. Mean annual rainfall recorded at Garapan, Saipan, is about 85 inches (2159 mm). The dry season extends from

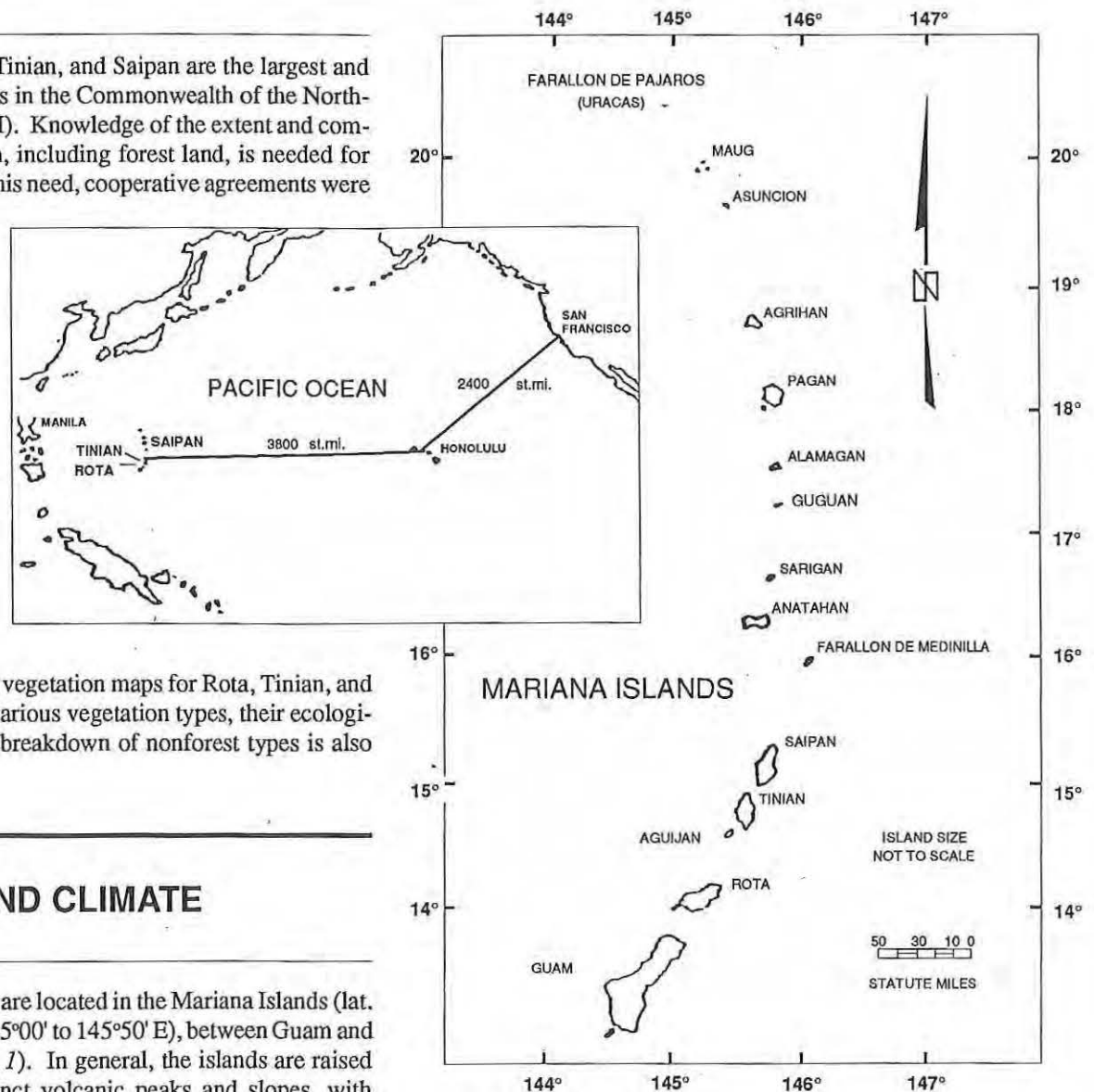


Figure 1—The islands of Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands, are located in the southern Mariana chain at the western end of Micronesia.

January to April, and the rainy season from mid-July to mid-November (Perry 1984). The Mariana Islands are located in the northeast trade wind belt and are frequently affected by typhoons, the most recent being Typhoon Roy, which caused major damage to Rota on January 12, 1988. This bulletin represents the vegetation of the CNMI before this storm.

SURVEY METHODS

Vegetation types of the Northern Mariana Islands were identified and delineated on black and white aerial photographs taken in 1976 at a nominal scale of 1:8,000.

Vegetation differences can often be recognized by examining photographs stereoscopically for differences in tone, texture, and image patterns. In some cases, individual species may be recognized by their distinctive shape. Thus, after comparing photom imagery with ground conditions in the field, a skilled interpreter can become fairly proficient at recognizing vegetative types on aerial photos. Overall accuracy will depend on the scale, age, and quality of the photographs; the skill of the interpreter; degree to which the vegetative types differ in image characteristics; and the amount of ground checking by the interpreter.

Before vegetation typing could begin, a vegetation mapping scheme was needed. Instead of devising an entirely new classification system for the Marianas, the system developed for use in the Caroline Islands was used to interpret the vegetation for Rota, Saipan, and Tinian (Cole and others 1987, Falanruw and others 1987a, 1987b; MacLean and others 1986; Whitesell and others 1986).

The vegetation of the three major islands was classified into types that could be identified on black and white aerial photographs without intensive ground checking, and which would be useful to foresters and land-use planners. Types were delineated on the photographs after stereoscopic examination and ground checking along roads and trails, in 1984. The photos were then edited and sent to the Engineering Geometrics Section of the Forest Service's Pacific Southwest Regional Office for transfer to base maps and measurements of type areas.

TYPE CLASSIFICATIONS

For mapping purposes, the islands of Rota, Tinian, and Saipan were divided into four broad land classes: forest, secondary vegetation, agroforest, and nonforest (table 1 and fig. 2):

Forest—The forest class includes five primary types of areas vegetated with trees (fig. 3):

Native limestone forest (LI)

Introduced trees (IF)

Mangrove forest (MN)

Casuarina forest (CA)

Atoll forest (AT)

Secondary vegetation (SV)—Secondary vegetation includes fast growing shrubs, small trees and vines on recently disturbed areas.

Agroforest (AG)—The agroforest class consists of areas with trees cultivated for food crops, fruit, wood, and other products. Coconut plantations are coded as CO.

Table 1—Area of three islands of the Commonwealth of the Northern Mariana Islands, by land class and type, 1984

Land class and type	Symbol	Saipan	Rota	Tinian	Total
————— acres (hectares) —————					
Forest					
Limestone forest	LI	1,182	12,147	1,714	15,043 (6,088)
Introduced trees	IF	7,888	292	2,478	10,658 (4,313)
Casuarina thickets	CA	1,137	465	1,865	3,467 (1,403)
Atoll forest	AT	11	82	-	93 (37)
Mangrove forest	MN	17	-	-	17 (7)
Total forest		10,235	12,986	6,057	29,278 (11,848)
Secondary vegetation	SV	8,651	2,719	13,616	24,986 (10,111)
Agroforest					
Agroforest	AG	9	6	2	17 (7)
Agroforest with coconuts	AG.CO	84	31	3	118 (48)
Coconut plantation	CO	2,979	1,075	284	4,338 (1,755)
Total agroforest		3,072	1,112	289	4,473 (1,810)
Nonforest					
Marsh, fresh	M.F	363	-	41	404 (164)
Savanna/grassland	G	3,237	3,125	2,872	9,234 (3,737)
Strand	S	1,112	683	1,212	3,007 (1,217)
Cropland	C	223	130	468	821 (332)
Urban	U	1,841	213	206	2,260 (915)
Barren	B	314	40	370	724 (293)
Water	W	45	-	5	50 (20)
Total nonforest		7,135	4,191	5,174	16,500 (6,678)
Total area		29,093	21,008	25,136	75,237 (30,447)

Nonforest—Nonforest areas include marshes, savanna/grasslands, and areas developed for urban use. The seven primary types in this class are:

Marsh (M)

Savanna/Grassland (G)

Strand (S)

Cropland (C)

Urban (U)

Barren (B)

Water (W)

The forest types are further subdivided into size and density classes identified by these codes:

Code	Size class
0	Short, shrub-like stands less than 5 inches (<12.5 cm) diameter at breast height (d.b.h.).
1	Trees averaging less than 12 inches (<30 cm) in d.b.h. but larger than or equal to 5 inches (>12.5 cm) in d.b.h.
2	Trees averaging 12 or more inches (>30 cm) in d.b.h.
Code	Density class
H	High—crown closure of main canopy over 70 percent.
M	Medium—crown closure of main canopy between 30 and 70 percent.
L	Low—crown closure of main canopy less than 30 percent.

