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Vegetation Survey of Yap, Federated States of Micronesia

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Cover: The Yapese have developed the art of food cultivation to a high degree. Here a path through an agroforest is lined with betel nut palms.

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CONTENTS

Introduction.....	1
Geography and Climate.....	1
Survey Methods.....	2
Type Classifications	2
Vegetation Type Descriptions.....	3
Forest	3
Secondary Vegetation	6
Agroforest.....	7
Nonforest.....	7
Glossary.....	8
References	8

INTRODUCTION

Yap is one of the four States in the Federated States of Micronesia. Knowledge of the extent and composition of its vegetation, including forest land, is needed for land-use planning. To fill this need, a formal agreement was drawn up between the High Commissioner of the U.S. Trust Territory of the Pacific Islands and two agencies of the U.S. Department of Agriculture—the Soil Conservation Service and the Forest Service—to map the vegetation of Yap. The four maps were prepared by the Forest Service in cooperation with the State Government of Yap and are intended to serve as a working tool for land-use planning and forest resource management, and to provide a basis for timber volume surveys.

This bulletin presents the vegetation maps of Yap and describes the different vegetation types, their ecological function, and uses. A breakdown of nonforest types is also provided.

GEOGRAPHY AND CLIMATE

Yap consists of four metamorphic, old volcanic high islands, and a group of about 15 coralline atolls. This bulletin applies

only to the high islands, which lie at lat. 9°33' N. and long. 138°09' E. in the western Caroline Islands (*fig. 1*). These islands consist of Yap, Maap, Rumung, and Gagil-Tamil, which lie within a broad fringing reef system that is about 30 km (19 statute mi) long and about 13 km (8 statute mi) at its widest point. The Yap Islands are located about 6,991 km (4,307 statute mi) southwest of Hawaii. The combined area of the four islands is 100.4 km² (39 mi²) and the highest point is 174 m (571 ft) (Nicholson 1969).

The climate of Yap is characterized by high temperatures, heavy rainfall, and high humidity. Mean annual rainfall for 1949 to 1980 was 3,028 mm (119 in). The driest months of the year are February to April, with an average of less than 180 mm (7 in) precipitation each month. On Yap, the wettest season of the year is July through October, when the average monthly rainfall is 330 mm (13 in). Mean annual temperature is 27 °C (81 °F), with a monthly variation of only 2 °C (3 °F) between the warmest and coolest months. The difference between the daytime maximum and nighttime minimum temperatures averages 7 °C (12 °F). Mean relative humidity ranges from 79 to 85 percent.

The vegetation of Yap has been much modified by man; other than mangroves, little native forest is left. Several factors have contributed to the great amount of disturbance to the native vegetation on Yap. Circa 1850, Yap's population was estimated to be five to six times as large as the 1980 census figure of 8,000 (Hunt and others 1954, Underwood 1969). While no definite figure is available on precontact populations, legends tell of the great number of people on Yap during this period (Hunt and others 1954). The pressure on natural resources to produce food for so many people must have been intense. This factor, combined with later Japanese agricultural practices, droughts, and

Figure 1—The state of Yap, Federated States of Micronesia, is located in the Western Caroline Islands, almost 7,00 km (4,300 mi) southwest of Hawaii.

repeated burning, has contributed to the destruction of the native vegetation, and the development or expansion of some savanna areas of degraded soils.

Throughout the years Yapese have developed food production systems that are now the best developed and most diverse among the high islands of Micronesia. These "agroforests" make up an estimated 26 percent of the vegetation of Yap (*table 1, fig. 2*).

Subsistence farming and copra production are the main agricultural enterprises on Yap. The main subsistence crops are taro, breadfruit, yams, coconuts, bananas, *Inocarpus*, and citrus. The local economy is also supported by fishing, handicrafts, tourism, and government employment. Soil scientists of the Soil Conservation Service have mapped and described 16 soil series and variants on Yap and provided guidelines for farmers, land managers, developers, and others (Smith 1983).

SURVEY METHODS

Yap's vegetation types were identified and delineated on black-and-white photographs taken in 1976 at a scale of 1:10,000. Since then, some changes have occurred. Except for the area of the new airstrip, however, updating the photography to account for these recent changes was not possible.

Table 1—Area of Yap, by land class and type, 1976

Land class and type	Symbol	Area	
		Hectares	Acres
Forest			
Upland forest	UP	2,556	6,316
Swamp forest	SW	155	383
Mangrove forest	MN	1,171	2,894
Total forest		3,882	9,593
Secondary Vegetation	SV	553	1,366
Agroforest			
Agroforest	AG	1,515	3,744
Agroforest (>20 pct coconut)	AG.CO	864	2,136
Coconuts	CO	159	392
Total agroforest		2,538	6,272
Nonforest			
Marsh, freshwater	M.F	165	407
Marsh, saline	M.S	6	15
Grassland/savanna	G	2,175	5,374
Cropland	C	46	115
Urban	U	244	602
Urban with agriculture	U/C, U/AG, U/AG.CO	61	150
Barren	B	8	21
Water	W	38	95
Total nonforest		2,743	6,779
Total area		9,716	24,010

Figure 2—Four major land classes were found on Yap, Federated States of Micronesia, 1976. Although the forest class encompasses 40 percent of the land area, about half of this area is disturbed and contains inclusions of secondary vegetation.

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

Before vegetation typing could begin, a vegetation mapping scheme was needed. Because much of the island is inaccessible by road and funds were limited, vegetation types were restricted to those that could be recognized on the photos without intensive ground checking. In addition, type characteristics were limited to those useful to foresters and land-use planners.

After preliminary field reconnaissance, the classification scheme presented in this bulletin was adopted. Types were delineated on the photos after stereoscopic examination and ground checking along roads and trails. Then the photos were edited and sent to the Engineering Geomtronics Section of the Forest Service's Pacific Southwest Regional Office, for transfer to base maps and measurement of type areas (*tables 1 and 2, figs. 2 and 3*).

TYPE CLASSIFICATIONS

For mapping purposes, the islands of Yap were divided into four broad land classes—forest, secondary vegetation, agroforest and nonforest. Saltwater bays and other bodies of water are

Figure 3—The forest land class was broken down into three types on Yap, Federated States of Micronesia, 1976. Both the swamp and upland forest types are heavily disturbed for agricultural purposes and contain much secondary vegetation.

listed under the nonforest class. Primary types under the major land classes include:

Forest—The forest class includes three types:

Upland forest (UP)

Swamp forest (SW)

Mangrove forest (MN)

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

Agroforest (AG)—The agroforest class is made of areas under cultivation for food crops, fruit, wood, and other products.

Nonforest—Nonforest areas include grasslands, marshes, degraded sites, and areas developed for urban use. Primary types in this class are:

Marsh (M)

Savanna grasslands (G)

Cropland (C)

Urban (U)

Barren (B)

Water (W)

The forest types are further subdivided into size and density classes (table 2), identified by these codes:

Code	Size class
0	Short, shrub-like stands smaller than 12.5 cm (5 in) in diameter at breast height (d.b.h.).
1	Trees averaging less than 30 cm (12 in) in d.b.h. but larger than or equal to 12.5 cm (5 in) in d.b.h.
2	Trees averaging 30 or more cm (>12 in) 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.

