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Federated States of Micronesia's Forest Resources: Forest Inventory and Analysis, 2016

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Cover photo: Pohnpei montane rainforest where there are many endemic and native species. USDA Forest Service photo by Matthew O'Driscoll.

Abstract

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In 2016, the U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis program collected forest and tree measurements from 149 plots in Yap, Chuuk, Pohnpei, and Kosrae states of the Federated States of Micronesia (FSM). Of these, 78 were remeasured plots first established in 2005, and 71 were new plots that were established to meet the Micronesia Challenge, a regional conservation initiative. We recorded 131 tree species and 280 dominant vascular plant species, including 18 invasive plant species. Invasive plant species were present in half of FSM forest area, and the vine *Merremia peltata* was the most common nontree plant species, comprising by far the largest weedy component. Two of the twenty most common and dominant tree species were invasive. Damage from wild pigs was observed in all states except for Yap and was the largest source of disturbance on Kosrae. No damage was observed in the FSM from coconut rhinoceros beetles.

Pohnpei clearly had the least disturbed forest condition among states, with about three-fourths of its forest area undisturbed, while 50 percent of forest area in Yap and 90 percent of forest area in Chuuk were disturbed.

Human disturbance was the most prevalent disturbance category in 2016, having increased by more than six times from the first inventory. In contrast, weather was the largest recorded source of disturbance in 2005. Disturbances caused by insects, disease, and animals were unrecorded in 2005, but cumulatively disturbed about 10 percent of total forest area in 2016.

Forests in the FSM were moderately dense with about 600 stems per acre and were characterized by a preponderance of small trees. The mean diameter at breast height, tree height, stem density, and basal area for the FSM overall did not change significantly between 2005 and 2016, but there were significant differences at the state level.

KEYWORDS:

Federated States of Micronesia

Forest carbon

Forest disturbance

Forest monitoring

Pacific Islands

Highlighted Forest Inventory and Analysis Statistics, Federated States of Micronesia

- Estimated total forest area: 148,924 acres
- Estimated total number of live trees (≥ 1 inch in diameter at breast height): 90,959,513
- Estimated total live, aboveground biomass: 14,117,155 tons
- Estimated total live, aboveground tree carbon: 7,058,577 tons

Preface

U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) is one of the largest ground-based forest monitoring programs in the world, continuously measuring forest structure and health across 49 U.S. states and collecting forest data in Hawai'i, U.S. territories, and the U.S.-Affiliated Pacific Islands about every 10 years. The FIA program began working with the U.S.-Affiliated Pacific Islands and other U.S. territories in 2001. The first forest inventory in the Federated States of Micronesia (FSM) began in 2005, and these plots were remeasured in 2016 (Agricultural Act 2014).

Differences Between 2005 and 2016 Inventories and Reports

There were some differences in the methodologies between the 2005 and 2016 inventories, and differences in reporting of summary results. Percentage of live

canopy cover for the entire plot, percentage of subplot area with pig damage, and percentage of cover of invasive species were not measured in the 2005 inventory; and percentage of forest area by disturbance, dominant species, growth habit, and canopy layer were not mentioned in the 2005 report.

The percentage of cover of culturally and economically important species (covering at least 1 percent of area) was not recorded in the 2016 inventory, and the topographic relative moisture index of forests in the FSM was not recalculated for the 2016 report.

The number of subplots, mean percentage of forest area cover and standard deviation of understory species and tree seedlings were listed for all species in the 2005 report, but only the 20 most common understory and tree seedling species are listed by percentage of forest area cover in the 2016 report.

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Introduction

This summary of forest resources of the Federated States of Micronesia (FSM) is based on forest inventories conducted in 2005 and 2016 by the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Forest Inventory and Analysis (FIA) program in cooperation with Yap, Chuuk, Pohnpei, and Kosrae state forestry programs. Cross-boundary partnerships between island entities, federal agencies, and the FIA program are instrumental to measuring forest plots safely and effectively in these unique areas and to supporting field data collection by a multinational crew. The inventory was designed to answer questions about the status and trends of forested ecosystems, to provide information to resource managers for making informed forest management decisions, and to share forestry skills among jurisdictions and agencies. The forest resources in the FSM are described in detail in the national Forest Action Plan (FSM 2020) published by the FSM Department of Resources and Development. This complementary report covers all four FSM states and describes forests and their ecosystem services; high-priority landscapes; and the primary issues threatening the health of trees, forests, and terrestrial wildlife.

Geography and Climate of the FSM

The FSM is a federation of four semiautonomous tropical Pacific Island states: Yap, Chuuk, Pohnpei, and Kosrae (figs. 1–4). Each state is based around at least one high island¹ and, except for Kosrae, has many small outlying islands, mostly atolls. The more than 600 islands of the FSM are located north of the equator, spreading across more than 1,600 miles longitudinally and covering 1 million square miles of the northwest Pacific Ocean. Less than 0.1 percent of this watery expanse is covered by land.

¹ High islands are generally those in which basalt rock from volcanic formation remains above the ocean surface, in contrast to low islands, which are composed of sediment, coral rubble, or reef material.

Given the small land and forest area of most of the islands, the base FIA plots were only located on the principal high islands of Yap state (13 plots on Yap island, 1 on Rumung), Chuuk (5 on Weno, 4 on Faichuk, 4 on Fefen, 1 each on Tonoas and Totiw), Pohnpei state (41 on Pohnpei island, 1 on Na), and Kosrae (13). The Micronesia Challenge program, a regional political conservation commitment, expanded the number of islands sampled and inventoried in 2016 (Dendy et al. 2020) by adding 38 plots in Yap state (16 on Yap island; 1 on Rumung; 4 on Fais; 3 on Ulithi; 2 on Sorol; 1 each on Falalis, Faraulep, Fassarai, Ifalik, Lamotrek, Lossau, Paliau, Pau, Tagaulap, Woleai, and Wottagai), 5 plots in Chuuk (3 on Weno, 1 each on Faichuk and Fefen), 14 plots in Pohnpei state (7 on Pohnpei island; 3 on Pamuk Imwintiat/Pah; 1 each on Imwinsapw/Pahnwasang, Pasa, Nikalap, and Sapwtik), and 14 plots on Kosrae (table 1). The sampled areas reported in this inventory of the FSM cover about 90.6 percent of the total land area.

The FSM has a tropical climate with hot and humid conditions throughout the year. Mean temperatures vary little during the day, throughout the year, and among islands. Mean maximum and minimum daily temperatures vary annually by less than 2 °F in each state; mean annual maximum and minimum temperatures are about 87 and 75 °F, respectively (figs. 5 and 6). Precipitation is more variable than temperature in the FSM but is generally high across the region; mean monthly rainfall amounts are between 10.1 and 15.6 inches (fig. 7) (NCEI 2020a, 2020b, 2020c, 2020d). There is more rainfall in Kosrae and Pohnpei, with both states receiving more than 180 inches annually, which is about 45 inches more than in Chuuk (NCEI 2020a, 2020b, 2020c). Yap has the lowest mean monthly rainfall in the country from November to June, with 3 months of about 6 inches or less. This, in conjunction with anthropogenic wildfires, has resulted in a higher proportion of grassland/savanna in Yap (NCEI 2020d).

Yap Vegetation and FIA Forest Plots

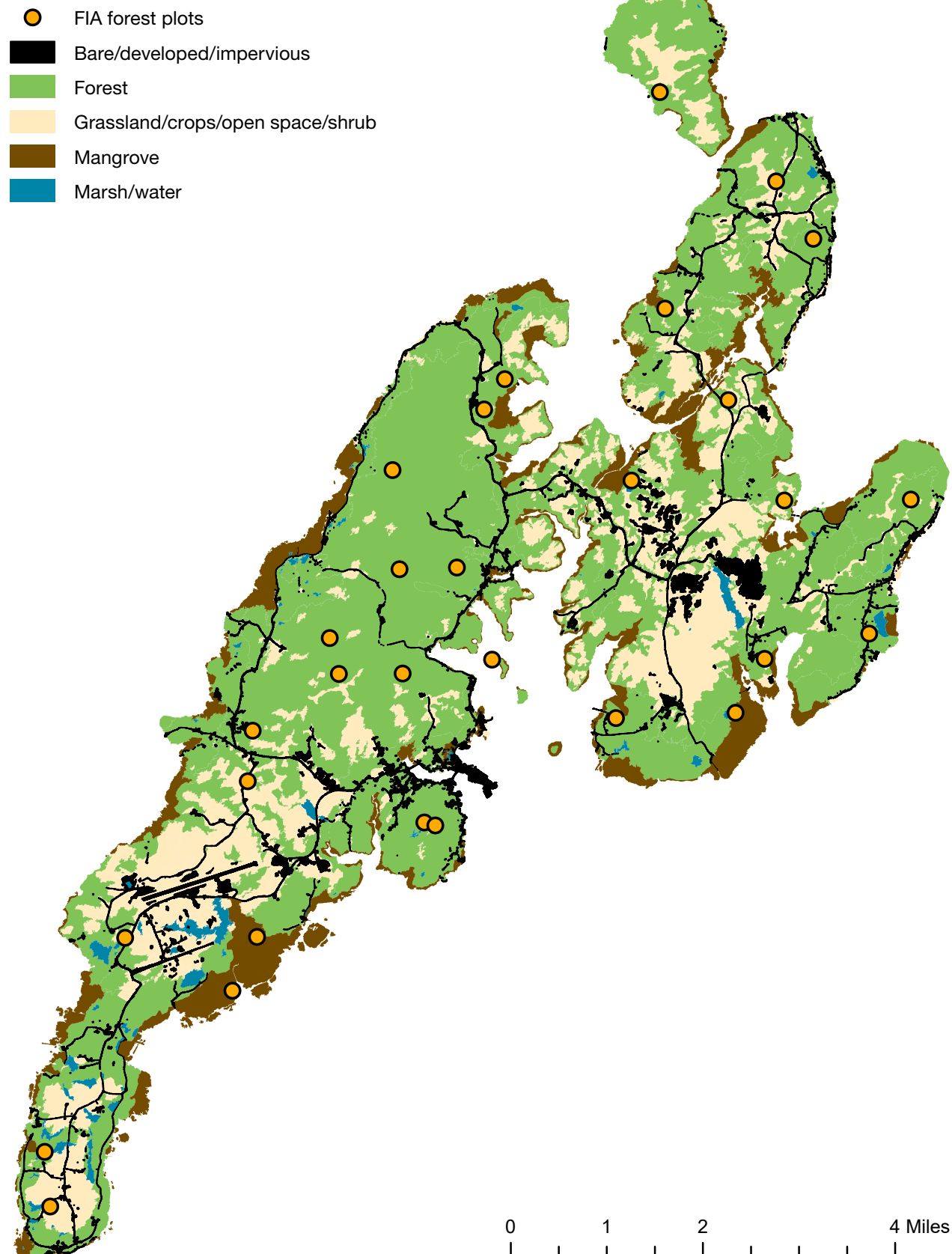


Figure 1—Vegetation cover with USDA Forest Service, Forest Inventory and Analysis (FIA), and Micronesia Challenge forest plots in Yap state, Federated States of Micronesia. Plot locations are approximate. Vegetation cover source: USDA FS (2005a)

Chuuk Vegetation and FIA Forest Plots

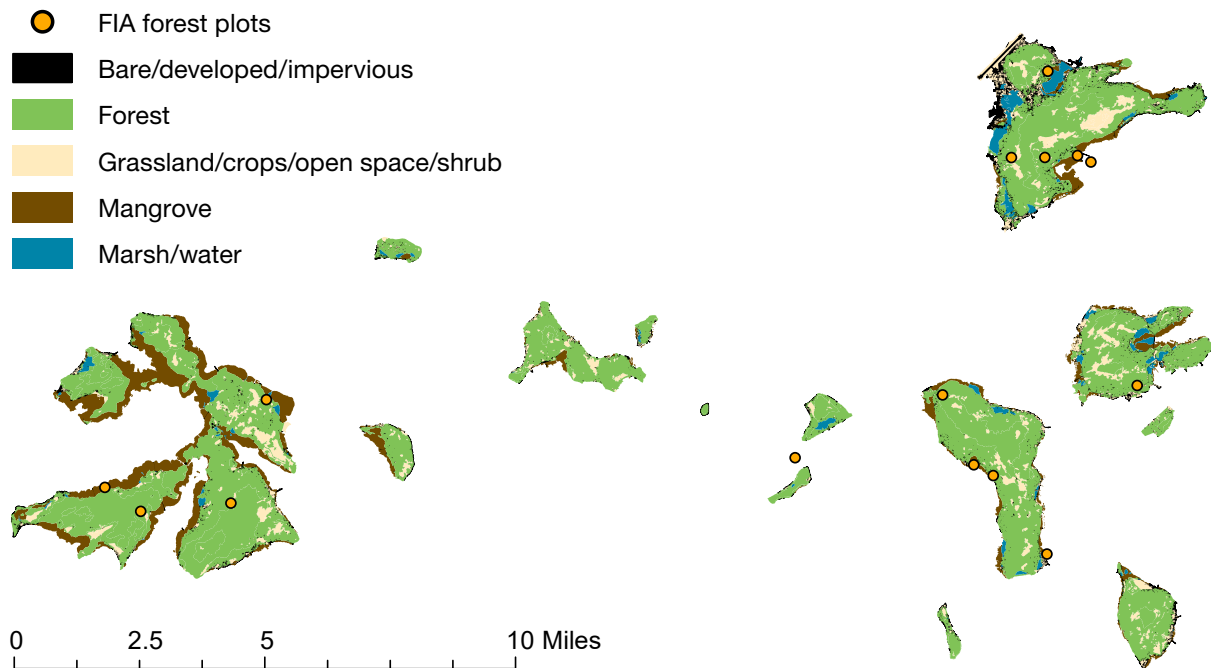


Figure 2—Vegetation cover with USDA Forest Service, Forest Inventory and Analysis (FIA), and Micronesia Challenge forest plots on the main islands of Chuuk state, Federated States of Micronesia. Plot locations are approximate. Vegetation cover source: USDA FS (2005b).

Pohnpei Vegetation and FIA Forest Plots

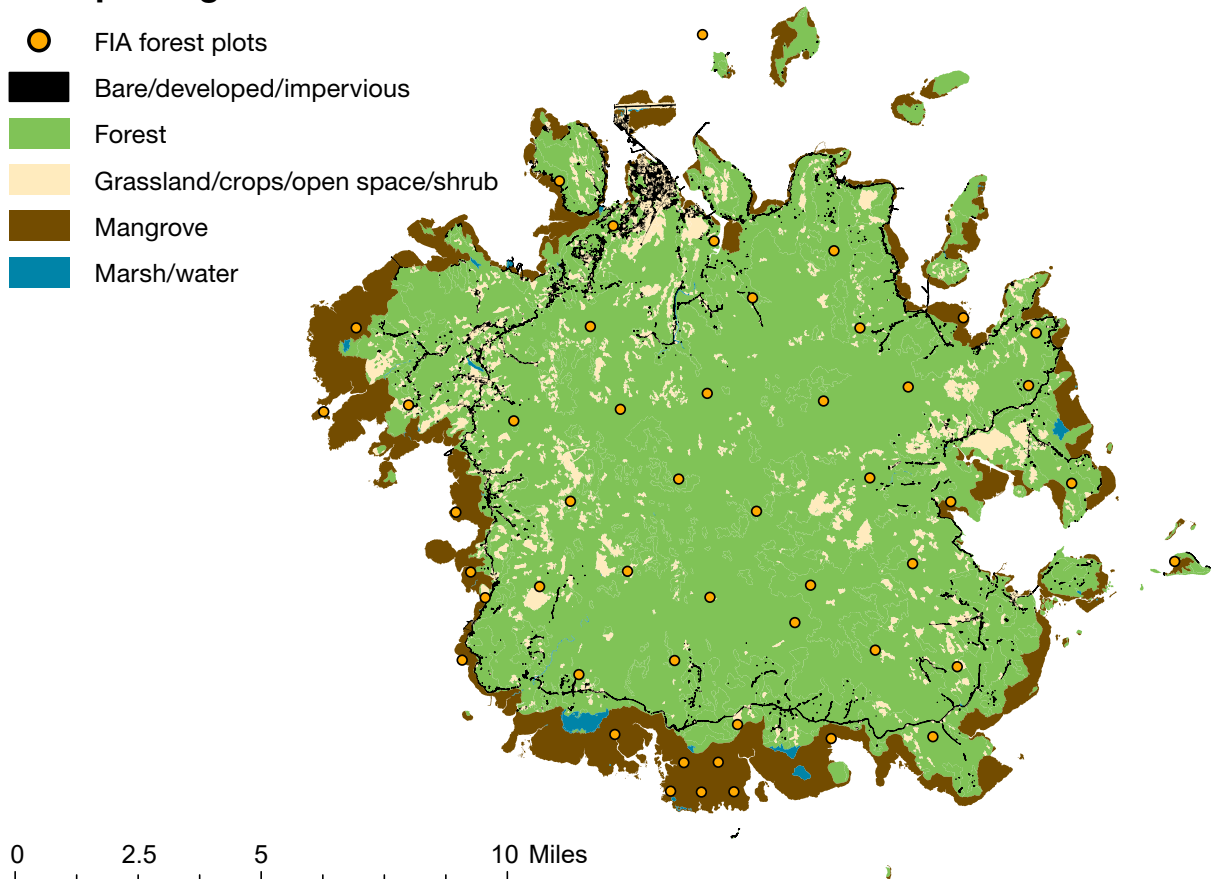


Figure 3—Vegetation cover with USDA Forest Service, Forest Inventory and Analysis (FIA), and Micronesia Challenge forest plots in Pohnpei state, Federated States of Micronesia. Plot locations are approximate. Vegetation cover source: USDA FS (2008).

Kosrae Vegetation and FIA Forest Plots

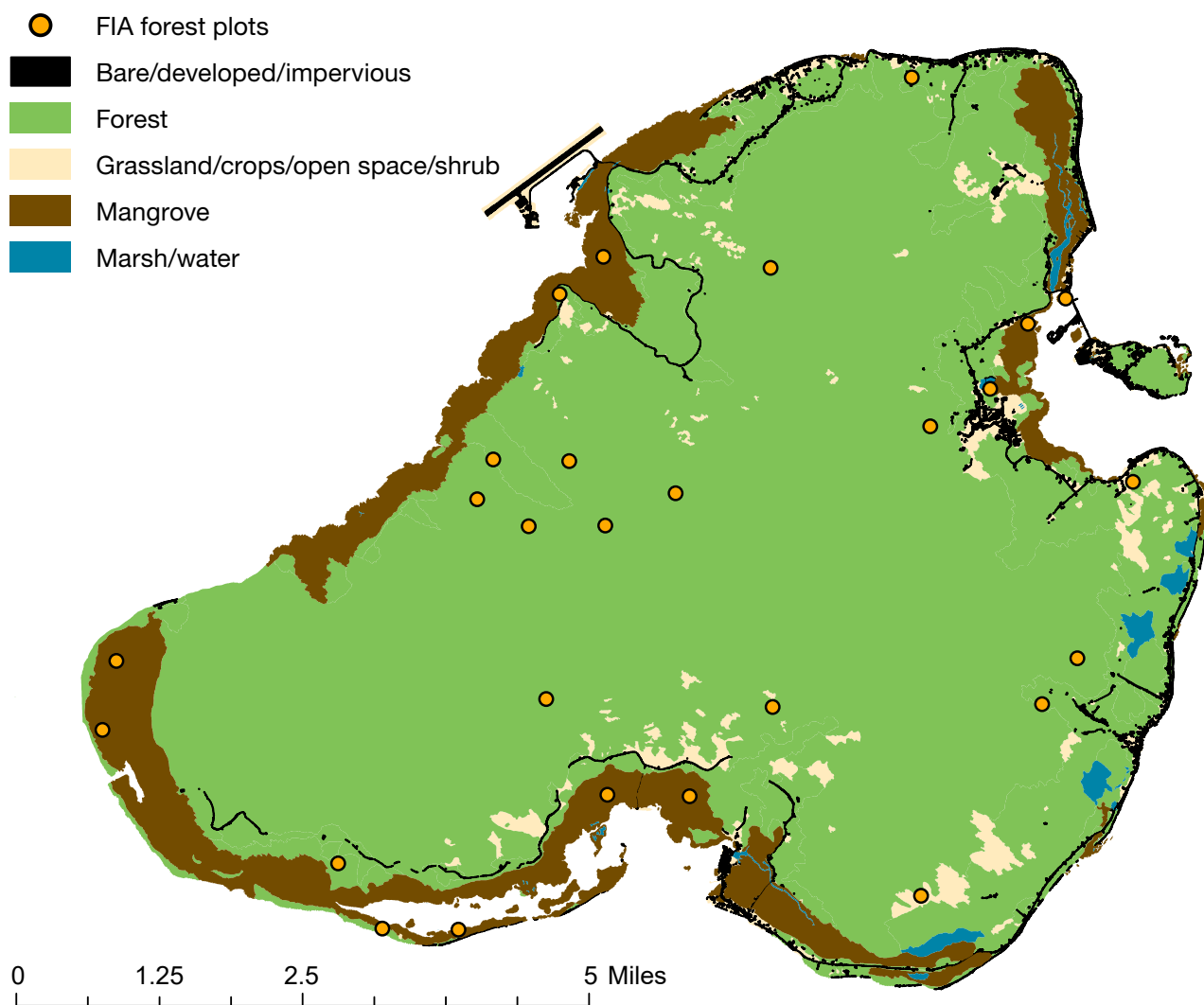


Figure 4—Vegetation cover with USDA Forest Service, Forest Inventory and Analysis (FIA), and Micronesia Challenge forest plots on the island state of Kosrae, Federated States of Micronesia. Plot locations are approximate. Vegetation cover source: USDA FS (2009).

Table 1—Sample size of measured forest plots by state, forest community, and inventory in the Federated States of Micronesia (FSM), 2016

State	Forest Inventory and Analysis	Micronesia Challenge
NUMBER OF PLOTS		
Yap	14	38
Chuuk	10	5
Pohnpei	41	14
Kosrae	13	14
Total FSM forest plots	78	71
Forest community	Forest Inventory and Analysis	Micronesia Challenge
Agroforest	15	13
Lowland rainforest	49	18
Mangrove	15	21
Montane rainforest	4	0
Strand forest	1	25

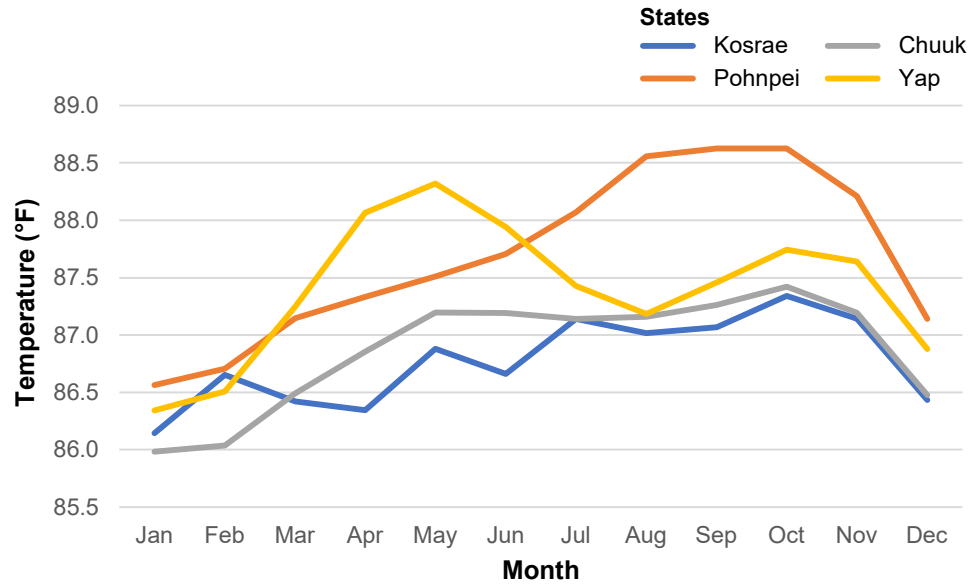


Figure 5—Daily mean maximum temperature by month in Federated States of Micronesia states, July 1951 through April 2020. Sources: NCEI (2020a, 2020b, 2020c, 2020d).

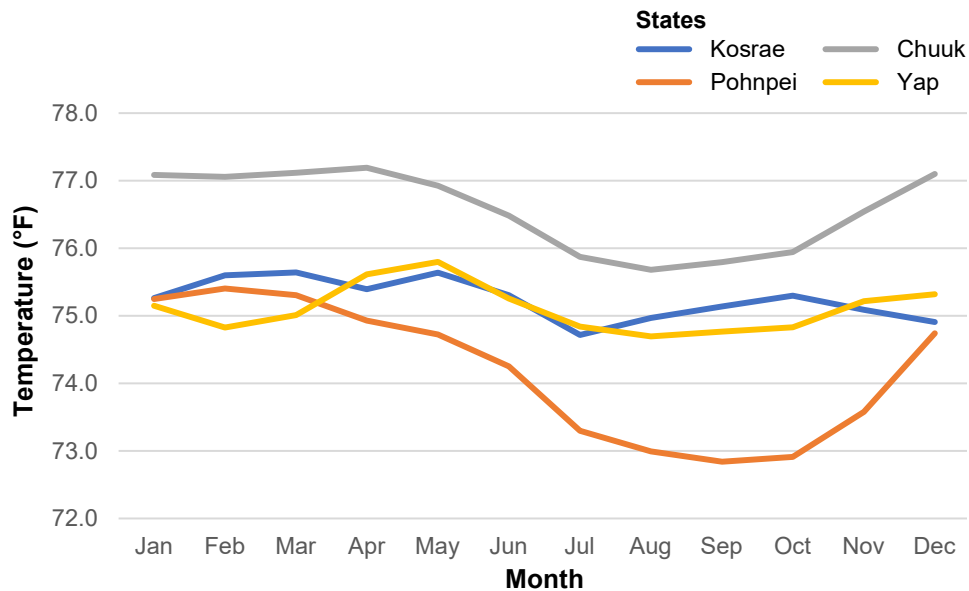


Figure 6—Daily mean minimum temperature by month in Federated States of Micronesia states, July 1951 through April 2020. Sources: NCEI (2020a, 2020b, 2020c, 2020d).

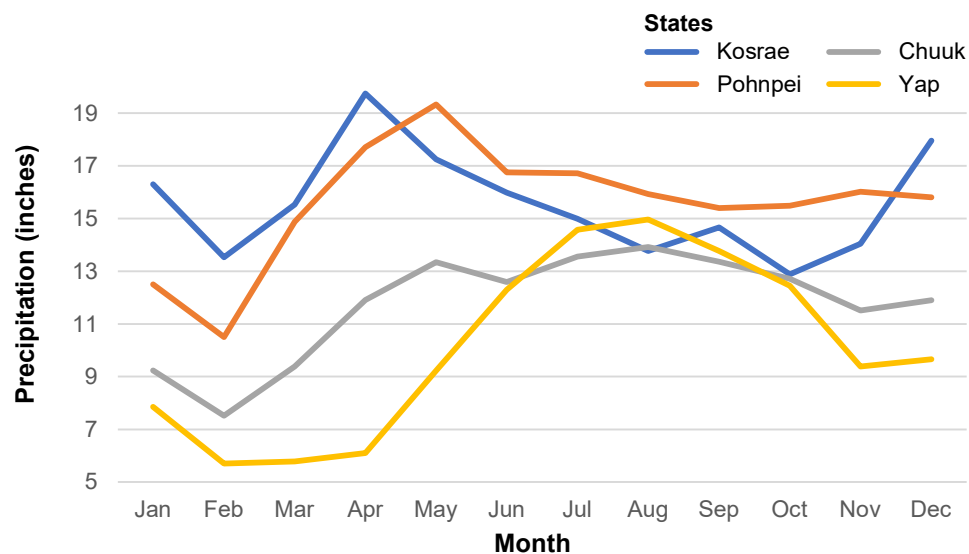


Figure 7—Mean monthly precipitation in Federated States of Micronesia states, July 1951 through April 2020. Sources: NCEI (2020a, 2020b, 2020c, 2020d).

The western half of the FSM is located within the typhoon belt of the Northwest Pacific Ocean basin, which is the most active region for typhoons on Earth. Since 1980, there have been 51 typhoons that have passed within the 12-nautical mile zone around Yap island, 55 in the Fais/Ulithi nautical zone, and 68 in Chuuk. In 2015, Typhoon Maysak caused significant damage to the main islands of Chuuk and catastrophic damage on some of the outer islands of Yap state, including Ulithi and Fais (figs. 8 and 9).

The high islands of the FSM are volcanic in origin and of varying age. Yap island is the most geologically complex with part composed of ancient weathered volcanic rock and part weathered metamorphic rock (Muller-Dombois and Fosberg 1998). It is composed of four closely grouped, hilly islands surrounded by barrier and fringing reefs and has 16 soil types (Laird 1983c). Chuuk island is known as an “almost-atoll,” with a huge barrier

reef and lagoon enclosing 19 high volcanic islands, which are characterized by steep, rugged uplands surrounded by coastal lowlands, and has 13 soil types (Laird 1983b). Pohnpei island has a steep, mountainous interior with the highest peaks in Micronesia (about 2,500 feet above sea level), and is surrounded by rolling hills and bottom lands with 18 soil types (Laird 1982). Kosrae island has a steep and rugged montane interior surrounded by foot slopes, alluvial fans, and bottom lands, with 17 soil types (Laird 1983a). Almost all the high volcanic islands of the FSM have coastlines with rock areas, sand beaches, alluvium, and mangrove swamps.