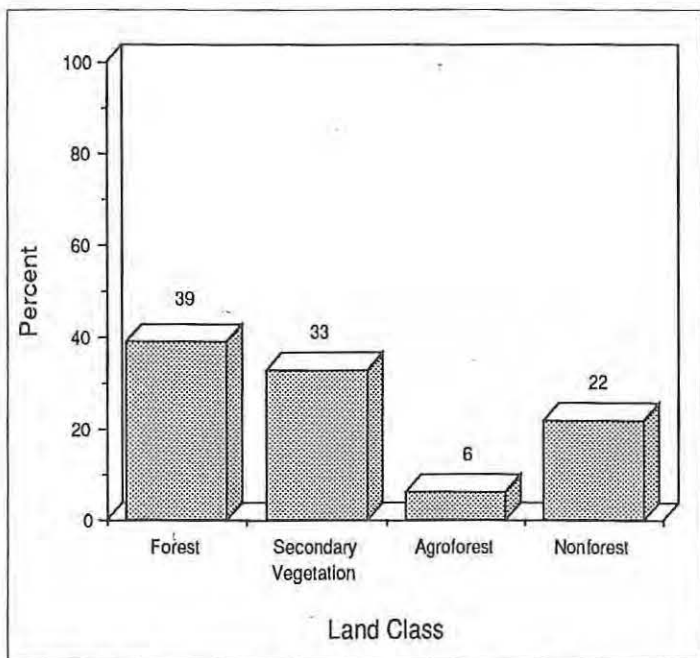


Figure 2—Four major land classes were mapped on Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands. Although forest is the largest land class, much of this area on Tinian and Saipan is composed of introduced trees (IF).

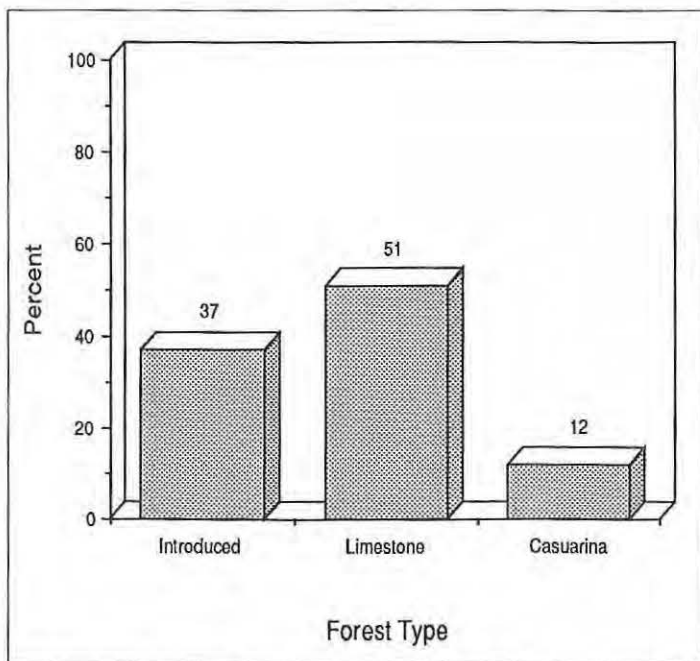


Figure 3—The forest land class was broken down into five types on Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands. Only three types are shown here because the mangrove and atoll types contain less than 1 percent of the total area.

On the folded maps, the vegetative areas are numbered and identified by symbols in the legends. In each symbol, the vegetation type code (table 2) is shown first, followed by the size class and crown density class given above. For example, LI1H would indicate a limestone forest with trees ranging between 5 and 12 inches (12.5 and 30 cm) in diameter and a high density crown

closure. Where possible, dominant species are identified. In such cases, the density class is followed by a period, then by one or two letters of the genus name, for example: IF1M.D as when *Delonix regia* makes up at least 20 percent of an introduced forest stand. Occasionally, mixed stands are identified by a slash between the primary vegetation type and a second type, with density and size classes given only for the primary type. For example, IF2L/SV.L would indicate scattered introduced trees 12 inches (30 cm) or greater in d.b.h., with inclusions or patches of secondary vegetation having *Leucaena leucocephala* as its major component.

The minimum type area mapped during photo interpretation was 1 acre (0.4 ha).

Table 2—Vegetation type codes used for mapping the vegetation of the Commonwealth of the Northern Mariana Islands, by land class, 1984

Vegetation codes	Vegetation types, subtypes, and components
Land class: Forest	
LI	Native limestone forest, various size and density classes apply
LI.CA	Native limestone forest, <i>Casuarina</i> component
LI.CO	Native limestone forest, coconut component
LI/S	Native limestone forest, strand understory
LI/SV	Native limestone forest, secondary vegetation
LI/SV.G	Native limestone forest, tall grass
LI/SV.G.S	Native limestone forest, tall grass and shrubs
LI/SV.P	Native limestone forest, <i>Pandanus</i> understory
LI/SV.S	Native limestone forest, shrub understory
IF	Thickets of introduced trees, various size and density classes apply
IF.D	Introduced trees with <i>Delonix</i> component
IF/SV	Introduced trees with secondary vegetation understory
IF/SV.B	Introduced trees with bamboo
IF/SV.G	Introduced trees with tall grass understory
IF.D/SV.G	Introduced trees, <i>Delonix</i> , with tall grass
IF/SV.L	Introduced trees, with <i>Leucaena</i>
IF.D/SV.L	Introduced trees, <i>Delonix</i> , with <i>Leucaena</i>
IF.D/SV.S	Introduced trees, <i>Delonix</i> , with shrubs
IF/SV.L.C	Introduced trees with <i>Leucaena</i> and <i>Casuarina</i> inclusions
IF/SV.L.G	Introduced trees with <i>Leucaena</i> and tall grass
IF/SV.S	Introduced trees with shrub understory
CA	<i>Casuarina</i> thicket, various size and density classes apply
CA.AT	<i>Casuarina</i> thicket, atoll forest component
CA.LI	<i>Casuarina</i> thicket, native limestone forest component
CA/G.G	<i>Casuarina</i> thicket, short grasses
CA/M.F	<i>Casuarina</i> thicket, freshwater marsh
CA/M.F.P	<i>Casuarina</i> thicket, freshwater marsh with <i>Phragmites</i>
CA/SV	<i>Casuarina</i> thicket, secondary vegetation understory
CA/SV.G	<i>Casuarina</i> thicket, tall grass
CA/SV.L	<i>Casuarina</i> thicket with <i>Leucaena</i>
CA/SV.L.G	<i>Casuarina</i> thicket with <i>Leucaena</i> and tall grass
CA/SV.S	<i>Casuarina</i> thicket, shrub understory
CA/U	<i>Casuarina</i> thicket in urban areas
AT	Atoll forest, various size and density classes apply
AT.LI	Atoll forest, native limestone forest component
AT/S	Atoll forest, strand understory
MN	Mangrove forest, various size and density classes apply
MN/SV.H	Mangrove with <i>Hibiscus</i>

(continued)

Table 2—Vegetation type codes used for mapping the vegetation of the Commonwealth of the Northern Mariana Islands, by land class, 1984 (continued)