On the folded maps, vegetative areas are numbered and identified by symbols in the legend. In each code, the vegetation type

is shown first, followed by the size and crown density class. For example, MN1H would indicate mangrove less than 30 cm (12 in) but at least 12 cm (5 in) in d.b.h. 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, MN1H.S, as when *Sonneratia alba* makes up at least 20 percent of the mangrove 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, UP2L/SV.H would indicate scattered upland trees, 30 cm (12 in) or greater in d.b.h., with inclusions or patches of secondary vegetation having *Hibiscus tiliaceus* as its major component (table 3).

VEGETATION TYPE DESCRIPTIONS

Land classes and primary types are described by habitat and major overstory and understory species listed below. Full species citations and families of plants mentioned in the text are given in table 4.

Forest

Upland Forest (UP)

The forests of Yap have been greatly modified from their original condition. Many stands are a mixture of native, agroforest, secondary, and introduced species. A common component of better developed native forest is *Camposperma brevipetiolata*

Table 2—Area of forest land, by size class and density, on Yap, 1976

Type	Size class ¹	Density class ²			Total
		Low	Medium	High	
		<i>Hectares (acres)</i>			
Upland forest	0	85	95	29	209 (516)
Upland forest	1	295	1,198	60	1,553 (3,837)
Upland forest	2	90	696	8	794 (1,962)
Swamp forest	1	3	111	0	114 (283)
Swamp forest	2	0	41	0	41 (102)
Mangrove forest	0	0	0	26	26 (64)
Mangrove forest	1	16	143	944	1,103 (2,725)
Mangrove forest	2	0	7	35	42 (104)
Total forest					3,882 (9,593)

¹0—Short, shrub-like stands smaller than 12.5 cm (5 in) in d.b.h.

¹1—Trees averaging less than 30 cm (12 in) in d.b.h. but larger than or equal to 12.5 cm (5 in) in d.b.h.

²2—Trees averaging 30 or more cm (>12 in) in d.b.h.

²3—Crown closure of main canopy: low, less than 30 pct; medium, 30–70 pct; high, greater than 70 pct.

Table 3—Vegetation type codes used for Yap, Federated States of Micronesia

Land class	Vegetation codes	Vegetation types, subtypes, and components
Forest	UP	Upland forest, size and density classes apply
	UP/SV	Secondary vegetation inclusions
	UP/SV.BB	Bamboo inclusions
	UP.AG	Agroforest component
	SW	Swamp forest, size and density classes apply
	SW/SV	Secondary vegetation inclusions
	SW/SV.H	Hibiscus inclusions
	SW/SV.BB	Bamboo inclusions
	SW.AG	Agroforest component
	MN	Mangrove forest, size and density classes apply
Secondary vegetation	MN.N	<i>Nypa</i> palm component
	MN.S	<i>Sonneratia</i> component
	SV	Secondary vegetation
	SV.BB	Bamboo component
	SV.H	Hibiscus component
Agroforest	SV.P	Pandanus component
	AG	Agroforest
	AG/SW	Swamp forest inclusions
	AG/SV	Secondary vegetation inclusions
	AG/SV.BB	Bamboo inclusions
	AG.CO	Coconut component
Nonforest	CO	Coconut plantation, size and density classes apply
	M.F	Freshwater marsh
	M.F.C	Freshwater cultivated marsh
	M.S	Saline marsh
	G	Savanna grassland
	G.B	Barren component
	G.CA	Abandoned cultivation
	G.D	Disturbed lands
	G.F	Fern component
	G.G	Grass component
	G.P	Pandanus component
	G.W	Wetlands component
	C	Open cultivation
	U	Urban
	U/AG	Agroforest inclusions
	U/AG.CO	Coconut inclusions
	U/B	Barren inclusions
	U/C	Cropland inclusions
	U/SV	Secondary vegetation inclusions
	W	Water, including fresh, saline, and bays

NOTES:

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

Various combinations of components are used, especially within the savanna grassland type, as for G.B.FP meaning Grassland with barren, fern, and pandanus components.

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

(Hosokawa 1954). In association with *Camposperma* are usually found the poison tree, *Semecarpus venenosus*, *Buchanania engleriana*, *Inocarpus fagifer*, *Pterocarpus indicus*, *Pentapthalangium volkensii*, and occasionally, *Garcinia rumiyo*. In some areas, large *Serianthes kanehirae* var. *yapensis*, *Ficus prolixa*,

and *Calophyllum inophyllum* occur. Characteristic species of the understory in better developed forests include *Barringtonia racemosa* (especially in wet situations), *Timonius albus*, *Ixora casei*, *Psychotria* spp., *Meryta seffiana*, and *Pandanus japonicus*. Lianas are characteristically *Raphidophora* spp.

Several phases of more scrubby forest occur on Yap. Species characteristic of forests occurring in better drained areas such as the summits of Mt. Tabiwol and Mt. Madade, include *Diospyros ferrea*, *Psychotria* spp., *Aidia cochinchinensis*, *Ixora triantha*, *Timonius albus*, *Glochidion* spp., *Desmodium heterocarpum*, and occasionally *Garcinia rumiyo*. *Cycas circinalis* is sometimes found in the understory.

A characteristic type of low elevation native forest is found growing in savanna areas, usually in steep ravines. The most common tree species of these forests are *Trichospermum ikutai*, *Commersonia bartramia*, *Camposperma brevipedunculata*, *Rhus taitensis*, and *Calophyllum inophyllum*. Species common to both the edges of these ravine forests and adjacent grassland areas include *Pandanus tectorius*, *Commersonia bartramia*, *Alphitonia carolinensis*, *Pouteria obovata*, and stunted individuals of *Trichospermum ikutai*.

Trees commonly found in coastal areas include *Terminalia catappa*, *Guettarda speciosa*, *Calophyllum inophyllum*, *Hernandia sonora*, *Vitex negundo*, and occasionally, *Pemphis acidula*, *Barringtonia asiatica*, and *Tournefortia argentea*. These species are characteristic of atoll forest. On Yap, however, they do not occur in areas large enough to delineate and are generally included with other categories.

Introduced species of trees characteristic of inhabited areas include *Adenanthera pavonina*, *Albizia lebbek*, *A. retusa*, *A. falcata*, *Cassia* spp., *Tectona grandis*, and *Swietenia mahagoni*. A stand of *Melaleuca quinquenervia* exists, and scattered *Swietenia mahagoni* occur in a number of native forest areas where it has naturalized.

Most of Yap is privately owned and utilized, at least intermittently, for agricultural production. This results in a characteristic patchwork pattern of forest, agroforest, and secondary vegetation—the fallow stage of Yapese gardening. Of the 2,556 ha (6,316 acres) mapped as upland forest, 1,271 ha (3,141 acres) or 50 percent had inclusions of secondary vegetation, coded UP/SV, or upland forest with agroforest, coded UP/AG (table 3).