Soils relevant to FSM forests are divided into four general categories in the most recent state soil surveys: bottomlands, uplands, coastal strands, and mangroves (Laird 1982, 1983a, 1983b, 1983c). Strand forests occur on deep and well-drained sandy soils, which only constitute about 4 percent of soils in Yap, 8 percent in Chuuk,

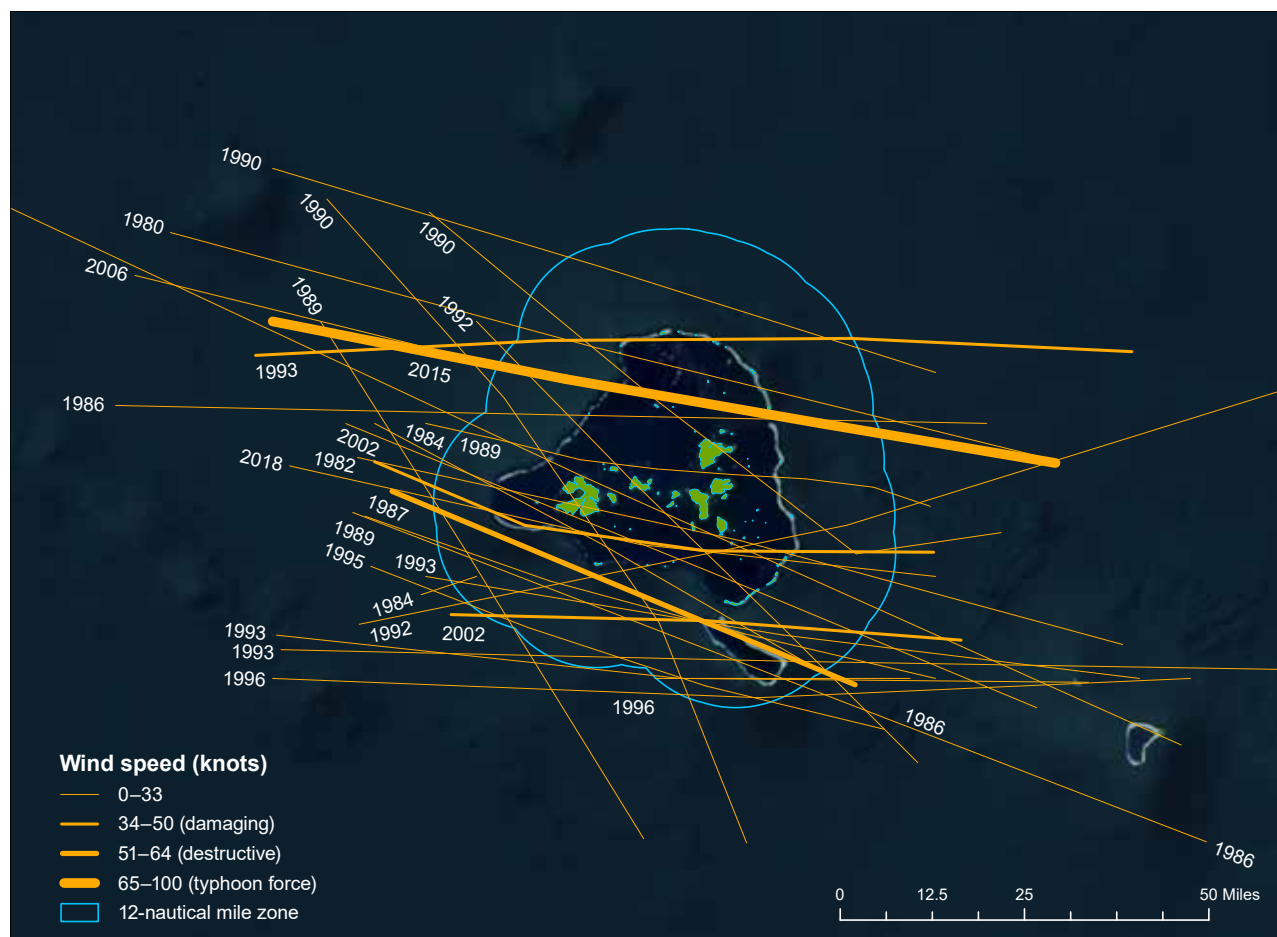


Figure 8—Typhoon tracks (1980–2021) that intersected the 12-nautical mile zone of Chuuk state. Sources: Gahtan et al. (2024), Knapp et al. (2010).

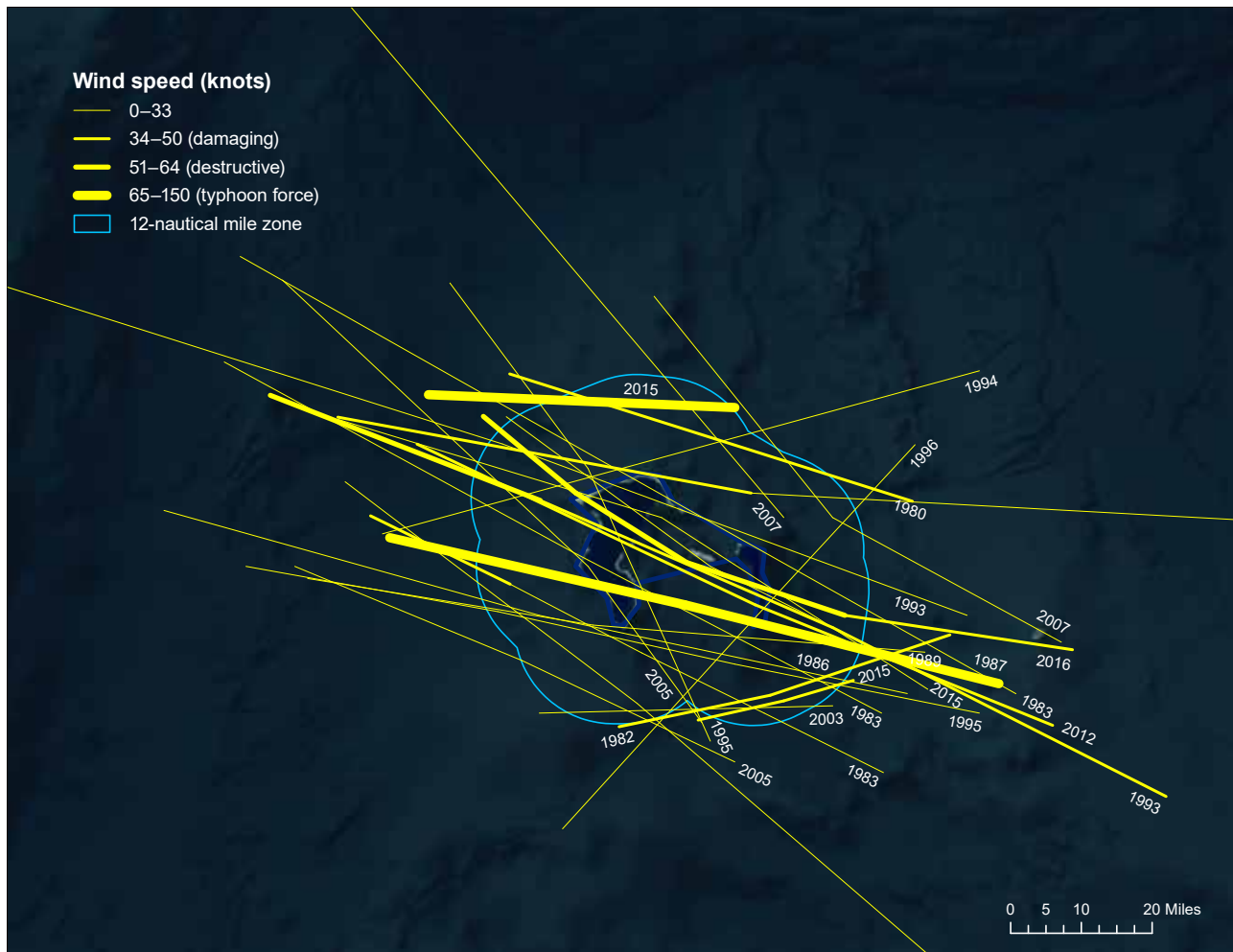


Figure 9—Typhoon tracks (1980–2021) that intersected the 12-nautical mile zone of Fais Island and Ulithi Atoll, Yap state. Sources: Gahtan et al. (2024), Knapp et al. (2010).

0 percent in Pohnpei, and 3 percent in Kosrae. These soils are similar to sandy soils found on low-elevation atolls, which characterize almost all of the outer islands/atolls inventoried for the Micronesia Challenge initiative. Mangrove forests occur in the intertidal zone on deep, poorly drained, anaerobic soils with high organic content and constitute about 12 percent of soils in Yap, 13 percent in Chuuk, 14 percent in Pohnpei, and 13 percent in Kosrae. Bottomland soils tend to be deep with highly variable drainage and are commonly under some kind of human-altered vegetation cover, such as a taro patch or agroforest, and they constitute about 8 percent of soils in Yap, 6 percent in Chuuk, 4 percent in Pohnpei, and 12 percent in Kosrae. Upland soils are deep and well drained, generally located where most native vegetation occurs, and constitute about 74 percent of soils in Yap (25 percent volcanic, 49 percent metamorphic substrate), 73

percent in Chuuk, 82 percent in Pohnpei, and 72 percent in Kosrae.

Humans have extensively modified the vegetation on all the inhabited islands across the FSM, and few areas of original forest remain (Mueller-Dombois and Fosberg 1998). Considerable human-caused forest disturbances occurred across the region during the past few hundred years under Spanish, German, and Japanese administrations. This is most apparent in Chuuk because of devastating World War II military activity, which included forest clearing, urban growth, and the introduction of many destructive invasive species. A less damaging conversion of forest to agroforestry has been practiced for centuries across the region, and coconut plantations mixed with native and introduced fruit trees occupy entire atolls and much, if not most, of the relatively flat, arable, lowland coastal zones of the high islands.

Forest and nonforest vegetation types that occur on the principal high islands in the FSM have been described and mapped. Upland forest, mangrove, and agroforests occur on all islands; swamp forest occurs on all islands (in tiny areas of Chuuk); palm and plantation forests occur in Chuuk and Pohnpei; and dwarf forest occurs in Pohnpei and Kosrae (Falanruw et al. 1987a, 1987b; MacLean et al. 1986; Whitesell et al. 1986). At the western edge of Micronesia, Yap has a distinct dry season and is the only state with sizable areas of grassland/savanna. The main forest types, their general characteristics, and descriptions of common species across Micronesia and the FSM are described in *Vegetation of the Tropical Pacific Islands* (Mueller-Dombois and Fosberg 1998) and are used by the FIA program to define forest communities in the region. The FIA program characterized five forest communities in the FSM: strand or halophytic vegetation, lowland tropical rainforest, mangrove swamp, montane rainforest, and agroforest.

Forest Inventory and Analysis Program

The plot sampling intensity was increased by a factor of three in the FSM—plots were sampled every 2,000 acres rather than every 6,000 acres as in the mainland U.S. inventory—to better account for the high diversity on a small land mass with a statistically relevant sample. The increased sampling regime located plots on all the principal high islands across the FSM but not on the many smaller outlying islands. The Micronesia Challenge program increased the sampling intensity again by a factor of 9 (for a total of 27 times base intensity) for sampling within protected areas, areas of biological significance, and previously unsampled islands (table 1) (Dendy et al. 2020).

The FIA plot cluster covers an area of about 1.5 acres and is composed of four 24-foot fixed radius subplots, with three subplots equidistant from a central subplot like spokes on a wheel (fig. 10) (USDA FS 2016). For each plot, field crews assigned condition classes and their proportions to the accessible forest land area sampled. The forest condition characteristics measured on accessible forest land and estimated for each condition on the entire plot footprint included forest disturbances, forest community, and dominant tree species. Live and dead trees that were ≥ 5 inches in diameter at breast height

(DBH) were measured in the subplots, with a cumulative area of about $\frac{1}{6}$ of an acre, or 676 square meters (0.07 hectares). Live and dead trees that were 1 to 5 inches in DBH were measured in the microplots, with a cumulative area of about $\frac{1}{50}$ of an acre or 53 square meters (0.005 hectares). In addition to DBH, crews measured tree height, identified tree species, and recorded tree damages from subplots and microplots. Crews estimated percentage of cover on each subplot for the four most dominant species (dominant species must meet a 3-percent cover threshold) in each growth habit: graminoids, shrubs, forbs, and trees. In 2016, crews estimated percentage of invasive plant species cover and percentage of live canopy cover and recorded the presence of tree pathogens/pests unique to the region.

The FIA program uses a statistical method called poststratification (based on the number of forest pixels in the satellite image used for each measurement cycle) to generate the estimated totals at the jurisdictional level from the plot-level data. This allows for estimates of total numbers or percentages of trees by species or diameter class; forest area by jurisdiction; or percentage of total forest area by forest type, disturbance, or canopy cover. Estimates were calculated based on FIA stratification and estimation procedures (Bechtold and Patterson 2005). Growth, removals, and mortality of trees, and change in forest area over time were calculated using a stratification that links measurements from at least two inventories.

The high species diversity and variability of tropical forests relative to the small land area of the Pacific Islands tend to result in high sample error (SE) values for FIA estimates in the region. Therefore, for this report, we mostly include results with SE values smaller than the mean, because mean estimates with equivalent or larger SE values are unreliable. Readers are encouraged to compare estimates with SE values and review the brief section on SE (app. 2).

Estimates of forest area and percentage of forest cover are also available from the Forest Service-led Land Cover Monitoring program for the consortium for the U.S.-Affiliated Pacific Islands (USDA FS 2010), which provides maps that summarize all vegetation cover using high-resolution satellite imagery (table 2). We combined vegetation classes to make maps comparable across

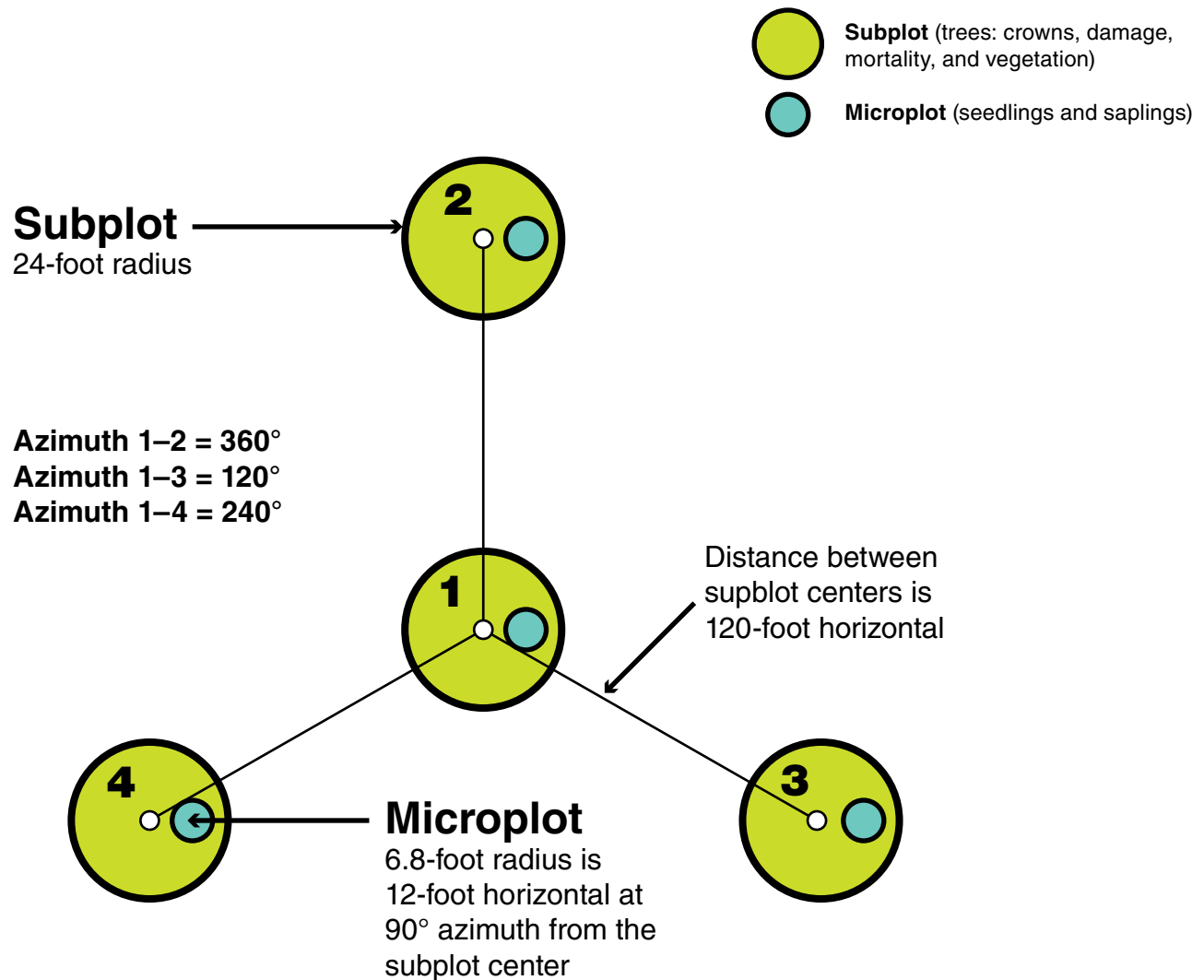


Figure 10—USDA Forest Service, Forest Inventory and Analysis plot diagram.

islands and the broader Micronesian region overall as follows. We merged all nonmangrove and strand forest types into one forest category equivalent to lowland tropical rainforest; we merged all nonforest vegetation categories into one grassland/crops/open space/shrub category; we merged all urban, built-up, and barren categories into one bare/developed/impervious category; and we merged all freshwater marsh, water, and inland water categories into the marsh/water category.

Forest Area and Community

According to vegetation maps from 2005 to 2009, about 89 percent of land area in the FSM is forested. Percentage of forest cover is slightly higher in Pohnpei and Kosrae.

In Chuuk, and particularly Yap, percentage of forest cover is lower and percentages of nonforest vegetation and nonvegetation cover are much higher (table 2). Plots were located in five forest communities—agroforest, lowland tropical rainforest (lowland rainforest), mangrove swamps (mangrove), montane rainforest, and halophytic strand vegetation (strand forest). Based on the random sampling, there were 148,924 acres (SE = 5,533) of forest in the FSM (table 3), of which 57.5 percent (SE = 4.9) was lowland rainforest, 17.9 percent (SE = 3.7) was agroforest, 17.1 percent (SE = 3.8) was mangrove, 4.6 (SE = 2.2) was montane rainforest, and 2.8 percent (SE = 1.4) was strand forest (table 4).

Table 2—Land cover estimates by state in the Federated States of Micronesia

Land cover	State			
	Yap	Chuuk	Pohnpei	Kosrae
	PERCENT OF LAND AREA			
Forest	72	83	93	94
Nonvegetation	4	4	1	1
Nonforest vegetation	24	12	6	4

Source: USDA FS (2010).

Live and Missing Canopy Cover

Multilayered forest vegetation with a high percentage of canopy cover maintains understory moisture and temperature, provides a three-dimensional matrix within which diverse life forms carry out their life cycles, and protects erodible soils from intense tropical rains (Mueller-Dombois and Fosberg 1998). The FIA program defines forest as areas that have ≥ 10 percent live and missing forest cover (USDA FS 2016). Missing canopy

cover estimates are based on canopy cover that existed prior to disturbance or tree harvest in the past 30 years.

In 2016, about three-quarters of total forest area in the FSM had ≥ 70 percent live canopy cover, and about one-tenth had ≤ 50 percent live canopy cover (table 5). Pohnpei and Kosrae states had the highest proportions of forest—about one-tenth of their respective forest areas each, with ≥ 90 percent live canopy cover. Pohnpei state had the lowest percentage of forest area, with ≤ 70 percent live canopy cover. Chuuk state had the highest percentage of forest area, with ≤ 50 percent canopy cover.

About one-fifth of total forest area in the FSM was missing canopy cover (5–40 percent) in 2016 (table 6). All states had some missing canopy cover and estimates of the percentage of total forest area with missing canopy cover ranged from 4 percent in Pohnpei to 69 percent in Chuuk. Plots with missing canopy cover had at least one disturbance recorded, and human-caused disturbance was the primary disturbance recorded for nearly 60 percent of these plots. In Yap, 75 percent of plots with

Table 3—Forest area by forest community and state in the Federated States of Micronesia (FSM)

Forest community	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	ACRES									
Strand forest	2,770	1,734	—	—	1,049	946	359	884	4,178	2,164
Montane rainforest	—	—	—	—	6,845	3,287	—	—	6,845	3,287
Mangrove	2,738	1,934	2,285	1,831	16,741	4,515	3,728	2,408	25,492	5,769
Agroforest	2,741	1,868	12,733	3,479	6,852	3,037	4,396	2,554	26,722	5,598
Lowland rainforest	15,884	3,076	5,979	2,936	45,734	5,753	18,090	3,226	85,687	7,848
Total	24,133	2,903	20,998	1,955	77,221	4,094	26,573	1,271	148,924	5,533

— = not observed, SE = sample error.

Table 4—Percentage of forest community area by state in the Federated States of Micronesia (FSM)

Forest community	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	PERCENT OF FOREST AREA									
Strand forest	11.5	7.0	—	—	1.4	1.2	1.4	3.3	2.8	1.4
Montane rainforest	—	—	—	—	8.9	4.2	—	—	4.6	2.2
Mangrove	11.3	7.8	10.9	8.9	21.7	5.7	14.0	8.9	17.1	3.8
Agroforest	11.4	7.7	60.6	14.6	8.9	3.9	16.5	9.7	17.9	3.7
Lowland rainforest	65.8	10.4	28.5	13.9	59.2	6.7	68.1	12.1	57.5	4.9

— = not observed, SE = sample error.

missing canopy cover were disturbed by humans, and in Chuuk, half of plots with missing canopy cover were disturbed by weather and one-third by humans. The plot with the most missing canopy cover recorded (40 percent) was disturbed by weather, in Chuuk.

Lowland rainforest had the highest overall percentage of live canopy cover among forest communities, followed by mangrove and strand forest (fig. 11). Agroforest had by far the lowest overall percentage of canopy cover, due to ongoing human management and maintenance activities.

Disturbance

Natural and human-caused disturbances to tropical forests affect canopy cover, structure, and plant species diversity and composition; outcomes vary depending on the disturbance type, duration and intensity, and timescale (Mueller-Dombois and Fosberg 1998). Forest disturbances can be either natural or human-caused, as noted above, and must meet some minimum criteria to be recorded. They must be at least 1 acre in size and

affect 25 percent of all trees, soil surface, or understory vegetation in a stand. If the disturbance affects only one species, at least 50 percent of individuals of this species must be affected to be recorded (USDA FS 2016).

In 2016, human-caused disturbance affected more forest area than any other disturbance in the FSM overall and in every state except for Kosrae, where animal damage was the most prevalent disturbance type (table 7 and fig. 12). Most of the human-caused disturbance occurred in agroforest—an estimated three-quarters of which experienced human-caused disturbance. In 2005, weather was the most prevalent disturbance type, and human-caused disturbance (3.2 percent [SE = 2.1]) (Donnegan et al. 2011) affected about six times less forest area than in 2016. The large increase in human-caused disturbance is likely in large part due to the expansion and maintenance of agroforest. It is not a result of the increase in sample size for the Micronesia Challenge, because the 2016 estimate for human disturbance from the base FIA plots is even higher (23.2 percent [SE = 4.5]);

Table 5—Forest area by live canopy cover and state in the Federated States of Micronesia (FSM), 2016

Canopy cover	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT	PERCENT OF FOREST AREA									
15 to 50	8.4	8.0	23.6	13.2	5.3	2.8	12.2	8.2	9.6	3.1
50 to 70	16.8	8.5	38.3	14.7	5.2	3.1	14.3	9.0	13.4	3.4
70 to 80	24.6	11.5	11.2	10.2	33.0	6.9	10.5	8.4	24.6	4.5
80 to 90	50.0	11.2	26.9	13.0	47.4	7.3	53.5	12.0	46.0	5.0
90 to 100	0.3	0.3	—	—	9.1	4.1	9.5	7.9	6.4	2.5

— = not observed, SE = sample error.

Table 6—Forest area by missing canopy cover and state in the Federated States of Micronesia (FSM), 2016

Missing canopy cover	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT	PERCENT OF FOREST AREA									
5–10	27.4	11.0	47.0	14.6	2.6	2.6	8.4	8.4	13.9	3.3
15–25	12.1	9.0	11.2	10.2	1.7	1.7	1.4	3.3	4.7	2.3
30–40	—	—	11.2	10.2	—	—	—	—	1.6	1.5
Total	39.5	13.1	69.3	14.2	4.3	2.9	9.9	8.1	20.2	3.7
No missing canopy	60.5	13.1	30.7	14.2	95.7	2.9	90.1	8.1	79.8	3.7

— = not observed, SE = sample error.

Note: Only observed missing canopy cover classes are displayed (e.g., there were no plots with 10–15 percent so that class is not displayed).

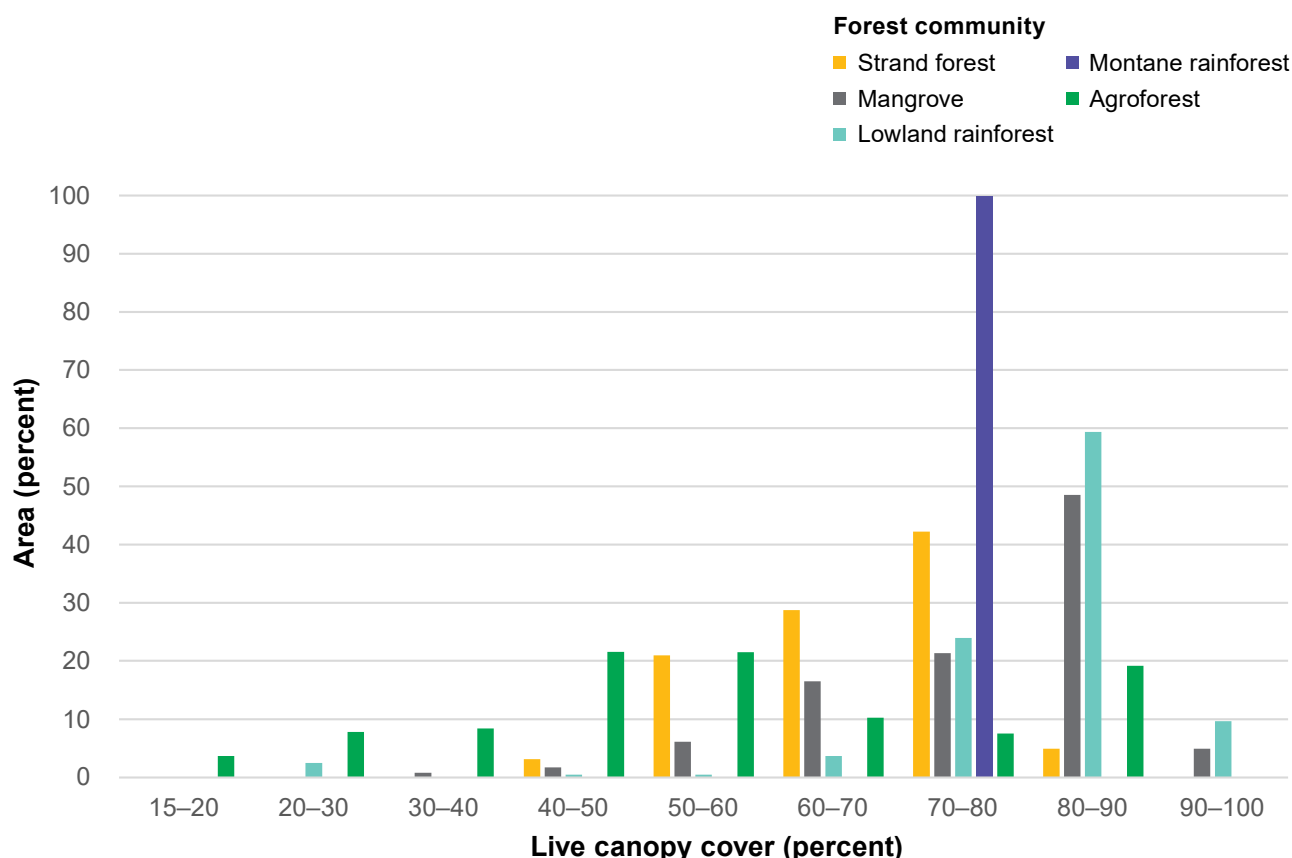


Figure 11—Forest community area by live canopy cover in the Federated States of Micronesia, 2016.

estimates for each state increased significantly (see app. 2) between inventories.

Weather was the second largest source of forest disturbance overall in 2016. This is mostly attributable to damage from Typhoon Maysak in 2015, which affected Chuuk state and the outer islands of Fais and Ulithi atoll in Yap state. Vegetation suppression (vines smothering trees) and disease damage caused equal amounts of disturbance overall, with vegetation suppression prevalent in Chuuk and Kosrae and disease damage only recorded in Pohnpei and Yap (table 7). Disease damage affected about 20 percent of mangrove forest area in the FSM and nearly 4 percent of lowland rainforest area.

Wildfires are all human caused in Micronesia and can be considered as a specific type of human-caused disturbance; however, fire is recorded separately from human-caused disturbance. Among all FSM states, fire caused the most disturbance in Yap, affecting about 17 percent of forest area, or 1.5 percent annually. Satellite-based wild-fire monitoring from 2016 to 2023 estimated 9 percent of total island area burned in Yap (1.1 percent per year), but

the forest area affected has not been estimated (Earl et al. 2024). A dry season with low precipitation in Yap in combination with fire maintains a relatively high proportion of savanna habitat there compared to other states. Fire was only observed in lowland rainforest and agroforest, but about twice as much agroforest area was proportionally disturbed by fire.

Agroforest was the most disturbed community, with human-caused, weather, vegetation-suppression, and fire disturbances all contributing to the high proportion of disturbed agroforest area (table 8 and fig. 13). Lowland rainforest had the highest total percentage of disturbed forest area and the most disturbance types recorded (table 8) but also covered the largest area overall, except in Chuuk.