Vegetation codes	Vegetation types, subtypes, and components
Land class: Secondary Vegetation	
SV	Secondary vegetation, size and density classes do not apply
SV.AS	Secondary vegetation, agri-scrub component
SV.AS.L	Secondary vegetation, agri-scrub and <i>Leucaena</i> components
SV.B	Secondary vegetation, bamboo component
SV.B.G	Secondary vegetation, bamboo and tall grass components
SV.B.S	Secondary vegetation with bamboo and shrubs
SV.G	Secondary vegetation, tall grass component
SV.G.C	Secondary vegetation, tall grass and <i>Casuarina</i> components
SV.G.C.L	Secondary vegetation, tall grass, <i>Casuarina</i> , and <i>Leucaena</i> components
SV.G/C	Secondary vegetation, tall grass, pasture land
SV.G.L	Secondary vegetation, tall grass and <i>Leucaena</i> components
SV.G.L.S	Secondary vegetation, tall grass, <i>Leucaena</i> , and shrub components
SV.G.S	Secondary vegetation, tall grass and shrub components
SV.H.L	Secondary vegetation, <i>Hibiscus</i> and <i>Leucaena</i> components
SV.L	Secondary vegetation, <i>Leucaena</i> component
SV.L.C	Secondary vegetation, <i>Leucaena</i> and <i>Casuarina</i> components
SV.L/C	Secondary vegetation, <i>Leucaena</i> pasture land
SV.L.S	Secondary vegetation, <i>Leucaena</i> and shrub components
SV.L.S.C	Secondary vegetation, <i>Leucaena</i> , shrub, and <i>Casuarina</i> components
SV.L.S.G	Secondary vegetation, <i>Leucaena</i> , shrub, and tall grass components
SV.S	Secondary vegetation, shrub component
SV.S.C	Secondary vegetation, shrub and <i>Casuarina</i> components
SV.S/C	Secondary vegetation, shrub, pasture land
SV.S/B.D	Secondary vegetation, shrub component, with disturbed understory
Land class: Agroforest	
AG	Agroforest
AG.CI	Agroforest, <i>Citrus</i> component
AG.CO	Agroforest, coconut component
AG.CO/SV	Agroforest, coconut component with secondary vegetation
AG.CO/SV.L	Agroforest, coconut component with <i>Leucaena</i>
CO	Coconut plantation, various size and density classes apply
CO.AT	Coconut plantation, atoll forest component
CO.LI	Coconut plantation, native forest component
CO.IF	Coconut plantation with introduced trees
CO/C	Coconuts growing in pasture land
CO/G.G	Coconut plantation, short grass understory
CO/S	Coconut plantation, strand understory
CO/SV	Coconut plantation, secondary vegetation understory
CO/SV.G	Coconut plantation, tall grass understory
CO/SV.G.S	Coconut plantation, tall grass and shrub understory
CO/SV.L	Coconut plantation, <i>Leucaena</i> understory
CO/SV.L.G	Coconut plantation, <i>Leucaena</i> and tall grass components
CO/SV.S	Coconut plantation, shrub understory
CO/U	Coconut trees in urban areas

(continued)

Vegetation codes	Vegetation types, subtypes, and components
Land class: Nonforest	
M.F	Freshwater marsh
M.F.P	<i>Phragmites</i> marsh
M.F.P/W.F	<i>Phragmites</i> marsh with open water inclusions
G.CA.S	Savanna/grassland, abandoned cropland with shrub component
G.G	Savanna/grassland, short grass component
G.G.B	Savanna/grassland, short grass and bamboo components
G.G.C	Savanna/grassland, short grass and <i>Casuarina</i> trees
G.G.C.D	Savanna/grassland, short grass and <i>Casuarina</i> components with disturbance
G.G.C.L	Savanna/grassland, short grass, <i>Casuarina</i> , and <i>Leucaena</i> components
G.G.C.S	Savanna/grassland, short grass, <i>Casuarina</i> , and shrub components
G.G/C	Savanna/grassland, short grass pasture land
G.G.D	Savanna/grassland, short grass, disturbed
G.G.S	Savanna/grassland, short grass and shrub components
G.G/S	Savanna/grassland, short grass with strand inclusions
G.G.S/C	Savanna/grassland, short grass and shrub pasture land
G.S	Savanna/grassland, shrub component
G.S/C	Savanna/grassland, shrub pasture land
S	Low strand
S.P	Low strand with <i>Pandanus</i> component
S.S	Tall strand
S.S.P	Tall strand with <i>Pandanus</i> component
S/B.L	Low strand with limestone outcrops
S/DV	Low strand with dwarf vegetation inclusions
S.S/DV	Tall strand with dwarf vegetation inclusions
C	Cropland
U	Urban land
B	Barren land
B.D	Disturbed land
B.L	Limestone outcrops
B.S	Beach sand
B/S	Strand inclusions
W.F	Water, fresh

NOTES:

Size classes and density codes are used only with the forest class and with the coconut plantation type.

All components, inclusions, or understory species must be present on at least 20 percent of the mapped area.

VEGETATION TYPE DESCRIPTIONS

Land classes and primary types are described by habitat and major overstory and understory species. Full species citations, families, and Chamorro names of plants mentioned in the text are given in table 3.

The vegetation descriptions for the island of Rota are summaries based on descriptions and species lists made at approximately 45 stations during two visits to Rota, totaling about 12 days of field and lab work. Field work on Tinian and Saipan was less extensive. Fosberg (1960) described the geology and terrain of Rota, Tinian, and Saipan, and provided a general history and description of vegetation changes. This bulletin updates those descriptions and includes information on a number of uncommon to potentially endangered endemic limestone forest species.

Table 3—Plant species mentioned in text¹

Genus, species, and author	Chamorro name	Family
<i>Abrus precatorius</i> L.	kulales halom tano	Fabaceae
<i>Acacia confusa</i> Merr.	sosigi	Mimosaceae
<i>Aglaia mariannensis</i> Merr.	mapuñiao	Meliaceae
<i>Aidia cochinchinensis</i> Lour.	sumac	Rubiaceae
<i>Albizia lebeck</i> (L.) Benth.	kalaskas	Mimosaceae
<i>Alyxia torresiana</i> Gaud.	nanagu	Apocynaceae
<i>Angiopteris evecta</i> (Forst. f) Hoffm.		Marattiaceae
<i>Annona muricata</i> L.	laguaná	Annonaceae
<i>Annona reticulata</i> L.	anonas	Annonaceae
<i>Annona squamosa</i> L.	ates	Annonaceae
<i>Antigonon leptopus</i> H. & A.	cadena de amor	Polygonaceae
<i>Araucaria</i> sp.		Araucariaceae
<i>Areca catechu</i> L.	puguá	Palmae
<i>Artocarpus altilis</i> (Park.) Fosb.	lemmai	Moraceae
<i>Artocarpus mariannensis</i> Tréc.	dokdok	Moraceae
<i>Asplenium nidus</i> L. sensu lato	galak	Polypodiaceae
<i>Averrhoa bilimbi</i> L.	kamis (pickle tree)	Oxalidaceae
<i>Averrhoa carambola</i> L.	bilembines	Oxalidaceae
<i>Barringtonia asiatica</i> (L.) Kurz	puteng	Lecythidaceae
<i>Bauhinia monandra</i> Kurz	flores mariposa	Caesalpiniaceae
<i>Benincasa hispida</i> (Thunb.) Cogn.	kodót	Cucurbitaceae
<i>Bidens</i> spp.		Compositae
<i>Bikkia tetrandra</i> (L. f.) A. Rich.	gausali	Rubiaceae
<i>Blechnum orientale</i> L.		Polypodiaceae
<i>Bruguiera gymnorhiza</i> (L.) Lam.	mangle machu	Rhizophoraceae
<i>Caesalpinia major</i> (Medic.) Dandy & Exell	pakao	Caesalpiniaceae
<i>Capparis cordifolia</i> Lam.	atkaparas	Capparidaceae
<i>Carica papaya</i> L.	papaya	Caricaceae
<i>Cassytha filiformis</i> L.	agasi	Lauraceae
<i>Casuarina litorale</i> L.	gagu	Casuarinaceae
<i>Catharanthus roseus</i> (L.) G. Don	chuchurika	Apocynaceae
<i>Ceiba pentandra</i> (L.) Gaertn.	atagodon	Bombacaceae
<i>Centrosema pubescens</i> Benth.		Fabaceae
<i>Cerbera dilatata</i> Mg.	chuti	Apocynaceae
<i>Chrysophyllum cainito</i> L.	star apple	Sapotaceae
<i>Citrus</i> spp.	kahat/limon	Rutaceae
<i>Claoxylon marianum</i> Muell.-Arg.	panao	Euphorbiaceae

(continued)

