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Technical Report 161

**Botanical survey of the War in the Pacific National Historical
Park Guam, Mariana Islands**

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ABSTRACT

This botanical inventory of War in the Pacific National Historical Park, located in the Territory of Guam, Mariana Islands, documents at least 90% of the plant taxa that occur within the seven units of the park (Asan Beach, Asan Inland, Fonte Plateau, Piti Guns, Agat, Mount Chachao-Mount Tenjo, and Mount Alifan). Documentation involved conducting field surveys, conducting literature searches for plants that occur in the park, vouchering plants and images, and populating the National Park Service Inventory and Monitoring biodiversity database (NPSpecies) to create a plant checklist for War in the Pacific National Historical Park. The project lead and assistant conducted the majority of fieldwork in the summer of 2004 and 2005. Surveys consisted of walk-throughs in all major vegetation types found in each of the units. Field surveys totaled 27 field days (224 person hours). In summary, 392 plant taxa were identified in the seven park units. Forty-four percent (173) of the plants are native to Guam and the Mariana Islands. Of the total plant taxa, four percent (15) are endemic and 40% (158) are indigenous to the Mariana Islands. Uncommon endemic plants observed during the survey included *Cerbera dilitata*, *Maytenus thompsonii*, *Macaranga thompsonii*, *Phyllanthus saffordii*, *Xylosma nelsonii*, *Tinospora homosepala*, and *Hedyotis laciniata*. One species, *Guamia mariannae*, is endemic to Guam and locally common in one unit. This report discusses areas of high native plant diversity observed in the park as well as resource management recommendations. During the course of this project, 755 plant specimens were collected as vouchers to create War in the Pacific National Historical Park's herbarium. In addition, 673 digital images were vouchered, 277 landscape images were archived, and 2,255 new records were added to NPSpecies.

INTRODUCTION

War in the Pacific National Historical Park (WAPA) is one of eleven national parks in the Pacific Island Network (PACN) of the National Park Service (NPS) Inventory and Monitoring (I&M) Program (Figure 1). In the summer of 2003, members of the PACN Vegetation Working Group established botanical inventory priorities for all PACN parks. Among the highest priorities was the need for a botanical survey of WAPA because a complete plant list did not exist for the park, as it does for all other parks within the network. Much of the work in recent years has focused on WAPA's marine resources that comprise over half of the acreage of the park. To provide a more complete understanding of WAPA's biological resources, a terrestrial botanical survey was needed.

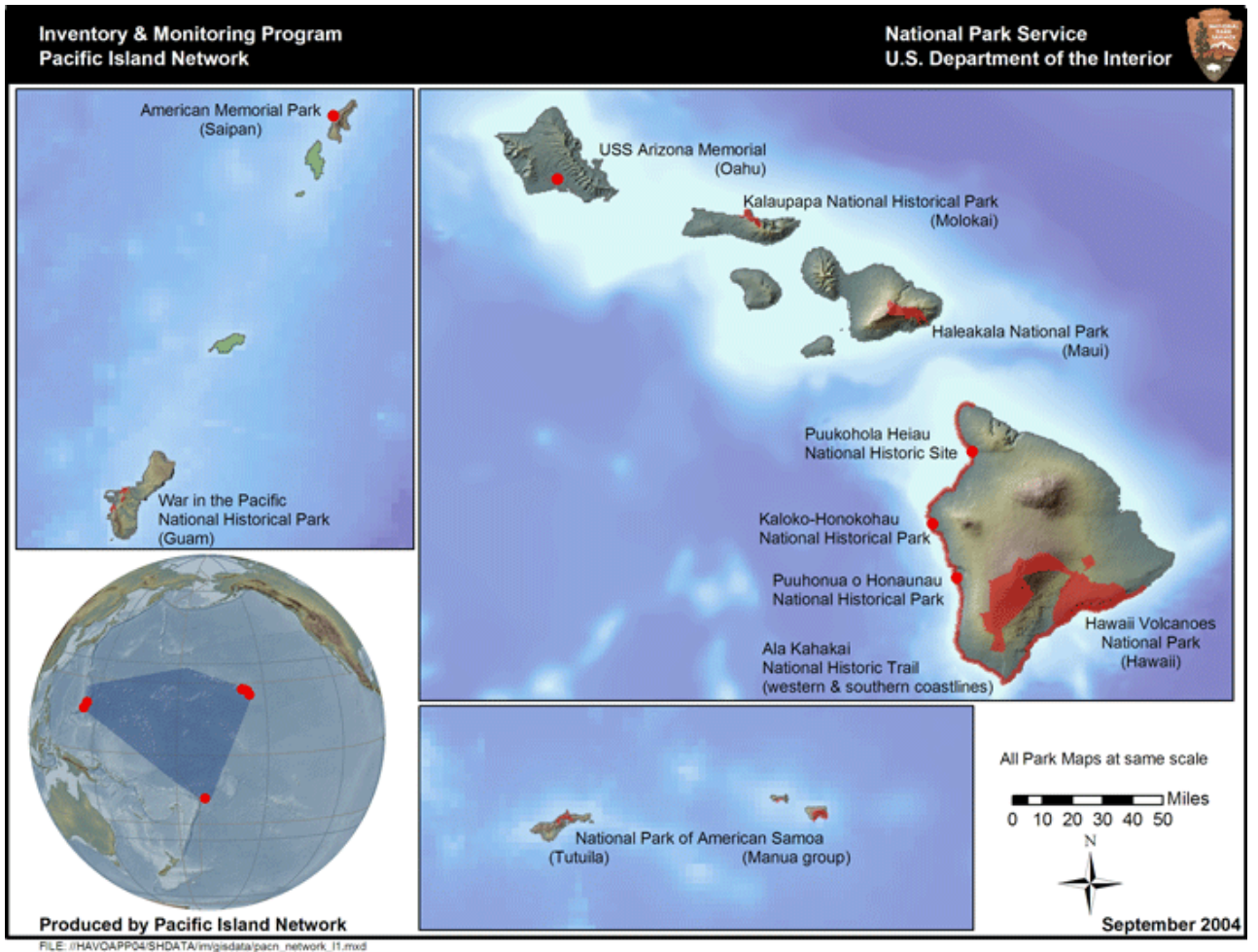


Figure 1. Map of the Pacific Island Network.