Treatments

We recorded silviculture treatments if they were at least 1 acre in size and if they had occurred since the previous inventory (or in the 5 years before an initial plot installation). Chuuk had nearly one-third of its forest

Table 7—Forest area by disturbance type and state in the Federated States of Micronesia (FSM), 2016

Disturbance type	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
Insect damage	6.9	7.0	—	—	1.9	1.9	—	—	2.1	1.5
Animal damage	0.2	0.2	—	—	0.2	0.2	16.8	9.9	3.2	1.8
Fire	16.8	9.6	—	—	1.3	1.3	—	—	3.4	1.7
Vegetation suppression	0.0	0.0	21.1	12.9	1.3	1.3	9.1	7.8	5.3	2.4
Disease damage	6.3	6.3	—	—	8.2	4.0	—	—	5.3	2.4
Weather	2.9	5.8	52.0	15.5	2.4	2.4	—	—	9.0	2.7
Human caused	26.2	11.2	66.8	13.1	11.1	4.7	9.9	8.1	21.2	3.9
Any disturbance	47.8	13.4	89.1	8.9	25.1	6.2	35.2	12.7	39.6	4.7
Undisturbed	52.2	13.4	10.9	8.9	74.9	6.2	64.8	12.7	60.4	4.7

— = not observed, SE = sample error.



Figure 12—Field crew taking a break in a cleared and burned nonforest area. USDA Forest Service photo by Matthew O'Driscoll.

area under silviculture treatment, which was by far the highest proportion among states (table 9). All FSM states had relatively high percentages of total forest area under silviculture treatment for the Micronesian region (≥ 9 percent) (Dendy et al. 2020). This indicates the importance of agroforest in the country—agroforest is generally the only forest community that receives a treatment, and more than half of agroforest area in the FSM was under treatment (table 10).

Trees

Tree Abundance, Dominance, and Species Composition

We report tree species by their scientific names. See appendix 1 for the associated common names, which usually differ by state. The most common tree species in the FSM by far was *Hibiscus tiliaceus*, with more than twice the relative abundance of the next most common

Table 8—Disturbance type by forest community area in the Federated States of Micronesia, 2016

Disturbance type	Strand		Mangrove		Lowland rainforest		Agroforest		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST COMMUNITY AREA										
Insect damage	0.1	0.1	—	—	2.0	1.4	—	—	2.1	1.5
Disease damage	—	—	3.3	1.9	2.0	1.4	—	—	5.3	2.4
Fire	—	—	—	—	2.0	1.5	1.4	1.0	3.4	1.7
Animal damage	—	—	—	—	3.1	1.8	—	—	3.2	1.8
Weather	0.1	0.1	0.1	0.1	4.4	2.2	4.4	2.1	9.0	2.7
Vegetation suppression	—	—	—	—	3.1	2.0	2.2	1.5	5.3	2.4
Human caused	0.3	0.6	1.2	1.1	6.6	2.6	13.1	3.3	21.2	3.9
Any disturbance	0.4	0.7	4.6	2.2	19.3	4.2	15.3	3.4	39.6	4.7
Undisturbed	2.4	1.4	12.5	3.4	38.3	4.9	2.6	1.6	60.4	4.7
Total	2.8	1.4	17.1	3.8	57.5	4.9	17.9	3.7	100.0	0.0

— = not observed, SE = sample error.

Note: There were no disturbances observed in montane rainforest.

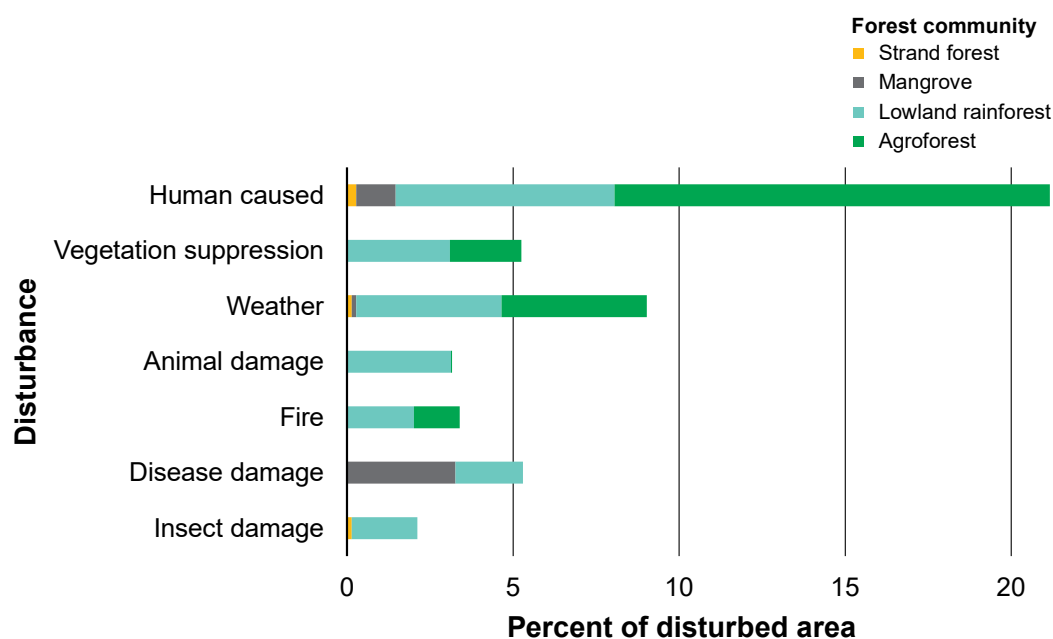


Figure 13—Forest community area affected by disturbance type in the Federated States of Micronesia, 2016. There were no disturbances observed in montane rainforests.

species, *Pandanus cominsii* (table 11). However, it often grows with multiple stems from a common base, so its actual abundance was likely lower. *Hibiscus tiliaceus* was the most abundant tree species in all states, except in Chuuk where the invasive species *Adenanthera pavonina* was more abundant (but with high SE). *Hibiscus tiliaceus* has many uses across the FSM and is sometimes planted as tree cover in agroforest areas during fallow intervals. It is also an indicator of forest recovery after disturbance (Falanruw 1993, Raynor and Fownes 1993). The large and fast-growing native rainforest tree *Camposperma brevipetiolatum* covered the most forest area overall in the FSM. Four different tree species were dominant by forest area in the four states (Yap—*Hibiscus tiliaceus*, Chuuk—*Artocarpus altilis*, Pohnpei—*Camposperma brevipetiolatum*, and Kosrae—*Horsfieldia nunu* [table 12]). *Hibiscus tiliaceus* was also the sixth most dominant species in terms of percentage of total forest basal area (relative dominance) in the FSM behind species growing to large sizes or covering large areas (table 13).

For each forest condition found on a plot, we recorded up to three dominant tree species with the highest total canopy cover. For 149 forest plots and 168 conditions in the FSM, we recorded 42 dominant tree species (table 12). The high number of dominant tree species relative to the number of sampled plots and conditions indicates high diversity of tree species in FSM forests.

We were able to reliably estimate tree abundance by diameter classes for 60 of the 131 tree species that we identified (table 14). About 43 percent of the tree species that we inventoried were only represented in the 1.0–9.9-inch DBH class, and 8 percent were only represented in the <5-inch DBH class. The high proportion of species occurring only as saplings or small-diameter trees is a common feature of lowland tropical rainforests with a high diversity of small trees and shrubs.

There was a mean of 5.9 tree species per plot (SE = 0.3). Tree species diversity per plot was higher in lowland rainforest, 7.7 (SE = 0.4), than in montane rainforest, agroforest, strand forest, or mangrove, which were 7.5 (SE = 1.0), 4.4 (SE = 0.5), 4.0 (SE = 0.4), and 3.2 (SE = 0.2), respectively.

Table 9—Forest area by treatment type and state in the Federated States of Micronesia (FSM), 2016

Treatment	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
Tree cutting	—	—	19.8	12.0	1.9	1.9	—	—	3.8	2.0
Site preparation	9.3	6.8	19.8	12.0	7.6	3.9	0.6	0.6	8.3	2.9
Artificial regeneration	1.6	1.6	—	—	2.4	2.4	8.4	8.4	3.0	1.7
Any treatment	9.3	6.8	29.7	13.7	12.0	4.7	9.0	7.7	13.5	3.6
No treatment	90.7	6.8	70.3	13.7	88.0	4.7	91.0	7.7	86.5	3.6

— = not observed, SE = sample error.

Table 10—Forest community area by treatment type in the Federated States of Micronesia, 2016

Treatment	Lowland rainforest		Montane rainforest		Agroforest	
	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST COMMUNITY AREA						
Artificial regeneration	—	—	—	—	16.8	8.7
Tree cutting	1.7	1.7	—	—	15.6	9.4
Site preparation	3.2	2.4	28.3	28.3	28.9	11.5
Any treatment	5.0	2.9	28.3	28.3	52.0	12.8
No treatment	95.0	2.9	71.7	22.8	48.0	12.8

— = not observed, SE = sample error.

Note: There were no observed treatments in strand forests or mangroves.

Table 11—Relative abundance and status of the 20 most common live tree species (≥ 1 inch in diameter at breast height) by state in the Federated States of Micronesia (FSM), 2016

Tree species	Yap		Chuuk		Pohnpei		Kosrae		FSM		Status
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	PERCENT OF TREES										
<i>Hibiscus tiliaceus</i>	11.9	5.2	11.7	6.8	12.3	4.2	14.9	7.2	12.6	2.8	N
<i>Pandanus cominsii</i>	0.3	0.8	3.2	3.2	9.6	2.5	—	—	5.3	1.4	N
<i>Exorrhiza ponapensis</i>	—	—	—	—	9.6	3.4	—	—	4.9	1.8	E
<i>Aglaia ponapensis</i>	—	—	—	—	9.5	2.1	—	—	4.8	1.1	E
<i>Cyathea</i> spp.	—	—	—	—	6.5	1.7	4.9	2.6	4.2	1.0	E
<i>Adenanthera pavonina</i>	—	—	22.6	22.6	0.5	0.3	2.5	0.9	3.1	2.2	I*
<i>Bruguiera gymnorhiza</i>	3.0	2.8	0.4	1.0	3.3	1.6	1.8	2.6	2.7	1.1	N
<i>Cananga odorata</i>	—	—	10.9	7.7	2.8	2.0	0.2	0.3	2.7	1.3	I
<i>Rhizophora stylosa</i>	0.9	0.9	1.2	2.7	3.9	3.2	0.1	0.1	2.3	1.7	N
<i>Spathodea campanulata</i>	—	—	—	—	4.3	2.9	—	—	2.2	1.5	I*
<i>Artocarpus altilis</i>	1.1	0.9	11.4	6.5	0.8	0.4	0.9	0.5	2.0	0.6	I
<i>Macaranga carolinensis</i>	3.0	2.2	5.2	3.5	1.4	0.8	—	—	1.9	0.7	N
<i>Horsfieldia nunu</i>	—	—	—	—	—	—	10.1	2.7	1.8	0.4	N
<i>Camptosperma brevipetiolatum</i>	2.8	2.8	—	—	2.2	0.5	0.4	0.2	1.8	0.6	N
<i>Morinda citrifolia</i>	2.3	2.1	—	—	0.7	0.5	4.5	2.8	1.7	0.7	N
<i>Rhizophora apiculata</i>	0.2	0.2	3.5	10.9	1.9	1.0	0.9	1.4	1.6	1.3	N
<i>Pandanus tectorius</i>	3.7	2.4	6.4	6.4	0.0	0.1	0.4	0.1	1.5	0.8	N
<i>Atuna racemosa</i>	0.6	0.6	—	—	1.9	1.1	1.5	1.0	1.4	0.6	N
<i>Glochidion</i> spp.	5.4	3.3	2.2	1.5	0.0	0.0	—	—	1.4	0.8	N
<i>Sonneratia alba</i>	0.2	0.4	—	—	2.3	1.2	0.9	0.7	1.3	0.6	N

— = not observed, E = endemic to Micronesia, I = introduced, I* = invasive, N = native, SE = sample error.

Endemic status source: Costion and Lorence (2012); other status source: USDA FS (2018).

Of all tree species tallied in the FSM, 23.6 percent (SE = 3.3) were endemic to Micronesia and 5.4 percent (SE = 2.6) were invasive (Costion and Lorence 2012, USDA FS 2018) (table 15). We observed 29 endemic tree species in the FSM, 10 of them in at least two forest communities. Of the 19 endemic species found in only one forest community, 17 were found in lowland rainforest and 2 in montane rainforest (fig. 14). Three endemic tree species, *Eugenia stelechantha*, *Exorrhiza ponapensis*, and *Aglaia ponapensis*, were much more abundant than all other endemic tree species in the FSM (table 16). Kosrae had the highest rate of tree endemism overall in lowland rainforest. The high proportion of invasive trees in Chuuk lowland rainforest is the main reason the percentage of invasive trees in lowland rainforest was higher than in agroforest in the FSM. We did not record any invasive

trees in mangroves, strand forest, or montane rainforest, which is likely because of the salty growing conditions in mangroves and coastal strands as well as the remoteness and small sample of plots in montane rainforest ($n = 4$).

Diameter and Height

In 2016, the mean DBH of all measured trees in the FSM was 4.4 inches (SE = 0.2), and the mean height was 27.3 feet (SE = 0.8). More than eight of ten trees were <7 inches in DBH (table 17). The size distribution for diameter was heavily weighted toward the smallest DBH class of 1.0–2.9 inches (fig. 15), and the height distribution was heavily weighted toward the height class of 15–24 feet (fig. 16). The tallest tree was an endemic *Elaeocarpus carolinensis* (165 feet tall and 29 inches in DBH) in Pohnpei. A *Sonneratia alba* tree in Kosrae mangrove had

Table 12—Dominant tree species by forest canopy cover and state in the Federated States of Micronesia (FSM), 2016

Tree species	Yap		Chuuk		Pohnpei		Kosrae		FSM		Status
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	PERCENT OF CANOPY COVER										
<i>Campnosperma brevipetiolatum</i>	6.3	6.3	—	—	38.0	7.1	25.4	11.4	25.2	4.4	N
<i>Hibiscus tiliaceus</i>	35.0	12.6	19.8	12.3	18.7	5.6	29.7	11.0	23.5	4.4	N
<i>Artocarpus altilis</i>	2.6	4.6	81.7	11.1	5.0	3.1	19.3	9.9	17.9	3.2	I
<i>Cocos nucifera</i>	24.1	10.2	60.6	14.6	7.3	3.2	8.0	6.9	17.7	3.5	N
<i>Exorrhiza ponapensis</i>	—	—	—	—	29.7	6.6	—	—	15.4	3.5	E
<i>Myristica insularis</i>	—	—	—	—	26.1	6.4	—	—	13.6	3.4	N
<i>Sonneratia alba</i>	1.7	3.8	—	—	17.9	5.5	13.6	9.0	12.0	3.4	N
<i>Elaeocarpus carolinensis</i>	—	—	—	—	18.7	5.6	12.4	7.3	11.9	3.2	E
<i>Horsfieldia nunu</i>	—	—	—	—	—	—	64.2	11.7	11.5	2.1	N
<i>Adenanthera pavonina</i>	—	—	9.9	9.9	8.9	4.3	29.5	11.2	11.2	3.3	I*
<i>Mangifera indica</i>	—	—	49.5	14.5	5.5	3.0	—	—	9.8	2.7	I
<i>Bruguiera gymnorhiza</i>	9.5	7.7	2.2	5.1	10.8	4.5	12.3	8.9	9.6	3.2	N
<i>Rhizophora apiculata</i>	2.3	3.1	2.2	5.1	10.0	4.1	11.4	8.6	7.9	2.8	N
<i>Xylocarpus granatum</i>	7.8	6.8	7.4	7.4	10.4	4.5	0.2	0.2	7.7	2.8	N
<i>Spathodea campanulata</i>	—	—	—	—	10.6	4.4	—	—	5.5	2.3	I*
<i>Rhizophora mucronata</i>	0.9	0.9	1.3	1.3	9.5	4.5	0.6	0.6	5.4	2.5	N
<i>Cananga odorata</i>	—	—	—	—	8.9	4.1	0.8	0.8	4.8	2.2	I
<i>Ficus prolixa</i>	1.3	3.0	0.3	0.3	2.6	2.6	16.8	9.9	4.6	2.2	N
<i>Macaranga carolinensis</i>	14.0	9.5	7.1	7.1	1.5	1.2	—	—	4.1	1.9	N
<i>Commersonia bartramia</i>	13.8	9.4	—	—	2.6	2.6	—	—	3.6	2.0	N
<i>Semecarpus venenosus</i>	20.7	11.2	—	—	—	—	—	—	3.4	1.9	E
<i>Calophyllum inophyllum</i>	20.3	10.8	—	—	—	—	—	—	3.3	1.8	N
<i>Pterocarpus indicus</i>	6.9	7.5	—	—	3.3	2.3	—	—	2.8	1.7	N
<i>Pandanus tectorius</i>	16.0	10.4	—	—	0.2	0.2	—	—	2.7	1.7	N
<i>Rhizophora stylosa</i>	1.8	1.8	1.3	1.3	3.9	2.4	—	—	2.5	1.4	N
<i>Swietenia macrophylla</i>	6.3	6.3	—	—	2.3	2.3	—	—	2.2	1.6	I
<i>Areca catechu</i>	13.3	8.3	—	—	—	—	—	—	2.2	1.3	I

— = not observed, E = endemic to Micronesia, I = introduced, I* = invasive, N = native, SE = sample error.

Note: List includes all trees covering >2 percent of total forest area in the FSM.

Endemic status source: Costion and Lorence (2012); other status source: USDA FS (2018).

the largest diameter (115 inches in DBH) and was 82 feet tall. There were more trees taller than 65 feet in Pohnpei and Kosrae than in Yap and Chuuk (table 18).

Mean tree DBH and the mean percentage of trees by DBH class for the FSM overall did not change significantly between the 2005 and 2016 FSM inventories (Donnegan et al. 2011). However, at the state level, mean DBH decreased in Chuuk by 1.4 inches (SE = 0.8) and increased in Yap by 0.6 inches (SE = 0.3). Mean tree

height did not change significantly for the FSM overall but decreased by 5.7 feet (SE = 1.3) in Chuuk; it increased by 3.6 feet (SE = 2.0) in Yap and by 2.4 feet (SE = 2.1) in Kosrae. The tree-height decrease in Chuuk may have been due to damage from Typhoon Maysak in 2015 but could be attributable, in part, to intensive agroforestry.

There were also significant changes in mean percentage of trees by DBH class between inventories by state (SE values are conservative). The number of trees

Table 13—Dominant tree species by relative basal area and state in the Federated States of Micronesia (FSM), 2016

Tree species	Yap		Chuuk		Pohnpei		Kosrae		FSM		Status
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	PERCENT OF BASAL AREA										
<i>Sonneratia alba</i>	0.9	2.0	—	—	17.1	5.5	13.2	10.6	12.9	4.1	N
<i>Camposperma brevipetiolatum</i>	2.7	2.8	—	—	11.7	3.2	4.0	1.6	8.0	1.9	N
<i>Exorrhiza ponapensis</i>	—	—	—	—	13.7	4.6	—	—	7.9	2.8	E
<i>Horsfieldia nunu</i>	—	—	—	—	—	—	24.9	7.3	5.4	1.5	N
<i>Bruguiera gymnorhiza</i>	5.5	4.9	0.3	0.5	6.0	2.0	1.9	3.3	4.6	1.5	N
<i>Hibiscus tiliaceus</i>	9.5	3.6	2.2	1.3	4.1	1.1	2.7	1.5	4.3	0.9	N
<i>Adenanthera pavonina</i>	—	—	1.5	1.5	1.6	1.2	12.8	6.5	3.8	1.9	I*
<i>Ficus prolixa</i>	0.5	0.9	1.6	1.1	—	—	16.2	7.3	3.7	2.0	N
<i>Artocarpus altilis</i>	0.8	0.8	25.9	6.2	0.9	0.4	4.4	2.8	3.7	0.9	I
<i>Cocos nucifera</i>	14.9	7.3	8.7	3.6	0.9	0.6	1.5	1.2	3.4	1.1	N
<i>Myristica insularis</i>	—	—	—	—	5.6	1.7	—	—	3.2	1.0	N
<i>Xylocarpus granatum</i>	0.2	0.2	1.8	1.8	4.9	2.4	0.1	0.1	3.1	1.5	N
<i>Mangifera indica</i>	—	—	20.8	6.8	1.2	0.7	1.3	1.0	2.7	0.9	I
<i>Cyathea</i> spp.	—	—	—	—	3.2	0.8	2.9	1.0	2.5	0.5	E
<i>Elaeocarpus carolinensis</i>	—	—	—	—	3.3	1.2	2.0	1.0	2.4	0.7	E
<i>Calophyllum inophyllum</i>	15.1	9.1	—	—	—	—	—	—	1.9	1.3	N
<i>Rhizophora mucronata</i>	0.3	0.7	1.3	1.2	2.9	1.5	0.2	0.4	1.8	0.9	N
<i>Spathodea campanulata</i>	—	—	—	—	3.0	1.6	—	—	1.7	0.9	I*
<i>Inocarpus fagifer</i>	2.1	1.4	—	—	2.4	2.4	—	—	1.6	1.2	N
<i>Cananga odorata</i>	—	—	6.9	5.0	1.7	0.7	0.4	0.6	1.6	0.6	I
<i>Rhizophora apiculata</i>	0.5	0.4	1.0	2.6	1.6	0.9	0.3	0.6	1.1	0.6	N

— = not observed, E = endemic to Micronesia, I* = invasive, I = introduced, N = native, SE = sample error.

Note: Totals include live trees ≥1 inch in diameter at breast height. Only trees making up ≥1 percent of total basal area are listed.

Endemic status source: Costion and Lorence (2012); other status source: USDA FS (2018).

Table 14—Number of live trees on forest land by species and diameter at breast height (DBH) class in the Federated States of Micronesia, 2016

Tree species	1.0–4.9 inch DBH class		5.0–9.9 inch DBH class		≥10 inch DBH class		All classes	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
NUMBER OF TREES								
<i>Hibiscus tiliaceus</i>	9,585,064	2,454,833	1,678,525	306,514	192,922	59,463	11,456,511	2,595,655
<i>Eugenia stelechantha</i>	6,140,220	2,087,610	40,408	25,438	—	—	6,180,628	2,082,723
<i>Pandanus cominsii</i>	4,791,894	1,279,790	—	—	—	—	4,791,894	1,279,790
<i>Exorrhiza ponapensis</i>	843,516	499,935	2,396,697	943,493	1,187,090	419,253	4,427,304	1,707,712
<i>Aglaia ponapensis</i>	4,241,245	1,029,164	97,942	36,311	35,702	33,796	4,374,888	1,034,997
<i>Cyathea</i> spp.	2,418,660	712,816	1,353,277	318,646	26,938	23,721	3,798,875	892,721
<i>Adenanthera pavonina</i>	2,329,301	2,027,446	270,360	79,597	254,851	133,483	2,854,511	2,047,572

Table 14 (continued)—Number of live trees on forest land by species and diameter at breast height (DBH) class in the Federated States of Micronesia, 2016

Tree species	1.0–4.9 inch DBH class		5.0–9.9 inch DBH class		≥10 inch DBH class		All classes	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	NUMBER OF TREES							
<i>Bruguiera gymnorhiza</i>	1,098,373	722,823	678,145	272,902	646,157	226,384	2,422,674	1,022,619
<i>Cananga odorata</i>	1,824,190	1,109,381	466,045	172,809	120,313	52,505	2,410,547	1,250,402
<i>Rhizophora stylosa</i>	1,643,487	1,239,865	396,666	291,472	51,865	47,330	2,092,018	1,541,976
<i>Spathodea campanulata</i>	1,458,755	1,078,309	337,628	197,156	208,622	102,512	2,005,005	1,351,730
<i>Artocarpus altilis</i>	1,157,590	547,188	342,945	100,737	331,218	75,451	1,831,753	575,200
<i>Macaranga carolinensis</i>	1,466,200	629,042	217,052	93,392	36,307	25,341	1,719,560	660,288
<i>Horsfieldia nunu</i>	427,953	266,128	524,192	141,225	663,957	165,313	1,616,102	374,859
<i>Camptosperma brevipetiolatum</i>	814,610	441,726	214,981	140,121	567,144	120,893	1,596,735	585,362
<i>Morinda citrifolia</i>	1,438,955	636,219	64,847	32,366	—	—	1,503,801	638,448
<i>Rhizophora apiculata</i>	945,753	1,170,897	387,554	198,645	95,147	103,120	1,428,454	1,204,523
<i>Pandanus tectorius</i>	982,672	686,982	405,474	173,157	—	—	1,388,146	754,397
<i>Atuna racemosa</i>	1,160,089	534,000	65,777	38,069	26,938	23,721	1,252,805	541,954
<i>Glochidion</i> spp.	1,146,024	713,180	54,296	29,930	50,026	35,558	1,250,346	713,023
<i>Sonneratia alba</i>	541,546	345,791	57,397	44,634	628,730	217,111	1,227,673	542,795
<i>Antidesma kusaiense</i>	1,174,480	396,444	13,469	11,861	—	—	1,187,949	403,194
<i>Myristica insularis</i>	627,069	277,586	162,920	57,577	335,002	100,079	1,124,992	383,407
<i>Cocos nucifera</i>	—	—	304,732	111,284	742,205	257,581	1,046,937	323,660
<i>Ficus copiosa</i>	958,772	652,623	61,869	60,390	—	—	1,020,640	707,001
<i>Barringtonia racemosa</i>	723,052	356,113	240,598	89,820	26,539	16,704	990,188	367,412
<i>Cyathea ponapeana</i>	444,725	420,991	379,867	169,513	107,105	70,438	931,696	582,232
<i>Syzygium carolinense</i>	809,414	384,529	50,340	27,613	62,240	33,452	921,994	427,595
<i>Rhizophora mucronata</i>	114,468	251,997	521,027	269,156	282,823	145,664	918,319	479,374
<i>Scaevola taccada</i>	911,722	768,161	—	—	—	—	911,722	768,161
<i>Premna</i> spp.	903,474	579,370	—	—	—	—	903,474	579,370
<i>Scyphiphora hydrophyllacea</i>	802,810	859,031	27,620	29,555	—	—	830,430	888,585
<i>Elaeocarpus carolinensis</i>	444,725	231,196	120,091	36,814	230,266	68,305	795,082	274,275
<i>Areca catechu</i>	399,550	358,887	381,824	253,992	—	—	781,374	543,640
<i>Garcinia rumiyo</i>	645,830	474,645	45,936	39,205	3,722	11,945	695,488	506,344
<i>Dendrocide latifolia</i>	534,144	335,149	133,584	92,819	1,236	4,381	668,965	404,665
<i>Trichospermum ikutai</i>	573,436	496,740	61,444	47,095	27,620	29,555	662,500	531,762
<i>Ficus prolixa</i>	351,016	204,330	84,130	52,372	191,606	120,003	626,753	342,470
<i>Trukia carolinensis</i>	623,160	442,937	—	—	—	—	623,160	442,937
Tree unknown	542,155	280,661	55,568	45,282	15,165	21,901	612,888	290,931
<i>Semecarpus venenosus</i>	291,614	304,721	124,260	71,674	140,601	82,686	556,476	394,770
<i>Premna obtusifolia</i>	416,237	236,660	99,056	43,611	38,932	30,335	554,225	254,422
<i>Commersonia bartramia</i>	244,825	173,959	257,877	216,314	47,275	49,419	549,977	284,042
<i>Xylocarpus granatum</i>	114,687	122,719	114,315	81,096	293,146	150,236	522,148	227,001
<i>Aidia cochinchinensis</i>	445,290	325,769	70,453	35,773	—	—	515,743	327,727

Table 14 (continued)—Number of live trees on forest land by species and diameter at breast height (DBH) class in the Federated States of Micronesia, 2016