Genus, species, and author	Chamorro name	Family
<i>Clerodendrum</i> spp.	lódigao	Verbenaceae
<i>Cocos nucifera</i> L.	niyog	Palmae
<i>Codiaeum variegatum</i> (L.) Bl.	leston puyitos	Euphorbiaceae
<i>Coelogyne guamensis</i> Ames		Orchidaceae
<i>Coix lacryma-jobi</i> L.	bilén	Gramineae
<i>Colocasia esculenta</i> (L.) Schott	suní agaga	Araceae
<i>Cordia subcordata</i> Lam.	niyoron	Boraginaceae
<i>Cordyline fruticosa</i> (L.) Chev.	baston San Jose	Liliaceae
<i>Crinum asiaticum</i> var. not determined	pigá palayi	Amaryllidaceae
<i>Crotalaria retusa</i> L.		Fabaceae
<i>Cucurbita</i> spp.	kalamasa	Cucurbitaceae
<i>Cycas circinalis</i> L.	fadang	Cycadaceae
<i>Cynometra ramiflora</i> L.	gulos	Caesalpiniaceae
<i>Cyrtosperma chamissonis</i> (Schott) Merr.	baba	Araceae
<i>Davallia solida</i> (Forst. f.) Sw.	puguá machena	Polypodiaceae
<i>Delonix regia</i> (Boj.) Raf.	atbot	Caesalpiniaceae
<i>Discocalyx</i> sp.	ottot	Myrsinaceae
<i>Dodonaea viscosa</i> (L.) Jacq.	lampuaye	Sapindaceae
<i>Dioscorea alata</i> L.	dagu	Dioscoreaceae
<i>Elaeocarpus joga</i> Merr.	yoggá	Tiliaceae
<i>Erythrina variegata</i> var. <i>orientalis</i> (L.) Merr.	gaogao	Fabaceae
<i>Eugenia palumbis</i> Merr.	agatélang	Myrtaceae
<i>Eugenia</i> spp.		Myrtaceae
<i>Eupatorium odoratum</i> L.	masigsig	Compositae
<i>Euphorbia milii</i> var. <i>splendens</i> (Bojer) Ursch & Leandri	crown of thorns	Euphorbiaceae
<i>Ficus prolixa</i> Forst. f.	nunu	Moraceae
<i>Ficus</i> spp.		Moraceae
<i>Ficus tinctoria</i> var. <i>neo-ebudarium</i> (Summerh.) Fosb.	hoda	Moraceae
<i>Flagellaria indica</i> L.	bejucó halom tano	Flagellariaceae
<i>Freycinetia reineckeii</i> Warb.	fianiti	Pandanaceae
<i>Gardenia</i> spp.		Rubiaceae
<i>Geniostoma micranthum</i> A. DC.	maholok hayu	Loganiaceae
<i>Gleichenia linearis</i> (Burm. f.) C.B.Cl	mana	Gleicheniaceae
<i>Guamia mariannae</i> (Safford) Merr.	paipai	Annonaceae
<i>Guettarda speciosa</i> L.	panao	Rubiaceae
<i>Hedychium coronarium</i> Koen.		Zingiberaceae
<i>Heritiera littoralis</i> Dry.	ufa	Sterculiaceae
<i>Heritiera longipetiolata</i> Kaneh.	ufa halom tanó	Sterculiaceae
<i>Hernandia labyrinthica</i> Tuyama		Hernandiaceae
<i>Hernandia sonora</i> L.	nonak	Hernandiaceae
<i>Hibiscus rosa-sinensis</i> L.		Malvaceae
<i>Hibiscus tiliaceus</i> L.	pago	Malvaceae
<i>Histiopteris incisa</i> (Thunb.) J. Sm.		Polypodiaceae
<i>Inocarpus fagifer</i> (Park.) Fosb.	budu (buoy)	Fabaceae
<i>Intsia bijuga</i> (Colebr.) O. Ktze.	ifil/ifit	Caesalpiniaceae
<i>Ipomoea batatas</i> (L.) Lam.	kamute	Convolvulaceae
<i>Ipomoea pes-caprae</i> ssp. <i>brasiliensis</i> (L.) v. Ooststr.	alalak tasi	Convolvulaceae
<i>Ipomoea</i> spp.		Convolvulaceae
<i>Ixora casei</i> Hance	santana	Rubiaceae
<i>Ixora</i> sp.		Rubiaceae
<i>Jasminum marianum</i> DC.	hasmin	Oleaceae
<i>Jatropha gossypifolia</i> L.		Euphorbiaceae
<i>Jatropha</i> sp.		Euphorbiaceae
<i>Laportea interrupta</i> (L.) Chew	palilolia	Urticaceae
<i>Laurentia longiflora</i> (L.) Endl.	star of Bethlehem	Lobeliaceae
<i>Leucaena insularum</i> var. <i>guamensis</i> Fosb. & Stone		Mimosaceae
<i>Leucaena leucocephala</i> (Lam.) de Wit	tangantangan	Mimosaceae
<i>Lycopodium cernuum</i> L.		Lycopodiaceae
<i>Lycopodium phlegmaria</i> var. <i>longifolium</i> Spring	kotdon di San Francisco	Lycopodiaceae

(continued)

Table 3—Plant species mentioned in text¹ (continued)

Genus, species, and author	Chamorro name	Family
<i>Macaranga thompsonii</i> Merr.	pengua	Euphorbiaceae
<i>Maesa</i> sp.		Myrsinaceae
<i>Mammea odorata</i> (Raf.) Kosterm.	chopak	Guttiferae
<i>Mangifera indica</i> L.	mangga	Anacardiaceae
<i>Manihot esculenta</i> Crantz	mendioka	Euphorbiaceae
<i>Maytenus thompsonii</i> (Merr.) Fosb.	luluhot	Celastraceae
<i>Medinilla medinilliana</i> (Gaud.) Fosb. & Sachet (ined.)	gafos	Melastomataceae
<i>Melanolepis multiglandulosa</i> var. <i>glabrata</i> (Muell.-Arg.) Fosb.	alom	Euphorbiaceae
<i>Melochia</i> spp.	sayafi	Sterculiaceae
<i>Merrilliodendron megacarpum</i> (Hemsl.) Sleumer	faniok	Icacinaceae
<i>Mikania scandens</i> (L.) Willd.		Compositae
<i>Mimosa invisa</i> Mart.	singbiguin sasa	Mimosaceae
<i>Miscanthus floridulus</i> (Labill.) Warb. ex K. Schum. & Lauterb.	nette	Gramineae
<i>Momordica charantia</i> L.	atmagosu	Cucurbitaceae
<i>Morinda citrifolia</i> L.	lada	Rubiaceae
<i>Moringa oleifera</i> Lam.	malungay (katdes)	Moringaceae
<i>Mucuna</i> spp.		Fabaceae
<i>Musa</i> spp.	choda	Musaceae
<i>Myrtella bennigseniana</i> (Volk.) Diels		Myrtaceae
<i>Neisosperma oppositifolia</i> (Lam.) Fosb. & Sachet	fagot	Apocynaceae
<i>Nephrolepis</i> spp.		Polypodiaceae
<i>Ochrosia mariannensis</i> A. DC.	langiti	Apocynaceae
<i>Ochrosia mariannensis</i> var. <i>crassicaarpa</i> Fosb. & Falanruw		Apocynaceae
<i>Operculina ventricosa</i> (Bert.) Peter	alalag	Convolvulaceae
<i>Osmoxylon mariannense</i> (Kaneh.) Fosb. & Sachet (ined.)		Araliaceae
<i>Pandanus dubius</i> Spreng.	pahong	Pandanaceae
<i>Pandanus tectorius</i> Park.	kafu	Pandanaceae
<i>Passiflora foetida</i> var. <i>hispida</i> (DC.) Killip	dulce	Passifloraceae
<i>Pemphis acidula</i> Forst.	nigas	Lythraceae
<i>Pennisetum</i> spp.	boksu	Gramineae
<i>Persea americana</i> Mill.	alageta	Lauraceae
<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	karisu	Gramineae
<i>Phyllanthus acidus</i> (L.) Skeels	ibba	Euphorbiaceae
<i>Piper belle</i> L.	pupulu	Piperaceae
<i>Piper guahamense</i> C. DC.	pupulon aniti	Piperaceae
<i>Pipturus argenteus</i> (Forst. f.) Wedd.	amahadyan	Urticaceae
<i>Pisonia grandis</i> R. Br.	amumo	Nyctaginaceae
<i>Pisonia umbellifera</i> (Forst.) Seem.		Nyctaginaceae
<i>Pithecellobium dulce</i> (Roxb.) Benth.	kamachile	Mimosaceae
<i>Pluneria</i> spp.	flores mayo	Apocynaceae
<i>Polypodium scolopendria</i> Burm. f.		Polypodiaceae
<i>Polyscias grandifolia</i> Volk.		Araliaceae
<i>Pouteria obovata</i> (R. Br.) Baehni	lala	Sapotaceae
<i>Premna obtusifolia</i> R. Br.	ahgao	Verbenaceae
<i>Psidium guajava</i> L.	abas	Myrtaceae
<i>Psychotria</i> spp.	aplokating	Rubiaceae
<i>Saccharum officinarum</i> L.	tupu (sugarcane)	Gramineae
<i>Saccharum spontaneum</i> L.		Gramineae
<i>Scaevola taccada</i> (Gaertn.) Roxb.	nanasu	Goodeniaceae
<i>Sechium edule</i> (Jacq.) Sw.	chayote	Cucurbitaceae
<i>Serianthes nelsonii</i> Merr.	tronkon guafi	Mimosaceae
<i>Spathoglottis</i> sp.		Orchidaceae