War in the Pacific National Historical Park is comprised of seven management units: Asan Beach, Asan Inland, Fonte Plateau, Piti Guns, Agat, Mount Chachao-Mount Tenjo, and Mount Alifan (Figure 2). These units total 780 hectares (ha) (1,928 acres [ac]) in area, of which 405 ha (1,002 ac) are represented by marine systems while the remaining 375 ha (926 ac) are terrestrial (National Park Service 2005).

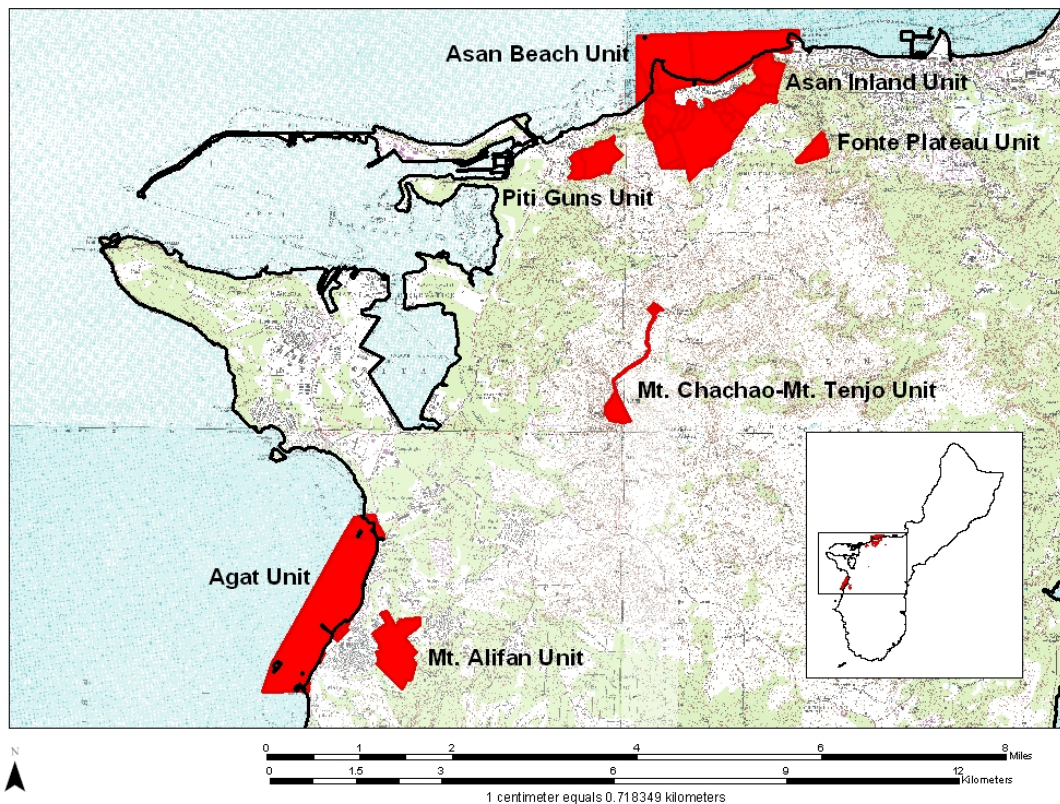


Figure 2. Map of the seven units of War in the Pacific National Historical Park, Guam.

The terrestrial vegetation of Guam can be classified into six basic habitat types: limestone forest, ravine communities, beach strand, savanna complex, marshlands, and swamplands (Department of the Interior 1983; Mueller-Dombois and Fosberg 1998). One or more of these representative community types is found in each of the seven management units of WAPA and are described in greater depth below.

The primary goal of this project is to inventory and empirically document at least 90% of the vascular plants that occur in WAPA and present the information in a plant checklist. The findings of the inventory, short vegetation descriptions characterizing major habitat types encountered, management recommendations, and suggested areas of focus for future surveys, are presented in this report. This report is only one piece of a suite of products provided to the NPS I&M Program as part of this project. Other products include a museum-quality plant collection, Automated National Catalog System Plus (ANCS+) data that provide detail for the plant collection, a voucher image collection, NPSpecies records, and geographic information system (GIS) maps with associated metadata documenting locations of plant occurrences and survey routes.

METHODS

This section describes the methodology implemented for field surveys, image and specimen voucher collections, and data management and analysis. A description of the study sites is also provided. Jenny Drake (NPS biological technician at WAPA) and I (report author, botanist), identified as “we” in those sections describing the work, completed the field surveys and voucher collections. I led the data management and data analysis part of the project, which included the plant observations, voucher database, and literature and herbarium reviews, and writing the report. Jenny Drake led the archival preparation of the plant specimens.

Field Surveys

We conducted field surveys of the seven units of WAPA from June 15 through July 12, 2004 and from June 18 through July 20, 2005. Prior to the field survey, we discussed possible survey routes and estimated the number of field days for each park unit based on recommendations by Linda Pratt (botanist, U.S. Geological Survey, Biological Resources Discipline (USGS/BRD), Hawaii Volcanoes National Park) and others who have experience conducting plant surveys on Guam. We considered the size of the unit, terrain, and what could be reasonably accomplished in a field day given Guam’s hot and humid environment. We estimated the survey would take at least 14 days for two people.