Swamp Forest (SW)

Swamp forest occurs where soils are inundated with fresh or slightly saline water. The most common habitat for such forests are low wet areas just inland of mangroves, above tidal influences but lower in elevation than the surrounding terrain. Other sites exist inland where water collects in low areas along rivers, and in areas of impeded drainage. Occasionally, the distinction between swamp and other forest is not clear due to the poorly drained and waterlogged nature of Yap's soil.

The vegetation survey had departed from Hosokawa (1952) and Stemmerman and Proby (1978) by not recognizing "hibiscus swamp" as a separate forest type. Though *Hibiscus tiliaceus* often grows in swampy places, it is not confined to such habitat and is a common component of secondary vegetation.

Table 4—Plant species mentioned in text¹

Genus	Species and author	Family	Genus	Species and author	Family
Acrostichum	aureum L.	Pteridaceae	Hedyotis	spp.	Rubiaceae
Adenanthera	pavonina L.	Mimosaceae	Heritiera	littoralis Dry.	Sterculiaceae
Aidia	cochinchinensis Lour.	Rubiaceae	Hernandia	sonora L.	Hernandiaceae
Albizia	falcata (L.) Fosc.	Mimosaceae	Hibiscus	tiliaceus L.	Malvaceae
Albizia	lebbeck (L.) Benth.	Mimosaceae	Hyptis	capitata Jacq.	Verbinaceae
Albizia	retusa Benth.	Mimosaceae	Inocarpus	fagifer (Park.) Fosc.	Fabaceae
Alphitonia	carolinensis Hosok.	Rhamnaceae	Ipomoea	aquatica Forsk.	Convolvulaceae
Annona	muricata L.	Annonaceae	Ipomoea	spp.	Convolvulaceae
Areca	cathecu L.	Palmae	Ischaemum	spp.	Gramineae
Artocarpus	altis L.	Moraceae	Ixora	casei Hance	Rubiaceae
Artocarpus	heterophyllus Lam.	Moraceae	Ixora	triantha Volk.	Rubiaceae
Averrhoa	bilimbi L.	Oxalidaceae	Lantana	camara L.	Verbenaceae
Averrhoa	carambola L.	Oxalidaceae	Leucaena	leucocephala (Lam.) de Wit	Mimosaceae
Bambusa	spp.	Gramineae	Ludwigia	hyssopifolia (G. Don) Exell	Onagraceae
Bambusa	vulgaris Schrad. ex Wendl.	Gramineae	Ludwigia	octovalvis (Jacq.) Raven	Onagraceae
Barringtonia	asiatica (L.) Kurz	Lecythidaceae	Lumnitzera	littorea (Jack.) Voigt	Combretaceae
Barringtonia	racemosa (L.) Spreng.	Lecythidaceae	Lycopodium	cernuum L.	Lycopodiaceae
Bruguiera	gymnorhiza (L.) Lam.	Rhizophoraceae	Macaranga	carolinensis Volk.	Euphorbiaceae
Buchanania	engleriana Volk.	Anacardiaceae	Mangifera	indica L.	Anacardiaceae
Calophyllum	inophyllum L.	Guttiferae	Melaleuca	quinquenervia (Cav.) Blake	Myrtaceae
Campnosperma	brevipetiolata Volk.	Anacardiaceae	Melastoma	malabathricum L.	Melastomataceae
Carica	papaya L.	Caricaceae	Melochia	spp.	Sterculiaceae
Cassia	spp.	Caesalpiniaceae	Merremia	spp.	Convolvulaceae
Cassytha	filiformis L.	Lauraceae	Meryta	senffiana Volk.	Araliaceae
Casuarina	litorea L.	Casuarinaceae	Mimosa	invisa Mart	Leguminosae
Cayratia	spp.	Vitaceae	Mimosa	pudica L.	Leguminosae
Cerbera	manghas L.	Apocynaceae	Morinda	citrifolia L.	Rubiaceae
Ceriops	tagal (Perr.) C.B. Rob	Rhizophoraceae	Musa	paradisica L.	Musaceae
Citrus	aurantifolia (Christm.) Swingle	Rutaceae	Musa	sapientum L.	Musaceae
Citrus	aurantium L.	Rutaceae	Musa	textilis Nees.	Musaceae
Citrus	grandis (L.) Osbeck	Rutaceae	Musa	trogodytarum L.	Musaceae
Citrus	hystrix DC.	Rutaceae	Myrtella	bennigseniana (Volk.) Diels	Myrtaceae
Citrus	macroptera Montr.	Rutaceae	Nepenthes	mirabilis (Lour.) Druce	Nepenthaceae
Citrus	mitis Blanco	Rutaceae	Nypa	fruticans Wurm.	Palmae
Citrus	reticulata Blanco	Rutaceae	Pandanus	japensis Mart.	Pandanaceae
Citrus	sinensis (L.) Osbeck	Rutaceae	Pandanus	tectorius Park.	Pandanaceae
Cocos	nucifera L.	Palmae	Pangium	edule Reinw. ex Bl.	Flacourtiaceae
Colocasia	esculenta (L.) Schott	Araceae	Paspalum	distichum L.	Gramineae
Commersonia	bartramia (L.) Merr.	Sterculiaceae	Passiflora	foetida var. hispida (DC.) Killip	Passifloraceae
Cratogeomys	speciosa Volk.	Capparidaceae	Pemphis	acidula Forst.	Lythraceae
Crotalaria	spp.	Papilionatae	Pennisetum	spp.	Gramineae
Cycas	circinalis L.	Cycadaceae	Pentapthalangium	volkensii Lauterb.	Guttiferae
Cynometra	ramiflora L.	Caesalpiniaceae	Phragmites	karka (Retz.) Trin. ex Steud.	Gramineae
Cyperus	javanicus Hoult.	Cyperaceae	Pongamia	pinnata (L.) Merr.	Fabaceae
Cyrtosperma	chamissonis (Schott) Merr.	Araceae	Pouteria	obovata (R.Br.) Baehni	Sapotaceae
Dalbergia	canadensis (Dennst.) Prain	Fabaceae	Premna	obtusifolia R.Br.	Verbinaceae
Decaspermum	fruticosum Forst.	Myrtaceae	Psidium	guajava L.	Myrtaceae
Derris	elliptica (Roxb.) Benth.	Fabaceae	Psychotria	spp.	Rubiaceae
Derris	trifoliata Lour.	Fabaceae	Pterocarpus	indicus Willd.	Fabaceae
Desmodium	heterocarpum (L.) DC.	Fabaceae	Raphidophora	spp.	Araceae
Dioscorea	spp.	Dioscoreaceae	Rhizophora	apiculata Bl.	Rhizophoraceae
Diospyros	ferrea (Willd.) Bakh.	Ebenaceae	Rhizophora	mucronata Lam.	Rhizophoraceae
Dolicandrone	spathacea (L.F.) K. Shum.	Bignoniaceae	Rhus	taitensis Guill.	Anacardiaceae
Eleocharis	spp.	Cyperaceae	Scaevola	taccada (Gaertn.) Roxb.	Goodeniaceae
Eugenia	spp.	Myrtaceae	Schypiphora	hydrophyllacea Gaertn.	Rubiaceae
Eupatorium	odoratum L.	Compositae	Semecarpus	venenosus Volk.	Anacardiaceae
Excoecaria	agalocha L.	Euphorbiaceae	Serianthes	kanehirae var. yapensis Fosc.	Mimosaceae
Ficus	prolixa var. carolinensis (Warb.) Fosc.	Moraceae	Sonneratia	alba J.E. Smith	Sonneratiaceae
Ficus	tintoria Forst. F.	Moraceae	Stachytarpheta	spp.	Verbenaceae
Fimbristylis	spp.	Cyperaceae	Swietenia	mahagoni (L.) Jacq.	Meliaceae
Garcinia	rumiyo Kaneh.	Guttiferae	Tacca	leontopetaloides (L.) O. Ktze.	Tacrecaceae
Gleichenia	linearis (Burm.F.) Clarke	Gleicheniaceae	Tectona	grandis L.F.	Verbenaceae
Glochidion	spp.	Euphorbiaceae	Terminalia	catappa L.	Combretaceae
Guettarda	speciosa L.	Rubiaceae	Timonius	albus Volk.	Rubiaceae
Hanguana	malayana (Jack) Merr.	Flagellariaceae	Tournefortia	argentea L.F.	Boraginaceae