(continued)

Genus, species, and author	Chamorro name	Family
<i>Stachytarpheta</i> spp.		Verbenaceae
<i>Swietenia</i> sp.		Meliaceae
<i>Tarenna sambucina</i> (Forst.) Dur.	sumak	Rubiaceae
<i>Terminalia catappa</i> L.	talisai	Combretaceae
<i>Thespesia populnea</i> (L.) Sol. ex Correa	banalo	Malvaceae
<i>Thevetia peruviana</i> (Pers.) K. Schum.		Apocynaceae
<i>Tournefortia argentea</i> L. f.	hunig	Boraginaceae
<i>Triphasia trifolia</i> (Burm. f.) P. Wils.	limon china	Rutaceae
<i>Vigna marina</i> (Burm.) Merr.	akankang manulasa	Fabaceae
<i>Wikstroemia elliptica</i> Merr.	gapetatayaki	Thymelaeaceae
<i>Xanthosoma</i> spp.	sun-i-Honolulu	Araceae
<i>Xylocarpus moluccensis</i> (Lam.) Roem.	lalanyok	Meliaceae
<i>Zoysia matrella</i> (L.) Merr.	chaguan hapon	Gramineae

¹Scientific names of Dicotyledonae are from Fosberg and others (1979), of Pteridophyta and Gymnospermae from Fosberg and others (1982), and of Monocotyledonae from Fosberg and others (1987). Common names are from Stone (1970) and Topping and others (1975).

Forest Class

The native forests of the Marianas are a unique natural heritage, being rich in endemic species. Native forest has however been altered by agricultural and wartime activities, bulldozing, animals, and replacement by introduced species such as *Leucaena leucocephala* and *Acacia confusa*. Because of their threatened status, descriptions of native limestone forests are the most detailed.

Native Limestone Forest (LI)

The species composition of limestone forest varies with habitat conditions and the amount of previous disturbance. The forests of Rota (figs. 4, 5) and southwest Tinian (figs. 6, 7) are the best examples of native forest, while the forests of Saipan (figs. 8, 9) show the greatest effects of wartime and other human activities. A generalized description of the native limestone forests of each island are given below.

Rota—A number of phases of limestone forest occur within this type. Forests located at Sabana are often shrouded in clouds and mist. Occurring in patches in the formerly mined Sabana area is an association of the endemic *Hernandia labyrinthica* and *Elaeocarpus joga* interspersed with *Pandanus* thickets. Mixed in with the *Elaeocarpus/Hernandia* are a few *Ficus* spp., *Artocarpus* spp., *Hibiscus tiliaceus*, and *Osmoxylon mariannense*. Understory species include *Macaranga thompsonii* and *Pipturus argenteus*. Epiphytes are abundant and include *Freycinetia reineckeii*, *Asplenium nidus*, *Davallia solida* and other ferns; *Coelogyne guamensis* and other orchids; and mosses.

In general the native forests of the interior Sabana terrace are shorter than those nearer the cliffs on the southern border of the area. The cloud forest on the rocky southern edge of the plateau consists of widely spaced trees of medium height, covered with a luxuriant growth of epiphytes. There is little undergrowth other than herbaceous ground cover and mosses growing over the limestone boulders.

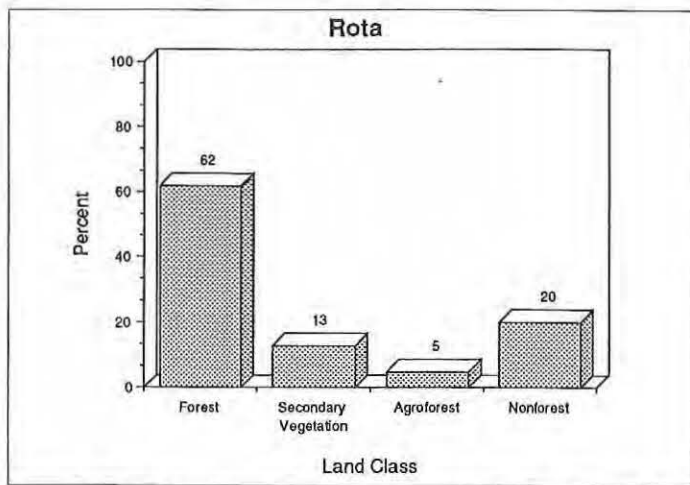


Figure 4—Rota, Commonwealth of the Northern Mariana Islands, is the least disturbed of the mapped islands. The forest class is by far the largest land class.

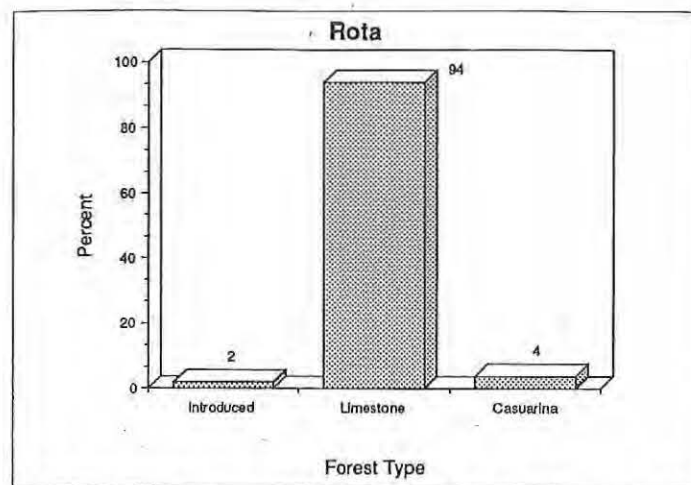


Figure 5—The native limestone forest type on Rota, Commonwealth of the Northern Mariana Islands, is the major forest type. The atoll forest type contains less than 1 percent of the total forest area and is not included here.

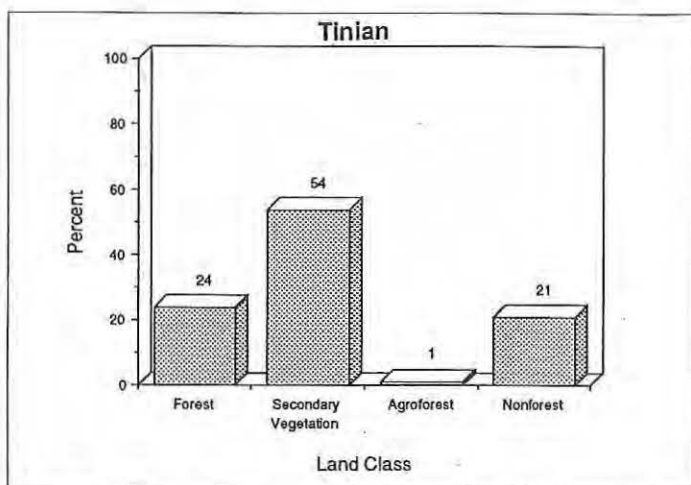


Figure 6—Tinian, Commonwealth of the Northern Mariana Islands, is the most heavily disturbed island mapped, with secondary vegetation being the largest land class.