Survey methods included a combination of walk-throughs and directed area searches. To develop a species list for the park, we walked through a designated area and surveyed the vegetation that was typical of the area (e.g., large areas of savanna or limestone forest). Directed area searches were conducted in a subset of those areas (i.e., unique natural communities) that were likely to house unique species (e.g., riparian areas or wetlands, riverine systems, disturbed sites).

Walk-throughs and directed area searches involved walking slowly through the area and recording any plant species within 10 meters (m) (33 feet [ft]) and in view of the observer. This essentially created a 20 m (66 ft)-wide sampling belt. Survey routes were mapped and recorded using a compass, 1:24,000 U.S. Geological Survey quad maps (Agat, Hagatna, Apra), digital orthophoto quadrangles, an altimeter (Suunto Thommen, Model TX-16), and visual placement. A geographic positioning system (GPS) was not available for use in the field. A GPS unit would have been of limited use, as much of the survey work was conducted in heavy rain or heavy vegetation cover. Maps of the survey routes are provided in the Results section.

Throughout the survey two distinct types of soils were encountered and are mentioned in this report: a rich brown soil of volcanic origin and a reddish clay soil. While non-technical terms are used to describe these soils, Young’s *Soil Survey of Territory of Guam* (1988) was consulted to verify the types.

Vouchers

To provide empirical documentation of a particular taxon in WAPA, we attempted to make at least one voucher (specimen or image) of each taxon observed within the park, regardless of the unit. We gave the highest priority to specimens (i.e., preferred voucher), second priority to image vouchers, and third priority to observations. If a specimen was difficult to obtain, we took a picture of the plant to create image vouchers. If obtaining image vouchers was not possible, observations were the only source of documentation.

While in the field at WAPA, we collected plant specimens, pressed them in standard plant presses, and dried them in plant driers at the University of Guam Science Building. Dr. Lynn Raulerson and/or I identified the plants. I then labeled the specimens with the taxon and an assigned collection ID number. The pressed, dried plants were stored at the University of Guam herbarium in 2004 and mounted the following year (2005). Plants were mounted on acid-free, 100% rag University of California-style mounting paper. Herbarium labels were printed from a Canon inkjet printer on acid-free, 100% cotton rag paper.

Dr. Lynn Raulerson and I completed the majority of plant identifications. Other botanists familiar with the vegetation of Guam such as Linda Pratt (USGS/BRD), Derral Herbst and Clyde Imada (Bishop Museum, Oahu) were consulted for the identification of unknown taxa. Dr. Lynn Raulerson reviewed all of the plant identifications and completed a review of the species.

Jenny Drake and I took digital photographs for plants that were difficult to collect (e.g., inaccessible plants or trees with branches too high to reach), for plants that were unknown to the surveyors, or to supplement the collections. When appropriate, we took landscape photos for eventual use by the NPS WAPA and PACN offices. Photographs were taken using an Olympus Stylus 400 digital camera.

Data Management

Plant Observations and Voucher Database

The following data were entered in an Excel spreadsheet for all vouchers and observations: family, genus, species, species author, variety or subspecies, variety or subspecies author, common name, repository, park code, park unit, date collected or observed, time (if applicable), collector or observer name(s), voucher type (e.g., specimen, image, observation), collection number or image file name (if applicable), habitat, frequency, plant description, locality, local location code (if applicable), elevation, elevation units, comments, record creator, and date the record was created. Integrated Taxonomic Information System (ITIS)-identified taxonomic serial numbers (TSN), standard scientific name, and synonyms were provided if available (www.itis.gov).

To determine the most current taxonomic name to be used in the plant observation and voucher database, I referenced several literature sources, including Guam, Hawaii, and Pacific Island floras. The most recent floral treatment of Guam's vascular plants was by

Benjamin Stone in 1970. Micronesian dicotyledonae, monocotyledonae, and pteridophyte checklists were created by F. R. Fosberg and others in 1979, 1982, and 1986. Because there is no current, definitive treatment of Guam's flora, I used the most recently published references from Hawaii. These include the *Manual of the Flowering Plants of Hawaii* (Wagner et al. 1999), including the supplement to the Manual (Wagner and Herbst 2003) for naturalized flowering plants; Palmer's *Hawaii's Ferns and Fern Allies* (2003) for ferns; and Staples and Herbst's *A Tropical Garden Flora* (2005) for ornamentals. If a plant taxon was not recognized in these references, Fosberg's Micronesian checklists (see above) were referenced and if not recognized there, the most recent name in Stone's *The Flora of Guam* (1970) was used. Dr. Lynn Raulerson provided guidance for scientific names that are locally recognized on Guam (e.g., taxa recognized by experts in Guam but not by others and vice versa); these are presented in the checklist (Appendix). Synonyms were also included in the checklist for commonly used alternate names or recent taxonomic name changes. Common names were derived from Stone's *The Flora of Guam*, Raulerson and Rinehart's *Trees and Shrubs of the Northern Mariana Islands* (1991) and *Ferns and Orchids of the Mariana Islands* (1992), and those identified in ITIS. I did not consult the ITIS list alone because I found it to be outdated, using both current and old names.

To complete the required fields for NPSpecies, the park status, abundance, cultivation, weediness, management priority, and exploitation concern fields were populated for each taxon. Nativity using NPSpecies definitions (i.e., nativity related to the park) was included as well. These definitions are provided at the end of the Appendix. If the plant was native, the taxon was identified as endemic or indigenous to the Mariana Islands and indicated in the Nativity Details field.