Tree species	1.0–4.9 inch DBH class		5.0–9.9 inch DBH class		≥10 inch DBH class		All classes	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	NUMBER OF TREES							
<i>Glochidion ramiflorum</i>	405,266	348,737	66,719	41,943	14,611	18,053	486,596	362,798
<i>Claoxylon carolinianum</i>	478,828	319,958	—	—	—	—	478,828	319,958
<i>Pandanus japensis</i>	458,749	379,009	—	—	—	—	458,749	379,009
<i>Timonius ponapensis</i>	444,725	420,991	11,901	11,265	—	—	456,626	420,605
<i>Lumnitzera littorea</i>	311,580	288,941	109,996	91,998	3,183	12,016	424,759	325,102
<i>Pangium edule</i>	364,689	211,474	22,348	15,486	32,812	26,984	419,849	215,247
<i>Tarenna sambucina</i>	378,903	280,246	12,538	21,811	833	4,865	392,273	280,811
<i>Ficus tinctoria</i>	195,562	161,531	147,655	58,642	2,122	5,495	345,339	173,632
<i>Timonius albus</i>	344,061	265,830	—	—	—	—	344,061	265,830
<i>Inocarpus fagifer</i>	234,211	339,721	33,052	18,201	72,368	42,989	339,631	369,768
<i>Cerbera manghas</i>	299,057	270,544	25,473	16,081	—	—	324,530	281,653
<i>Heritiera littoralis</i>	312,274	275,106	9,207	9,852	—	—	321,481	275,282
<i>Garcinia ponapensis</i>	296,483	193,674	11,901	11,265	—	—	308,384	193,224
<i>Mangifera indica</i>	—	—	64,664	37,636	237,166	76,968	301,830	107,590
<i>Diospyros ferrea</i>	260,494	209,919	833	4,865	—	—	261,327	210,976
<i>Premna serratifolia</i>	179,090	158,523	55,115	34,323	1,061	4,005	235,267	164,554
<i>Calophyllum inophyllum</i>	114,687	122,719	30,951	21,511	86,078	40,911	231,716	144,066
<i>Rhus taitensis</i>	114,687	122,719	95,790	42,889	14,594	16,411	225,071	134,724
<i>Ponapea ledermanniana</i>	167,783	147,746	40,408	25,438	14,638	12,333	222,829	146,890
<i>Elaeocarpus kusanoi</i>	148,242	140,330	27,779	17,172	14,638	12,333	190,659	153,641
<i>Glochidion marianum</i>	158,615	152,856	25,042	22,880	—	—	183,657	173,816
<i>Cinnamomum carolinense</i>	148,242	140,330	25,370	16,358	—	—	173,611	140,747
<i>Averrhoa bilimbi</i>	114,687	122,719	55,241	49,485	—	—	169,928	137,828
<i>Antidesma</i> spp.	167,783	147,746	—	—	—	—	167,783	147,746
<i>Allophylus timorensis</i>	167,783	147,746	—	—	—	—	167,783	147,746
<i>Celtis paniculata</i>	114,687	122,719	27,620	15,696	21,713	15,217	164,021	142,007
<i>Rinorea carolinensis</i>	149,529	135,272	—	—	—	—	149,529	135,272
<i>Drypetes yapensis</i>	114,687	122,719	27,620	21,340	—	—	142,308	142,004
<i>Buchanania engleriana</i>	114,687	122,719	27,620	21,340	—	—	142,308	142,004
<i>Pouteria obovata</i>	114,687	122,719	18,414	13,386	—	—	133,101	132,178
<i>Timonius</i> spp.	114,687	122,719	11,901	11,265	—	—	126,588	123,235
<i>Artocarpus mariannensis</i>	103,077	303,639	2,906	10,513	11,508	20,030	117,491	311,489
<i>Ficus</i> spp.	114,687	122,719	—	—	—	—	114,687	122,719
<i>Melochia</i> spp.	114,687	122,719	—	—	—	—	114,687	122,719
<i>Meryta senffiana</i>	114,687	122,719	—	—	—	—	114,687	122,719
<i>Neuburgia celebica</i>	—	—	110,226	70,824	—	—	110,226	70,824
<i>Pterocarpus indicus</i>	—	—	10,872	13,846	85,067	62,827	95,939	74,082
<i>Neisosperma oppositifolia</i>	77,253	247,942	13,647	43,798	4,962	15,927	95,862	307,667
<i>Sterculia ponapensis</i>	—	—	71,403	67,592	11,901	11,265	83,304	78,858

Table 14 (continued)—Number of live trees on forest land by species and diameter at breast height (DBH) class in the Federated States of Micronesia, 2016

Tree species	1.0–4.9 inch DBH class		5.0–9.9 inch DBH class		≥10 inch DBH class		All classes	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	NUMBER OF TREES							
<i>Swietenia macrophylla</i>	—	—	33,008	24,590	42,215	29,931	75,223	53,889
<i>Citrus reticulata</i>	—	—	67,346	59,304	—	—	67,346	59,304
<i>Clinostigma carolinense</i>	—	—	12,506	11,598	50,026	35,558	62,532	39,840
<i>Barringtonia asiatica</i>	—	—	28,060	45,688	24,044	54,546	52,105	97,022
<i>Syzygium</i> spp.	46,194	163,715	1,236	4,381	1,241	3,982	48,670	168,143
<i>Guettarda speciosa</i>	15,451	49,588	9,925	18,200	19,849	27,782	45,225	61,311
<i>Palaquium karrak</i>	—	—	—	—	41,177	20,374	41,177	20,374
<i>Syzygium malaccense</i>	—	—	12,506	11,598	25,013	23,196	37,519	34,793
<i>Thespesia populnea</i>	—	—	29,957	29,071	6,181	21,904	36,138	45,745
<i>Ponapea hosinoi</i>	—	—	35,702	33,796	—	—	35,702	33,796
<i>Pipturus argenteus</i>	30,901	99,177	2,481	5,556	—	—	33,382	103,131
<i>Heterospathe elata</i>	15,451	49,588	16,128	44,310	—	—	31,578	93,517
<i>Terminalia samoensis</i>	30,901	99,177	—	—	—	—	30,901	99,177
<i>Pittosporum</i> spp.	—	—	14,638	12,333	14,638	12,333	29,276	24,667
<i>Pisonia grandis</i>	15,451	49,588	4,962	12,491	8,684	20,466	29,097	65,019
<i>Anacardium occidentale</i>	15,451	49,588	9,925	31,853	2,481	7,963	27,857	89,405
<i>Leucaena leucocephala</i>	—	—	27,620	29,555	—	—	27,620	29,555
<i>Dysoxylum mollissimum</i>	—	—	—	—	25,013	15,560	25,013	15,560
<i>Rhizophora</i> spp.	—	—	25,013	23,196	—	—	25,013	23,196
<i>Pandanus utilis</i>	19,806	73,532	—	—	—	—	19,806	73,532
<i>Pericopsis mooniana</i>	—	—	—	—	18,414	19,703	18,414	19,703
<i>Pandanus dubius</i>	—	—	18,414	19,703	—	—	18,414	19,703
<i>Hernandia sonora</i>	—	—	14,638	12,333	3,722	11,945	18,360	17,170
<i>Eugenia malaccensis</i>	—	—	4,962	12,491	9,925	19,074	14,887	27,449
<i>Cyclophyllum barbatum</i>	—	—	—	—	14,638	12,333	14,638	12,333
<i>Fagraea berteriana</i>	—	—	14,638	12,333	—	—	14,638	12,333
<i>Albizia</i> spp.	—	—	14,638	12,333	—	—	14,638	12,333
<i>Terminalia catappa</i>	—	—	11,684	11,493	1,236	4,381	12,920	12,208
<i>Pandanus dilatatus</i>	—	—	12,919	20,569	—	—	12,919	20,569
<i>Cynometra ramiflora</i>	—	—	—	—	11,901	11,265	11,901	11,265
<i>Parinari laurina</i>	—	—	—	—	11,901	11,265	11,901	11,265
<i>Metroxylon amicarum</i>	—	—	—	—	11,901	11,265	11,901	11,265
<i>Acacia auriculiformis</i>	—	—	9,207	9,852	1,061	4,005	10,268	10,635
<i>Swietenia mahagoni</i>	—	—	9,207	9,852	—	—	9,207	9,852
<i>Maranthes corymbosa</i>	—	—	9,207	9,852	—	—	9,207	9,852
<i>Swietenia</i> spp.	—	—	9,207	9,852	—	—	9,207	9,852
<i>Eugenia</i> spp.	—	—	9,207	9,852	—	—	9,207	9,852
<i>Macaranga</i> spp.	—	—	9,207	9,852	—	—	9,207	9,852
<i>Terminalia carolinensis</i>	—	—	—	—	8,653	26,392	8,653	26,392
<i>Tournefortia argentea</i>	—	—	2,481	7,963	1,241	3,982	3,722	11,945

Table 14 (continued)—Number of live trees on forest land by species and diameter at breast height (DBH) class in the Federated States of Micronesia, 2016

Tree species	1.0–4.9 inch DBH class		5.0–9.9 inch DBH class		≥10 inch DBH class		All classes	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
NUMBER OF TREES								
<i>Euphoria longana</i>	—	—	3,722	11,945	—	—	3,722	11,945
<i>Rhizophora lamarckii</i>	—	—	2,297	5,936	—	—	2,297	5,936
<i>Kleinhovia hospita</i>	—	—	1,666	9,730	—	—	1,666	9,730
<i>Pongamia pinnata</i>	—	—	1,241	3,982	—	—	1,241	3,982
<i>Cycas micronesica</i>	—	—	1,241	3,982	—	—	1,241	3,982
<i>Cyathea nigricans</i>	—	—	1,236	4,381	—	—	1,236	4,381
<i>Pemphis acidula</i>	—	—	—	—	1,236	4,381	1,236	4,381
<i>Citrus mitis</i>	—	—	833	4,865	—	—	833	4,865

— = not observed, SE = sample error.



Figure 14—Montane rainforest where there are many endemic and native species, Pohnpei, Federated States of Micronesia. USDA Forest Service photo by Matthew O'Driscoll.

Table 15—Tree species status by state and forest community in the Federated States of Micronesia (FSM), 2016

Species status	FSM		State						Forest community									
			Yap		Chuuk		Pohnpei		Kosrae		Strand forest		Lowland rainforest		Montane rainforest		Agroforest	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF ALL SPECIES																		
Endemic	23.6	3.3	17.1	7.0	7.1	3.8	25.7	4.5	35.0	9.3	6.1	15.1	27.1	3.7	63.4	14.5	2.2	1.7
Invasive	5.4	2.6	0.1	0.1	22.6	22.6	4.9	2.9	2.5	0.9	—	—	7.2	3.5	—	—	2.6	1.7

— = not observed, SE = sample error.

Note: No endemic or invasive tree species were observed in mangroves.

<5.0 inches in DBH increased in Chuuk by 14 percent (SE = 8.7) and decreased in Yap by 8.7 percent (SE = 4.2). The number of trees from 5.0 to 10.0 inches in DBH decreased by 11.3 percent (SE = 6.4) in Chuuk and 3.6 percent (SE = 3.0) in Pohnpei. In Yap, the number of trees from 5.0 to 10.0 inches in DBH increased by 5.1 percent (SE = 3.2), and trees >10.0 inches in DBH increased by 3.6 percent (SE = 1.7) (fig. 17).

Tree Damages

Assessing tree damages can provide insights into forest health and succession patterns. Insects, disease, weather, vegetation suppression, human activities, and animals can affect the health of each tree. Field crews assessed damages on trees from bottom to top, prioritizing those that lead to mortality, then those that reduce near-term growth, and finally those that hinder the tree from becoming a marketable product. Crews recorded up to three damage agents per tree and documented root and butt defects, cankers, and stem decay when any evidence was detected. This is a change from the previous inventory in which disease was only recorded if it affected a minimum threshold of 20 percent of roots or branches. Crews coded other damage agents only if they met a threshold that would lead to death or reduced growth. Details on this field protocol and the listed thresholds by damage agent can be found in USDA FS (2016).

In 2016, crews coded a damage on 24.2 percent (SE = 2.3) of all live trees ≥ 1 inch in DBH in the FSM. The largest category of damage was stem decay, which affected 13.1 percent (SE = 1.6) (table 19). This is an 11.1-percent (SE = 2.6) increase from 2005 in the percentage of trees with any damage coded (Donnegan et al. 2011). This change appears to be due to a large increase in tree disease, including root disease and especially stem decay, which may be due to the protocol change (Randolph et al. 2021). Other categories of damage were relatively unchanged, although there was more physical damage, such as broken treetops, in all states.

Tree damages varied by state—Pohnpei had the lowest rate of damage, and Chuuk had the highest rate. Chuuk had about three times the percentage of broken tops than other states, which is likely related to typhoon damage from 2015, although the percentage of wind-damaged trees from Typhoon Maysak was lower than expected. Vine-damaged trees may have been related to typhoon effects as well and were significantly more common in Chuuk (fig. 18). Human-caused damage was also significantly higher in Chuuk, which is likely because of the higher proportion of agroforest there.

There were six tree species ($n \geq 50$) estimated to have more than half of all individuals with damage (table 20). There was a high rate of root/butt disease in *Rhizophora stylosa*; vine damage in *Pandanus tectorius*; broken tops in *Cananga odorata*, *Ficus prolixa*, and *Mangifera indica*; human-caused damage in *Cocos nucifera*; and dead tops in *Ficus prolixa*.

Table 16—Number of live trees ≥ 1 inch in diameter at breast height by forest community for species endemic to the Federated States of Micronesia, 2016

Endemic tree species	Montane rainforest		Strand forest		Lowland rainforest		Agroforest		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
NUMBER OF TREES										
<i>Eugenia stelechantha</i>	—	—	15,398	54,572	6,165,230	2,082,008	—	—	6,180,628	2,082,723
<i>Exorrhiza ponapensis</i>	2,228,821	1,497,388	—	—	2,198,483	900,887	—	—	4,427,304	1,707,712
<i>Aglaia ponapensis</i>	572,433	341,356	—	—	3,654,213	1,022,620	148,242	140,330	4,374,888	1,034,997
<i>Elaeocarpus carolinensis</i>	195,844	185,392	—	—	599,238	218,180	—	—	795,082	274,275
<i>Garcinia rumiyo</i>	—	—	—	—	695,488	506,344	—	—	695,488	506,344
<i>Trichospermum ikutai</i>	—	—	—	—	662,500	531,762	—	—	662,500	531,762
<i>Trukia carolinensis</i>	—	—	—	—	623,160	442,937	—	—	623,160	442,937
<i>Semecarpus venenosus</i>	—	—	—	—	556,476	394,770	—	—	556,476	394,770
<i>Claoxylon carolinianum</i>	—	—	—	—	478,828	319,958	—	—	478,828	319,958
<i>Pandanus jenkinsii</i>	—	—	—	—	458,749	379,009	—	—	458,749	379,009
<i>Timonius albus</i>	—	—	—	—	344,061	265,830	—	—	344,061	265,830
<i>Garcinia ponapensis</i>	296,483	193,674	—	—	11,901	11,265	—	—	308,384	193,224
<i>Ponapea ledermanniana</i>	—	—	—	—	222,829	146,890	—	—	222,829	146,890
<i>Elaeocarpus kusanoi</i>	—	—	1,241	3,982	189,419	153,589	—	—	190,659	153,641
<i>Glochidion marianum</i>	—	—	—	—	183,657	173,816	—	—	183,657	173,816
<i>Cinnamomum carolinense</i>	148,242	140,330	—	—	25,370	16,358	—	—	173,611	140,747
<i>Buchanania engleriana</i>	—	—	—	—	142,308	142,004	—	—	142,308	142,004
<i>Drypetes yapensis</i>	—	—	—	—	142,308	142,004	—	—	142,308	142,004
<i>Artocarpus mariannensis</i>	—	—	97,486	305,441	17,524	62,218	2,481	7,963	117,491	311,489
<i>Meryta senftiana</i>	—	—	—	—	114,687	122,719	—	—	114,687	122,719
<i>Sterculia ponapensis</i>	—	—	—	—	83,304	78,858	—	—	83,304	78,858
<i>Clinostigma carolinense</i>	—	—	—	—	25,103	23,196	37,519	34,793	62,532	39,840
<i>Palaquium karrak</i>	—	—	—	—	41,177	20,374	—	—	41,177	20,374
<i>Ponapea hosinoi</i>	35,702	33,796	—	—	—	—	—	—	35,702	33,796
<i>Pittosporum</i> spp.	—	—	—	—	29,276	24,667	—	—	29,276	24,667
<i>Metroxylon amicarum</i>	11,901	11,265	—	—	—	—	—	—	11,901	11,265
<i>Terminalia carolinensis</i>	—	—	7,417	26,285	1,236	4,381	—	—	8,653	26,392
<i>Cycas micronesica</i>	—	—	—	—	1,241	3,982	—	—	1,241	3,982
<i>Cyathea nigricans</i>	—	—	—	—	1,236	4,381	—	—	1,236	4,381

— = not observed, SE = sample error.

Note: No endemic or invasive tree species were observed in mangroves.

Table 17—Live trees by diameter at breast height (DBH) class and state in the Federated States of Micronesia (FSM), 2016

DBH class	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
INCHES	PERCENT OF TREES									
1.0–2.9	62.6	4.8	74.8	9.1	49.1	3.7	61.4	5.8	56.8	2.8
3.0–4.9	15.2	3.5	8.2	5.0	20.6	2.4	14.7	3.3	17.1	1.7
5.0–6.9	10.2	2.2	4.8	2.7	9.0	0.8	7.3	1.1	8.5	0.7
7.0–8.9	4.2	0.9	2.9	1.2	7.1	0.9	4.7	0.8	5.7	0.6
9.0–10.9	2.9	1.0	3.3	1.4	5.7	1.0	3.2	0.8	4.4	0.6
11.0–12.9	2.6	0.7	1.5	0.7	3.2	0.5	2.1	0.5	2.7	0.3
13.0–14.9	0.9	0.4	0.8	0.3	1.2	0.3	1.1	0.3	1.1	0.2
15.0–16.9	0.7	0.3	1.2	0.5	0.8	0.3	1.1	0.3	0.9	0.2
≥17	0.7	0.4	2.6	1.0	3.3	0.6	4.3	1.0	2.9	0.4

SE = sample error.

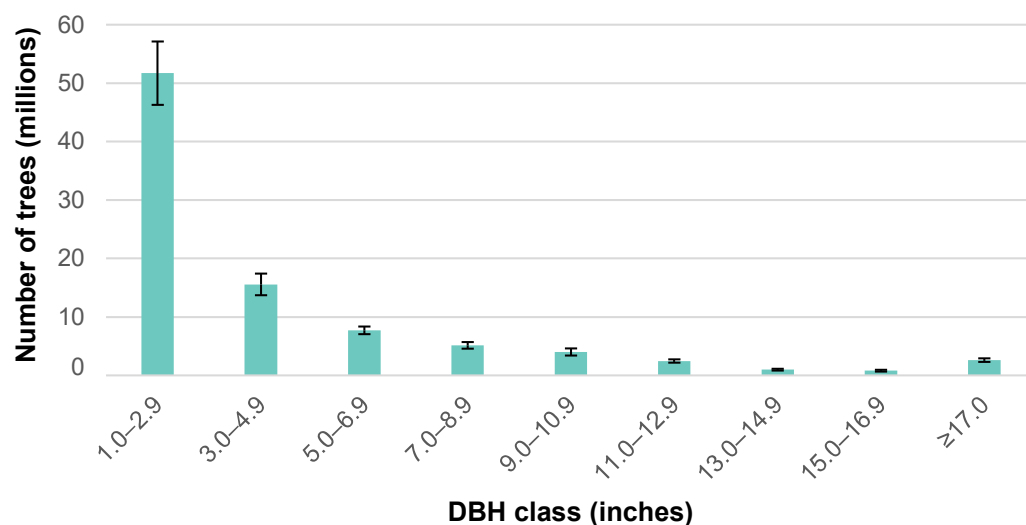


Figure 15—Number of live trees by diameter at breast height (DBH) class in the Federated States of Micronesia, 2016. Error bars represent 68-percent confidence level.

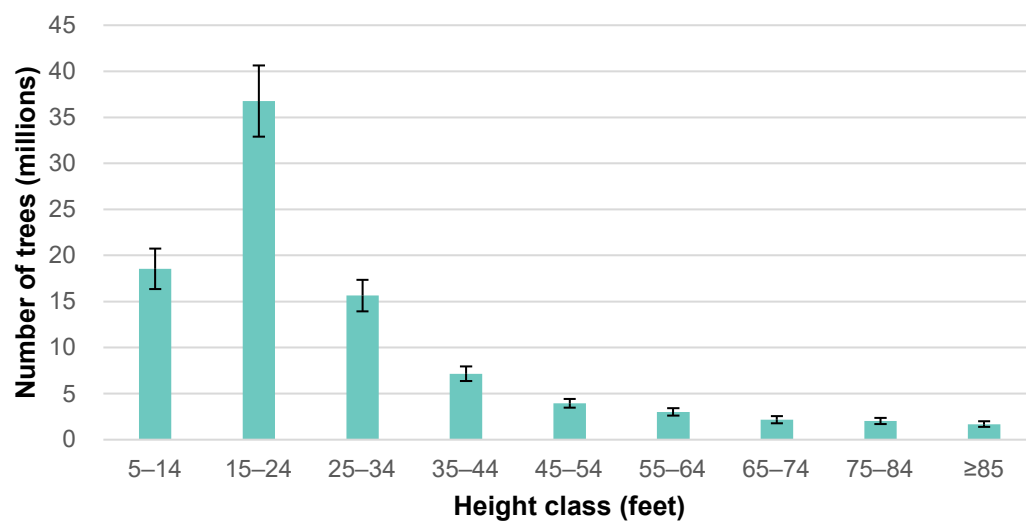


Figure 16—Number of live trees by height class in the Federated States of Micronesia, 2016. Error bars represent 68-percent confidence level.

Table 18—Live trees by height class and state in the Federated States of Micronesia (FSM), 2016

Height class	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
FEET	PERCENT OF TREES									
5–14	25.6	4.6	33.1	6.7	16.6	1.6	17.7	3.8	20.4	1.7
15–24	37.8	5.0	49.9	9.2	39.9	2.7	39.3	5.7	40.4	2.3
25–34	18.1	3.8	7.8	2.9	16.2	1.8	24.7	2.7	17.2	1.4
35–44	10.6	2.5	2.8	1.0	8.6	1.0	5.7	1.3	7.9	0.8
45–54	4.4	1.2	2.4	0.8	4.6	0.7	4.5	1.0	4.3	0.5
55–64	2.4	0.7	2.7	1.2	4.0	0.7	2.9	0.4	3.3	0.4
65–74	0.7	0.3	0.7	0.3	3.8	0.8	1.4	0.3	2.4	0.4
75–84	0.4	0.2	0.4	0.3	3.4	0.7	2.2	0.5	2.2	0.4
≥85	0.1	0.1	0.1	0.1	3.0	0.7	1.6	0.6	1.8	0.4

SE = sample error.

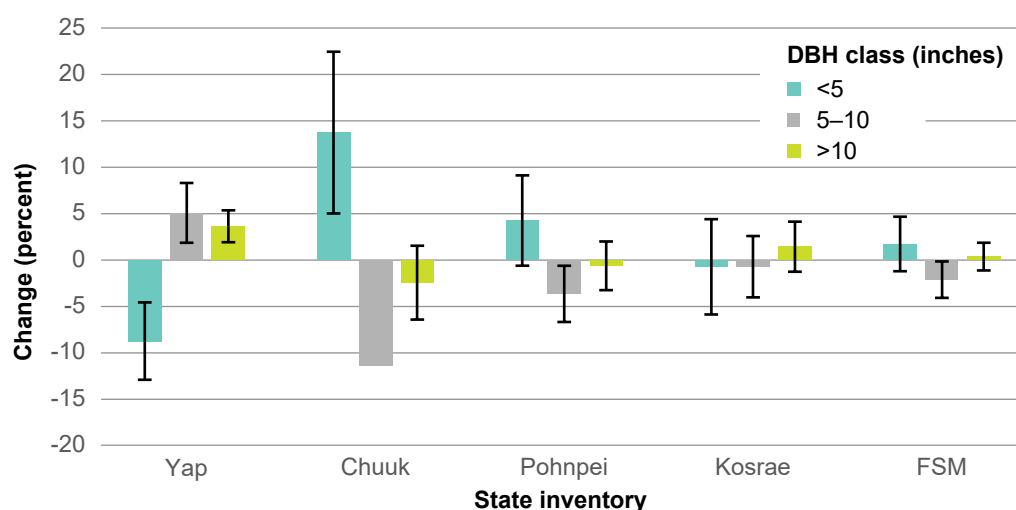


Figure 17—Change in percentage of live trees by diameter at breast height (DBH) class and state between 2005 and 2016 USDA Forest Service, Forest Inventory and Analysis inventories in the Federated States of Micronesia (FSM). Error bars represent 68-percent confidence level. Sample error is conservative.

Table 19—Live-tree damage type by state in the Federated States of Micronesia (FSM), 2016

Damage type	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF TREES										
No damage	67.1	4.4	59.4	12.0	82.4	2.6	77.3	5.8	75.8	2.3
Any damage	32.9	4.4	40.6	12.0	17.6	2.6	22.7	5.8	24.2	2.3
Stem decay	19.2	4.3	17.8	6.8	10.3	2.0	11.2	2.9	13.1	1.6
Broken top	3.3	1.5	15.7	7.2	5.0	0.9	6.5	2.3	6.1	1.0
Vine damage	3.1	1.9	16.4	8.0	0.1	0.1	6.4	5.3	3.6	1.3
Dead top	3.0	2.1	5.9	3.5	2.5	0.8	5.0	2.5	3.4	0.8
Human caused	1.5	0.7	7.6	3.8	0.9	0.6	1.9	1.0	1.9	0.5
Root/butt diseases	2.1	1.4	0.9	0.6	2.4	1.0	0.4	0.2	1.9	0.6
Open wound	6.1	1.9	2.4	1.7	0.3	0.1	0.5	0.2	1.8	0.5
Competition	—	—	4.8	1.5	0.8	0.4	1.0	1.0	1.1	0.3
Other damages and symptoms	2.1	1.0	0.4	0.2	0.1	0.1	0.3	0.2	0.6	0.2
Defoliators	—	—	—	—	1.2	0.6	—	—	0.6	0.3
General insects	2.7	1.1	—	—	—	—	—	—	0.6	0.2
Abiotic damage	0.1	0.1	0.3	0.3	—	—	2.1	2.1	0.4	0.3
Decline complexes/ dieback/wilts	1.6	1.3	—	—	—	—	—	—	0.3	0.3
Fire	0.7	0.6	—	—	0.0	0.0	—	—	0.2	0.1
Foliage diseases	0.1	0.1	0.1	0.1	—	—	—	—	0.0	0.0
Parasitic plants	—	—	—	—	0.0	0.0	0.0	0.0	0.0	0.0
Cankers	—	—	—	—	0.0	0.0	—	—	0.0	0.0
Boring insects	—	—	—	—	—	—	—	—	—	—
General diseases	—	—	—	—	—	—	—	—	—	—
Wild animals	—	—	—	—	—	—	—	—	—	—
Domestic animals	—	—	—	—	—	—	—	—	—	—

— = not observed, SE = sample error.

Note: Data are for live trees ≥ 1 inch in diameter at breast height.



Figure 18—Agroforest and vine suppression in an upland location where forests see frequent typhoon damage, Fefen island, Chuuk, Federated States of Micronesia. USDA Forest Service photo by Michael Ausman.

Table 20—Live-tree species by damage type in the Federated States of Micronesia, 2016

Tree species (n)	General insects		Root/butt diseases		Stem decay		Shade		Human caused		Other damages		Broken top		Dead top		Open wound		Vine damage		Any damage		No damage	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF TREES																								
<i>Commersonia bartramia</i> (74)	1.7	1.7	3.8	1.9	49.7	17.7	—	—	1.7	1.7	24.2	20.6	—	—	—	—	2.2	2.2	—	—	72.2	13.6	27.8	13.6
<i>Pandanus tectorius</i> (110)	13.6	7.6	5.3	3.9	18.2	9.3	—	—	1.0	1.0	0.7	0.7	44.9	44.9	22.4	22.4	2.0	2.0	45.6	27.7	70.1	18.8	29.9	18.8
<i>Premna obtusifolia</i> (52)	0.2	0.2	1.7	1.7	63.2	23.9	—	—	—	—	0.2	0.2	25.1	20.0	1.9	2.2	—	—	2.4	2.4	65.7	23.8	34.3	23.8
<i>Rhizophora stylosa</i> (102)	—	—	19.4	3.3	44.1	7.4	—	—	0.6	0.6	—	—	9.4	1.3	9.3	1.5	—	—	—	—	62.8	10.0	37.2	10.0
<i>Cananga odorata</i> (188)	—	—	—	—	29.6	7.0	6.5	6.5	8.0	8.0	0.5	0.5	31.7	11.8	7.9	4.0	0.5	0.5	21.5	21.5	55.3	12.5	44.7	12.5
<i>Ficus prolixa</i> (65)	—	—	—	—	47.8	20.7	—	—	—	—	—	—	43.5	18.5	35.2	17.1	—	—	4.0	4.0	51.8	20.5	48.2	20.5
<i>Xylocarpus granatum</i> (107)	—	—	3.0	2.3	48.6	17.1	—	—	14.4	14.4	—	—	13.0	7.3	5.6	5.6	2.4	2.4	—	—	49.0	17.0	51.0	17.0
<i>Sonneratia alba</i> (152)	—	—	6.4	1.9	39.9	9.9	—	—	—	—	—	—	17.3	7.2	17.2	7.2	1.2	1.2	—	—	41.9	8.6	58.1	8.6
<i>Mangifera indica</i> (51)	—	—	—	—	16.6	16.6	—	—	4.1	4.1	4.8	4.8	29.3	11.3	4.1	4.1	—	—	4.1	4.1	38.3	10.2	61.7	10.2
<i>Myristica insularis</i> (87)	—	—	1.3	1.3	2.1	0.9	—	—	—	—	—	—	19.9	12.9	16.2	16.2	—	—	1.1	1.1	36.5	13.6	63.5	13.6
<i>Artocarpus altilis</i> (144)	—	—	—	—	3.4	1.8	—	—	2.2	1.3	1.4	1.0	23.4	10.7	2.0	1.2	9.2	6.3	1.7	1.2	36.2	9.0	63.8	9.0
<i>Macaranga carolinensis</i> (94)	—	—	2.4	2.0	11.0	8.5	—	—	0.6	0.5	0.7	0.7	—	—	—	—	2.1	1.1	20.3	15.0	35.3	16.6	64.7	16.6
<i>Hibiscus tiliaceus</i> (580)	0.1	0.1	0.6	0.3	18.3	4.0	—	—	5.9	2.4	0.3	0.2	7.4	2.4	5.6	2.8	1.1	0.4	3.5	2.9	34.0	6.3	66.0	6.3
<i>Cocos nucifera</i> (481)	—	—	—	—	14.8	6.6	—	—	25.7	9.8	—	—	—	—	—	—	1.3	1.3	—	—	29.7	10.3	70.3	10.3
<i>Horsfieldia nunu</i> (231)	—	—	0.8	0.8	27.1	9.6	—	—	—	—	—	—	8.3	2.5	—	—	—	—	15.4	11.2	29.6	11.0	70.4	11.0
<i>Pandanus cominsii</i> (53)	—	—	9.3	6.3	3.1	3.1	7.6	3.7	—	—	—	—	7.6	7.6	—	—	—	—	—	—	26.9	8.4	73.1	8.4
Other species	1.3	0.8	1.4	1.1	15.4	4.3	0.7	0.7	1.4	0.8	0.6	0.5	2.3	0.9	2.5	1.1	4.3	1.7	3.1	1.8	25.5	4.5	74.5	4.5
<i>Spathodea campanulata</i> (111)	—	—	5.8	5.8	21.4	2.8	—	—	0.7	0.7	—	—	11.3	1.6	2.2	0.7	2.2	1.5	2.2	1.5	24.7	2.8	75.3	2.8
<i>Semecarpus venenosus</i> (69)	1.7	1.7	—	—	6.6	4.7	—	—	1.7	1.7	1.7	1.7	—	—	—	—	—	—	11.6	11.3	19.9	15.3	80.1	15.3
<i>Rhizophora mucronata</i> (174)	—	—	2.7	2.7	9.5	8.1	—	—	4.1	4.1	—	—	4.6	2.5	4.3	2.6	—	—	—	—	15.4	11.2	84.6	11.2
<i>Adenanthera pavonina</i> (102)	—	—	—	—	5.5	4.4	5.5	5.5	—	—	1.9	1.8	1.8	1.2	1.4	1.2	1.4	1.3	1.4	1.3	12.8	4.4	87.2	4.4
<i>Elaeocarpus carolinensis</i> (62)	—	—	—	—	9.9	4.5	—	—	—	—	—	—	6.9	4.1	3.5	2.3	1.7	1.7	1.7	1.7	11.8	5.5	88.2	5.5
<i>Eugenia stelechantha</i> (83)	—	—	—	—	2.7	2.7	2.7	2.7	—	—	—	—	2.7	2.7	5.4	2.6	—	—	2.9	2.9	11.1	2.7	88.9	2.7
<i>Aglaiia ponapensis</i> (64)	—	—	—	—	10.2	5.7	—	—	—	—	—	—	0.3	0.3	0.3	0.3	—	—	—	—	10.7	5.6	89.3	5.6
<i>Campnosperma brevipetiolatum</i> (132)	—	—	0.6	0.6	1.3	1.1	—	—	—	—	7.2	7.2	0.7	0.7	—	—	1.5	1.1	—	—	10.6	5.3	89.4	5.3
<i>Bruguiera gymnorhiza</i> (406)	—	—	0.6	0.6	6.7	3.1	—	—	0.5	0.5	—	—	0.7	0.6	0.4	0.4	2.6	1.2	—	—	8.8	3.4	91.2	3.4
<i>Barringtonia racemosa</i> (61)	—	—	—	—	5.3	4.0	—	—	2.7	2.7	—	—	5.1	3.6	—	—	—	—	—	—	7.7	4.9	92.3	4.9
All tree species	0.6	0.2	1.9	0.6	13.1	1.6	1.1	0.3	1.9	0.5	0.6	0.2	6.1	1.0	3.4	0.8	1.8	0.5	3.6	1.3	24.2	2.3	75.8	2.3

— = not observed, SE = sample error.