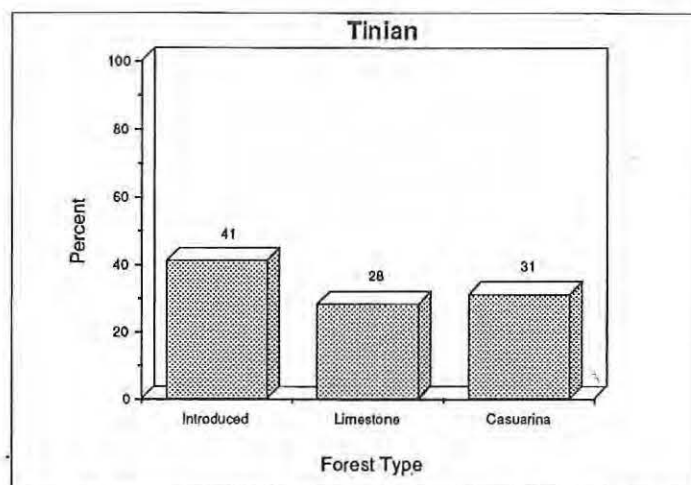


Figure 7—Three forest types were mapped on Tinian, Commonwealth of the Northern Mariana Islands. As on Saipan, the native forests of Tinian are limited.

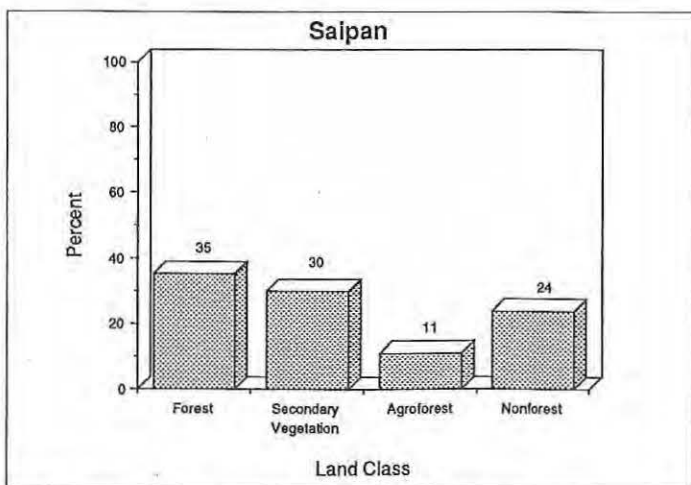


Figure 8—Four land classes were mapped on Saipan, Commonwealth of the Northern Mariana Islands. Although the forest land class is the largest, it consists mostly of thickets of introduced trees.

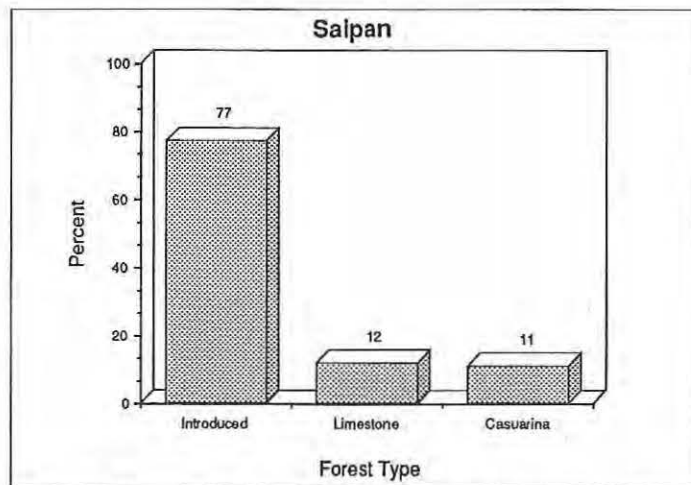


Figure 9—Five forest vegetation types were mapped on Saipan, Commonwealth of the Northern Mariana Islands. Both the mangrove and atoll forest types are excluded due to their small total area. Saipan is in a state of constant change, and there are few remnants of native forest.

Forests on the western and northern slopes of the Sabana terrace are a rich mix of species including in the overstory: *Artocarpus* spp., *Elaeocarpus joga*, *Hernandia labyrinthica*, *Pisonia* spp., *Guettarda speciosa*, *Neisosperma oppositifolia*, *Claoxylon marianum*, *Ficus prolixa*, and *Serianthes nelsonii*. Understory species include these: *Barringtonia asiatica*, *Discocalyx* sp., *Guamia mariannae*, *Annona reticulata*, *Aglaiia mariannensis*, *Melanolepis multiglandulosa* var. *glabrata*, *Morinda citrifolia*, *Triphasia trifolia*, *Maytenus thompsonii*, *Cycas circinalis*, *Polyscias grandifolia*, *Psychotria* sp., *Eugenia palumbis*, *Pandanus* spp., *Ficus tinctoria* var. *neo-ebudorum*, *Pipturus argenteus*, *Laportea interrupta*, *Macaranga thompsonii*, *Pisonia umbellifera*, *Maesa* sp., *Premna obtusifolia*, *Tarenna sambucina*, herbs such as *Piper guahamense*, and many ferns. Climbers and vines include *Freycinetia reineckeii*, *Alyxia torresiana*, *Mucuna* sp., and *Flagellaria indica*.

Of the two species of *Hernandia* found in the native forests of Rota, *H. labyrinthica* occurs mainly in the Sabana area while *H. sonora* is more common in coastal areas and higher parts of interior cliffs. *Elaeocarpus joga* is especially abundant in upper areas.

Stands of the endangered tree *Serianthes nelsonii*, endemic to the southern Mariana Islands, occur about the Gayaugan cliffs in the Isang area and on steep slopes in the Uyulan hulo area to the northwest and west of the Sabana terrace. At one time, only two specimens of this tree were known to exist, both on Guam. The population on Rota is now known to include at least 84 trees with diameters estimated to range from 6 inches to 47 inches (15 cm to 120 cm). One tree we measured had a diameter of 41 inches (103.5 cm) and a height of 77 feet (23.4 m). There were few seedlings and no saplings of *Serianthes* in the areas we visited. A patch of *Merrilliodendron megacarpum* occurs at the base of Mananana cliffs between the Santa Cruz and Inayan areas.

Native forest with larger trees (coded LI2) are generally located on steep areas or where the terrain is especially rocky and uneven. Overstory species common to these forests include *Artocarpus mariannensis*, especially in the interior, with *A. altilis* more commonly located on the coast.

In the drier forests of northeast Rota, where the terrain is more level and less rocky, small to medium size *Intsia bijuga* are common. Some of these forests are relatively low and scrubby with *Hibiscus tiliaceus* and *Pandanus* spp. being common. Other species include *Guamia mariannae*, *Guettarda speciosa*, *Eugenia* spp., *Morinda citrifolia*, *Maytenus thompsonii*, *Triphasia trifolia*, *Polyscias grandifolia*, *Cycas circinalis*, *Flagellaria indica*, and *Caesalpinia major*.

Taller forests with canopies from 22- to 45-feet (7- to 14-m) high include *Intsia bijuga*, *Guamia mariannae*, and larger trees such as *Artocarpus* spp., *Ficus prolixa*, *Elaeocarpus joga*, *Hernandia sonora*, and *Pisonia grandis*. In more coastal forests, *Neisosperma oppositifolia*, *Cynometra ramiflora*, *Pouteria obovata*, *Cordia subcordata*, *Erythrina variegata* var. *orientalis*, *Hernandia sonora*, and *Casuarina litorea* are more common.

Tinian—The only limestone forest remaining on Tinian occurs on the steep cliff-sides. A remnant forest occurs about Mt. Lassu, mixed with secondary vegetation including *Leucaena leucocephala* at its edges. A small forest dominated by *Cynometra ramiflora* trees occurs along cliffs to the southeast of the Lassu shrine. Other species include large *Erythrina variegata* var. *orientalis* trees,

Neisosperma oppositifolia, *Cerbera dilatata*, *Psychotria* sp., *Eugenia* sp., *Guamia mariannae*, *Pandanus* spp., and *Terminalia catappa*.

Native forest is also found on the lower, drier, and narrower terraces of Laderan Lasu and consists of *Cynometra ramiflora* and *Pisonia grandis*. Smaller trees and shrubs in these dry forests include *Pouteria obovata*, *Pandanus* spp., *Erythrina variegata* var. *orientalis*, *Aglaiia mariannensis*, *Melanolepis multiglandulosa* var. *glabrata*, and *Morinda citrifolia*. There is little undergrowth on the dry rocky ground. The forests along the Mahalang and Manapang cliffs are similar with the addition of some *Ficus* trees.