The voucher and observation information from the Excel spreadsheet was later transferred to a MS Access database and merged into NPSpecies, which will be available to the public. The information was also prepared for download into ANCS+, the NPS's cultural resources database. The voucher information was incorporated into ANCS+ by the cultural resources office in September 2005 and is now part of the NPS's permanent voucher collection.

After digital photos were taken, the image files were renamed using PACN I&M conventions that include a six-letter species code, park unit code, and date the photo was taken. The naming convention is documented in a MS Word file that accompanies the voucher database. Descriptions of the landscape photos are provided in an Excel spreadsheet. The images and accompanying documentation are archived in PACN's ThumbsPlus image database, which is available through the PACN I&M office.

Literature and Herbarium Reviews

I conducted literature and herbarium reviews at the Bishop Museum herbarium in June 2004 and July 2005 and at the University of Guam (UOG) herbarium in June and July 2005. Information about plants previously collected from WAPA and/or references of plants known from within the park boundaries were added to the plant observation and voucher database from which I derived the WAPA plant checklist.

I obtained a copy of the UOG herbarium database from Dr. Lynn Raulerson that contains label information for all specimens in the collection. To be able to query the database, the I&M Data Manager and I exported the 100 separate Filemaker Pro files in the database to text files and combined all files in MS Access 2003. I queried the locality field of the herbarium database's 44,297 records for place names that occur in WAPA. The place names list was generated from Geonames at the USGS website: <http://geonames.usgs.gov>. I reviewed the location information from each of the extracted records to determine whether the specimen was indeed collected from within WAPA boundaries. If the specimen was collected from near or in the park, I tagged the record as present in the park, probably present, unconfirmed, encroaching, historic, false report, or not applicable (per NPSpecies definitions, provided in the Appendix), and I indicated the unit in which it was observed or was encroaching. In addition the 185 new records were entered in the database created for this inventory from which the WAPA plant checklist (Appendix) was generated. If specimen information existed in the UOG database for taxa that were observed in the park previously, but not during our survey, that record was added to the inventory database. All park unit occurrences and abundances of these taxa are indicated in the checklist with an asterisk.

Description of Study Sites

This section briefly describes the seven units of WAPA. The results section provides maps of each unit.

Asan Beach Unit

This unit includes 44 ha (109 ac) of land and 180 ha (445 ac) of marine area. The terrestrial portion of the unit is located along the ocean side of Marine Corps Drive (Route 1, formerly Marine Drive) between Asan Point and Adelup Point. Asan Memorial Beach, which lies within the boundaries of the park, comprises the majority of the terrestrial part of the unit and is accessible to the public during business hours. Houses and other structures occupy inholdings along this strand. A three to nine meter (10 to 30 ft)-wide white sand beach fronts the shoreline. Extending from the inland unit across Marine Corps Drive at Asan Point, is a limestone ridge with a trail that affords visitors a 180-degree view of Asan. The park boundary extends toward the ocean, behind the governmental buildings at Adelup Point. The Matgue River follows the western (Piti) edge of the Asan Inland unit and enters the ocean along the western boundary of the Asan Beach unit. The Asan River enters the ocean in the middle of Asan Bay.

Asan Inland Unit

This 240 ha (593 ac) unit encompasses the largest land area in WAPA. It is located between Asan Village near sea level and Nimitz Hill at about 150 m (500 ft) in elevation. This unit is accessible from multiple sites as Route 8 and Route 1 bound it. The Asan and Matgue (or Nidual) rivers lie almost entirely within the Asan units. The central portion of the unit is comprised of primarily non-native-dominated savanna altered from a long history of human-set fires that still occur today. Access to the savanna is made via the eastern branch of Asan River, Asan Overlook, and at the end of residential roads in the

village of Asan. The stream east of the village of Bacuna (west of Chorrito Cliff) and lower reaches of Asan River can be used to access the limestone forests located in the eastern portion of the unit.

Fonte Plateau Unit

This relatively small unit (15 ha [38 ac]) is located along Route 8 (Nimitz Hill Road) between 140 and 195 m (460 and 640 ft) in elevation and contains a stone quarry. A U-shaped cave that was once the site of the Japanese Command Post in World War II is located next to the parking area off Route 8. The quarry is accessed via the parking area. Although a steep descent is required where a road once lay, access to the base of the quarry is fairly level albeit thick with vegetation. Access to the east side of the unit is along Route 8, at a vehicle pull-off spot (parking area) downslope from the limestone peak.

Piti Guns Unit

This 40 ha (98 ac) unit is located above the village of Piti and encompasses much of the upper reaches of Taguag River to the east, from about 12 to 104 m (40 to 340 ft) in elevation. This unit features three guns the Japanese planned to use during World War II. However, these guns were never fired and remain a popular tourist attraction in the park. One of the now-defunct Guam Experimental Station sites was once located within this unit. Access to the paved road that dissects the unit, under the power lines (from Piti Power Plant), is via a trail upslope from the third and last gun. This road provides access to the savanna areas in the eastern portion of the unit.

Mount Chachao-Mount Tenjo Unit

This 18 ha (45 ac) unit is located along a narrow strip of land on the top of a ridge between Mount Chachao and Mount Tenjo. The unit itself ranges in elevation from 268 m (880 ft) at the lowest point to 318 m (1,042 ft) at the top of Mount Chachao and runs along the summit jeep road and trail. Access to the larger bowl-shaped area downslope (and directly east) from Mount Tenjo is made via this trail. The areas along the western edge of the bowl are accessed by way of a makeshift trail along the ridgeline. This region afforded Japanese forces a vantage point of Agat and Apra Harbor during World War II.