continued

Table 4—Plant species mentioned in text (continued)

Genus	Species and author	Family
Trema	spp.	Ulmaceae
Trichospermum	ikutai Kaneh.	Tiliaceae
Vigna	marina (Burm.) Merr.	Fabaceae
Vitex	negundo var. bicolor (Willd.) Lam	Verbinaceae
Wedelia	triloba (L.) Hitchc.	Compositae
Wollastonia	biflora (L.) DC.	Compositae
Xylocarpus	granatum Koen.	Meliaceae

¹Scientific names of dicotyledonae, monocotyledonae, and palmae follow Fosberg and others (1979), Fosberg (1960) and Moore and Fosberg (1956) respectively.

Many areas which probably once supported swamp forest on Yap have been converted into taro patch systems. Swamp forests are now limited in area and are poorly developed and heavily disturbed. Species characteristic of swamp forest habitat just inland of mangroves include *Dolicandrone spathacea*, *Heritiera littoralis*, *Pongamia pinnata*, *Cynometra ramiflora*, *Dalbergia candenatensis*, *Derris trifoliata*, and *Acrostichum aureum*. A few almost pure stands of *Dolichandrone spathacea* can be found, and *Barringtonia racemosa* is common in wetter areas. The most common situation found, however, is swamp forest mixed with secondary vegetation or agroforest with taro patches. In fact, 85 percent of the total swamp forest area contain secondary vegetation or agroforest inclusions.

Swamp forest species growing along rivers do not generally cover areas extensive enough to be separately mapped and are generally included in the upland forest class. Woody species characteristic of these riverine areas and in wet inland depressions include *Barringtonia racemosa*, *Hibiscus tiliaceus*, *Semecarpus venenosus*, *Inocarpus fagifer*, *Ficus tinctoria*, *Pandanus jenkinsii*, *Cerbera manghas*, *Ixora casei*, and *Derris elliptica*.

Mangrove Forest (MN)

The most distinctive vegetation type on Yap is mangrove. These forests have specialized roots inundated at least periodically by sea water. Mangroves are found around most of Yap's coast, and are especially well developed on mud flats at the mouths of drainage systems. They serve as a natural filtering and nutrient buffering system between the island and lagoon, settling silt and providing for a slow sustained release of nutrients. Mangroves also serve as fish nurseries and habitat for birds and fruit bats, and provide house posts, craftwood, firewood, and fishing and gathering grounds.

The mangrove type is distinct on aerial photos due to its dark tone and smooth texture. The inland margins of mangroves, however, are sometimes hard to separate from the adjacent vegetation. The most common size class of mangroves on Yap are stands of medium stature (MNI). Another type of mangrove consists of areas of low tangled growth generally found where water circulation is limited and the soil more firm. These almost

impenetrable stands consist of *Rhizophora* trees and occasionally *Bruguiera gymnorhiza*. These areas are coded MNOH (table 3).

Species composition of mangroves varies by habitat. *Nypa fruticans* is generally found in the more brackish areas, in stands generally too narrow to map. Where *Nypa* palm makes up at least 20 percent of the stand, the area is typed as MNIM.N or MNIH.N.

Where other mangrove species can be recognized on photographs and make up at least 20 percent of the stand, they are indicated by type symbols. *Sonneratia alba* is often taller and has a less dense canopy and is coded MNIH.S. *Bruguiera gymnorhiza* and *Xylocarpus granatum* tend to grow along the landward edge of mangroves. However, they do not generally present a distinct canopy texture for consistent identification. *Lumnitzera littorea* also grows along the landward edge of mangrove areas, but usually does not occur in pure stands and, therefore, is not generally typed. *Schypiphora hydrophyllacea*, *Ceriops tagal*, and *Excoecaria agallocha* are other mangrove species which are not distinguished on the vegetation maps.

Secondary Vegetation

This vegetation class is somewhat intermediate between forest and nonforest. Secondary vegetated areas are generally covered with fast-growing weedy species. Quite often, these areas of secondary vegetation represent Yapese garden sites in the fallow phase. Due to the slash and burn agriculture and bulldozing, much of the native forest is now mixed with secondary vegetation. Of the total land area of 9,716 ha (24,010 acres) mapped on Yap, it was found that 2,799 ha (6,917 acres) or 29 percent are mixed with secondary vegetation. Besides the 553 ha (1,366 acres) in the secondary vegetation class, this figure includes SV inclusions in the agroforest, forest, swamp forest, and urban types.

On aerial photos, secondary vegetation is characterized by a low uneven canopy, usually of medium density. The type is readily identified by its hazy texture, especially when vines are present. Tall stands of bamboo which appear as plumes and are easily identified, are typed as SV.BB. Characteristic species, many introduced, of the secondary vegetation type on Yap include *Macaranga carolinensis*, *Hibiscus tiliaceus*, *Rhus taitensis*, *Melochia* spp., *Ishaemum* spp., *Morinda citrifolia*, *Glochidion* spp., *Trema* spp., *Commersonia bartramia*, *Cayratia* spp., *Merremia* spp., *Ipomoea* spp., *Bambusa* spp., *Passiflora foetida* var. *hispida*, *Mimosa invisa*, *M. pudica*, *Crotalaria* spp., *Cassia* spp., *Lantana camara*, *Premna obtusifolia*, *Hyptis capitata*, *Pennisetum* spp., and *Stachytarpheta* spp., and occasionally *Casuarina littorea*. Recently introduced and spreading are *Eupatorium odoratum* and *Wedelia triloba*, and *Leucaena leucocephala* especially in areas of corral rock.

Species characteristic of atoll forest and strand vegetation that occur along the sandy coasts of Yap are sometimes included in the secondary vegetation type when they occur in strips too narrow to be mapped.