Aerial photographs show an extensive forest with a distinctive texture of light colored crowns amid darker vegetation occurring southeast of the Kastiyu terrace of southern Tinian. Most of this area now consists of weedy grasses and tangantangan (*Leucaena*). A remnant of the type occurs near the gate of the Bar K Ranch. This forest is dominated by large *Pisonia grandis* trees with huge gnarled compound trunks. This tree is adapted to typhoons in that its weak limbs are easily broken off by high winds. The trees then regrow repeatedly from their massive trunks. The light colored crowns on the aerial photos appear to be the once emergent crowns of *P. grandis*. The forest texture was not seen elsewhere in the CNMI, and the small patch of *Pisonia* forest may be a remnant of a once more extensive native forest type.

This remnant forest consists of large *Pisonia* with an understory of *Guamia mariannae*, some *Intsia bijuga*, *Neisosperma oppositifolia*, *Pandanus* spp., *Psychotria* spp., *Premna obtusifolia*, *Ficus* sp., *Eugenia* sp., *Melanolepis multiglandulosa* var. *glabrata*, the climbing shrub *Jasminum marianum* and climbing vines, *Flagellaria indica* and *Abrus precatorius*.

Limestone forest occurs along cliffs around the Kastiyu and Pina plateaus in southeast Tinian. One area of this forest, along the cliffs east of the Kastiyu pasture area, consists of a low forest, approximately 33 ft (10 m) high, growing on a substrate of clay and bare rock. Common species include *Ochrosia mariannensis*, *Psychotria* sp., *Neisosperma oppositifolia*, *Guamia mariannae*, *Pandanus* spp., *Cynometra ramiflora*, *Maytenus thompsonii*, *Pisonia grandis*, *Aidia cochinchinensis*, *Aglaiia mariannensis*, *Erythrina variegata* var. *orientalis*, *Polyscias grandifolia*, *Capparis cordifolia*, *Ficus prolixa*, *Jasminum marianum*, and *Abrus precatorius*. At the edge of the cliff a crevasse shelters a large specimen of *Heritiera longipetiolata* with a d.b.h. of about 28 inches (70 cm), and height of 76 ft (23 m). A native forest also occurs on the narrow terrace below.

Saipan—The native limestone forest type is very limited and disturbed on Saipan. A few areas remain in scattered pockets on the Bañadero cliffs, Kagman plateau and peninsula, near Mt. Tagpochau, on small plateau terraces along the east coast, and mixed with secondary vegetation along the cross island road.

Most of the remaining stands of limestone forest are largely scrubby. Common species include *Pandanus dubius* and *P. tecatorius*, *Ochrosia mariannensis*, *Guamia mariannae*, *Psychotria* sp., *Hibiscus tiliaceus*, *Premna obtusifolia*, *Morinda citrifolia*, *Pouteria obovata*, *Cynometra ramiflora*, *Ficus* spp., *Claoxylon marianum*, *Ixora* sp., *Aglaiia mariannensis*, *Polyscias grandifolia*, and *Flagellaria indica*. *Capparis cordifolia* occurs on exposed coastal areas and *Bikkia tetrandra* on exposed cliffs.

Remnant limestone forests along roads and in protected inland areas are dominated by *Artocarpus mariannensis*. The major large species in the Kagman plateau forest is *Pisonia grandis* with diameters from 41 to 47 inches (105 to 120 cm). *Guamia* growing to 30 ft (9 m) tall can also be seen in this forest. Other trees include *Erythrina variegata* var. *orientalis*, *Ficus* spp., *Melanolepis multiglandulosa* var. *glabrata*, *Barringtonia asiatica*, and *Cynometra ramiflora* with admixtures of introduced trees.

Trees growing in forests nearer the coast include: *Neisosperma oppositifolia*, *Barringtonia asiatica*, *Terminalia catappa*, *Heritiera longipetiolata*, *Cynometra ramiflora*, *Cordia subcordata*, and *Casuarina litorea*.

Introduced Trees (IF)

A number of trees have been introduced to the CNMI and have become naturalized including: *Acacia confusa*, flame tree (*Delonix regia*), *Albizia lebeck*, and *Pithecellobium dulce*. In places, these trees form thickets and are dense enough to be classified as forests. Such stands are given the designation IF for introduced trees to distinguish them from native limestone forest. The type is most common on Saipan and Tinian.

Rota—The highest point in the Sabana area of Rota is “a knoll of volcanic material protruding up through the limestone terrace” (Fosberg 1960, p. 51). In this misty area is a dense low forest of the introduced tree *Acacia confusa*. A number of native and endemic species grow in the understory or as epiphytes in this forest. They include the giant fern *Angiopteris evecta*, the magenta flowered *Medinilla medinilliana*, pendant *Lycopodium phlegmaria* var. *longifolium*, and *Coelogyne guamensis*—an orchid with large white blossoms. The large fern *Histiopteris incisa* also occurs in this area.

Other areas of the introduced forest type on Rota include thickets of *Delonix regia* especially in cleared areas along the road in the Sinpalu area where dense stands of saplings occur.

Tinian—On Tinian, the Introduced Tree type includes low forests of *Acacia confusa* on volcanic soils between the Banaderon Lemmai and Banaderon Nunu areas. These forests consist of a single story of *Acacia* trees with d.b.h. generally not over 18 inches (45 cm), growing over weedy growth including the noxious *Eupatorium odoratum* and *Mimosa invisa*, as well as *Mikania scandens*, *Momordica charantia*, *Passiflora foetida* var. *hispida*, *Centrosema pubescens*, and *Stachytarpheta* spp. Adjacent open areas are filled with tall *Pennisetum* grass.

Other components of the IF type include groves of *Delonix regia*, especially along the road between Taga Beach and Bar K Ranch. Throughout the island, especially the northern two-thirds, groves of *Acacia confusa*, *Albizia lebeck*, *Casuarina litorea*, *Delonix regia*, *Ceiba pentandra*, and *Bauhinia monandra* occur amid thickets of secondary vegetation, mostly *Leucaena leucocephala*.

Saipan—On Saipan, the IF type is extensive, including groves of *Acacia confusa* and patches of *Albizia lebeck* mixed in with other vegetation, especially *Leucaena*. *Delonix regia* is common along roads and grows in stands in many areas. *Pithecellobium dulce* is also common.

Mangrove Forest (MN)

Mangroves are marine forests with specialized roots inundated at least periodically by sea water. The mangrove type is represented by very small patches of *Bruguiera gymnorrhiza*, *Heritiera littoralis*, and *Xylocarpus moluccensis*. While the only mappable mangrove stands were on Saipan, Fosberg (1979) does list mangroves occurring on Tinian and Rota.

Casuarina Thickets (CA)

Casuarina litorea trees are fairly distinctive on aerial photographs and easily identified. *Casuarina* typically occurs along the coast, in bands too narrow to be separately delineated, in which case they are often typed with strand (S) or atoll forest (AT). They are also common in quarry sites and areas of secondary vegetation where they are classified as CA/SV, or mixed in with limestone forest vegetation (CA.LI), with atoll forest vegetation (CA.AT), or scattered in grassy areas (CA/G.G). Stands of *Casuarina* are common on all three islands.

Atoll Forest (AT)

Along the coast, the strand type merges with the atoll forest type. Rota has the most extensive stands of atoll forest, the type is quite limited on Saipan and Tinian. Dominant canopy species in these coastal forests on Rota are large *Hernandia sonora* and *Artocarpus* sp. Generally, the understory consists of *Guettarda speciosa*, *Neisosperma oppositifolia*, *Pandanus* spp., and occasionally *Mammea odorata*. The “fadang” (*Cycas circinalis*) may occur in the lower understory and the fern *Polypodium scolopendria* is quite common. *Casuarina* trees are often associated with the atoll forest type and where they predominate the type is coded as CA.

Secondary Vegetation Class

The secondary vegetation land class is intermediate between forest and nonforest. Secondary vegetation occurs in areas where the natural vegetation has been disturbed and replaced by fast-growing weedy species. The most common species in this class is the introduced *Leucaena leucocephala*, which forms dense thickets and is typed as SV.L. Extensive stands of *Leucaena* occur on Saipan and Tinian.