Agat Unit

The Agat unit comprises 225 ha (557 ac) of marine and 15 ha (37 ac) of land area. Three separate subunits that lie on the ocean side of Route 2 (Apaca Point, Gaan Point, and Bangi Point) comprise the terrestrial portion of this unit and occupy relatively few acres compared to its offshore parts. All three non-contiguous terrestrial subunits are located along approximately two kilometers (1.2 mi) of shoreline in Agat. The Apaca Point subunit is located immediately north of the mouth of Namo River from sea level to three meters (10 ft) in elevation. This subunit also includes the Pelagi Islets, which have a substrate of Alifan Limestone, a highly permeable, poorly consolidated detrital limestone and conglomeritic clay marl (Gingerich 2003; L. Raulerson, personal communication, October 20, 2005). Gaan Point subunit includes a large lawn area located at the mouth of Salinas River and on the ocean side of Agat from sea level to less than three meters (10

ft) in elevation. It also includes a jetty that extends approximately 60 m (200 ft) out to sea. The Bangi Point subunit is located along the shore and is adjacent to Inaso Maso Village, the Gaan River to the north, and private inholdings to the south. The elevation here is low, rising just a few feet above sea level. This area includes the mouth of Auau Creek as well as the islets of Alutom, Yona, and Bangi. These islets are comprised of Mariana Limestone, a reef and lagoonal limestone with a wide variety of rock compositions (Gingerich 2003; L. Raulerson, personal communication, October 20, 2005).

Mount Alifan Unit

This 64 ha (158 ac) unit is located above the village of Agat and adjacent to and west of Santa Rita. Lying on the western slopes of Mount Alifan, the unit rises from 10 to 200 m (30 to 650 ft) in elevation. Its prominent limestone peak, at 265 m (871 ft) in elevation, is located 0.2 km (0.1 mi) east of the unit's easternmost boundary, which abuts a United States Naval Magazine. This unit encompasses the headwaters of Togcha River, including its many tributaries. The area was historically a major battlefield during World War II, and remnants of foxholes, pillboxes, and other important foundations remain. Access to the unit is via roads in the villages of Santa Rita and Agat. The eastern boundary of the unit is accessible from the southeasternmost extent of Santa Rita Village, at the end of Obispo Olaiz Road by the green water tank. The unit can also be reached via a side street off Chalan Pale Duenas Haya Road that accesses the mayor's office. This side street dead-ends at the park boundary. The western areas of the unit are accessible from the residential area (North Comm. Charfauros Court Road) in Agat.

RESULTS

A total of 755 plant specimens from WAPA were collected for this project (NPS Accession number WAPA-00268; Catalog numbers WAPA 2913 through 3667). All but seven plants vouchered during the survey were identified to the species level. Six of these were identified to the generic level and one remains unidentified. All of the specimens are stored at the T. Stell Newman Visitor Center in Sumay, Guam. We took 673 image vouchers and 277 landscape photos during the course of this project.

Summary of Plant Taxa at WAPA

A total of 392 distinct plant taxa is recorded from WAPA. Of the 392 taxa, six taxa are identified only to the generic level and three remain unidentified. The total represents two fern allies, 38 ferns, one gymnosperm, 228 dicots, and 123 monocots. The Appendix presents the complete checklist for WAPA vascular plants. This checklist also indicates the units in which each taxon was found. The survey results and herbarium reviews revealed that, in addition to the 392 taxa present in WAPA, four are probably present, 10 are encroaching, and one is unconfirmed. All of these 407 taxa are presented in the checklist.

Of the 392 plant taxa that are confirmed from WAPA, Jenny Drake and I found 95% (371) during this survey and gleaned the remaining five percent (21) from previously

collected specimens housed at the UOG herbarium. Almost half (10) of the 21 species were from the islets off the Agat unit in the Apaca and Bangi subunits, which we did not survey. Of the remaining 11 taxa, six were found in Asan Inland unit, three in Asan Beach unit, one in Mount Chachao-Mount Tenjo unit, and one in Piti Guns unit. The 15 taxa that were probably present (four), encroaching (10), or unconfirmed (one) were derived from the UOG herbarium database and added to the checklist. All taxa derived from the UOG database are indicated in the Appendix with an asterisk. I did not glean any new species from literature reviews to add to the list. Jenny Drake and I did not find any species that were not already known from Guam during our surveys.

Of the 392 vascular plant taxa known from WAPA, 173 (44%) are native, 210 (54%) are non-native, and nine (two percent) are unidentified. Of those that are native, 15 (four percent of all taxa) are endemic, which means that they are unique to the Mariana Islands. These plants are indicated with an “E” in the nativity column of the checklist (Appendix). A larger number of the natives (158 [40% of all taxa]) are indigenous, meaning they occur naturally in the Mariana Islands as well as other parts of the world. These plants are indicated with an “I” in the checklist. The non-native plants (indicated with an “N” in the nativity column) were classified as “cultivated,” “persistent,” “not cultivated” (i.e., naturalized), or “unknown” per NPSpecies definitions. The number of taxa in each of these categories is summarized in Table 1. The percent nativity by unit is provided in the Description of Vegetation section below.

The checklist reflects the most current nomenclature based on available references. Some commonly used synonyms are also provided within the checklist.

Table 1. Summary of nativity of plant taxa at War in the Pacific National Historical Park, Guam.

Native		Non-Native		Unidentified	
173 Total	15 Endemic	210 Total	144 Naturalized	9 Total	3 Unidentified, genus & species unknown
			66 Not naturalized		
	19 Currently cultivated		6 Unidentified, species unknown		
	54 Persistent from cultivation				
158 Indigenous	132 Not cultivated				
	6 Unknown				

Field Surveys

A total of 27 survey days were conducted, totaling 224 person hours. Surveyors recorded the date, the unit(s) surveyed, and a general description of the survey area. Each of the survey routes is illustrated in the unit maps following the Description of Vegetation at WAPA section. Factors that influenced the survey efforts are described in detail below.