Note: Data are for live trees ≥ 1 inch in diameter at breast height for species with at least 50 trees measured ($n \geq 50$).

Pacific Island-Specific Damages

A priority damage for this report is a parameter specific to the Pacific Islands inventory that does not meet the national minimum thresholds for recording damage but is of special interest to this region (Cannon et al. 2022, USDA FS 2016). Of the eight priority damages on the FIA list, only two—wild pig damage and brown root rot (a disease caused by the fungus *Phellinus noxius*)—were recorded in the FSM.

Pig Damage

Evidence of pig damage was recorded and estimated at the subplot level as a percentage of subplot area damaged. About 1.4 percent (SE = 0.5) of the total forest area in the FSM was estimated to be damaged by pigs (table 21). Evidence of pigs was not observed in Yap, but in Kosrae, pigs were evident in 23.4 percent (SE = 9.9) of forest area, and damaged 5.9 percent (SE = 2.6) of forest area.

Brown Root Rot—*Phellinus noxius*

We observed eight species of trees (*Camposperma brevipetiolatum*, *Elaeocarpus carolinensis*, *Ficus copiosa*, *Garcinia rumiyo*, *Hibiscus tiliaceus*, *Horsfieldia nunu*, *Macaranga carolinensis*, and *Sonneratia alba*) with brown root rot, and only 0.4 percent (SE = 0.3) of all trees were estimated to have brown root rot damage.

Epiphyte Loading

Epiphytes are vascular plants that grow on trees or other plants and include native orchids, forbs, and vines. Epiphytes are common in tropical forests and often make up a substantial component of total species diversity in lowland tropical and montane rainforests. However, when epiphyte loading becomes excessive, it can cause tree damage, mortality, or lack of growth. Epiphyte load was estimated for trees that were ≥ 1 inch in DBH using a composite score of none (0), light (1), or heavy (2) in three sections of each tree—the bottom, middle, and top—for a total epiphyte load composite score that ranges from 0 to 6. In the FSM, about 1 percent of all trees were heavily covered in epiphytes (epiphyte load composite score of 6), about 9 percent were moderately covered (4–5), about 56 percent were lightly covered in epiphytes (1–3), and about 34 percent had no epiphytes (0) (fig. 19). There appears to be a steady increase in the percentage of trees with no epiphytes going west from Kosrae.

In 2016, the percentage of trees with heavy epiphyte loads was one-sixth of that in 2005 (a decrease from 6 to 1 percent), and the percentage of trees with moderate loads also decreased (from 14 to 9 percent), while trees with light epiphyte loads increased (from 49 to 56 percent) (Donnegan et al. 2011). These changes are largely due to significant decreases in the percentage of trees with heavy epiphyte loads in Pohnpei and moderate loads in Pohnpei and Yap, and significant increases in the percentage of trees with light epiphyte loads in Pohnpei and Kosrae. This could be due to conditions becoming hotter and drier across the region. The largest change by state was an 11.5-percent (SE = 7.3) increase in the percentage of trees with light epiphyte composite load scores in Pohnpei, and an 8.3-percent (SE = 2.7) decrease in heavy epiphyte loads there (fig. 20). Montane rainforest in Pohnpei had large **increases** in the percentage of trees with no epiphytes (by 15.4 percent [SE = 6.2]) and low epiphyte loads (by 30.7 percent [SE = 6.1]) and **decreases** in the percentage of trees with moderate (by 11.2 percent [SE = 6.4]) and heavy epiphyte loads (by 4.1 percent [SE = 1.2]).

The characteristic Micronesian forest tree *Camposperma brevipetiolatum*, the tree fern *Cyathea ponapeana*, the endemic *Elaeocarpus carolinensis*, and *Myristica insularis* were the only 4 of 24 live tree species with sample sizes >30 , with mean epiphyte load composite scores ≥ 3.5 (fig. 21). The three mangrove trees *Rhizophora stylosa*, *R. mucronata*, and *Xylocarpus granatum* had the lowest mean epiphyte loads, with essentially no epiphytes; this is not surprising given the constant salty air exposure but could be due to tree age as well.

Growth, Mortality, and Removals

We estimated that there were 41,110,614 (SE = 5,104,143) new trees ≥ 1 inch in DBH added to the FSM between 2005 and 2016. During the same period, 33,832,479 (SE = 5,352,465) trees were lost to mortality, and 8,909,239 (SE = 2,775,281) trees were removed (table 22). The sum of these categories resulted in a total net loss of 1,631,105 (SE = 6,222,206) trees. However, the net loss was not statistically significant, so we do not know for sure if there was an increase or decrease in the number of trees in the FSM during this time. There was a clear growth trend of relatively more trees transitioning into the next largest diameter class (fig. 22).

Table 21—Forest area with pig damage by state in the Federated States of Micronesia (FSM), 2016

Evidence of pig damage	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
Present	—	—	7.4	4.8	2.2	1.1	23.4	9.9	6.4	2.0
Absent	100	0	92.6	4.8	97.8	1.1	76.6	9.9	93.6	2.0
Damage	—	—	0.9	0.6	0.5	0.4	5.9	2.6	1.4	0.5

— = not observed, SE = sample area.

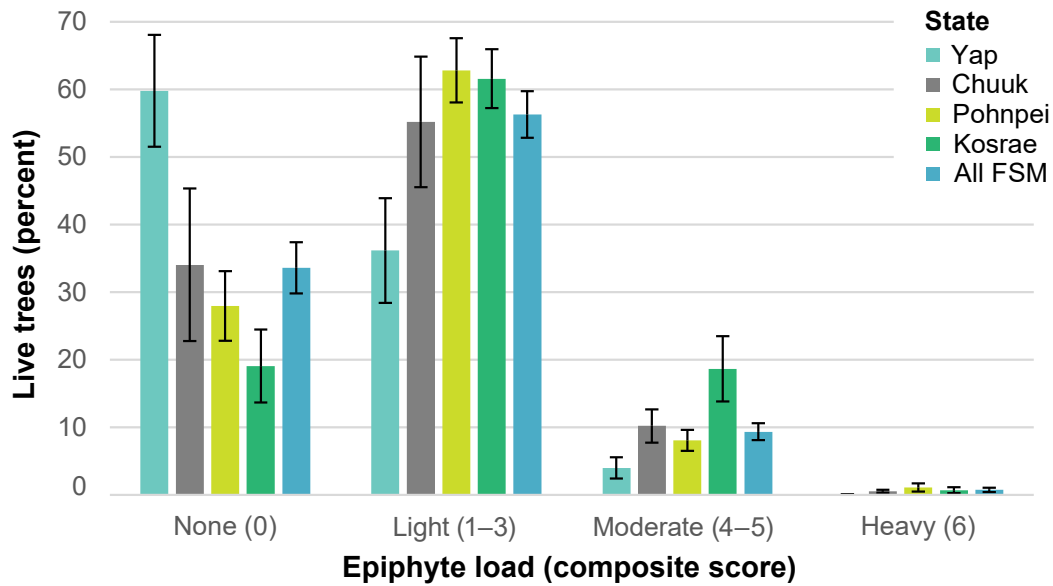


Figure 19—Live trees (≥ 1 inch in diameter at breast height) in the Federated States of Micronesia (FSM) by epiphyte load composite score and state, 2016. Error bars represent 68-percent confidence level.

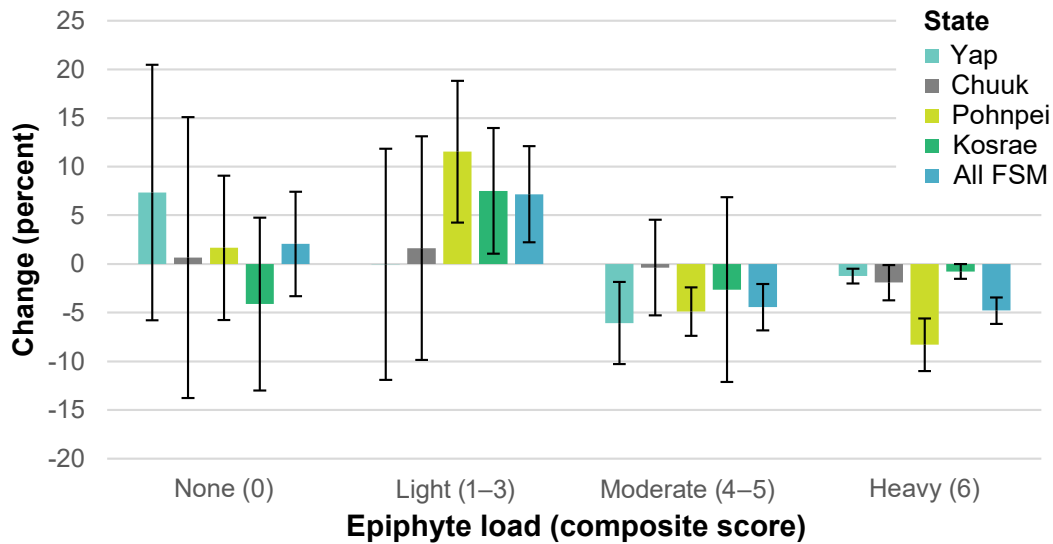


Figure 20—Change in percentage of live trees (≥ 1 inch in diameter at breast height) by epiphyte load composite score and state between 2005 and 2016. USDA Forest Service, Forest Inventory and Analysis inventories in the Federated States of Micronesia (FSM). Error bars represent 68-percent confidence level.

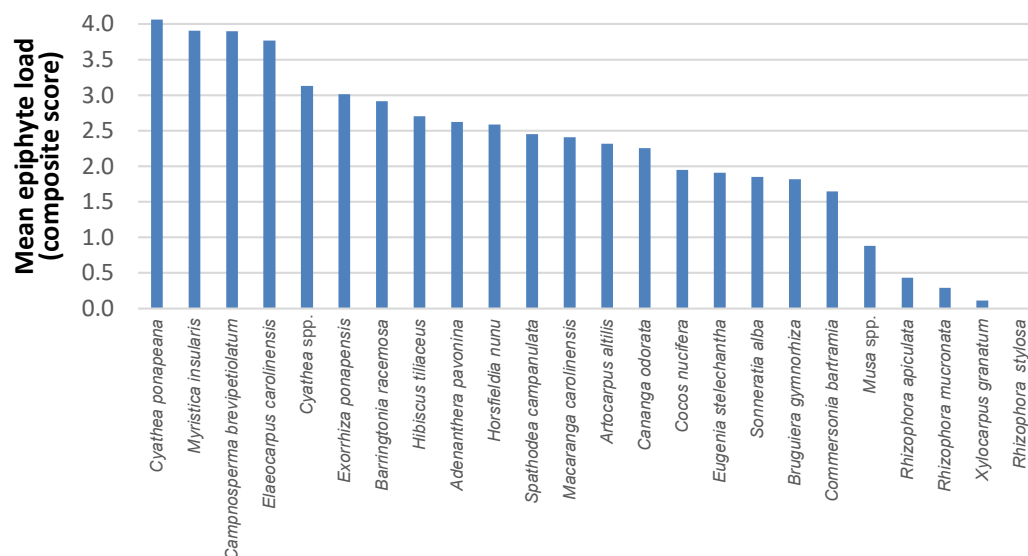


Figure 21—Mean epiphyte load composite score by tree species (n > 30) in the Federated States of Micronesia, 2016.

Table 22—Growth, mortality, removals (GMR), and net change in abundance of trees ≥1 inch in diameter at breast height by state in the Federated States of Micronesia (FSM) from 2005 to 2016

GMR category	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
NUMBER OF TREES										
2005	17,538,693	3,335,209	7,869,938	2,695,770	43,301,825	5,523,069	16,214,416	3,597,743	84,924,872	7,863,768
2016	15,062,442	3,653,488	9,661,822	3,192,252	43,448,152	4,540,300	15,121,351	3,317,747	83,293,767	7,426,992
Growth	6,992,912	2,009,380	6,185,464	2,826,892	20,588,194	2,984,778	7,344,044	2,261,514	41,110,614	5,104,143
Mortality	-6,174,594	1,757,106	-3,926,857	1,693,796	-15,536,137	3,823,182	-8,194,892	2,841,794	-33,832,479	5,352,465
Removals	-3,294,568	1,474,034	-466,723	386,065	-4,905,730	2,313,191	-242,218	171,785	-8,909,239	2,775,281
Net change	-2,476,250	2,627,046	1,791,884	2,672,602	146,327	4,094,401	-1,093,065	2,812,037	-1,631,105	6,222,206

SE = sample error.

Note: 2016 totals are for remeasured plots only.

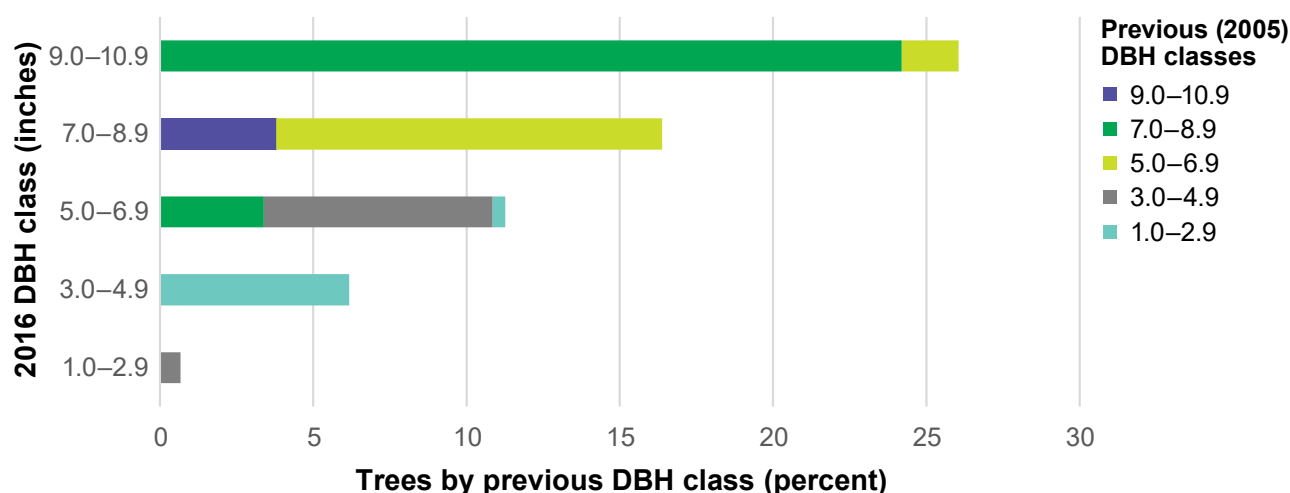


Figure 22—Trees that transitioned between diameter at breast height (DBH) classes between the 2005 and 2016 USDA Forest Service, Forest Inventory and Analysis inventories in the Federated States of Micronesia. Potential reasons for trees moving to smaller DBH classes include crew errors, damage at the point of measurement, and naturally occurring variation in trees near DBH class boundaries.

The tree species with the most reliable net gain in number of trees was the endemic *Aglaia ponapensis*, followed by *Pandanus cominsii* and *Antidesma kusaiense* (table 23). The tree species with the greatest significant net loss of trees was *Cananga odorata*, which had the most absolute losses due to mortality and removals.

FSM forests grew 4,104,055 (SE = 341,269) tons of tree biomass (live, aboveground, dry weight) and lost 2,474,723 (SE = 430,921) tons to tree mortality and 561,775 (SE = 175,868) tons to tree removal. This resulted in a total net gain of 1,067,557 (SE = 460,724) tons of tree biomass from 2005 to 2016 (Chave et al. 2014) (table 24). This translates to an annual gain in biomass from tree growth of about 3.3 percent and an annual loss of 2.0 percent to mortality and 0.4 percent to removals for an annual net gain of 0.9 percent of forest biomass. All FSM states gained biomass between inventories, but it was not significant in Chuuk and Kosrae states. There was considerable variation in annual net change of biomass among states—0.1 percent in Kosrae, 0.5 percent in Chuuk, 0.8 percent in Pohnpei, and 5.0 percent in Yap. The weight of aboveground forest carbon (total, gained, or lost) is about half the weight of the respective biomass.

Thirty-six tree species had significant net changes (with SE/estimate ratio <0.9) in biomass between inventories, of which 31 were positive. The tree species with the most reliable change in biomass was *Myristica insularis*, with a net gain, followed by *Hibiscus tiliaceus*, which had the largest significant net loss among tree species (table 25).

In 2016, 6.8 percent (SE = 0.9) of all trees ≥ 5 inches in DBH were standing dead trees, which was slightly higher than in 2005 (5.1 percent [SE = 0.7]). Kosrae had the highest percentage of standing dead trees ≥ 5 inches in DBH among states at 8.9 percent (SE = 2.6), and Yap had the lowest at 4.8 percent (SE = 2.0). Chuuk and Pohnpei were almost equal (6.8 percent [SE = 1.9] and 6.7 percent [SE = 1.1], respectively).

We inventoried 55 species of standing dead trees ≥ 1 inch in DBH. The most common species of dead trees were *Hibiscus tiliaceus*, with 9.1 percent of inventoried standing dead trees, and *Cocos nucifera* and *Cyathea* spp., with about 7 percent each (fig. 23). About 55 percent of dead trees ≥ 5 inches in DBH had an unknown cause of death, while about 18 percent were killed by disease, 14 percent by silvicultural or land clearing activity, 9 percent by weather (wind), 3 percent by vegetation suppression, and 1 percent by insects. The high rate of tree mortality with unknown cause of death is likely due to the rapid rate of decay in tropical forests. There was a steadily decreasing rate of mortality by increasing DBH class (fig. 24).

Removed trees composed less than 1.0 percent of all inventoried trees in 2016. There were 13 species of trees removed between the 2005 and 2016 inventories, which were all recorded as killed by silvicultural or land clearing activity. Breadfruit, *Artocarpus altilis*, was the most common species removed (all for silviculture/land clearing), followed by *Glochidion* spp. and the invasive *Adenanthera pavonina*.

Table 23—Growth, mortality, removals, and net change in number of trees ≥1 inch in diameter at breast height by species in the Federated States of Micronesia from 2005 to 2016

Tree species	2005			2016			Growth			Mortality			Removals			Net change		
	Mean	SE		Mean	SE		Mean	SE		Mean	SE		Mean	SE		Mean	SE	
	NUMBER OF TREES																	
<i>Aglaia ponapensis</i>	2,413,513	646,854	4,416,159	1,161,847	2,375,925	736,479	–373,280	217,494	–	–	–	–	–	–	–	2,002,645	781,184	
<i>Cocos nucifera</i>	740,307	214,542	508,190	143,556	9,911	11,371	–205,778	92,749	–36,250	29,544	–	–	–	–	–	–232,117	106,711	
<i>Cananga odorata</i>	5,192,048	2,443,825	2,485,077	1,521,074	300,830	316,996	–2,171,201	935,787	–836,600	855,275	–	–	–	–	–	–2,706,971	1,331,125	
<i>Myristica insularis</i>	1,417,992	529,735	1,348,008	525,814	–	–	–42,631	30,973	–27,353	19,007	–	–	–	–	–	–69,984	35,541	
<i>Rhizophora mucronata</i>	709,180	415,863	639,196	389,664	–	–	–69,984	40,030	–	–	–	–	–	–	–	–69,984	40,030	
<i>Mangifera indica</i>	734,132	345,764	288,411	113,992	–	–	–431,025	256,136	–14,696	14,090	–	–	–	–	–	–445,721	255,974	
<i>Pandanus cominsii</i>	3,216,986	1,087,060	4,894,672	1,447,391	3,230,921	904,672	–1,553,235	570,966	–	–	–	–	–	–	–	1,677,686	968,309	
<i>Antidesma kusaense</i>	515,942	376,955	1,155,576	488,064	652,804	386,428	–13,169	13,634	–	–	–	–	–	–	–	639,634	388,498	
<i>Morinda citrifolia</i>	286,424	194,248	1,337,176	706,746	1,200,549	632,776	–26,339	18,525	–123,458	141,645	–	–	–	–	–	1,050,753	655,271	
<i>Horsfieldia nunu</i>	1,556,329	482,263	1,182,417	337,157	163,201	168,961	–537,113	273,720	–	–	–	–	–	–	–	–373,912	237,565	
<i>Rhizophora apiculata</i>	864,985	550,476	1,513,014	665,737	707,032	415,697	–45,834	30,900	–13,169	13,634	–	–	–	–	–	648,028	419,788	
<i>Glochidion</i> spp.	1,331,499	696,763	315,610	196,933	123,458	141,645	–221,228	187,817	–918,118	655,818	–	–	–	–	–	–1,015,889	675,170	
<i>Xylocarpus granatum</i>	664,609	277,358	618,775	261,488	–	–	–45,834	30,900	–	–	–	–	–	–	–	–45,834	30,900	
<i>Pittosporum</i> spp.	42,631	30,973	15,278	14,119	–	–	–27,353	19,007	–	–	–	–	–	–	–	–27,353	19,007	
<i>Ficus tinctoria</i>	864,262	407,464	401,842	241,247	190,315	175,882	–462,419	332,859	–190,315	175,882	–	–	–	–	–	–462,419	332,859	
<i>Trukia carolinensis</i>	–	–	727,702	532,875	727,702	532,875	–	–	–	–	–	–	–	–	–	727,702	532,875	
<i>Lumnitzera littorea</i>	590,862	443,869	566,255	426,090	–	–	–9,911	11,371	–14,696	14,090	–	–	–	–	–	–24,607	18,106	
<i>Atuna racemosa</i>	865,130	571,242	1,263,087	615,679	667,289	327,451	–269,332	193,976	–	–	–	–	–	–	–	397,957	297,261	
<i>Glochidion ramiflorum</i>	–	–	283,783	212,330	283,783	212,330	–	–	–	–	–	–	–	–	–	283,783	212,330	
<i>Commersonia bartramia</i>	2,363,449	1,660,678	1,090,619	784,056	123,458	141,645	–1,376,466	971,790	–19,822	22,742	–	–	–	–	–	–1,272,831	989,972	
<i>Ficus copiosa</i>	523,563	458,902	1,017,393	763,397	493,830	386,059	–	–	–	–	–	–	–	–	–	493,830	386,059	
<i>Timonius albus</i>	123,458	141,645	370,373	307,545	246,915	193,030	–	–	–	–	–	–	–	–	–	246,915	193,030	
<i>Aidia cochinchinensis</i>	184,570	148,304	416,207	229,230	246,915	193,030	–15,278	14,119	–	–	–	–	–	–	–	231,637	193,545	
<i>Pandanus jipensis</i>	–	–	493,830	438,217	493,830	438,217	–	–	–	–	–	–	–	–	–	493,830	438,217	
<i>Garcinia rumiyo</i>	153,190	163,967	637,110	508,745	493,830	438,217	–9,911	11,371	–	–	–	–	–	–	–	483,919	435,468	

– = not observed, SE = sample error.

Note: Includes only tree species with ratio of SE/estimate of less than 0.9 for net change. Estimates are in ascending order of the ratio of SE to the estimate (SE/estimate), so the values at the top of the table are more reliable.

Table 24—Growth, mortality, removals (GMR), and net change in biomass of trees (live, aboveground dry weight) by state in the Federated States of Micronesia (FSM) from 2005 to 2016

GMR category	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
TONS										
2005	540,975	152,153	1,184,307	411,894	8,292,275	1,408,306	2,431,896	724,548	12,449,453	1,643,503
2016	813,072	195,050	1,244,989	346,465	8,994,579	1,544,658	2,464,371	759,172	13,517,011	1,766,463
Growth	459,480	117,316	632,179	192,474	2,399,789	237,058	612,607	97,255	4,104,055	341,269
Mortality	-131,741	40,985	-541,905	339,674	-1,288,913	199,792	-512,163	169,463	-2,474,723	430,921
Removals	-55,642	30,153	-29,592	19,723	-408,572	166,181	-67,969	44,892	-561,775	175,868
Net change	272,097	98,632	60,682	337,206	702,304	254,823	32,475	154,582	1,067,557	460,724

SE = sample error.

Table 25—Growth, mortality, removals, and net change in biomass (live, aboveground dry weight) by tree species in the Federated States of Micronesia from 2005 to 2016 sorted by confidence in the estimate (greatest to least)

Tree species	2005		2016		Growth		Mortality		Removals		Net change	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
TONS												
<i>Myristica insularis</i>	422,531	152,632	558,490	197,762	151,798	52,426	-10,469	7,474	-5,370	4,176	135,959	51,185
<i>Hibiscus tiliaceus</i>	491,840	97,845	301,662	65,310	273,159	54,717	-376,279	88,456	-87,057	51,695	-190,177	74,919
<i>Camprosperma brevipetiolatum</i>	798,851	266,483	967,406	305,114	346,522	89,377	-149,643	60,030	-28,324	18,387	168,555	75,251
<i>Mangifera indica</i>	238,587	108,550	411,265	156,720	249,093	96,102	-72,561	37,594	-3,855	3,696	172,677	82,075
<i>Horsfieldia nunu</i>	414,172	155,278	516,868	194,265	172,922	57,140	-70,226	33,812	—	—	102,696	53,954
<i>Xylocarpus granatum</i>	786,228	403,475	918,147	449,763	173,698	94,164	-41,779	26,658	—	—	131,919	76,068
<i>Calophyllum inophyllum</i>	144,657	124,693	217,092	151,967	75,507	44,168	-3,072	3,524	—	—	72,435	42,234
<i>Spathodea campanulata</i>	185,147	111,845	241,429	135,856	152,322	94,134	-89,978	76,190	-6,063	5,603	56,282	36,121
<i>Semecarpus venenosus</i>	27,162	18,431	51,706	34,678	27,153	17,538	-2,609	1,840	—	—	24,544	16,314
<i>Premna</i> spp.	4,575	3,855	6,280	4,554	1,705	1,161	—	—	—	—	1,705	1,161
<i>Pandanus</i> spp.	2,135	1,463	—	—	215	159	-1,182	945	-1,168	1,340	-2,135	1,463
<i>Ponapea ledermanniana</i>	14,930	10,547	20,497	14,169	5,567	3,819	—	—	—	—	5,567	3,819

Table 25 (continued)—Growth, mortality, removals (GRM), and net change in biomass (live, aboveground dry weight) by tree species in the Federated States of Micronesia from 2005 to 2016 sorted by confidence in the estimate (greatest to least)

Tree species	2005			2016			Growth		Mortality		Removals		Net change	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
TONS														
<i>Trukia carolinensis</i>	—	—	2,785	1,916	2,785	1,916	—	—	—	—	—	—	2,785	1,916
<i>Pandanus tectorius</i>	12,020	5,999	15,266	7,830	4,283	2,154	-1,037	821	—	—	—	—	3,246	2,249
<i>Claoxylon carolinianum</i>	1,876	1,336	4,526	3,153	3,783	2,799	-1,134	1,195	—	—	—	—	2,649	1,842
<i>Dysoxylum mollissimum</i>	134,945	93,070	212,316	147,181	77,371	54,130	—	—	—	—	—	—	77,371	54,130
<i>Cocos nucifera</i>	278,103	94,556	217,758	69,038	42,724	17,016	-78,101	35,450	-24,967	21,446	-60,344	42,238	—	—
<i>Dendrocnide latifolia</i>	5,278	4,016	5,464	4,139	651	580	-465	481	—	—	—	—	186	131
<i>Bruguiera gymnorrhiza</i>	487,858	242,987	568,481	266,165	128,921	56,570	-48,297	43,526	—	—	—	—	80,623	56,782
<i>Neuburgia celebica</i>	4,683	3,074	7,234	4,247	3,094	1,684	—	—	-543	562	2,551	1,800	—	—
<i>Rhizophora apiculata</i>	708,047	549,030	848,477	653,498	168,561	121,565	-22,043	16,831	-6,089	6,304	140,429	104,988	—	—
<i>Lumnitzera littorea</i>	12,998	9,918	23,617	17,958	13,376	9,906	-621	712	-2,136	2,048	10,619	8,041	—	—
<i>Palaquium karak</i>	140,429	82,422	164,853	98,761	24,424	18,699	—	—	—	—	—	—	24,424	18,699
<i>Pittosporum</i> spp.	46,722	37,043	6,253	5,779	10,644	8,516	-51,112	39,931	—	—	-40,469	31,425	—	—
<i>Inocarpus fagifer</i>	173,893	141,929	238,446	191,659	64,553	50,317	—	—	—	—	—	—	64,553	50,317
<i>Macaranga carolinensis</i>	20,746	9,125	41,207	18,981	42,011	17,950	-18,804	8,911	-2,746	1,505	20,461	16,032	—	—
<i>Glochidion ramiflorum</i>	—	—	7,786	6,203	7,786	6,203	—	—	—	—	—	—	7,786	6,203
<i>Elaeocarpus kusanoi</i>	11,990	8,788	29,941	22,517	25,349	15,331	-6,015	6,338	-1,383	1,457	17,952	14,659	—	—
<i>Commersonia bartramia</i>	38,487	32,272	121,335	93,279	120,981	87,771	-37,085	27,247	-1,048	1,202	82,849	69,310	—	—
Tree unknown	4,051	3,168	11,608	9,495	7,557	6,358	—	—	—	—	—	—	7,557	6,358
<i>Adenanthera pavonina</i>	738,855	464,390	548,517	379,088	117,331	78,305	-207,986	170,199	-99,684	92,124	-190,338	162,951	—	—
<i>Ficus copiosa</i>	5,063	4,680	9,562	8,409	4,499	3,863	—	—	—	—	—	—	4,499	3,863
<i>Pandanus cominsii</i>	7,218	2,534	11,828	5,062	11,157	4,018	-6,546	2,403	—	—	—	—	4,611	3,992
<i>Cananga odorata</i>	241,341	80,565	188,670	67,930	50,793	19,012	-86,072	36,576	-17,392	14,367	-52,671	45,610	—	—
<i>Rhizophora mucronata</i>	387,959	220,011	433,501	253,954	67,680	43,057	-22,138	16,444	—	—	—	—	45,543	40,130
<i>Rhizophora stylosa</i>	70,266	60,848	119,975	104,833	57,909	51,563	-8,199	7,577	—	—	—	—	49,710	43,993
<i>Averrhoa bilimbi</i>	1,863	1,565	2,025	1,708	161	144	—	—	—	—	—	—	161	144

— = not observed, SE = sample error.