Introduced trees common in areas of secondary vegetation include *Albizia lebeck*, *Acacia confusa*, *Delonix regia*, and *Pithecellobium dulce*. Tall grasses include *Pennisetum* spp. and *Saccharum spontaneum*. The noxious climbing shrubs *Mimosa invisa* and *Eupatorium odoratum* were common. Other woody secondary species include *Dodonaea viscosa*, *Jatropha* sp., and *Melochia* spp. Vines include *Mikania scandens*, *Momordica charantia*, *Mucuna* sp., *Operculina ventricosa*, *Ipomoea* spp., and *Passiflora foetida* var. *hispida*. *Bidens* spp. and other herbaceous weeds also occur.

Agroforest Class

Agroforest (AG)

The agroforest land class category is applied to areas of mixed growth including trees, managed for fruit, food, wood, and other products such as formerly occurred in Chamorro "ranches" and villages. The area along the road to Lake Susupe on Saipan approaches this definition of the agroforest type. The agroforest type, at this writing, is quite limited in the Mariana Islands. Major food tree species in this area include the following: coconut (*Cocos nucifera*), breadfruit (*Artocarpus altilis*), tropical almond (*Terminalia catappa*), mango (*Mangifera indica*), *Citrus* spp., betel nut (*Areca catechu*), buoy nuts (*Inocarpus fagifer*), "apples" (*Eugenia* spp.), papaya (*Carica papaya*), custard apple (*Annona reticulata*), sour sop (*Annona muricata*), sweet sop (*Annona squamosa*), bananas (*Musa* spp.), star fruit (*Averrhoa carambola*), pickle fruit (*Averrhoa bilimbi*), iba fruit (*Phyllanthus acidus*), guava (*Psidium guajava*), star apple (*Chrysophyllum cainito*), horse-radish tree (*Moringa oleifera*), and avocado (*Persea americana*).

Other food plants growing in the understory include these: sugar cane (*Saccharum officinarum*), taro (*Cyrtosperma chamissonis*, *Colocasia esculenta*, and *Xanthosoma* spp.), cassava (*Manihot esculenta*), bittermelon (*Momordica charantia*), pumpkin (*Cucurbita* spp.), wax gourds (*Benincasa hispida*), "chayote" (*Sechium edule*), yam (*Dioscorea alata*), and sweet potato (*Ipomoea batatas*). Common ornamentals include *Hibiscus rosa-sinensis* and other species and hybrids of hibiscus, *Plumeria* spp., *Clerodendrum* spp., croton (*Codiaeum variegatum*), chain-of-love vine (*Antigonon leptopus*), ti plant (*Cordyline fruticosa*), *Araucaria* sp., white ginger (*Hedygium coronarium*), Job's tears (*Coix lacryma-jobi*), bush *Ipomoea*, kapok tree (*Ceiba pentandra*), crown of thorns (*Euphorbia milii* var. *splendens*), gardenia (*Gardenia* spp.), mahogany (*Swietenia* sp.), ornamental aroids, *Thevetia peruviana*, *Catharanthus roseus*, *Ixora casei*, and a number of semi-wild species useful for medicinals, cordage and other purposes, such as "lada" *Morinda citrifolia*, "pago" (*Hibiscus tiliaceus*), *Piper betle*, and *Ficus* spp. When there are at least 20 percent coconuts, the area is typed as AG.CO. The designation AG.CI is used when at least 20 percent *Citrus* trees are present.

Coconut Plantations (CO)

Dense groves of coconut trees that were originally planted for commercial reasons are designated as CO. When mixed with secondary vegetation, they are typed as CO/SV, with elements of limestone forest (CO.LI), atoll forest (CO.AT), and introduced forest (CO.IF).

Nonforest Class

Strand (S)

Strand vegetation is common along coasts of all three islands but is generally too narrow to be separately demarcated and is often included with Atoll Forest, Native Limestone Forest, or other types. Species characteristic of beach strand include the small trees *Tournefortia argentea*, *Thespesia populnea* and *Scaev-*

ola taccada. Vines such as *Ipomoea pes-caprae* ssp. *brasiliensis*, *Vignamarina*, and *Cassytha filiformis* may be present. Patches of *Crinum asiaticum* occasionally occur in more open areas. *Pemphis acidula* occurs in rocky areas along with normal and dwarfed *Scaevola taccada*. The native species *Leucaena insularum* var. *guamensis* is occasionally present, and further back from the shore, *Ochrosia mariannensis* var. *crassicarpa*, *Barringtonia asiatica*, *Pandanus dubius*, *Neisosperma oppositifolia*, *Erythrina variegata* var. *orientalis*, and *Cordia subcordata* may be present.

When *Pandanus* is a dominant feature, strand vegetation is typed as S.P. The type S/DV characterizes the dwarfed windswept vegetation of exposed coastal areas. Denser stands of *Mammea odorata* occur on rocky windswept coasts and stands of dwarfed *Scaevola taccada* also occur in such areas on Rota and Saipan. There are also open patches of *Zoysia matrella* occurring in flat areas.

Savanna/Grasslands (G)

Areas dominated by grassy and low herbaceous vegetation occur on both limestone and volcanic soils. Open areas in the formerly mined Sabana area of Rota are covered with herbaceous growth which is meadowlike and quite different in aspect and species composition from the vegetation of volcanic savanna areas of other parts of Micronesia. *Pennisetum* spp. are common, as well as patches of *Eupatorium odoratum* and areas of mixed ferns with *Gleichenia linearis*, *Nephrolepis* sp., and *Blechnum orientale* being prominent. Often mixed in with the ferns is the ground orchid *Spathoglottis* sp. and the morning-glory vine, *Ipomoea* spp. *Miscanthus floridulus* occurs on both limestone and volcanic soils on Saipan. On Rota, the savanna/grassland type on volcanic slopes was reported to include species characteristic of the savanna/grasslands of southern Guam such as *Gleichenia linearis*, *Lycopodium cernuum*, *Myrtella bennigseniana*, *Geniostoma micranthum*, *Wikstroemia elliptica*, and *Scaevola taccada* (Fosberg 1960). In the limited area of volcanic soils on Tinian, these species have been replaced by introduced weeds such as *Pennisetum* spp. and *Mimosa invisa*.

On Tinian, the savanna/grassland type includes some pastures planted to *Panicum* at the Bar K Ranch. Other pastures consist of *Leucaena leucocephala* which had been bulldozed to form a dense low forage. A number of toxic weedy species seen in pastures included *Jatropha gossypifolia*, *Laurentia longiflora*, *Crotalaria retusa*, and *Abrus precatorius*.

Subtypes of the savanna/grassland type include:

- G.G — grasses or sedges
- G.S — shrubs
- G.B — areas of exposed (bare) soil
- G.P — *Pandanus*
- G.CA — abandoned agricultural areas
- G.C — *Casuarina* trees
- G/C — pasture land

Marsh (M)

Marshes are areas of grasses, sedges, and herbs growing in standing water most of the year. Marshes occur in the area of Lake Susupe on Saipan and Lake Hagoi on Tinian.

Barren Areas (B)

The designation, barren areas, is applied to areas that lack natural vegetation, because of factors such as rocks, sterile soil, and bulldozing.

Cropland (C)

Croplands are areas of cultivated lands without tree cover. Many areas in the Northern Marianas under cultivation are below the minimal size to be typed and are included with the agroforest or secondary vegetation classes.

Urban (U)

Towns, villages, and other inhabited areas are classified as urban.

Water (W)

Lake Susupe and Lake Hagoi in northeast Tinian are the only mappable bodies of freshwater on the surveyed islands. They are coded W.F.

GLOSSARY

Agroforest: An area of mixed growth including trees, cultivated for fruit, food, wood, and other products.

D.b.h.: Diameter at breast height. Tree diameter outside bark measured at breast height, 4.5 ft (1.3 m) above the ground.

Forest land: Land at least 10 percent stocked by live trees or land formerly having such tree cover and not currently developed for nonforest use.

Land area: Land area includes dry land and land temporarily or partially covered by water, such as marshes, swamps, and river flood plains; streams or sloughs.

Land class: A classification of land by major use or major vegetative characteristics, i.e., forest, secondary vegetation, agroforest, and nonforest.

Nonforest land: Land that has never supported forests or was formerly forested and is currently developed for nonforest use.

Secondary vegetation: A vegetative type characterized by small, fast-growing trees, shrubs, and vines; usually weedy invaders.

Vegetative type: An area delineated on the maps as having similar plant composition to one of the types described in the section on type classification.

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