Challenges to Field Work

Inclement weather

In the five weeks on Guam in June–July 2004, several unanticipated challenges affected the field work. Among the most severe was inclement weather that involved heavy rains, widespread flooding, high seas, and lightning storms which caused electrical power outages. During the field schedule, two tropical storms passed near Guam. One of these, Tropical Storm Tinting, turned into a typhoon as it passed Guam and devastated the Mariana Islands to the north. This storm resulted in the loss of dozens of homes and the deaths of seven people. The high storm winds and heavy downpours damaged and destroyed many plants, including the devastation of flowers, fruits, and leaves necessary for plant identification. Although efforts were made to collect adequate plant material for identification, a small proportion of the vouchers gathered after the storm lacked floral parts. Subsequent collections of fertile specimens in 2005 served to enhance our 2004 efforts. Fieldwork was affected for three days because of flooding that prevented access to park units and resulted in national park closures. The rainy season in Guam typically begins in July or August. However, Guam experienced severe, record-breaking rains in June during the survey period (National Oceanic and Atmospheric Administration 2004), thus most of our field surveys were conducted in the rain. Lightning storms did not affect field dates, but power outages affected our ability to work on the computer and enter data for two days.

Plants and animals

Sword grass (*Miscanthus floridulus*) is a dominant plant in the savannas found in four of the units (Asan Inland, Mount Chachao-Mount Tenjo, Mount Alifan, and Piti Guns). True to its name, it cuts flesh easily, which required surveyors to wear gloves and long-sleeved shirts. Although sword grass did not affect overall field effort, it did hamper access to riparian areas where it grows in dense thickets. Stinging insects found in savanna areas such as wasps (locally called “boonie bees”) can deliver multiple, significant stings that can result in severe allergic reactions, as the surveyors discovered. However, this did not affect total field hours. Brown tree snakes (*Boiga irregularis*), which occur in dense numbers on Guam, were not encountered during the field surveys because these snakes are primarily nocturnal.

Heat and humidity

The heat and humidity experienced on Guam had a substantial effect on field hours. On sunny days without cloud cover, field work was limited to half-days or strenuous and challenging full days. During rainy weather, field days extended into the late afternoon.

Unexploded ordnance

We observed an unexploded ordnance at 165 m (540 ft) elevation in the limestone forest of Mount Alifan on July 8, 2004. It was later determined by Naval Explosive Ordnance Detachment to be an especially volatile ordnance, sensitive to vibrations such as footsteps (J. Drake, personal communication, August 10, 2004).

Description of Vegetation at WAPA

This section describes the vegetation communities observed in each of the seven WAPA units. I used broad habitat categories (limestone forest, ravine communities, beach strand, savanna complex) to describe the vegetation communities of each unit. In some cases, very disturbed habitats were encountered in the park. In these cases, I defined the habitat in descriptive terms, such as disturbed limestone forest or maintained lawn. Ravine communities comprised both ravine forests and riverine communities and are described as such in this report.

All park units of WAPA were easily accessible to surveyors by rental vehicle and usually only entailed a short walk to the boundary of the unit. On the maps, survey routes are indicated in blue and park boundaries are outlined in red. For some units, the park boundary is indicated by multiple red-lined polygons that comprise the entire unit. These polygons reflect different land ownership categories such as federal, private, etc. We completed each survey session in one field day, varying in length from three to 10 hours. Recommendations, including suggested areas for future surveys, follow in the Discussion section.

Based on the total number of plant taxa observed during the survey and taxa that were gleaned from literature and herbarium reviews, I determined the total number of species reported in each unit and calculated the percent nativity by unit. This information is summarized in Table 2, and I elaborate on these data in the vegetation descriptions below.

Table 2. Summary of nativity by unit in War in the Pacific National Historical Park, Guam.

WAPA Unit	Native	Endemic	Indigenous	Non-Native	Naturalized	Not Naturalized	Unknown	Total # SPP by unit	% Nativity by unit
Asan Beach	54	4	50	83	69	14	1	138	39%
Asan Inland	97	7	90	96	68	28	1	194	50%
Fonte Plateau	48	7	41	81	66	15	2	131	37%
Piti Guns	50	4	46	94	73	21	2	146	34%
Mount Chachao-Mount Tenjo	66	6	60	50	49	1	1	117	56%
Agat – Apaca Point subunit	35	0	35	54	49	5	0	89	39%
Agat – Gaan Point subunit	26	0	26	70	59	11	0	96	27%
Agat – Bangi Point subunit	35	1	34	46	33	13	0	81	43%
Agat (All subunits)	56	1	55	102	78	24	0	158	35%
Mount Alifan	83	7	76	71	54	17	2	156	53%

Asan Beach Unit (44 ha [109 ac])

We spent three field days (22 person hours) in the Asan Beach unit (Figure 3). Results from this survey and literature and herbarium reviews show a total of 138 plant taxa in this unit. Of these, 54 are native, representing 39% nativity within the unit. The vegetation of the terrestrial portion of this unit is regularly-mowed lawn and beach strand.

Beach strand

Plants typically found on the beach strand at Asan Beach (Figure 4) and elsewhere included native *Ipomoea pes-caprae*, *Fimbristylis cymosa*, and *Canavalia rosea*, non-native *Macrottilium atropurpureum*, planted and naturalized *Cocos nucifera*, and a variety of non-native and indigenous grasses such as *Sporobolus virginicus*, *Thuarea involuta*, and *Cynodon dactylon*. Interestingly, indigenous *Sporobolus farinosus* was also discovered along the wind-swept shores of Asan Point, which is the first occurrence of this species on the western side of the island (L. Raulerson, personal communication, July 20, 2005).