Agroforest

Productive agroforests have been created by the Yapese. Fruit bats and birds also assist, by spreading seeds. Agroforests consist of a mixture of food and other useful trees found growing around villages. Scattered coconut trees and breadfruit trees are an indicator of agroforest. The canopy is often uneven, and may be interspersed with open areas of taro patches, croplands, and areas of secondary vegetation or upland forest too small to be separately mapped.

Most agroforests include coconut trees. If coconut trees make up 20 percent or more of the canopy, the area is classified as AG.CO. If the crown cover of an area is almost exclusively composed of coconut trees, it is classified as coconut plantation and coded CO.

On Yap, the agroforest class is part of a three-component system of food production which involves tree gardens, taro patches, and intermittent open gardens. The following description of this system is adapted from Falanruw 1980, 1982, and 1985. Tree species commonly found in the agroforest overstory are *Cocos nucifera*, *Artocarpus altilis*, *Areca cathecu*, *Mangifera indica*, *Inocarpus fagifer*, *Pangium edule*, *Artocarpus heterophyllus*, *Rhus taitensis*, and *Calophyllum inophyllum*. Common smaller trees include *Citrus aurantifolia*, *C. aurantium*, *C. hystrix*, *C. sinensis*, *C. mitis*, *C. reticulata*, *C. grandis*, *C. macroptera*, *Eugenia* spp., *Crateva speciosa*, *Averrhoa bilimbi*, *A. carambola*, *Musa paradisiaca*, *M. sapientum*, *M. textilis*, *M. troglodytarum*, *Annona muricata*, *Carica papaya*, and *Psidium guajava*. A wide variety of ornamental and useful shrubs are planted along paths through agroforests. Other useful shrubs and herbs grow in the understory, as do epiphytes, vines, and ground cover plants. They provide food, fuel, fiber, ornamentations, and medicines, meet other needs, and include some uncultivated species. Yap's tree gardens are relatively self-perpetuating and are tended on an intermittent basis throughout the year.

The second component of Yap's agroforest class consists of taro patches developed in low areas and often connected via water channels. Many varieties of *Cyrtosperma chamissonis* and *Colocasia esculenta* are grown. *Ipomoea aquatica* may be present in deeper areas of some of the larger taro patches.

The tree gardens and taro patches of Yap's agroforests function as a unit and are managed together. The canopy of the tree gardens protects the soil from erosion by the often torrential rainfall, and provides for the recycling of nutrients via the decomposition of leaves and debris. Ditches, often stone lined, drain the tree gardens and direct an aerated flow of water through a system of channels and taro patches, where silt and nutrients are trapped and utilized. The management of these areas involves removal of undesirable species, pruning and general care of useful trees, transfer of accumulated organic matter from fertile low areas to raised areas, and the harvesting and replanting of taro patches.

The third part of the Yapese system involves intermittent gardens of yams (*Dioscorea* spp.) and other crops. Areas of secondary vegetation or forest, found throughout agroforest areas, are usually cleared or partially cleared for such gardens. The common practice is to burn a small area during the dry season.

The opening or "skylight" created is then planted to a variety of crops. With the resultant ash fertilizer and beginning rains, crops generally grow fast and form a multilayered cover over the soil by the time the heavy rains come. After several harvests, these gardens are allowed to go fallow so that the canopy reforms and soil fertility is renewed.

Nonforest

Marshes (M)

Areas of grasses, sedges, and herbs growing in standing water most of the year are classified as marshes. Graminoid marshes give a characteristic smooth texture on the aerial photos. Two types of marshes are demarcated:

- Marsh, saline (M.S)—Areas generally along the coast adjacent to mangroves, or sometimes in depressions, where there are sand or mud flats periodically inundated by salt water or with standing pools of salt or brackish water. Common herbaceous species include *Cyperus javanicus*, *Derris trifoliata* (especially at the edge of mangroves), *Eleocharis* spp., *Fimbristylis* spp., *Paspalum distichum*, *Vigna marina*, and *Wollastonia biflora*. A number of woody species characteristic of strand, swamp forest, and mangrove may surround or be sparsely scattered in such marshes.

- Marsh, freshwater (M.F)—Areas generally located slightly above sea level, often landward of mangroves; or in depressions in upland areas. The vegetation in these areas may consist of tall reeds, especially *Phragmites karka*, sedges, and other herbaceous growth often including *Ludwigia hyssopifolia*, and *L. octovalvis*, and in some areas *Hanguana malayana*. The large fern *Acrostichum aureum* is often present in marshes which are more brackish. Freshwater marshes cultivated for *Cyrtosperma chamissonis* and *Colocasia esculenta* are designated M.F.C. Many taro patches are below the minimal size for mapping or occur in areas identified as agroforest. Our vegetation maps therefore do not reflect the actual area in taro.

Savanna Grasslands (G)

Savanna grasslands are areas of land with a layer of low herbaceous cover. Shrubs and trees, if present, are widely scattered. The soils are generally infertile poorly drained clays. Savanna grassland areas are thought to be the result of destruction of the forest vegetation, particularly by fire, loss of the humus layer, and exposure of the soil to rain and sun. Frequent fires prevent tree species from returning, and the soil becomes more and more degraded.

A number of subtypes of savanna grasslands have been demarcated and are identified by letters following the designation G:

- Bare—Areas with very poor soil, with patches of bare soil intermittent with low herbaceous growth of grasses and sedges or the fern *Gleichenia linearis* (designated G.B).

- Formerly cultivated—Grasslands which are known to have been cultivated recently or in the past, by the Yapese or the Japanese, as indicated by patterns of raised garden beds (designated

G.CA). Occasionally, elevated grave sites may be included in this type, as they give a similar pattern on the aerial photos, but they can be distinguished on the ground. The mapped incidence of abandoned agricultural areas is lower than their actual frequency due to the covering of dense grass, preventing identification.

- **Disturbed**—Land that bears the signs of having been disturbed by recent human activity such as bulldozing. Generally, these areas will remain degraded savanna land, due to the loss of the humus layer (designated G.D).

- **Fern land**—Areas where the predominant cover is a tangled growth of *Gleichenia linearis* fern, sometimes with a mix of other species including *Lycopodium cernuum*. Fires in such areas burn the vegetation completely, selecting against other species, whereas the *Gleichenia* resprouts (designated G.F).

- **Grasses and sedges**—A predominance of graminoid species (designated G.G).

- **Pandanus**—Savanna land with at least 20 percent *Pandanus tectorius* (designated G.P).

- **Shrubs**—Grasslands with a mix of graminoid species and shrubs. Stunted small trees such as *Trichospermum*, *Commer-sonia*, *Alphitonia*, and *Timonius albus* characteristic of the ravine scrub forest may occur. Also commonly found are *Decaspermum fruticosum*, *Myrtella bennigiana*, *Melastoma malabathricum*, *Nepenthes mirabilis*, *Cassytha filiformis*, *Morinda citrifolia*, *Hyp- tis capitata*, *Scaevola taccada*, *Hedyotis* spp., *Tacca leontope- taloides*, and *Desmodium* spp. (designated G.S).