Note: Includes only tree species with ratio of SE/estimate of less than 0.9 for net change. Estimates are in ascending order of the ratio of SE to the estimate (SE/estimate), so the values at the top of the table are more reliable, and the values at the bottom of the table are less reliable.

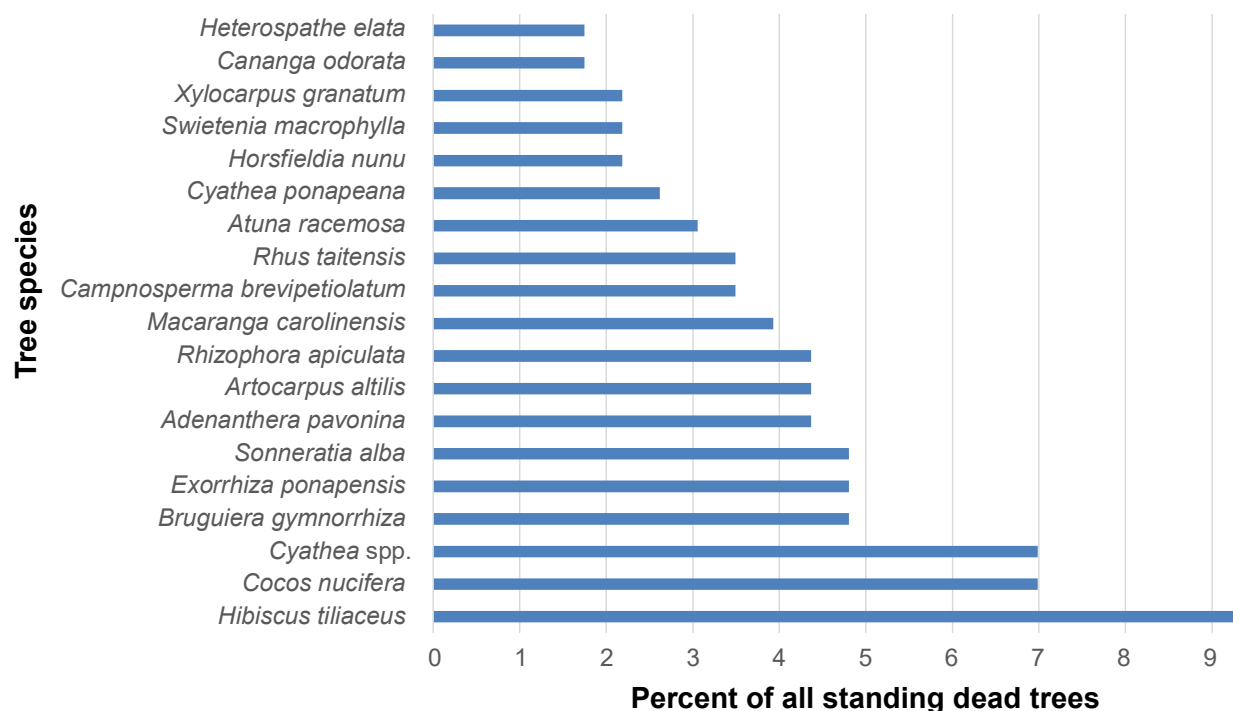


Figure 23—Standing dead trees by species that were inventoried in the Federated States of Micronesia, 2016.

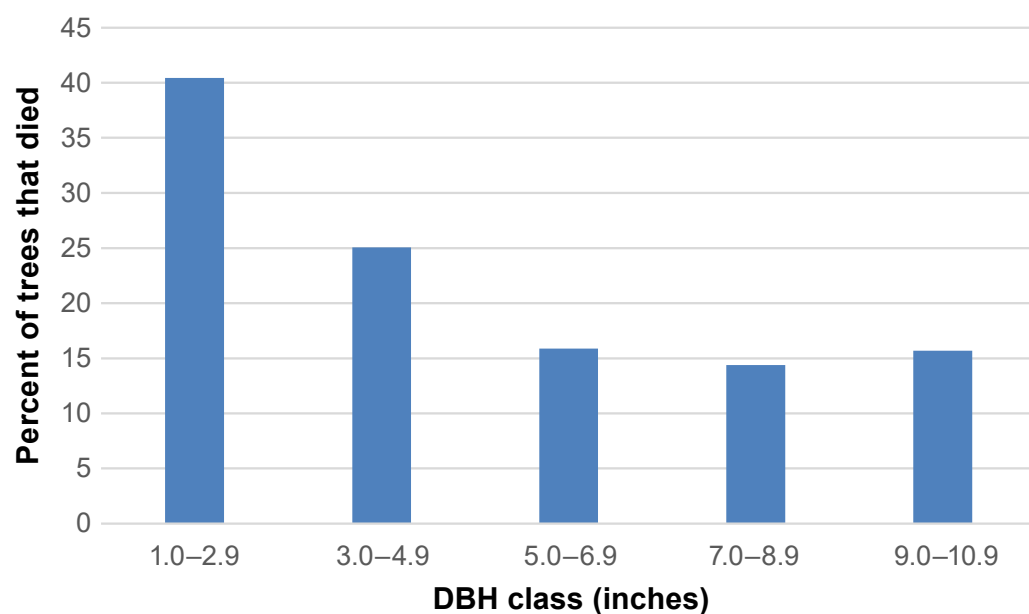


Figure 24—Trees that died by diameter at breast height (DBH) class between the 2005 and 2016 USDA Forest Service, Forest Inventory and Analysis inventories in the Federated States of Micronesia.

Forest Structure

Stand Size Class

The Forest Service FIA program uses six stand size classes based on the predominant size of all live trees and saplings. Forests inventoried in the FSM were all considered hardwood forests, with stand size classes of nonstocked, class 1 (1.0–4.9 inches in DBH), class 2 (5.0–10.9 inches), class 3 (11.0–19.9 inches), class 4 (20.0–39.9 inches), and class 5 (≥ 40 inches). Most of the forest area in the FSM and in three of the four states was defined as stand size class 3 (table 26). There were no nonstocked or class 5 forest plots measured in the FSM.

Volume, Biomass, Carbon, Stem Density, and Basal Area

In 2016, we estimated 487,849,430 cubic feet (SE = 56,059,542) of live tree stem volume and 14,117,154 tons (SE = 1,472,671) of live, aboveground biomass (7,058,577 tons of carbon [SE = 736,335]) in FSM forests. There were no significant changes in mean stem density (trees per acre) or basal area (square feet per acre) between the 2005 and 2016 inventories overall for the FSM (table 27), but there was an increase in mean basal area in Yap state.

Table 26—Forest area by state and stand size class in the Federated States of Micronesia (FSM), 2016

Stand size class (DBH)	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
1 (1.0–4.9 inches)	4.1	2.9	7.6	7.6	1.3	1.3	6.3	3.6	3.5	1.5
2 (5.0–10.9 inches)	46.2	15.1	8.2	8.0	29.2	7.0	28.5	12.8	28.5	5.0
3 (11.0–19.9 inches)	45.7	15.9	84.2	11.1	60.7	7.7	56.6	14.3	61.2	5.6
4 (20.0–39.9 inches)	4.1	4.1	—	—	8.8	4.5	8.5	8.5	6.8	2.9

— = not observed, DBH = diameter at breast height, SE = sample error.

Note: There were no nonstocked or class 5 plots in the FSM in 2016.

Table 27—Stem density and basal area and their changes by state based on remeasured plots from the 2005 and 2016 USDA Forest Service, Forest Inventory and Analysis inventories in the Federated States of Micronesia (FSM)

State	Stem density					
	2005		2016		Change	
	Mean	SE	Mean	SE	Mean	SE
STEMS PER ACRE						
Yap	833	134	779	150	–53	129
Chuuk	448	117	465	143	18	150
Pohnpei	588	66	589	53	0	57
Kosrae	717	124	662	137	–55	132
FSM	626	49	611	48	–15	48

State	Basal area					
	Mean	SE	Mean	SE	Mean	SE
SQUARE FEET PER ACRE						
Yap	66	12	93	12	27	8
Chuuk	112	20	89	18	–23	16
Pohnpei	164	16	164	17	0	5
Kosrae	160	33	172	40	13	16
FSM	141	11	144	12	3	5

SE = sample error.

In 2016, data from all plots showed that agroforest had the lowest volume (cubic feet per acre) of the five forest communities in the FSM (table 28). Volume was relatively similar among most nonagroforest communities but significantly lower in lowland rainforest. Lowland and montane rainforests had significantly higher stem densities than other communities, while basal area was

highest in mangrove and montane rainforests. In 2016, stem density was highest in Yap and lowest in Chuuk. Both states had volume estimates less than half of those for Pohnpei and Kosrae, which can be attributed to the higher mean tree height and volume of lowland tropical rainforests and mangroves in Pohnpei and Kosrae (tables 29 and 30).

Table 28—Stem density, basal area, and volume by forest community in the Federated States of Micronesia, 2016

Forest community	Stem density		Basal area		Volume	
	Mean	SE	Mean	SE	Mean	SE
	STEMS PER ACRE		SQUARE FEET PER ACRE		CUBIC FEET PER ACRE	
Agroforest	325	62	77	13	1,557	299
Lowland rainforest	760	54	141	13	3,134	456
Mangrove	379	91	210	32	5,034	1,044
Montane rainforest	804	95	228	23	4,617	961
Strand forest	475	205	155	47	4,245	2,416

SE = sample error.

Table 29—Stem density, basal area, and volume by state in the Federated States of Micronesia (FSM), 2016

State	Stem density		Basal area		Volume	
	Mean	SE	Mean	SE	Mean	SE
	STEMS PER ACRE		SQUARE FEET PER ACRE		CUBIC FEET PER ACRE	
Yap	784	129	111	15	1,761	441
Chuuk	463	129	82	15	1,601	311
Pohnpei	599	47	162	15	3,755	472
Kosrae	604	100	178	35	4,583	1,272
FSM	611	41	145	10	3,276	348

SE = sample error.

Table 30—Volume of live trees ≥ 5 inches in diameter at breast height by forest community and state in the Federated States of Micronesia, 2016

Forest community	Yap		Chuuk		Pohnpei		Kosrae	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	CUBIC FEET PER ACRE							
Strand forest	4,508	2,788	—	—	1,812	1,716	9,321	9,809
Mangrove	1,085	484	699	530	6,410	1,318	4,415	1,273
Lowland rainforest	1,453	370	1,780	625	3,119	438	5,097	1,741
Agroforest	1,446	801	1,678	374	950	205	2,224	1,244

— = not observed, SE = sample error.

Note: We only recorded montane rainforest in Pohnpei, so it is not included in this state comparison.

Vegetation Profile

Vascular Plant Species Composition

Vegetation profile data collected on each subplot include two different datasets: (1) dominant vascular species composition and (2) growth habit by vegetation height layer. Dominant vascular species composition is collected for the four most abundant plant species in each growth habit (graminoids, shrubs, forbs, and trees) that meet a 3-percent cover threshold. The height layer is listed where the most species cover occurs. The coverage of each growth habit is also described by height layer along with an overall aerial cover estimate for the subplot.

Dominant Vascular Plant Species Composition

We recorded 280 dominant vascular plant species (including tree seedlings/saplings) in FSM forests in 2016 (274 were recorded in 2005). About 50 percent of the dominant vascular plant species inventoried in the FSM were trees (including seedlings/saplings), 16 percent were shrubs, 28 percent were forbs, and 6 percent were graminoids. Two FSM endemics (*Freycinetia ponapensis* and *Hoya schneei*) were among the twenty most dominant nontree plant species, and a native but weedy species (*Merremia peltata*) was the most widespread dominant nontree plant species in the FSM (table 31) (Costion and Lorence 2012). Of the six most dominant nontree plant species, three were ferns (*Nephrolepis oblitterata*, *Cyclosorus heterocarpus*, *Asplenium nidus*), and the other three were vines (*Merremia peltata*, *Derris elliptica*, *Piper ponapense*). These three vines and *Asplenium nidus* were counted as epiphytes and accounted for most cover in the upper height layers. Two tree species endemic to the FSM, two species endemic to Micronesia, and one invasive species were in the twenty most dominant tree seedling/sapling species (table 32) (Costion and Lorence 2012).

Seedlings/saplings of *Hibiscus tiliaceus* covered the most forest area of any dominant plant species in the FSM, with nearly double the cover of the next two most widespread tree seedlings/saplings (*Pandanus cominsii* and *Cyathea* spp.). This is perhaps unsurprising because it was the most abundant tree species and covered the second most forest area as a dominant tree species in the country. The native weedy vine, *Merremia peltata*, was the next most widespread plant species. Overall, the forests in the FSM had relatively abundant understory cover from nontree growth habits compared to elsewhere in Micronesia, with particularly abundant cover from several species of ferns.

Growth Habit and Vegetation Height Layer

The Forest Service FIA program uses four vegetation height layers: layer 1 (0.0–2.0 feet aboveground), layer 2 (2.1–6.0 feet), layer 3 (6.1–16.0 feet), and layer 4 (>16.0 feet). Trees composed the most vegetation cover in FSM forests, with the most cover in vegetation height layer 4 (table 33). However, in Chuuk, vegetation height layer 2 composed the most vegetation cover, and in Yap, layers 3 and 4 had equal cover (table 34). Yap had about half the vegetation cover in layer 1 as other states. Both Yap and Chuuk had significantly less cover in layer 4 than Pohnpei and Kosrae, and Kosrae had the most overall vegetation cover.

There were differences in vegetation cover by growth habit and by vegetation height layer among forest communities in the FSM (figs. 25 and 26). Mangrove had the lowest percentage of forest area covered by vegetation <6.0 feet and the lowest percentage of forest area covered by shrubs, forbs, and graminoids, which makes sense given the challenging saline growing conditions. Agroforest had the lowest percentage of forest area covered by vegetation >16.0 feet, the lowest percentage of forest area covered by trees, and the highest percentage of forest area covered by forbs and graminoids. Lowland and montane rainforest had similar values of vegetation cover by growth habit, but different trends by height layer.

Invasive Species

Invasive species are a threat to native biodiversity and forest health, which is why the FIA program incorporated an invasive plant species protocol in the most recent measurement cycle. State forestry offices provided lists of invasive plants and trees. These included *Merremia peltata*, which is a native species but is considered a weed because of its invasive habits. Any invasive plant species observed from the list was recorded. We recorded 18 species of invasive plants in the inventory, covering about 11.3 percent (SE = 1.8) of total forest area (including overlap of invasive species) in the FSM (table 35). Kosrae and Chuuk had the highest percentages of forest area covered with invasive plants. Half of total forest area in the FSM had an invasive species present on the plot, indicating how widespread invasives are across the landscape (table 36). Yap had the smallest relative forest area with invasives. *Merremia peltata*, a native vine, was the most common invasive (weedy) plant species in every state (fig. 27).

Table 31—Forest community area by nontree plant species in the Federated States of Micronesia, 2016

Forest community	Plant species	Mean	SE	Growth habit	Status
PERCENT OF FOREST AREA					
Lowland rainforest	<i>Nephrolepis oblitterata</i>	8.2	1.5	Forb (fern)	
Lowland rainforest	<i>Merremia peltata</i>	6.7	1.7	Forb (vine)	I*
Lowland rainforest	<i>Cyclosorus heterocarpus</i>	3.5	0.8	Forb (fern)	
Lowland rainforest	<i>Asplenium nidus</i>	3.4	0.5	Forb (fern)	
Lowland rainforest	<i>Piper ponapense</i>	3.4	0.6	Forb (vine)	
Lowland rainforest	<i>Derris elliptica</i>	2.9	0.6	Shrub (woody vine)	
Lowland rainforest	<i>Angiopteris evecta</i>	2.0	0.6	Forb (fern)	
Lowland rainforest	<i>Freycinetia ponapensis</i>	1.7	0.4	Shrub (woody vine)	E
Lowland rainforest	<i>Bolbitis heteroclita</i>	1.7	0.7	Forb (orchid)	
Lowland rainforest	<i>Hoya schneei</i>	1.6	0.4	Shrub (woody vine)	E
Lowland rainforest	<i>Ixora casei</i>	1.3	0.3	Shrub	
Lowland rainforest	<i>Flagellaria indica</i>	1.3	0.6	Shrub (woody vine)	
Lowland rainforest	<i>Tectaria grandifolia</i>	1.2	0.4	Forb (fern)	
Lowland rainforest	<i>Costus speciosus</i>	1.1	0.6	Forb	I*
Lowland rainforest	<i>Procris pedunculata</i>	1.0	0.4	Forb	
Lowland rainforest	<i>Davallia solida</i>	0.9	0.4	Forb (fern)	
Lowland rainforest	<i>Melastoma malabathricum</i>	0.7	0.5	Shrub	
Lowland rainforest	<i>Hypserpa polyandra</i>	0.7	0.4	Shrub (woody vine)	
Agroforest	<i>Musa</i> spp.	11.4	2.6	Forb	
Agroforest	<i>Merremia peltata</i>	11.3	2.4	Forb (vine)	I*
Agroforest	<i>Acalypha amentacea</i>	9.0	2.6	Shrub	
Agroforest	Unknown graminoid	7.9	4.6	Grass	
Agroforest	<i>Dioscorea bulbifera</i>	5.4	1.9	Forb (vine)	
Agroforest	<i>Derris elliptica</i>	4.7	1.6	Shrub (woody vine)	
Agroforest	<i>Cyclosorus heterocarpus</i>	3.4	1.8	Forb (fern)	
Agroforest	<i>Costus speciosus</i>	3.2	1.6	Forb	I*
Agroforest	<i>Nephrolepis oblitterata</i>	3.1	1.4	Forb (fern)	
Agroforest	<i>Ischaemum polystachyum</i>	2.8	1.7	Grass	
Agroforest	<i>Dissotis rotundifolia</i>	1.7	1.4	Forb	
Agroforest	<i>Oplismenus hirtellus</i>	1.6	0.9	Grass	
Agroforest	<i>Centotheca lappacea</i>	1.5	0.6	Grass	
Agroforest	<i>Blechum pyramidatum</i>	1.3	0.8	Forb	
Agroforest	<i>Cyrtosperma chamissonis</i>	1.2	1.0	Forb	
Agroforest	<i>Pteris plumula</i>	1.2	0.7	Forb (fern)	
Agroforest	<i>Piper ponapense</i>	1.2	0.5	Forb (vine)	
Agroforest	<i>Chromolaena odorata</i>	1.1	0.7	Forb	I*
Agroforest	<i>Manihot esculenta</i>	0.9	0.4	Shrub	
Montane rainforest	<i>Cyclosorus heterocarpus</i>	10.5	5.0	Forb (fern)	
Montane rainforest	<i>Asplenium nidus</i>	2.9	0.4	Forb (fern)	
Montane rainforest	<i>Angiopteris evecta</i>	2.9	1.6	Forb (fern)	
Montane rainforest	<i>Bolbitis heteroclita</i>	2.0	1.0	Forb (fern)	
Mangrove	<i>Nephrolepis acutifolia</i>	0.7	0.3	Forb (fern)	
Mangrove	<i>Asplenium nidus</i>	0.5	0.3	Forb (fern)	

E = endemic to Micronesia, I* = invasive, SE = sample error.

Note: There were no species with statistically reliable values in strand forest.

Source: Endemic status from Costion and Lorence (2012).

Table 32—Forest community area by tree seedling/sapling species in the Federated States of Micronesia, 2016

Forest community	Tree species	Mean	SE	Status
PERCENT OF FOREST COMMUNITY AREA				
Lowland rainforest	<i>Hibiscus tiliaceus</i>	11.7	2.2	
Lowland rainforest	<i>Pandanus cominsii</i>	6.7	1.5	
Lowland rainforest	<i>Cyathea</i> spp.	5.4	1.1	E
Lowland rainforest	<i>Aglaia ponapensis</i>	3.9	1.0	E
Lowland rainforest	<i>Atuna racemosa</i>	1.8	0.7	
Lowland rainforest	<i>Exorrhiza ponapensis</i>	1.7	0.7	E
Lowland rainforest	<i>Adenanthera pavonina</i>	1.6	0.6	I*
Lowland rainforest	<i>Syzygium stelechanthum</i>	1.3	0.7	
Lowland rainforest	<i>Horsfieldia nunu</i>	1.3	0.4	
Lowland rainforest	<i>Macaranga carolinensis</i>	1.1	0.3	
Lowland rainforest	<i>Cyathea ponapeana</i>	1.1	0.9	E
Lowland rainforest	<i>Eugenia stelecantha</i>	1.0	0.6	
Lowland rainforest	<i>Spathodea campanulata</i>	0.9	0.6	I*
Lowland rainforest	<i>Ficus tinctoria</i>	0.8	0.3	
Lowland rainforest	<i>Pandanus tectorius</i>	0.8	0.3	
Lowland rainforest	<i>Antidesma kusaiense</i>	0.7	0.2	
Lowland rainforest	<i>Dendrocnide latifolia</i>	0.7	0.4	
Lowland rainforest	<i>Pandanus japensis</i>	0.6	0.4	E
Lowland rainforest	<i>Barringtonia racemosa</i>	0.6	0.2	
Lowland rainforest	<i>Semecarpus venenosus</i>	0.6	0.4	E
Agroforest	<i>Hibiscus tiliaceus</i>	6.5	2.3	
Agroforest	<i>Artocarpus altilis</i>	2.4	0.6	
Agroforest	<i>Macaranga carolinensis</i>	2.1	1.2	
Agroforest	<i>Areca catechu</i>	2.0	1.1	
Agroforest	<i>Cocos nucifera</i>	1.8	0.7	
Mangrove	<i>Rhizophora apiculata</i>	6.8	2.3	
Mangrove	<i>Bruguiera gymnorhiza</i>	4.1	1.4	
Mangrove	<i>Rhizophora stylosa</i>	3.8	2.0	
Montane rainforest	<i>Pandanus cominsii</i>	14.2	5.3	
Montane rainforest	<i>Exorrhiza ponapensis</i>	9.7	3.8	E
Montane rainforest	<i>Cyathea</i> spp.	5.4	2.7	E
Strand forest	<i>Cocos nucifera</i>	17.5	9.9	
Strand forest	<i>Scaevola taccada</i>	7.3	6.6	

E = endemic to Micronesia, I* = invasive, SE = sample error.

Source: Endemic status from Costion and Lorence (2012).

Table 33—Forest area by growth habit and vegetation height layer in the Federated States of Micronesia, 2016

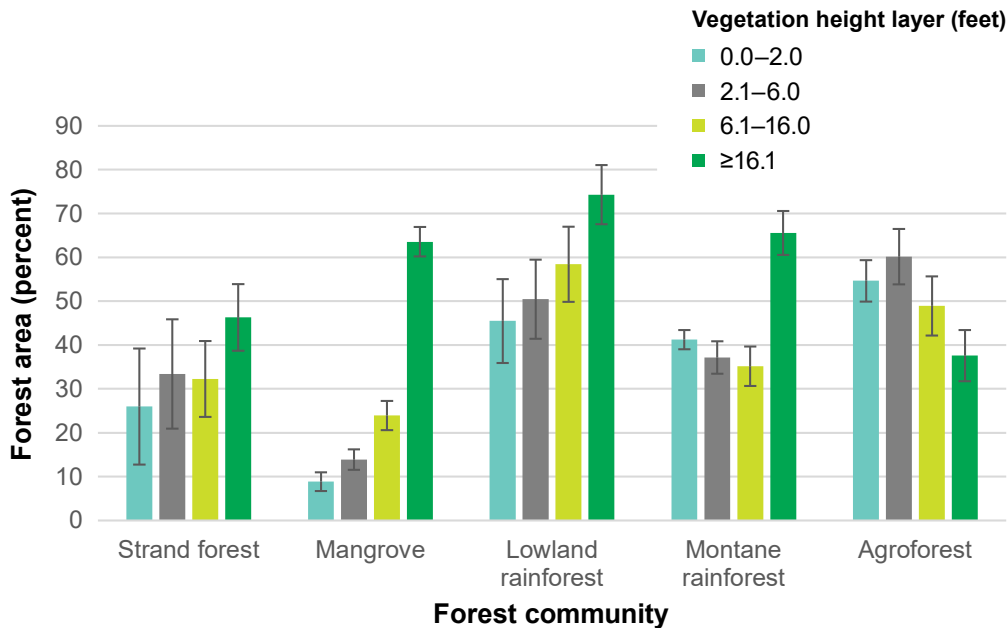
Growth habit	Layer 1 (0.0–2.0 feet)		Layer 2 (2.1–6.0 feet)		Layer 3 (6.1–16.0 feet)		Layer 4 (>16.0 feet)		Overall aerial	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
Tree	8.1	0.9	18.9	1.4	32.1	1.8	53.7	1.8	70.4	1.7
Shrub	3.4	0.4	6.9	0.7	5.6	0.7	3.7	0.5	12.5	1.1
Grass	4.4	1.1	2.7	0.7	0.8	0.4	0.4	0.3	5.5	1.2
Forb	17.0	1.5	16.1	1.4	10.3	1.1	6.9	0.7	31.5	2.2

SE = sample error.

Table 34—Forest area covered by all growth habits by state and vegetation height layer in the Federated States of Micronesia (FSM), 2016

Vegetation height layer	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
1 (0.0–2.0 feet)	26	3	48	3	41	4	43	4	40	2
2 (2.1–6.0 feet)	42	4	70	7	37	3	49	5	45	2
3 (6.1–16.0 feet)	51	5	66	9	41	3	59	8	49	3
4 (>16.0 feet)	51	6	33	5	71	3	84	7	65	2

SE = sample error.