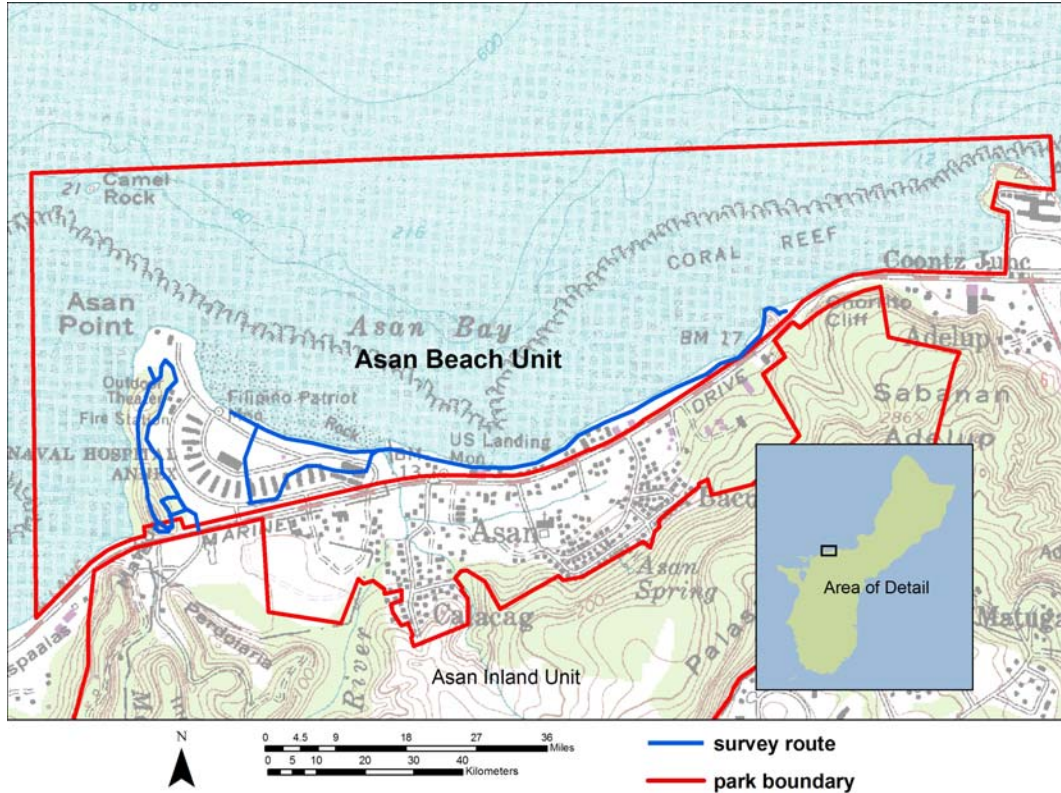


Figure 3. Map of field survey routes in the Asan Beach unit, War in the Pacific National Historical Park, Guam.



Figure 4. Beach strand habitat. Asan Beach unit, War in the Pacific National Historical Park, Guam.

Disturbed limestone forest

On the Piti side (western) of the Asan Beach unit, rises a limestone ridge that is an extension of an inland ridge. This ridge extends toward the coast (Figure 5). While much of the strand vegetation consists of non-native or indigenous species commonly found along the coast, the vegetation on the limestone ridge was interestingly variable. Along the base of the ridge, *Artocarpus altilis* and *Leucaena leucocephala* are common. The large *Artocarpus altilis* trees provide significant shade under which *Triphasia trifolia*, *Pouteria obovata*, and a number of native trees survive. The shaded site also houses a variety of native epiphytic and groundcover ferns (*Phymatosorus grossus*, *Nephrolepis* spp., etc). On the upper slopes of this ridge and along the trail to its peak, *Colubrina asiatica*, *Pandanus tectorius*, *Leucaena leucocephala*, and tangles of the vines *Flagellaria indica*, *Ipomoea indica*, and *Tinospora homosepala* are commonly seen. *Tinospora homosepala* is a rare vine in the Menispermaceae family found in two sites on Guam other than this limestone ridge. Dr. Lynn Raulerson reports that the plants on Guam are all male and has suggested that the species may be the same as a Philippine species and therefore invalid (L. Raulerson, personal communication, July 16, 2005). Further research is needed to determine its validity. *Tinospora homosepala* is currently considered a Species of Concern by the U.S. Fish and Wildlife Service. Less common native trees or shrubs on this ridge are *Intsia bijuga*, *Eugenia palumbis*, *Clerodendrum inerme*, *Callicarpa candicans*, *Psydrax odorata*, the orchid *Geodorum densiflorum*, and the epiphytic tapeworm-like orchid *Taeniophyllum marianense* found on the southern aspect of a *Pandanus tectorius* tree. Much of the exposed sides and lower elevation parts of the ridge have been highly modified and include large areas of non-native trees, shrubs, herbs, and vines such as *Leucaena leucocephala*, *Momordica charantia*, *Euphorbia heterophylla*, and *Bidens alba*.



Figure 5. Atop the limestone ridge. Asan Beach unit, War in the Pacific National Historical Park, Guam.