- **Wetlands**—Grasslands in low areas where the soil is usually very poorly drained. Vegetation is generally low grasses and sedges although some *Pandanus* may be present (designated G.W).

Cropland (C)

Areas of cultivated lands without tree cover. They are usually large sweet potato gardens. Most Yapese open canopy gardens are below the minimal size to be typed and are included with the agroforest or secondary vegetation classes.

Urban (U)

Towns, villages, and areas developed for nonforest use. Where buildings, roads, etc. are interspersed with vegetation, the area may be classed as Urban/Secondary vegetation (U/SV), Urban/Agroforest land (U/AG), Urban/Coconuts (U/AG.CO), Urban/Cropland (U/C), or Urban/Barren (U/B).

Barren (B)

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

Water (W)

Includes both fresh and brackish water and enclosed salt water bays.

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, 1.3 m above the ground.

Forest land: Land at least 10 percent stocked by live trees and not currently developed for nonforest use.

Land class: A classification of land by major use or major vegetative characteristics.

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

Secondary vegetation: A vegetative type characterized by small fast-growing trees, which grow in disturbed areas. Vines are often present.

Vegetative types: Areas 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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YAP ISLANDS

Index Map

Sheet 1 of 4

Falanruw, Marjorie C., Whitesell, Craig D., Cole, Thomas G.,
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YAP ISLANDS
Sheet 1 of 4

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Index Map

Sheet 2 of 4

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For explanation of vegetation type codes see Table 3.

YAP ISLANDS

Index Map

Sheet 3 of 4

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VEGETATION LEGEND
For explanation of vegetation type codes see Table 3.

ITEM	LABEL	AREA	ITEM	LABEL	AREA	ITEM	LABEL	AREA
2	UPIM	127 51.4	168	UPIL SV	15 6.1	322	G CA	13 5.3
3	UPIL SVBB	11 4.5	169	U	1 4	323	SV	6 2.4
4	UPIM	10 10	170	G S	2 8	324	G F S	46 18.6
5	G G P S	10 10	171	G CA	32 12.9	325	G F S	14 5.7
6	UPIM SV	11 17.4	172	U	7 2.8	326	G S	4 1.6
7	UPIM SVBB	13 5.7	173	G F P S	1 4	327	G S	8 3.2
8	AG CO	1 1.6	174	SV	13 5.3	328	G F S	30 12.1
9	UPIM SVBB	1 1.6	175	G G	1 4	329	UPIM	3 1.2
10	G CA G P	1 4	176	MNHH	69 27.9	330	UPIM SV	10 4.0
11	MNHH	12 17.0	177	AG CO	13 5.3	331	UPIM SV	29 11.7
12	SV BB	17 9	178	AG CO	62 25.1	332	MNHH	31 12.5
13	UPIL SV	20 8.1	179	AG SV BB	41 16.6	333	C	5 2.0
14	UPIL SV	15 14.2	180	UPIL SV	31 12.5	334	AG SV BB	36 14.6
15	UPIL SV	15 14.2	181	UPIL SV	31 12.5	335	UPIM SV	62 25.1
16	UPIL SV	15 14.2	182	G S	3 1.2	336	MNHH	5 2.0
17	UPIL SV	15 14.2	183	MNHH	152 61.5	337	UPIM SV	45 18.2
18	UPIL SV	15 14.2	184	UPIL SV	152 61.5	338	UPIM SV	1 4
19	UPIL SV	15 14.2	185	MNHH	1 4	339	AG CO	56 22.7
20	UPIL SV	15 14.2	186	AG CO	41 17.4	340	G S	12 4.8
21	UPIL SV	15 14.2	187	G G	1 4	341	AG CO	219 88.6
22	UPIL SV	15 14.2	188	G S	2 8	342	UPIM SVBB	11 4.5
23	UPIL SV	15 14.2	189	M S	9 3.6	343	UPIM	61 24.7
24	UPIL SV	15 14.2	190	G F P S	1 4	344	MNHH	1 4
25	UPIL SV	15 14.2	191	MNHH	4 1.6	345	SV	30 12.1
26	UPIL SV	15 14.2	192	M F C	1 4	346	AG	27 10.9
27	UPIL SV	15 14.2	193	M F C	1 4	347	U/C	3 1.2
28	UPIL SV	15 14.2	194	G P	19 7.7	348	MNHH	3 1.2
29	UPIL SV	15 14.2	195	G G	1 4	349	AG CO	8 3.6
30	UPIL SV	15 14.2	196	UPIL	6 2.4	350	UPIM SV	10 4.0
31	UPIL SV	15 14.2	197	UPIL	6 2.4	351	UPIM SV	4 1.6
32	UPIL SV	15 14.2	198	UPIL	6 2.4	352	AG	5 2.0
33	UPIL SV	15 14.2	199	UPIL	6 2.4	353	UPIM SV	10 4.0
34	UPIL SV	15 14.2	200	UPIL	6 2.4	354	UPIM SV	10 4.0
35	UPIL SV	15 14.2	201	UPIL	6 2.4	355	UPIM SV	10 4.0