**Figure 25—Forest community area (mean and sample error) by vegetation height layer in the Federated States of Micronesia, 2016. Error bars represent 68-percent confidence level.**

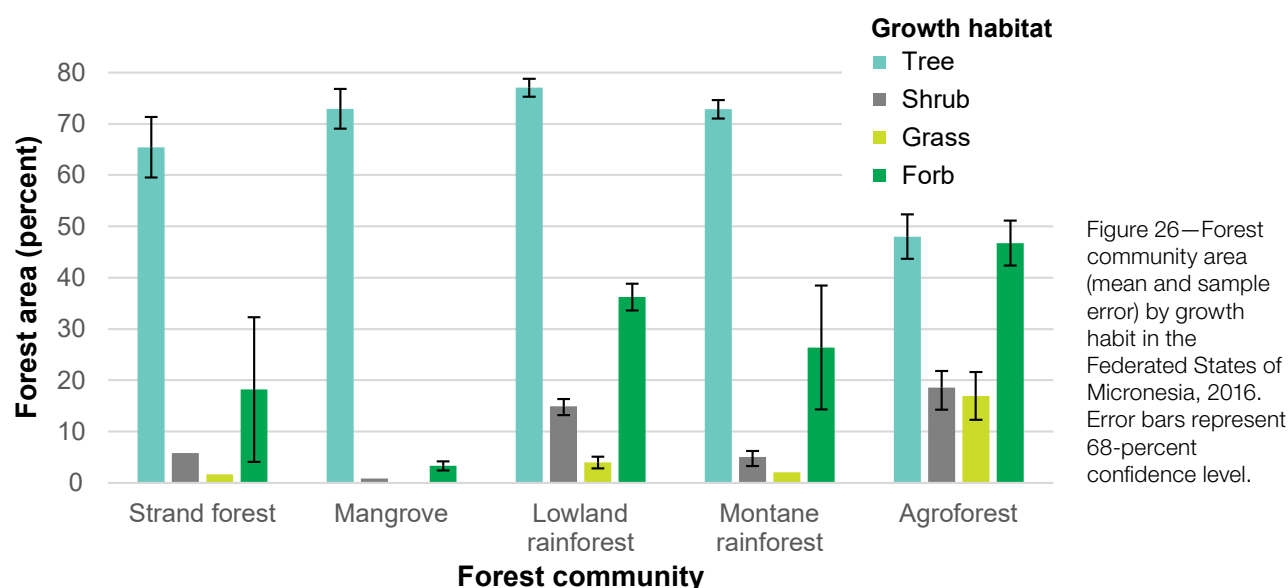


Table 35—Forest area cover by invasive plant species and state in the Federated States of Micronesia (FSM), 2016

Plant species	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
<i>Merremia peltata</i>	0.8	0.6	13.9	3.2	2.5	0.9	16.6	4.7	6.4	1.1
<i>Costus speciosus</i>	0.2	0.1	—	—	2.1	0.9	2.3	1.1	1.6	0.5
<i>Spathodea campanulata</i>	—	—	—	—	2.4	1.3	—	—	1.3	0.7
<i>Falcataria moluccana</i>	—	—	—	—	0.8	0.6	—	—	0.4	0.3
<i>Chromolaena odorata</i>	0.1	0.1	1.6	0.9	0.2	0.1	—	—	0.4	0.1
<i>Mikania micrantha</i>	—	—	—	—	—	—	1.7	1.7	0.3	0.3
<i>Clerodendrum quadriloculare</i>	—	—	0.2	0.2	0.5	0.4	—	—	0.3	0.2
<i>Coccinia grandis</i>	—	—	0.4	0.4	—	—	0.6	0.6	0.2	0.1
<i>Momordica charantia</i>	—	—	1.1	0.6	0.0	0.0	—	—	0.2	0.1
<i>Hedychium coronarium</i>	—	—	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<i>Sphagneticola trilobata</i>	0.0	0.0	0.1	0.1	—	—	0.5	0.4	0.1	0.1
<i>Dieffenbachia seguine</i>	—	—	0.4	0.4	—	—	—	—	0.1	0.1
<i>Lantana camara</i>	—	—	0.4	0.2	—	—	—	—	0.1	0.0
<i>Leucaena leucocephala</i>	0.2	0.2	—	—	—	—	—	—	0.0	0.0
<i>Saccharum</i> spp.	—	—	0.1	0.1	—	—	—	—	0.0	0.0
<i>Mimosa diplotricha</i>	0.0	0.0	—	—	0.0	0.0	—	—	0.0	0.0
<i>Mimosa pudica</i>	0.1	0.1	—	—	—	—	—	—	0.0	0.0
<i>Phragmites karka</i>	—	—	—	—	—	—	0.0	0.0	0.0	0.0
Total	1.4	0.7	18.5	3.4	8.8	2.4	21.8	6.5	11.3	1.8

— = not observed, SE = sample error.

Table 36—Forest area by state and presence/absence of invasive plants in the Federated States of Micronesia (FSM), 2016

Invasive plants	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
Present	20.6	8.4	79.2	12.2	41.6	5.9	77.8	8.9	50.0	4.1
Absent	79.4	8.4	20.8	12.2	58.4	5.9	22.2	8.9	50.0	4.1

SE = sample error.



Figure 27—*Merremia peltata*, a native but weedy vine, covering a large section of the forest in Kosrae state, Federated States of Micronesia. USDA Forest Service photo by Michael Ausman.

Forest Community Highlights

Strand Forest

Strand forest includes vegetation near the shore with species adapted to high rates of evaporation by wind and to high salt concentrations from windblown, ocean spray or inundation by saltwater. Strand forest was barely inventoried in 2005. To improve sampling in protected areas and previously unsampled areas, 25 additional strand forest plots were added in 2016, mostly on the outer islands of Yap state. Tree species composition in strand forest was surprisingly variable among islands and included many agroforest species. *Cocos nucifera* was by far the most dominant tree species in FSM strand forests.

Mangrove

Mangroves are inhabited by trees with high salt tolerance growing on tidally inundated shores and in landlocked depressions. Many species have pneumatophores, adaptive structures for aeration of waterlogged root systems (fig. 28).

We recorded 10 mangrove tree species—*Bruguiera gymnorhiza*, *Heritiera littoralis*, *Lumnitzera littorea*, *Rhizophora apiculata*, *R. lamarckii*, *R. mucronata*, *R. stylosa*, *Scyphiphora hydrophyllacea*, *Sonneratia alba*, and *Xylocarpus granatum*—in the mangrove forest community in the FSM. Mangrove trees were larger (taller and larger in diameter) in Pohnpei and Kosrae than in Chuuk and Yap (fig. 29). The difference in size was substantial; both mean DBH and mean height of trees in Pohnpei and Kosrae were about twice that of trees in Chuuk and Yap. Tree mean DBHs were significantly larger in Kosrae than in Pohnpei, but mean tree heights were not. Mangroves in Kosrae had a bimodal size distribution, with many trees in the smallest and largest size classes, which seems to result from the size distribution of *Sonneratia alba*. Pohnpei had the largest mean mangrove tree sizes (excluding *Sonneratia alba*) and by far the most mangrove trees of all states in the FSM. *Bruguiera gymnorhiza* was by far the most dominant mangrove species in Yap, and *Sonneratia alba* was by far the most dominant mangrove tree species in Kosrae and Pohnpei. Three or four species were potentially codominant in Chuuk, including *Xylocarpus granatum*, *Lumnitzera littorea*, and one or two species of *Rhizophora* (table 37).

Agroforest

Agroforest includes tree species found in agricultural ecosystems used in crop or animal production. Chuuk had by far the highest percentage of forest area as agroforest (61 percent [SE = 15]), with the most *Artocarpus altilis* (breadfruit), *Pandanus tectorius*, *Cocos nucifera* (coconut), and *Mangifera indica* (mango) trees, suggesting that agroforest is particularly important and widespread there (fig. 30). *Artocarpus altilis* was the most dominant species in Chuuk and Pohnpei agroforests, but much less so in Pohnpei. In agroforest among states, Yap had the most native species, the highest relative dominance of native species, the lowest percentage of invasive species present, and the highest understory coverage with food species (table 38).

Lowland Rainforest

Lowland rainforest is a multistoried forest with many canopy-dwelling epiphytes, open-ground, and shrub layers. This forest community can extend up the lower slopes with windward rainy exposures.

Yap has the most seasonal rainfall pattern, the most frequent and extensive wildfires, and the most area of nonforest vegetation (savanna). Nevertheless, it had the highest tree species richness in lowland rainforest among all states. Chuuk had the lowest percentage of lowland rainforest among forest communities, and it was dominated by invasive tree species and species characteristic of agroforest. Surprisingly, Pohnpei was the only island with lowland rainforest dominated by the classic Micronesian tree species, *Camptosperma brevipedunculatum*, which made up only about 5 percent of basal area in Yap and Kosrae lowland rainforests and was not observed in Chuuk. Kosrae's lowland rainforest characteristics appear to be influenced by the swamp forest there, as the swamp tree, *Horsfieldia nunu*, was the most dominant species overall.

Montane Rainforest

Montane rainforest is the predominant forest on moist hilltops and mountain slopes in many tropical islands. The forests are of low stature and rich in shrubs and epiphytes. Montane rainforest was only sampled in four plots on Pohnpei island and had the highest percentage of endemic tree species (63 percent) of any area summarized across Micronesia (Dendy et al. 2020).



Figure 28—Mangrove forest in Kosrae state, Federated States of Micronesia. USDA Forest Service photo by Michael Ausman.

Table 37—Relative basal area by mangrove tree species and state in the Federated States of Micronesia (FSM), 2016

Tree species	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF BASAL AREA										
<i>Sonneratia alba</i>	9.5	18.4	0.0	0.0	51.0	6.6	83.7	20.9	52.2	7.3
<i>Bruguiera gymnorhiza</i>	59.0	13.7	3.8	3.7	17.3	5.1	12.3	19.1	18.2	5.2
<i>Xylocarpus granatum</i>	2.5	2.5	21.3	21.3	14.7	5.2	0.6	0.6	12.4	4.5
<i>Rhizophora mucronata</i>	3.1	6.6	15.3	8.4	8.5	4.2	1.1	2.6	7.4	3.4
<i>Rhizophora stylosa</i>	1.2	1.2	19.5	35.8	4.3	3.9	0.0	0.0	4.0	3.3
<i>Rhizophora apiculata</i>	5.2	2.6	11.5	30.2	4.1	2.6	1.6	3.6	4.0	2.3
<i>Lumnitzera littorea</i>	7.9	7.9	21.7	21.7	0.1	0.1	—	—	1.0	0.7

— = not observed, SE = sample error.

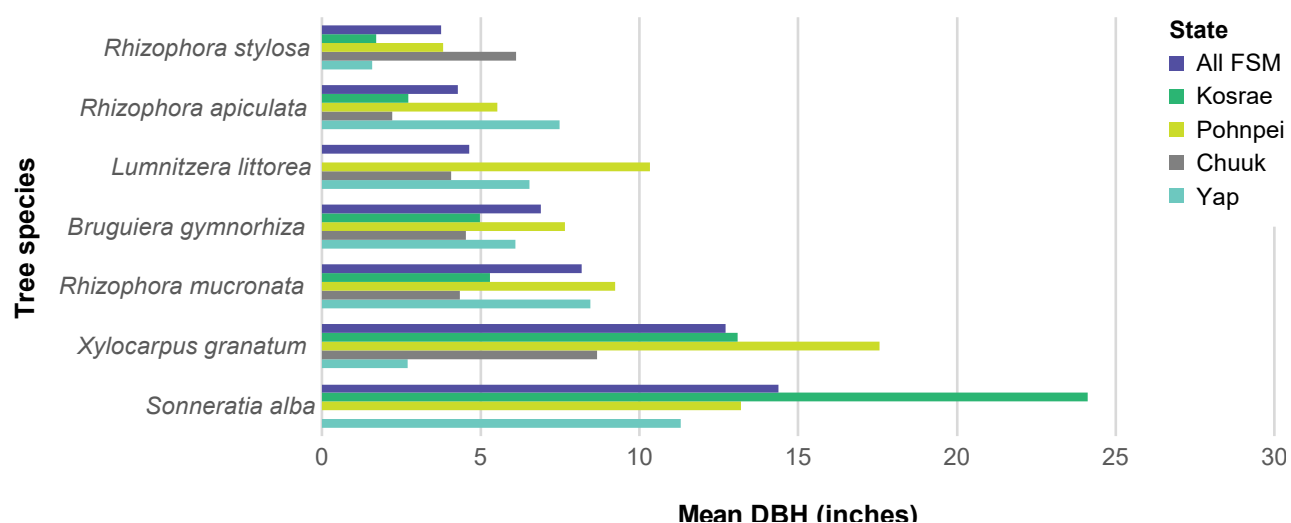
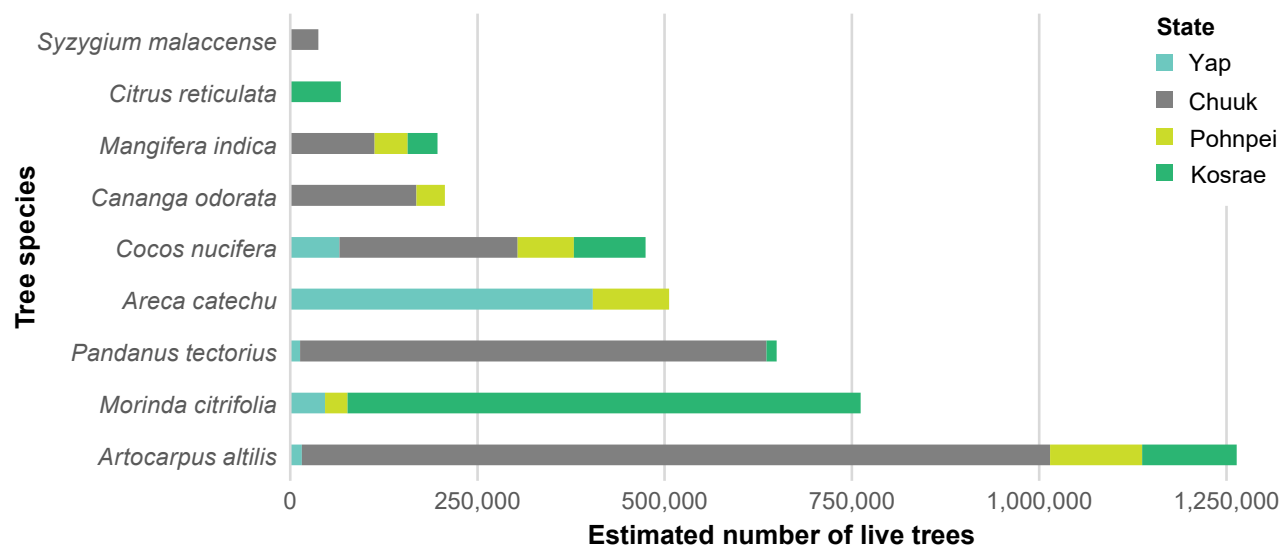
**Figure 29—Mean diameter at breast height (DBH) of mangrove trees by species and state in the Federated States of Micronesia (FSM), 2016.****Figure 30—Live agroforest trees ≥1 inch in diameter at breast height by species and state in the Federated States of Micronesia, 2016.**

Table 38—Agroforest area by food plant species and state in the Federated States of Micronesia (FSM), 2016

Food plant species	Yap		Chuuk		Pohnpei		Kosrae		FSM	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PERCENT OF FOREST AREA										
<i>Musa</i> spp.	1.5	1.2	11.1	3.2	15.8	7.1	11.2	4.9	11.4	2.6
<i>Dioscorea bulbifera</i>	—	—	10.3	3.3	—	—	3.2	3.2	5.4	1.9
<i>Artocarpus altilis</i>	0.6	0.6	4.2	1.1	1.4	0.3	—	—	2.4	0.6
<i>Areca catechu</i>	13.4	7.3	—	—	1.3	1.3	1.5	1.5	2.0	1.1
<i>Cocos nucifera</i>	8.4	4.7	1.3	0.5	—	—	1.7	1.1	1.8	0.7
<i>Morinda citrifolia</i>	1.0	3.1	1.6	0.6	0.4	0.4	4.4	2.6	1.7	0.7
<i>Cyrtosperma chamissonis</i>	12.1	6.9	—	—	—	—	—	—	1.2	1.0
<i>Piper ponapense</i>	—	—	1.3	1.0	—	—	3.4	0.6	1.2	0.5
<i>Manihot esculenta</i>	—	—	1.4	0.8	1.0	1.0	—	—	0.9	0.4
<i>Piper methysticum</i>	—	—	—	—	3.4	3.4	—	—	0.9	0.9
<i>Colocasia esculenta</i>	—	—	1.6	1.6	—	—	—	—	0.8	0.8
<i>Alocasia macrorrhizos</i>	—	—	0.6	0.6	1.8	1.0	—	—	0.8	0.4
<i>Pandanus tectorius</i>	0.3	0.3	1.4	1.4	—	—	—	—	0.7	0.6
<i>Carica papaya</i>	—	—	1.4	0.9	—	—	—	—	0.7	0.5
<i>Cananga odorata</i>	—	—	0.9	0.5	0.8	0.5	—	—	0.6	0.3
<i>Mangifera indica</i>	0.1	0.1	0.4	0.2	—	—	1.3	1.3	0.4	0.2
<i>Momordica charantia</i>	—	—	0.8	0.8	—	—	—	—	0.4	0.4
<i>Citrus</i> spp.	—	—	0.2	0.2	0.3	0.3	—	—	0.1	0.1
<i>Averrhoa bilimbi</i>	1.4	1.4	—	—	—	—	—	—	0.1	0.1
<i>Cyrtosperma merkusii</i>	0.3	0.3	—	—	—	—	0.5	0.5	0.1	0.1
<i>Abelmoschus moschatus</i>	—	—	0.2	0.2	—	—	—	—	0.1	0.1
<i>Saccharum</i> spp.	—	—	0.2	0.2	—	—	—	—	0.1	0.1
<i>Citrus reticulata</i>	—	—	—	—	—	—	0.5	0.5	0.1	0.1
<i>Citrus x limon</i>	0.6	0.6	—	—	—	—	—	—	0.1	0.1
<i>Inocarpus fagifer</i>	0.6	0.6	—	—	—	—	—	—	0.1	0.1
<i>Ananas comosus</i>	0.4	0.4	—	—	—	—	—	—	0.0	0.0
<i>Annona muricata</i>	0.3	0.3	—	—	—	—	—	—	0.0	0.0
<i>Artocarpus mariannensis</i>	0.2	0.2	—	—	—	—	—	—	0.0	0.0
All species	41.0	14.0	39.0	6.0	26.2	4.8	27.7	3.1	34.1	3.6

— = not observed, SE = sample error.

Conclusion

Overall, the forests of the FSM were in variable condition in 2016. Forests in the eastern FSM were generally less disturbed than in the western FSM, and the forests in Chuuk were the most disturbed. Human-caused disturbance was the most prevalent disturbance to forest area, and most human-caused disturbance took place in agroforest. Agroforest was the most disturbed forest community by far and had the lowest stem density, basal area, and volume per acre compared to other forest types. Agroforest is important to food security in the country and requires ongoing management. This management accounts for the human-caused disturbance in agroforest. However, it is unclear why human-caused disturbance increased so much between inventories. Weather was the second most prevalent disturbance, mostly due to typhoon winds affecting half of the forest in Chuuk. Fire was the major source of disturbance in Yap, and wild pigs disturbed the most forest in Kosrae.

Like findings for the 2005 FIA inventory, smaller trees continued to characterize FSM forests in 2016. Most trees in 2016 were <5.0 inches in DBH, and <25-foot tall. Among all states, Yap forests had the highest stem density and Chuuk forests the lowest, and both had significantly lower basal area and volume per acre than forests in Pohnpei and Kosrae. The FSM had high percentages of live canopy coverage overall, with about 10 percent more relative forest area with ≥ 90 percent canopy cover in Pohnpei and Kosrae than Yap and Chuuk. About half of all plots were in partial forest, which suggests that the forests in the FSM are patchy with scattered nonforested areas. Given that strand forest tends to grow in relatively narrow bands along coastal areas, it comprised the highest proportion of partial forest plots, with 69 percent of randomly placed plots in partial beach or ocean areas. Agroforest had the second highest proportion of partial forest plots (59 percent), while mangrove and lowland rainforest were similarly intact (39 and 42 percent, respectively).

There were some clear changes that occurred between the 2005 and 2016 FIA inventories. Total forest area decreased by about 2 percent between the 2005 and 2016 inventories. Total biomass increased by about 1.1 million tons, which is directly correlated with aboveground carbon (534,000 tons). Pohnpei saw the largest change in biomass among FSM states, with a significant gain equal

to about half that of the country overall. Relatively little tree harvest appears to have occurred between inventories, with less than 1 percent of all trees harvested. FSM forests appear to have been highly dynamic during this period, with roughly similar numbers of new tree recruits and dead trees (about 3.7 million new trees and 3.1 million dead trees per year). Most of the species with the largest gains or losses in number of trees or wood volume are among the most abundant or dominant species, although it could be of some concern that coconut trees (*Cocos nucifera*) were among the species with highest absolute loss of biomass.

Invasive plant species were present in about half of FSM forest area and made up about 5 percent of all trees. Two invasive tree species, *Adenanthera pavonina* and *Spathodea campanulata*, were in the top twenty most abundant and most dominant trees, and *Adenanthera pavonina* was the most abundant tree in Chuuk and one of the most widespread tree seedlings. The vine, *Merremia peltata*, was the most prevalent invasive species by far in all states except Pohnpei, where it covered about equal areas of forest as the forb *Costus speciosus* and seedlings of *Spathodea campanulata*. Brown root rot (caused by the fungus *Phellinus noxius*) was observed on eight tree species but on less than 1 percent of all trees. The coconut rhinoceros beetle (*Oryctes rhinoceros*) was not observed in any state of the FSM.

Endemic species play important roles in FSM forests, as 24 percent of trees recorded in the FSM are endemic to Micronesia. Three of the top twenty most abundant and dominant tree species and one of the most dominant nontree plant species were endemic. Lowland rainforest had by far the most endemic tree species among forest communities in the FSM. Of the 29 endemic tree species inventoried, 2 were limited to montane rainforest, which had the highest overall percentage of endemic trees. Kosrae had the highest rate of tree endemism overall and in lowland rainforest (44 percent, SE = 8.9).

FIA inventory results for mangroves mostly agree with the mangrove studies that have been conducted in the FSM, but there were some differences with a comparative regional study by Cole et al. (1999). In that study, *Bruguiera gymnorhiza* was the most abundant species in the FSM, not *Sonneratia alba*; *Lumnitzera littorea* had the lowest volume per acre, not *Rhizophora mucronata*; and *Rhizophora apiculata* trees were not taller and did

not have larger volume in Kosrae than everywhere else (Cole et al. 1999). A study of mangrove soils in Yap found extremely high carbon stocks (144 megagrams per hectare [$SE = 23$]); and while mangrove soils remain unstudied in Pohnpei and Kosrae, given the higher volume per acre in mangroves there, high soil carbon stocks would be expected (Kauffman et al. 2011).

FSM forests have the largest trees and most well-developed mangroves in Micronesia and one of the highest rates of plant species endemism among island biodiversity hotspots globally (Costion and Lorence 2012, Dendy et al. 2020). They also provide a wide range of ecosystem services and functions beneficial to human beings and other organisms, such as coastal stabilization; protection and creation of soil; carbon storage; provision of clean freshwater; regulation of temperature; and production of food, medicine, and building materials (FSM 2020). As such, ongoing monitoring of forests in the FSM through programs such as the FIA are important for detecting and responding to changes in forest health.

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Metric Equivalents

When you know:	Multiply by:	To find:
Inches	2.54	Centimeters
Feet	0.3048	Meters
Miles	1.609	Kilometers
Acres	0.405	Hectares
Cubic feet	0.0283	Cubic meters
Tons	0.907	Tonnes or megagrams
Square feet per acre	0.229	Square meters per hectare
Cubic feet per acre	0.07	Cubic meters per hectare
Trees per acre	2.47	Trees per hectare
Degrees Fahrenheit (°F)	0.56(°F–32)	Degrees Celsius

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APPENDIX 1

Scientific and Common Names of Plants Found During Inventory

Life form	Scientific name	Authority	Common name
Tree	<i>Acacia auriculiformis</i>	A. Cunn. ex Benth.	akasia ^Y , akesia ^K , earleaf acacia
Tree	<i>Adenanthera pavonina</i>	L.	churruwa ^Y , mwetkwem ^K , red beadtrees
Tree	<i>Aglaia ponapensis</i>	Kaneh.	marasau ^P
Tree	<i>Aidia cochinchinensis</i>	Lour.	gathemech ^Y , kehnmant ^P
Tree	<i>Aidia racemosa</i>	(Cav.) Tirveng.	gathemech ^Y , kahmaut ^P
Tree	<i>Albizia</i> spp.	Durazz.	albizia
Tree	<i>Allophylus timoriensis</i>	(DC.) Blume	angel ^Y , ngo ^C , sekese ^P , lah ^K
Tree	<i>Anacardium occidentale</i>	L.	cashew
Tree	<i>Annona muricata</i>	L.	sausau ^Y , saasaf ^C , sei ^P , sosap ^P , sourso ^P
Tree	<i>Antidesma kusaiense</i>	Kaneh.	chinalaurel
Tree	<i>Antidesma</i> spp.	L.	chinalaurel
Tree	<i>Areca catechu</i>	L.	buw ^C , pwuh ^P , katar ^K , betel palm
Tree	<i>Artocarpus altilis</i>	(Parkinson) Fosberg	thow ^Y , mei ^C , mahi ^P , mos ^K , breadfruit
Tree	<i>Artocarpus mariannensis</i>	Trécul	meipah ^P
Tree	<i>Atuna racemosa</i>	Raf.	adid ^Y , ais ^C , ^P , ahset ^K
Tree	<i>Averrhoa bilimbi</i>	L.	kumim ^Y , bilimbi ^P
Tree	<i>Barringtonia asiatica</i>	(L.) Kurz	biuwol ^Y , wawáánúúw ^C , wihnsed ^P , pucspucs ^K
Tree	<i>Barringtonia racemosa</i>	(L.) Spreng.	wathol ^Y , kun ^C , winmarr ^P , kwenguhl ^K
Tree	<i>Bruguiera gymnorhiza</i>	(L.) Lam. ex Savigny	rok ^Y , buru ^C , sohmw ^P , sroal ^K
Tree	<i>Buchanania engleriana</i>	Volkens	Engler's buchanania
Tree	<i>Calophyllum inophyllum</i>	L.	biyuuch ^Y , rackich ^C , isou ^P , ituc ^K
Tree	<i>Campnosperma brevipetiolatum</i>	Volkens	ramlieu ^Y , dohng ^P , elak ^K
Tree	<i>Cananga odorata</i>	(Lam.) Hook. f. & Thomson	mara ^Y , pwanang ^C , seir en wai ^P , elangelang ^K
Tree	<i>Carica papaya</i>	L.	babay babae ^Y , memiap lih ^P , es ^P , papaya
Tree	<i>Ceiba pentandra</i>	(L.) Gaertn.	batey ^Y , kuhtin ^K , kapoktree
Tree	<i>Celtis paniculata</i>	(Endl.) Planch.	zahle ^Y
Tree	<i>Cerbera manghas</i>	L.	riya ^Y , sahk naci ^K
Tree	<i>Cinnamomum carolinense</i>	Koidz.	madeu ^P , mahsro ^K
Tree	<i>Citrus × limon</i>	(L.) Osbeck	karer ^P , lemon
Tree	<i>Citrus mitis</i>	Blanco	gingang ^Y , calamansi ^K
Tree	<i>Citrus reticulata</i>	Blanco	goligaw ^Y , mantirihng ^P , muhsrisrik ^K , tangerine
Tree	<i>Citrus</i> spp.	L.	citrus
Tree	<i>Claoxylon carolinianum</i>	Pax & K. Hoffm.	koahi ^P
Tree	<i>Clinostigma carolinense</i>	(Becc.) H.E. Moore & Fosberg	palm tree
Tree	<i>Cocos nucifera</i>	L.	niew ^Y , núú ^C , nih ^P , kwoacnu ^K , coconut palm
Tree	<i>Commersonia bartramia</i>	(L.) Merr.	guguw ^Y , on ^C , keil ^P
Tree	<i>Crateva religiosa</i>	G. Forst.	abiuuch ^Y , abuts ^C , apoot ^P
Tree	<i>Cyathea nigricans</i>	Mett.	katar ^P , po ^K , treefern
Tree	<i>Cyathea ponapeana</i>	(Hosok.) Glassman	katar ^P , po ^K
Tree	<i>Cyathea</i> spp.	Sm.	treefern
Tree	<i>Cycas micronesica</i>	K.D. Hill	faltir ^Y , manu atapapo ^P

Life form	Scientific name	Authority	Common name
Tree	<i>Cyclophyllum barbatum</i>	(G. Forst.) N. Hallé & J. Florence	kehnmant ^P
Tree	<i>Cynometra ramiflora</i>	L.	manbul ^Y , remek ^P
Tree	<i>Dendrocnide latifolia</i>	(Gaudich.) Chew	sar elat ^K
Tree	<i>Dimocarpus longan</i>	Lour.	longan
Tree	<i>Diospyros ferrea</i>	(Willd.) Bakh.	achingal ^Y , black ebony
Tree	<i>Diospyros foliosa</i>	(Rich ex A. Gray) Bakh.	achingal ^Y
Tree	<i>Diospyros sandwicensis</i>	(A. DC.) Fosberg	lama
Tree	<i>Drypetes yapensis</i>	Tuyama	
Tree	<i>Dysoxylum mollissimum</i>	Blume	
Tree	<i>Elaeocarpus carolinensis</i>	Koidz.	sadak ^P , nahnek ^K
Tree	<i>Elaeocarpus kusanoi</i>	Koidz.	opop ^P
Tree	<i>Eugenia carolinensis</i>	Koidz.	kehnpap ^P
Tree	<i>Eugenia malaccensis</i>	L.	arfath ^Y , fááriyap ^C , apel en ^P , acpul ^K
Tree	<i>Eugenia</i> spp.	L.	
Tree	<i>Eugenia stelechantha</i>	(Diels) Kaneh.	kirekinwel ^P , fukunes ^K
Tree	<i>Euphoria longana</i>	Lam.	longan
Tree	<i>Exorrhiza ponapensis</i>	(Becc.) Burret	kotop
Tree	<i>Fagraea berteriana</i>	A. Gray ex Benth.	
Tree	<i>Falcataria moluccana</i>	(Miq.) Barneby & Grimes	albizia ^Y , tuhke karisih ^P
Tree	<i>Ficus copiosa</i>	Steud.	plentiful fig
Tree	<i>Ficus prolixa</i>	G. Forst.	aw ^Y , aiau ^P , kohnyah ^K , fig
Tree	<i>Ficus</i> spp.	L.	fig
Tree	<i>Ficus tinctoria</i>	G. Forst	wachaguy ^Y , nihn ^P , srah ^K , fig
Tree	<i>Flacourtia jangomas</i>	(Lour.) Rausch.	Indian plum
Tree	<i>Garcinia ponapensis</i>	Lauterb.	kehnpwil ^P
Tree	<i>Garcinia rumiyo</i>	Kaneh.	rumiyo
Tree	<i>Gironniera celtidifolia</i>	Gaudich.	kehrmwut ^P
Tree	<i>Glochidion marianum</i>	Müll. Arg.	luwekindinloal ^P
Tree	<i>Glochidion ramiflorum</i>	J.R. Forst. & G. Forst.	ngumol ^Y , mwehk ^P
Tree	<i>Glochidion</i> spp.	J.R. Forst. & G. Forst.	
Tree	<i>Guettarda speciosa</i>	L.	blaw ^Y , mosor ^C , ihd ^P , kwehnlakh ^K
Tree	<i>Heritiera littoralis</i>	Dryand.	rung ^Y , zwobott ^C , marapwenseth ^P , lum ^K
Tree	<i>Hernandia sonora</i>	L.	gachal ^Y , pingiping ^P , pingping ^K , lantern tree
Tree	<i>Heterospatha elata</i>	Scheff.	buwog ^Y , para rubber ^P
Tree	<i>Hibiscus tiliaceus</i>	L.	gal ^Y , shrifa ^C , kalau ^P , lo ^K
Tree	<i>Horsfieldia nunu</i>	Kaneh.	nunu ^K
Tree	<i>Inocarpus fagifer</i>	(Parkinson) F.R. Fosberg	buoy ^Y , kurrat ^C , mwuopw ^P , kurak ^K
Tree	<i>Kleinhovia hospita</i>	L.	guest tree
Tree	<i>Leucaena leucocephala</i>	(Lam.) de Wit	ganitnityuan ^Y , dangandangan ^P , tangantangan ^K
Tree	<i>Lumnitzera littorea</i>	Voigt	yyi ^Y , aciuro ^C , wengal ^P , oi ^K
Tree	<i>Macaranga carolinensis</i>	Volkens	bith ^Y , aput ^C , apwid ^P , lo fwasrfwas ^K
Tree	<i>Macaranga</i> spp.	Thouars	macaranga
Tree	<i>Maesa carolinensis</i>	Mez	

Life form	Scientific name	Authority	Common name
Tree	<i>Mangifera indica</i>	L.	manga ^Y , kangit ^C , kangit ^P , macngko ^K , mango
Tree	<i>Maranthes corymbosa</i>	Blume	bkau
Tree	<i>Melaleuca quinquenervia</i>	(Cav.) S.F. Blake	paperbark tree
Tree	<i>Melochia</i> spp.	L.	melochia
Tree	<i>Melochia villosissima</i>	(C. Presl) Merr.	guwguw ^Y , kethoal ^P , ahlko ^K
Tree	<i>Melochia villosissima</i> var. <i>compacta</i>	(Hochr.) Fosberg	guwguw ^Y , kethoal ^P , ahlko ^K
Tree	<i>Meryta senffiana</i>	Volkens	
Tree	<i>Metroxylon amicarum</i>	(H.A. Wendl.) Becc.	oahs ^P , ivory kwoacnu ^K , Caroline ivory nutpalm
Tree	<i>Morinda citrifolia</i>	L.	mangeluag ^Y , arin ^C , weipwul ^P , ii ^K
Tree	<i>Myristica insularis</i>	Kaneh.	karara ^P , Caroline nutmeg
Tree	<i>Neisosperma oppositifolia</i>	(Lam.) Fosberg & Sachet	mow ^Y
Tree	<i>Neuburgia celebica</i>	(Koord.) Leenh.	ralm
Tree	<i>Nypa fruticans</i>	Wurmb	eang ^Y , pahrum ^P , fahsuc ^K , nipa palm
Tree	<i>Palaquium karrak</i>	Kaneh.	
Tree	<i>Pandanus cominsii</i>	Hemsl.	mwatal ^P
Tree	<i>Pandanus dilatatus</i>	Kaneh.	kienpel ^P
Tree	<i>Pandanus dubius</i>	Spreng.	bakong
Tree	<i>Pandanus jenkinsii</i>	Martelli	tha ^Y
Tree	<i>Pandanus tectorius</i>	Parkinson ex Zucc.	choi ^Y , mweng ^K
Tree	<i>Pandanus utilis</i>	Bory	Common screwpine
Tree	<i>Pangium edule</i>	Reinw.	rowal ^Y , false durian ^P , turian ^K , football fruit
Tree	<i>Parinari laurina</i>	A.Gray	adid ^Y , ais ^C , ais ^P , ahset ^K
Tree	<i>Pemphis acidula</i>	J.R. Forst. & G. Forst.	gangiy ^Y , ngih ^P , kwacngi ^K
Tree	<i>Pericopsis mooniana</i>	Thw.	
Tree	<i>Pipturus argenteus</i>	(G. Forst.) Wedd.	kehrari ^P
Tree	<i>Pisonia grandis</i>	R. Br.	adaburrungakiy ^Y , muk ^K
Tree	<i>Pittosporum</i> spp.	Banks ex Sol.	cheesewood
Tree	<i>Polyscias grandifolia</i>	Volkens	yabung ^Y
Tree	<i>Polyscias macgillivrayi</i>	(Benth.) Harms	MacGillivray's aralia
Tree	<i>Ponapea hosinoi</i>	Kaneh.	kattei ^P
Tree	<i>Ponapea ledermanniana</i>	Becc.	kedei ^P , kutacr ^K
Tree	<i>Pongamia pinnata</i>	(L.) Pierre	ngelak ^Y
Tree	<i>Pouteria obovata</i>	(R. Br.) Baehni	
Tree	<i>Premna obtusifolia</i>	R. Br.	arr ^Y , noir ^C , oahr ^P , fienkack ^K
Tree	<i>Premna serratifolia</i>	L.	arr ^Y , noir ^C , topwuk ^P , fienkack ^K
Tree	<i>Premna</i> spp.	L.	
Tree	<i>Psychotria carolinensis</i>	(Valeton) Fosberg	
Tree	<i>Pterocarpus indicus</i>	Willd.	lach ^Y , narra ^P , burmese rosewood ^K
Tree	<i>Rhizophora apiculata</i>	Blume	roway ^Y , akapah ^P , suhkasrik fwel ^K
Tree	<i>Rhizophora lamarckii</i>	Montrouz.	roway ^Y
Tree	<i>Rhizophora mucronata</i>	Lam.	roway ^Y , akelel ^P , sukasnik lolacp ^K
Tree	<i>Rhizophora</i> spp.	L.	mangrove
Tree	<i>Rhizophora stylosa</i>	Griff.	roway ^Y , small stilted mangrove

Life form	Scientific name	Authority	Common name
Tree	<i>Rhus taitensis</i>	Guill.	glad ^Y
Tree	<i>Rinorea carolinensis</i>	Kaneh.	
Tree	<i>Scaevola taccada</i>	(Gaertn.) Roxb.	noth ^Y , remek ^P , kusrohsr ^K
Tree	<i>Scyphiphora hydrophyllacea</i>	C.F. Gaertn.	guad ^Y
Tree	<i>Semecarpus venenosus</i>	Volkens	changath ^Y
Tree	<i>Sesbania grandiflora</i>	(L.) Poir.	bakphul ^P
Tree	<i>Sonneratia alba</i>	J.E. Sm.	abrur ^Y , saras ^C , koatoa ^P , fulohfohl ^K
Tree	<i>Soulamea amara</i>	Lam.	maraj ^P
Tree	<i>Spathodea campanulata</i>	P. Beauv.	African tuliptree
Tree	<i>Sterculia ponapensis</i>	Kaneh.	
Tree	<i>Swietenia macrophylla</i>	King	Honduras mahogany
Tree	<i>Swietenia mahagoni</i>	(L.) Jacq.	West Indian mahogany
Tree	<i>Swietenia</i> spp.	Jacq.	mahogany
Tree	<i>Syzygium carolinense</i>	(Koidz.) Hosok.	kehnpap ^P
Tree	<i>Syzygium malaccense</i>	(L.) Merr. & L.M. Perry	arfath ^Y , apel en ^P , acpul ^K
Tree	<i>Syzygium samarangense</i>	(Blume) Merr. & L.M. Perry	murop ^P , acpul tahpeng ^K
Tree	<i>Syzygium</i> spp.	P. Br. ex Gaertn.	
Tree	<i>Syzygium stelechanthum</i>	(Diels) Glassman	kirekinwel ^P , fukunes ^K
Tree	<i>Tarennia sambucina</i>	(G. Forst.) Durand	
Tree	<i>Terminalia carolinensis</i>	Kaneh.	kehma ^P , sahk ka ^K
Tree	<i>Terminalia catappa</i>	L.	kel ^Y , asas ^C , wahn dipwoapw ^P , srihfact ^K , tropical almond
Tree	<i>Terminalia samoensis</i>	Rech.	kil ^Y , ken ^P , srihfact samo ^K
Tree	<i>Thespesia populnea</i>	(L.) Sol. ex Corrêa	bungbeng ^Y , pone ^P , pahnuh ^K
Tree	<i>Timonius albus</i>	Volkens	gatemach ^Y
Tree	<i>Timonius ponapensis</i>	Valeton	kehn ^P
Tree	<i>Timonius</i> spp.	DC.	
Tree	<i>Tournefortia argentea</i>	L.f.	chen ^Y , amnoset ^C , titin ^P , sruhsruh ^K
Tree	<i>Trichospermum ikutai</i>	Kaneh.	wapof ^Y
Tree	<i>Trukia carolinensis</i>	(Valeton) Kaneh. & Hatus.	
Tree	<i>Xylocarpus granatum</i>	J. Koenig	yamgur ^Y , punopun ^C , brok ^P , tui ^K
Forb	<i>Achyranthes aspera</i>	L.	devil's horsewhip
Forb	<i>Acrostichum aureum</i>	L.	golden leatherfern
Forb	<i>Alocasia macrorrhizos</i>	(L.) G. Don	giant taro
Forb	<i>Alpinia purpurata</i>	(Vieill.) K. Schum.	red ginger
Forb	<i>Ananas comosus</i>	(L.) Merr.	pineapple
Forb	<i>Angiopteris evecta</i>	(J.R. Forst.) Hoffm.	Oriental vessel fern
Forb	<i>Arachniodes aristata</i>	(G. Forst.) Tindale	
Forb	<i>Asplenium laserpitiiifolium</i>	Lam.	Johnstone River fern
Forb	<i>Asplenium nidus</i>	L.	Hawai'i birdnest fern
Forb	<i>Asplenium pellucidum</i>	Lam.	
Forb	<i>Asplenium</i> spp.	L.	spleenwort
Forb	<i>Blechnum pyramidatum</i>	(Lam.) Urb.	Browne's blechnum
Forb	<i>Bolbitis heteroclita</i>	(C. Presl) Ching	

Life form	Scientific name	Authority	Common name
Forb	<i>Bolbitis</i> spp.	Schott	creepingfern
Forb	<i>Bulbophyllum</i> spp.	Thouars	bulbophyllum
Forb	<i>Caesalpinia bonduc</i>	(L.) Roxb.	yellow nicker
Forb	<i>Canavalia</i> spp.	Adans.	jackbean
Forb	<i>Cayratia trifolia</i>	(L.) Domin	threeleaf cayratia
Forb	<i>Chromolaena odorata</i>	(L.) R.M. King & H. Rob.	Jack in the bush
Forb	<i>Coccinia grandis</i>	(L.) Voigt	ivy gourd
Forb	<i>Colocasia esculenta</i>	(L.) Schott	coco yam
Forb	<i>Cordyline fruticosa</i>	(L.) A. Chev	tiplant
Forb	<i>Costus speciosus</i>	(J. Koenig) Sm.	canereed
Forb	<i>Crinum asiaticum</i>	L.	poisonbulb
Forb	<i>Curcuma australasica</i>	Hook. f.	
Forb	<i>Cyathula prostrata</i>	(L.) Blume	pastureweed
Forb	<i>Cyclosorus heterocarpus</i>	(Blume) Ching	maiden fern
Forb	<i>Cyrtosperma chamissonis</i>	(Schott) Merr.	swamp taro
Forb	<i>Cyrtosperma merkusii</i>	(Hassk.) Schott	gallan
Forb	<i>Davallia heterophylla</i>	Sm.	
Forb	<i>Davallia pectinata</i>	Sm.	haresfoot fern
Forb	<i>Davallia solida</i>	(J.R. Forst.) Sw.	
Forb	<i>Dendrobium</i> spp.	Sw.	dendrobium
Forb	<i>Derris elliptica</i>	(Wall.) Benth.	tubaroot
Forb	<i>Derris trifoliata</i>	Lour.	threeleaf derris
Forb	<i>Dicranopteris linearis</i>	(Burm.) Underw.	Old World forkedfern
Forb	<i>Dieffenbachia seguine</i>	(Jacq.) Schott	dumbcane
Forb	<i>Dioscorea bulbifera</i>	L.	air yam
Forb	<i>Dissotis rotundifolia</i>	(Sm.) Triana	pinklady
Forb	<i>Elaphoglossum aemulum</i>	(Kaulf.) Brack.	creeping tonguefern
Forb	<i>Epipremnum carolinense</i>	Volkens	Caroline tongavine
Forb	<i>Epipremnum pinnatum</i>	(L.) Engl.	centipede tongavine
Forb	<i>Freycinetia ponapensis</i>	Martelli	freycinetia
Forb	<i>Hedychium coronarium</i>	J. Koenig	white garland-lily
Forb	<i>Histiopteris incisa</i>	(Thunb.) J. Sm.	batwing fern
Forb	<i>Homalomena rubescens</i>	(Roxb.) Kunth	
Forb	<i>Humata banksia</i>	Alston	haresfoot fern
Forb	<i>Hymenophyllum</i> spp.	Sm.	filmy fern
Forb	<i>Hyptis capitata</i>	Jacq.	false ironwort
Forb	<i>Ipomoea indica</i>	(Burm. f.) Merr.	oceanblue morning-glory
Forb	<i>Lindsaea repens</i>	(Bory) Thwaites	creeping necklace fern
Forb	<i>Lindsaea</i> spp.	Dryand. ex Sm.	necklace fern
Forb	<i>Ludwigia hyssopifolia</i>	(G. Don) Exell	linear leaf primrose-willow
Forb	<i>Lycopodiella cernua</i>	(L.) Pic. Serm.	staghorn clubmoss
Forb	<i>Lygodium auriculatum</i>	(Willd.) Alston	
Forb	<i>Lygodium circinnatum</i>	(Burm. f.) Sw.	red finger fern
Forb	<i>Lygodium microphyllum</i>	(Cav.) R. Br.	small-leaf climbing fern

Life form	Scientific name	Authority	Common name
Forb	<i>Marattia mertensiana</i>	(C. Presl) C. Chr.	Micronesian ptisana
Forb	<i>Merremia peltata</i>	(L.) Merr.	woodrose
Forb	<i>Microsorium scolopendria</i>	(Burm. f.) Copeland	monarch fern
Forb	<i>Mikania micrantha</i>	Kunth	mile-a-minute
Forb	<i>Mimosa pudica</i>	L.	shameplant
Forb	<i>Momordica charantia</i>	L.	balsampear
Forb	<i>Mucuna</i> spp.	Adans.	mucuna
Forb	<i>Musa</i> spp.	L.	banana
Forb	<i>Nepenthes mirabilis</i>	Druce	
Forb	<i>Nephrolepis acutifolia</i>	(Desv.) Christ	
Forb	<i>Nephrolepis biserrata</i>	(Sw.) Schott	giant swordfern
Forb	<i>Nephrolepis hirsutula</i>	(J.R. Forst.) C. Presl	scaly swordfern
Forb	<i>Nephrolepis obliterated</i>	(R. Br.) J. Sm.	Australian swordfern
Forb	<i>Nephrolepis</i> spp.	Schott	swordfern
Forb	<i>Passiflora foetida</i>	L.	fetid passionflower
Forb	<i>Phymatosorus scolopendria</i>	(Burm. f.) Pic. Serm.	monarch fern
Forb	<i>Piper fragile</i>	Benth.	pepper
Forb	<i>Piper ponapense</i>	C. DC.	pepper
Forb	<i>Polypodium triseriale</i>	Sw.	anglevein fern
Forb	<i>Procris pedunculata</i>	(J.R. Forst.) Wedd.	
Forb	<i>Pteris plumula</i>	Desv.	striped brake
Forb	<i>Pteris tripartita</i>	Sw.	giant brake
Forb	<i>Selaginella</i> spp.	P. Beauv.	spikemoss
Forb	<i>Sida rhombifolia</i>	L.	Cuban jute
Forb	<i>Sphagneticola trilobata</i>	(L.) Pruski	Bay Biscayne creeping-oxeye
Forb	<i>Stachytarpheta urticifolia</i>	Sims	nettleleaf velvetberry
Forb	<i>Tacca leontopetaloides</i>	(L.) Kuntze	batflower
Forb	<i>Tectaria crenata</i>	Cav.	
Forb	<i>Tectaria grandifolia</i>	Copel.	
Forb	<i>Thelypteris unita</i>	(L.) Morton	
Forb	<i>Vigna marina</i>	(Burm. f.) Merr.	notched cowpea
Forb	<i>Wedelia biflora</i>	(L.) DC.	
Forb	<i>Wollastonia biflora</i>	(L.) DC.	sea daisy
Graminoid	<i>Bambusa longifolia</i>	(Fourn.) McClure	American long-leaved bamboo
Graminoid	<i>Bambusa</i> spp.	Schreb.	bamboo
Graminoid	<i>Bambusa vulgaris</i>	Schrad. ex J.C. Wendl.	common bamboo
Graminoid	<i>Centotheca lappacea</i>	(L.) Desv.	
Graminoid	<i>Chrysopogon aciculatus</i>	(Retz.) Trin.	golden false beardgrass
Graminoid	<i>Cyperus rotundus</i>	L.	nutgrass
Graminoid	<i>Cyrtococcum patens</i>	(L.) A. Camus	
Graminoid	<i>Hypolytrum nemorum</i>	(Vahl) Spreng.	woodland hypolytrum
Graminoid	<i>Ischaemum polystachyum</i>	J. Presl	
Graminoid	<i>Mapania sumatrana</i> ssp. <i>pandanophylla</i>	(F. Muell.) D.A. Simpson	pandanus-leaf sawsedge
Graminoid	<i>Oplismenus compositus</i>	(L.) P. Beauv.	running mountaingrass

Life form	Scientific name	Authority	Common name
Graminoid	<i>Opismenus hirtellus</i>	(L.) P. Beauv.	basketgrass
Graminoid	<i>Paspalum conjugatum</i>	P.J. Bergius	hilograss
Graminoid	<i>Phragmites karka</i>	(Retz.) Trin. ex Steud.	tall reed
Graminoid	<i>Saccharum</i> spp.	L.	sugarcane
Graminoid	<i>Schoenus calostachyus</i>	Poir.	bogrush
Graminoid	<i>Scleria lithosperma</i>	(L.) Sw.	Florida Keys nutrush
Graminoid	<i>Scleria</i> spp.	P.J. Bergius	nutrush
Shrub	<i>Abelmoschus moschatus</i>	Medik.	musk okra
Shrub	<i>Acalypha amentacea</i>	Roxb.	catch me if you can
Shrub	<i>Calliandra surinamensis</i>	Benth.	Surinamese stickpea
Shrub	<i>Callicarpa candicans</i>	(Burm. f.) Hochr.	
Shrub	<i>Chromolaena odorata</i>	(L.) R.M. King & H. Rob.	Jack in the bush
Shrub	<i>Clerodendrum quadriloculare</i>	(Blanco) Merr.	Philippine glorybower
Shrub	<i>Cordyline fruticosa</i>	(L.) A. Chev	tiplant
Shrub	<i>Cypholophus moluccanus</i>	(Blume) Miq.	Hawai'i lopleaf
Shrub	<i>Decaspermum fruticosum</i>	J.R. Forst.	
Shrub	<i>Derris elliptica</i>	(Wall.) Benth.	poisonvine
Shrub	<i>Derris trifoliata</i>	Lour.	threeleaf derris
Shrub	<i>Discocalyx ponapensis</i>	Mez	
Shrub	<i>Eugenia</i> spp.	L.	stopper
Shrub	<i>Eurya japonica</i> var. <i>nitida</i>	(Korth.) Dyer	
Shrub	<i>Flagellaria indica</i>	L.	
Shrub	<i>Freycinetia ponapensis</i>	Martelli	freycinetia
Shrub	<i>Hedyotis</i> spp.	L.	starviolet
Shrub	<i>Hibiscus rosa-sinensis</i>	L.	shoeblackplant
Shrub	<i>Hoya schneei</i>	Schltr.	
Shrub	<i>Hoya trukensis</i>	Hosok.	
Shrub	<i>Hypserpa polyandra</i>	Becc.	
Shrub	<i>Ixora casei</i>	Hance	everblooming ixora
Shrub	<i>Ixora chinensis</i>	sensu Stone p.p., non Lam.	
Shrub	<i>Ixora triantha</i>	Volkens	
Shrub	<i>Lantana camara</i>	L.	lantana
Shrub	<i>Leea sambucina</i>	Willd.	
Shrub	<i>Loeseneriella macrantha</i>	(Korth.) A.C. Sm.	
Shrub	<i>Ludwigia</i> spp.	L.	primrose-willow
Shrub	<i>Maesa carolinensis</i>	Mez	
Shrub	<i>Manihot esculenta</i>	Crantz	cassava
Shrub	<i>Melastoma malabathricum</i>	L.	Malabar melastome
Shrub	<i>Mimosa diplotricha</i>	C. Wright	giant false sensitive plant
Shrub	<i>Mucuna gigantea</i>	(Willd.) DC.	seabean
Shrub	<i>Mucuna platyphylla</i>	A. Gray	
Shrub	<i>Myrtella bennigseniana</i>	(Volkens) Diels	
Shrub	<i>Pachygone ledermannii</i>	Diels	Ledermann's pachygone
Shrub	<i>Piper methysticum</i>	G. Forst.	kava, sakau ^P

Life form	Scientific name	Authority	Common name
Shrub	<i>Piper ponapense</i>	C. DC.	pepper
Shrub	<i>Polyscias scutellaria</i>	(Burm. f.) Fosberg	shield aralia
Shrub	<i>Polyscias subcapitata</i>	Kaneh.	polyscias
Shrub	<i>Psychotria hombroniana</i>	(Baill.) Fosberg	wild coffee
Shrub	<i>Psychotria leptothyrsa</i>	Miq.	slendercluster wild coffee
Shrub	<i>Rubus moluccanus</i>	L.	eelkek
Shrub	<i>Ryssopterys abutilifolia</i>	A. Juss.	
Shrub	<i>Salacia chinensis</i>	L.	
Shrub	<i>Smythea lanceata</i>	(Tul.) Summerhayes	
Shrub	<i>Triphasia trifolia</i>	(Burm. f.) P. Wilson	limeberry
Shrub	<i>Vigna marina</i>	(Burm. f.) Merr.	notched cowpea
Shrub	<i>Wedelia biflora</i>	(L.) DC.	
Shrub	<i>Zehneria mucronata</i>	(Blume) Miq.	

^CChuuk, ^KKosrae, ^PPohnpei, ^YYap.

Note: Common names often differ between states. Footnotes refer to the state which uses the common name. Common names without footnotes have more widespread use and are provided if local common names are unavailable or if there is a well-known international common name, e.g., breadfruit.

Sources: Balick (2009) (Pohnpei); Falanruw (2015) (Yap, Chuuk, and sometimes Pohnpei); Lee et al. (2024) (Kosrae); Royal Botanic Gardens, Kew (2024); USDA (n.d.); USDA FS (2016).

Scientific Name Changes and Considerations

Tree species are listed here as they appear in the U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) field instructions (USDA FS 2016). One exception is *Bruguiera gymnorhiza*, which field crews recorded as *B. sexangula*, except for one tree. *Bruguiera sexangula* occurs across Southeast Asia and is invasive in Hawai'i. It is almost indistinguishable from *B. gymnorhiza*, which has a broader distribution from eastern Africa through Asia and across Micronesia (Allen and Duke 2006). Another exception is *Campnosperma brevipetiolatum*, which was recorded with the alternate spelling, *C. brevipetiolata*. *Parinari laurina* is a synonym of *Atuna racemosa*, *Eugenia malaccensis* is a synonym of *Syzygium malaccense*, *Eugenia javanica* Lam. is a synonym of *Syzygium samarangense*

(Falanruw 2015) and *Pouteria obovata* is a synonym of *Planchonella obovata* (R. Br.) Pierre (USDA, n.d.).

The FIA program does not have an official nontree species list and uses the USDA Plants database (USDA, n.d.) for nontree plant species names. Some species names have been revised since the fieldwork was completed in 2016. *Cyclosorus heterocarpus* is a synonym of *Thelypteris heterocarpa* (Blume) C.V. Morton; *Derris elliptica* is a synonym of *Paraderris elliptica* (Wall.) Adema; *Humata banksia* is a synonym of *Davallia pectinata*; *Leea sambucina* is a synonym of *Leea indica* (Burm. f.) Merr.; *Marattia mertensiana* is a synonym of *Ptisana mertensiana* (C. Presl) Murdock; *Microsorium scolopendria* is a synonym of *Phymatosorus scolopendria*; *Tectaria grandifolia* is a synonym of *Tectaria crenata*; and *Wedelia biflora* and *Wollastonia biflora* are synonyms of *Melanthera biflora* (L.) Willd.

APPENDIX 2

Sample Error/Other Error

We report sample error (SE) of the mean for every estimate in this report, and it is crucial for assessing reliability of the estimate. The smaller the SE value is compared to the estimate, the more reliable the estimate is.

The value of SE added to and subtracted from the estimate creates a range (low value to high value) of confidence in which the true value of the population is likely to occur. If we repeatedly sampled the population and constructed a confidence interval in such a way, the true value would be within these confidence intervals about 68 percent of repeats. Throughout this report, when addressing values, the term “significant” refers to this 68-percent confidence interval. A 95-percent confidence level interval can be created by multiplying the SE by two (and adding to and subtracting from the estimate). SE can be used to create intervals with any confidence level, as needed, using a statistical reference table (t table).

The U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis program follows a strict protocol to ensure the high quality of data collected, including quality assurance and control procedures for measurements, data entry, and processing. However, measurement errors; species misidentifications; and mistakes in data entry, processing, and analysis still occur, although the program makes considerable effort to minimize them. We presented data with the precision of one decimal point, which in some cases results in totals not summing to exactly 100 percent.

Glossary

biodiversity—Variety and variability among living organisms and the ecological complexes in which they occur. Biodiversity can include genetic, species, and ecosystem diversity, including the number of different items and their relative frequencies (Glowka et al. 1994).

biomass—The aboveground weight of wood and bark in live trees, that are ≥ 1 inch in diameter at breast height, from the ground to the tip of the tree, excluding all foliage. The weight of wood and bark in lateral limbs, secondary limbs, and twigs under 0.5 inch in diameter at the point of occurrence on sapling-size trees is included.

damage—Damage to trees caused by biotic agents such as insects, diseases, and animals or abiotic agents such as weather, fire, or mechanical equipment.

diameter at breast height (DBH)—The diameter of a tree stem, located 4.5 feet above the ground (“breast height”) on the uphill side of a tree. The point of diameter measurement may vary on abnormally formed trees (USDA FS 2016).

disturbance—Any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment (Helms 1998).

ecosystem—A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and components of the abiotic environment within its boundaries. An ecosystem can be of any size: a log, a pond, a field, a forest, or the Earth’s biosphere (Helms 1998).

endemic—Plant species that are unique to a defined geographical location, e.g., species only found in Micronesia.

forb—A broad-leaved herbaceous plant, as distinguished from grasses, shrubs, and trees (USDA FS 2016).

forest community—A classification of forest land based on the tree species that forms the plurality of live-tree cover that are not overtopped; delineated by the classification guide outlined in Mueller-Dombois and Fosberg (1998).

forest land—The U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis program defines forest land as an area currently or formerly (within 30 years) exhibiting at least 10 percent crown cover of trees of any size and which is not currently developed for nonforest use (USDA FS 2016). Forest land must occupy at least 1 acre and have a minimum continuous width of 120 feet.

grassland—Land on which the vegetation is dominated by grasses, grass-like plants, or forbs.

introduced (species)—Species that are nonnative or naturalized and are introduced by humans and have established or expanded their populations (Balick and Kitalong 2020).

invasive species—Species that are nonnative to the ecosystem under consideration and that cause or are likely to cause economic or environmental harm or harm to human, animal, or plant health.

live trees—All living trees, including all size classes, all tree classes, and both commercial and noncommercial species listed in the U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis field manual (USDA FS 2016).

mortality—The death of trees from natural causes or following incidents such as storms, wildfire, or insect and disease epidemics (Helms 1998).

native species—Plant species that were native to a region prior to Euro-American settlement.

pathogen—An organism or virus directly capable of causing disease or mortality.

sample error—Difference between a population value and a sample estimate that is attributable to the sample, as distinct from errors due to bias in estimation, errors in observation, etc. Sample error is measured as the standard error of the sample estimate (Helms 1998).

sapling—A live tree 1.0–4.9 inches in diameter at breast height (USDA FS 2016).

seedlings—Live trees <1 inch in diameter at breast height and ≥12 inches in height (USDA FS 2016).

shrub—Perennial, multistem woody plant, usually <16 feet in height, although under certain environmental conditions shrubs may be single-stem or >16 feet in height. Includes succulents (e.g., cacti) and woody vines.

stand-size class—A classification of stands based on tree size. Most trees in large-diameter stands are ≥11 inches in diameter at breast height (DBH). Most trees in medium-diameter stands are ≥5 inches in DBH but not as large as large-diameter trees. Most trees in small-diameter stands are <5 inches in DBH.

succession—The gradual supplanting of one community of plants by another (Helms 1998).

tree—The U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) program defines a tree as a woody perennial plant, usually with a single, well-defined stem supporting a crown of leaves, with a minimum diameter at breast height of 3 inches (7.6 cm) and a minimum height of 15 feet (4.6 m) at maturity. Tally trees are defined as all live and standing dead trees (i.e., snags) in accessible forest land or measurable nonforest land condition classes (USDA FS 2016). Any plant species on FIA's tree list in the current field manual is measured as a tree.

understory—Lowermost canopy layer, including shrubs, vines, and herbaceous vegetation such as forbs and graminoids.

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