36	UPIL SV	15 14.2	202	UPIL	6 2.4	356	UPIM SV	10 4.0
37	UPIL SV	15 14.2	203	UPIL	6 2.4	357	UPIM SV	10 4.0
38	UPIL SV	15 14.2	204	UPIL	6 2.4	358	UPIM SV	10 4.0
39	UPIL SV	15 14.2	205	UPIL	6 2.4	359	UPIM SV	10 4.0
40	UPIL SV	15 14.2	206	UPIL	6 2.4	360	UPIM SV	10 4.0
41	UPIL SV	15 14.2	207	UPIL	6 2.4	361	UPIM SV	10 4.0
42	UPIL SV	15 14.2	208	UPIL	6 2.4	362	UPIM SV	10 4.0
43	UPIL SV	15 14.2	209	UPIL	6 2.4	363	UPIM SV	10 4.0
44	UPIL SV	15 14.2	210	UPIL	6 2.4	364	UPIM SV	10 4.0
45	UPIL SV	15 14.2	211	UPIL	6 2.4	365	UPIM SV	10 4.0
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55	UPIL SV	15 14.2	221	UPIL	6 2.4	375	UPIM SV	10 4.0
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57	UPIL SV	15 14.2	223	UPIL	6 2.4	377	UPIM SV	10 4.0
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62	UPIL SV	15 14.2	228	UPIL	6 2.4	382	UPIM SV	10 4.0
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92	UPIL SV	15 14.2	258	UPIL	6 2.4	412	UPIM SV	10 4.0
93	UPIL SV	15 14.2	259	UPIL	6 2.4	413	UPIM SV	10 4.0
94	UPIL SV	15 14.2	260	UPIL	6 2.4	414	UPIM SV	10 4.0
95	UPIL SV	15 14.2	261	UPIL	6 2.4	415	UPIM SV	10 4.0
96	UPIL SV	15 14.2	262	UPIL	6 2.4	416	UPIM SV	10 4.0
97	UPIL SV	15 14.2	263	UPIL	6 2.4	417	UPIM SV	10 4.0
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102	UPIL SV	15 14.2	268	UPIL	6 2.4	422	UPIM SV	10 4.0
103	UPIL SV	15 14.2	269	UPIL	6 2.4	423	UPIM SV	10 4.0
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106	UPIL SV	15 14.2	272	UPIL	6 2.4	426	UPIM SV	10 4.0
107	UPIL SV	15 14.2	273	UPIL	6 2.4	427	UPIM SV	10 4.0
108	UPIL SV	15 14.2	274	UPIL	6 2.4	428	UPIM SV	10 4.0
109	UPIL SV	15 14.2	275	UPIL	6 2.4	429	UPIM SV	10 4.0
110	UPIL SV	15 14.2	276	UPIL	6 2.4	430	UPIM SV	10 4.0
111	UPIL SV	15 14.2	277	UPIL	6 2.4	431	UPIM SV	10 4.0
112	UPIL SV	15 14.2	278	UPIL	6 2.4	432	UPIM SV	10 4.0
113	UPIL SV	15 14.2	279	UPIL	6 2.4	433	UPIM SV	10 4.0
114	UPIL SV	15 14.2	280	UPIL	6 2.4	434	UPIM SV	10 4.0
115	UPIL SV	15 14.2	281	UPIL	6 2.4	435	UPIM SV	10 4.0
116	UPIL SV	15 14.2	282	UPIL	6 2.4	436	UPIM SV	10 4.0
117	UPIL SV	15 14.2	283	UPIL	6 2.4	437	UPIM SV	10 4.0
118	UPIL SV	15 14.2	284	UPIL	6 2.4	438	UPIM SV	10 4.0
119	UPIL SV	15 14.2	285	UPIL	6 2.4	439	UPIM SV	10 4.0
120	UPIL SV	15 14.2	286	UPIL	6 2.4	440	UPIM SV	10 4.0
121	UPIL SV	15 14.2	287	UPIL	6 2.4	441	UPIM SV	10 4.0
122	UPIL SV	15 14.2	288	UPIL	6 2.4	442	UPIM SV	10 4.0
123	UPIL SV	15 14.2	289	UPIL	6 2.4	443	UPIM SV	10 4.0
124	UPIL SV	15 14.2	290	UPIL	6 2.4	444	UPIM SV	10 4.0
125	UPIL SV	15 14.2	291	UPIL	6 2.4	445	UPIM SV	10 4.0
126	UPIL SV	15 14.2	292	UPIL	6 2.4	446	UPIM SV	10 4.0
127	UPIL SV	15 14.2	293	UPIL	6 2.4	447	UPIM SV	10 4.0
128	UPIL SV	15 14.2	294	UPIL	6 2.4	448	UPIM SV	10 4.0
129	UPIL SV	15 14.2	295	UPIL	6 2.4	449	UPIM SV	10 4.0
130	UPIL SV	15 14.2	296	UPIL	6 2.4	450	UPIM SV	10 4.0
131	UPIL SV	15 14.2	297	UPIL	6 2.4	451	UPIM SV	10 4.0
132	UPIL SV	15 14.2	298	UPIL	6 2.4	452	UPIM SV	10 4.0
133	UPIL SV	15 14.2	299	UPIL	6 2.4	453	UPIM SV	10 4.0
134	UPIL SV	15 14.2	300	UPIL	6 2.4	454	UPIM SV	10 4.0
135	UPIL SV	15 14.2	301	UPIL	6 2.4	455	UPIM SV	10 4.0
136	UPIL SV	15 14.2	302	UPIL	6 2.4	456	UPIM SV	10 4.0
137	UPIL SV	15 14.2	303	UPIL	6 2.4	457	UPIM SV	10 4.0
138	UPIL SV	15 14.2	304	UPIL	6 2.4	458	UPIM SV	10 4.0
139	UPIL SV	15 14.2	305	UPIL	6 2.4	459	UPIM SV	10 4.0
140	UPIL SV	15 14.2	306	UPIL	6 2.4	460	UPIM SV	10 4.0
141	UPIL SV	15 14.2	307	UPIL	6 2.4	461	UPIM SV	10 4.0
142	UPIL SV	15 14.2	308	UPIL	6 2.4	462	UPIM SV	10 4.0
143	UPIL SV	15 14.2	309	UPIL	6 2.4	463	UPIM SV	10 4.0
144	UPIL SV	15 14.2	310	UPIL	6 2.4	464	UPIM SV	10 4.0
145	UPIL SV	15 14.2	311	UPIL	6 2.4	465	UPIM SV	10 4.0
146	UPIL SV	15 14.2	312	UPIL	6 2.4	466	UPIM SV	10 4.0
147	UPIL SV	15 14.2	313	UPIL	6 2.4	467	UPIM SV	10 4.0
148	UPIL SV	15 14.2	314	UPIL	6 2.4	468	UP	

YAP ISLANDS

Index Map

Sheet 4 of 4

Falanrow, Marjorie C., Whitesell, Craig D., Cole, Thomas G.,
MacLean, Colin D., Ambacher, Alan H. Vegetation survey of
Yap, Federated States of Micronesia. Resour. Bull. PSW-21.
Berkeley, CA: Pacific Southwest Forest and Range Experiment
Station, Forest Service, U.S. Department of Agriculture, 1987.

VEGETATION LEGEND

For explanation of vegetation type codes see Table 3.

ITEM	LABEL	AREA (ACRES) (HECTARES)	ITEM	LABEL	AREA (ACRES) (HECTARES)
3	G.P.S.	35 14.2	138	SV	52 21.0
4	AG/SV	10 4.0	139	AG/SV	33 13.4
5	MN/H	1 4	140	MN/H	1 4
7	SW1M/SV	6 2.4	141	MN/H	2 8
8	G.S.	3 1.2	142	G.G.	7 2.8
9	AG/SV	11 4.5	143	SV	21 8.5
11	U	1 4	144	M.F.	11 4.5
13	MN/H	29 11.7	145	MN/M.N	5 2.0
14	UP2M/SV	1 4	146	MN/H	3 1.2
15	UP1M/SV.BB	22 8.9	147	UP1M/SV	50 20.2
16	UP2M/SV	1 4	148	MN/H	79 32.0
17	SV	189 76.5	150	M.F.	2 8
18	G.P.S.	47 19.0	151	AG/SV	7 2.8
19	UP1M/SV	19 7.7	152	AG/SV	36 14.6
20	W	2 8	154	M.F.C.	3 1.2
21	SV	1 4	155	AG	34 13.8
22	AG	37 15.0	156	M.F.	5 2.0
23	UP1M/SV	13 5.3	157	MN/H	11 4.5
24	UP0M	7 2.8	158	U/C	24 9.7
25	SV	9 3.6	159	MN/H	23 9.3
26	U	5 2.0	160	M.F.	13 5.3
27	G.W.	57 23.1	162	AG.CO	4 1.6
28	M.F.C.	8 3.2	165	AG.CO	5 2.0
30	G.G.	6 2.4	166	SW1M/SV	4 1.6
31	G.P.S.	76 30.8	167	AG/SV.BB	65 26.3
32	MN/H	5 2.0	168	AG.CO	61 24.7
33	SW1M/SV	14 5.7	170	M.F.	2 8
34	U	15 6.1	171	B	3 1.2
35	MN/H	1 4	172	MN/H	4 1.6
36	AG.CO/M.F.C.	281 113.7	175	AG/SV	51 20.6
37	SV	6 2.4	176	CO1H	33 13.4
38	M.F.C.	2 8	177	M.F.	8 3.2
39	AG	19 7.7	179	B	1 4
40	MN/H	9 3.6	180	B	1 4
41	G.C.A.	5 2.0	181	MN/H	17 6.9
42	MN/H	1 4	182	MN/H	47 19.0
43	G.G.	1 4	183	B	1 4
44	M.F.C.	1 4	184	CO1H	50 20.2
45	MN/H	1 4	185	SV.BB	31 12.5
48	AG/SV.BB	44 17.8	186	MN/H	1 4
47	SV	6 2.4	187	M.F.	11 4.5
48	MN/H	1 4	189	M.F.C.	2 8
50	U/AG	9 3.6	190	SV	7 2.8
51	MN/H	1 4	191	MN/H	4 1.6
52	MN/H	3 1.2	192	SV.BB	61 24.7
53	AG	7 2.8	193	G.C.A.	13 5.3
54	SW1M/SV	5 2.0	194	M.F.	6 2.4
55	C	6 2.4	195	AG/SV	22 8.9
56	MN/H	2 8	197	M.F.	5 2.0
57	G.P.S.	11 4.5	198	CO1H	27 10.9
58	G.S.	24 9.7	199	U	1 4
59	C	1 4	200	SV	2 8
60	UP1M/SV	13 5.3	201	M.F.	9 3.6
61	M.F.C.	1 4	202	AG/SV	29 11.7
62	UP1M/SV	5 2.0	203	SV.BB	3 1.2
63	B	1 4	204	AG	65 26.3
64	G.P.S.	14 5.7	206	SV	6 2.4
66	M.F.	1 4	207	MN/H	1 4
67	AG	76 30.8	208	MN/H	1 4
68	MN/H	19 7.7	209	U/C	9 3.6
69	U	5 2.0	210	M.F.	7 2.8
70	U	14 5.7	211	MN/H	4 1.6
71	MN/H	8 3.2	212	CO1H	46 18.6
72	UP1M/AG	42 17.0	213	AG	1 4
73	MN/H	35 14.2	214	MN/H	1 4
74	MN/H	6 2.4	215	MN/H	3 1.2
75	G.C.A.	13 5.3	216	MN/H	12 4.9
76	AG	1 4	217	SV	9 3.6
77	G.C.A.	9 3.6	218	MN/H	6 2.4
78	G.C.A.	36 14.6	220	M.F.	17 6.9
79	AG/SV.BB	59 24.1	221	M.F.C.	1 4
80	G.S.	13 5.3	222	MN/H	4 1.6
81	G.C.A.	64 25.9	223	G.B.	2 8
82	CO1H	3 1.2	224	SV.BB	74 29.9
83	M.F.C.	1 4	225	MN/H	1 4
84	AG.CO/M.F.C.	2 8	227	SW1H	7 2.8
85	AG/SV	12 4.9	228	AG	18 7.3
87	MN/H	1 4	229	M.F.	7 2.8
88	MN/H	333 134.8	230	U	8 3.2
90	U/SV	2 8	231	U	2 8
91	U/SV	15 6.1	232	SV	11 4.5
92	SV	1 4	233	AG	13 5.3
93	W	1 4	234	M.F.C.	2 8
94	M.F.	4 1.6	235	MN1	6 2.4
95	AG.CO	70 28.3	236	SV	27 10.9
96	M.F.	9 3.6	237	AG.CO/M.F.C.	246 99.6
97	AG	57 23.1	238	MN/H	4 1.6
98	SV	12 4.9	239	U	9 3.6
100	G.C.A.F.	7 2.8	241	M.F.	17 6.9
102	G.W.D.	6 2.4	242	AG/SV	43 17.4
103	SV	6 2.4	243	M.F.	1 4
104	G.B.F.	67 27.1	244	U/SV	9 3.6
105	M.F.	1 4	246	G.C.A.	3 1.2
106	G.C.A.	34 13.8	247	AG	22 8.9
107	AG/SV	46 18.6	248	MN/H	1 4
108	MN/H	4 1.6	249	U	4 1.6
109	G.B.	7 2.8	250	M.F.	1 4
110	G.W.D.	18 7.3	252	M.F.	2 8
111	AG	8 3.2	254	U	4 1.6
114	G.B.F.	25 10.1	255	MN/H	1 4
115	G.W.	26 10.5	256	AG	2 8
116	UP2M/SV	4 1.6	257	MN/H	18 7.3
117	MN/H	24 9.7	258	MN/H	2 8
118	U	17 6.9	259	MN/H	2 8
119	M.F.	3 1.2	260	MN/H	1 4
120	SV	30 12.1	301	G.P.S.	9 3.6
121	MN/H	26 10.5	302	G.P.S.	2 8
122	G.C.A.	16 6.5	303	UP1M/SV	13 5.3
123	SV	6 2.4	304	UP1M/SV	1 4
124	G.C.A.S.	9 3.6	305	AG.CO	4 1.6
125	SV	2 8	306	G.P.S.	5 2.0
126	AG/SV	6 2.4	307	G.P.S.	9 3.6
127	MNOM	1 4	308	G.P.S.	1 4
128	M.F.	25 10.1	309	UP1M/SV	1 4
129	U/B	62 25.1	310	G.P.S.	1 4
130	UP1M/SV	29 11.7	311	G.P.S.	15 6.1
131	MN/H	3 1.2	312	G.C.A.	37 15.0
132	MN/H	1 4	313	AG	11 4.5
133	W	6 2.4	314	MN/H	5 2.0
134	AG.CO	117 47.3	315	AG/SV	10 4.0
135	G.W.	1 4	316	SV.BB	1 4
136	G.B.F.	12 4.9	317	G.B.G.	304 123.0
137	M.F.	2 8	318	U/B	27 10.9

Falanruw, Marjorie C.; Whitesell, Craig D.; Cole, Thomas G.; MacLean, Colin D.; Ambacher, Alan H. **Vegetation survey of Yap, Federated States of Micronesia**. Resour. Bull. PSW-21. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1987. 9 p. + 4 maps.

The vegetation of Yap, Federated States of Micronesia, in the western Caroline Islands was mapped for land-use planning, forest resource management, and timber volume surveys. The maps show the location and extent of vegetation types identified from 1976 aerial photographs. Forest area is estimated at 3,882 ha (9,593 acres), with an additional 553 ha (1,366 acres) in secondary vegetation. Twenty-six percent (2,538 ha or 6,272 acres) of the island is used for agroforestry.

Retrieval Terms: vegetation survey, vegetation maps, forest resources, Yap, Federated States of Micronesia, Caroline Islands, Micronesia