Maintained lawn

The Asan Memorial Park at Asan Point is a popular destination for tourists and locals alike. The majority of the terrestrial part of the unit is comprised of lawn and two large parking areas (Figure 6). The National Park Service maintains the lawn and mows it frequently. As such, the lawn is home to a variety of common lawn grasses and weed species such as *Cynodon dactylon*, *Digitaria* spp., *Sporobolus* spp., *Stenotaphrum* sp., *Sphagneticola trilobata*, *Tridax procumbens*, *Alysicarpus vaginalis*, and *Desmodium triflorum*. Ornamental shrubs and trees located in the lawn surrounding the Asan Memorial are actively maintained by the park. These include *Hibiscus rosa-sinensis*, *Veitchia merrillii*, *Bougainvillea spectabilis*, and *Hymenocallis littoralis*. Large ornamental trees are also maintained in the lawn area. These include *Cocos nucifera*, *Calophyllum inophyllum*, *Peltophorum pterocarpum*, *Samanea saman*, and others. A vegetative *Crinum* sp. plant grows along Marine Corps Drive. Because of the regular use of the park by visitors and residents, there are several incipient and/or adventive plant species not found in other WAPA units. These species probably arrived at the unit by car, on people, or on animals as unintentional introductions. Interesting and unexpected discoveries included *Dentella repens* and *Bacopa monnieri* growing in a wet depression adjacent to the parking lot, and *Nopalea cochenillifera*, a thornless cactus that had apparently rooted from a discarded cutting.



Figure 6. Mowed lawn and limestone ridge in background. Asan Beach unit, War in the Pacific National Historical Park, Guam.

Asan Inland Unit (240 ha [593 ac])

We spent seven field days (58 person hours) in the Asan Inland unit (Figure 7). Results from this survey and literature and herbarium reviews show a total of 194 plant taxa in

this unit. Of these, 97 are native, representing 50% nativity within the unit. The Asan Inland unit is comprised of three dominant vegetation types: non-native-dominated savanna, mixed limestone forests, and mixed riparian communities.

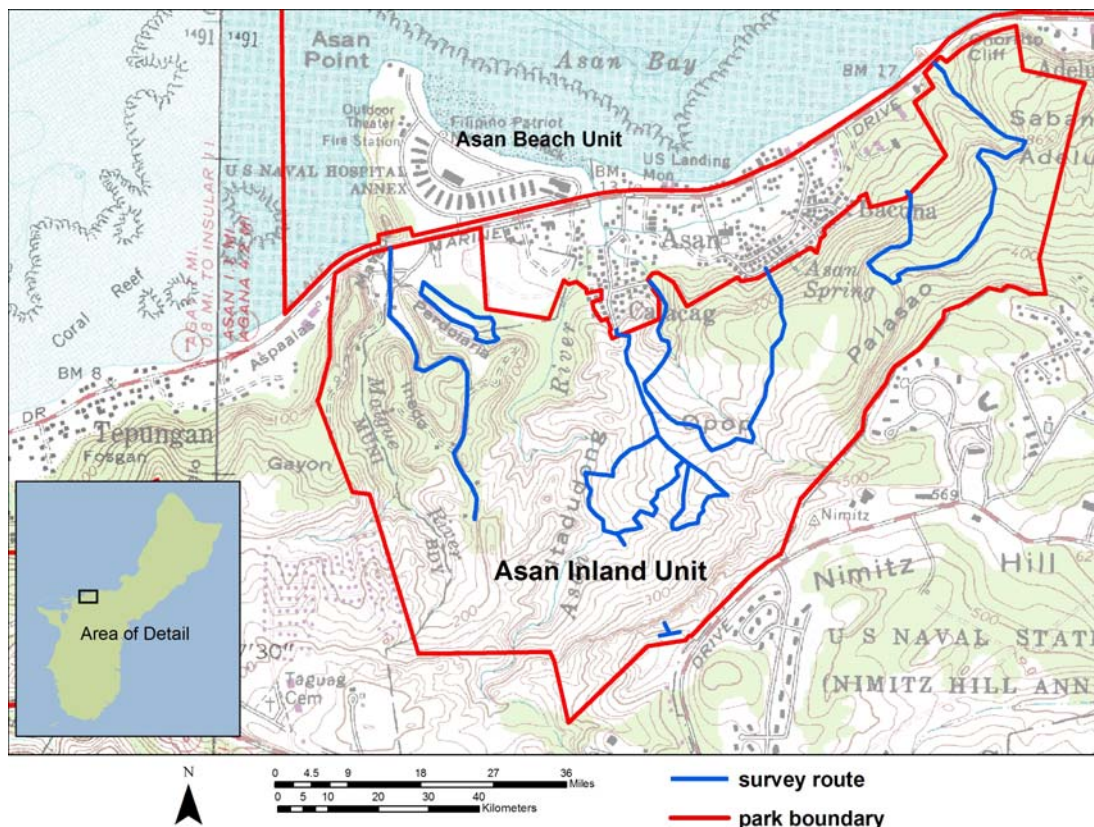


Figure 7. Map of field survey routes in the Asan Inland unit, War in the Pacific National Historical Park, Guam.

Savanna complex

The non-native-dominated savanna located in the mid-section of the unit, between the west and east forks of Asan River, is characterized predominantly by non-native grasses, shrubs, and herbs. The substrate in the savanna is primarily red clay soil. Although the savanna is comprised primarily of grasses (Figure 8), there remain expanses of exposed soil and large areas of bedrock, locally called “badlands.” The area has a long history of human-set fires resulting in these exposed soils, which contribute to sedimentation in the coral reefs offshore from this unit. Growing concern has prompted the NPS to implement erosion plots within this unit and sedimentation traps offshore to document the effect of soil run-off from this unit. Predominant non-native grasses in the savanna include *Panicum maximum*, *Pennisetum polystachion*, and *Saccharum spontaneum*. Native grasses such as *Dimeria chloridiformis* and *Miscanthus floridulus* were also persistent in this non-native-dominated vegetation.



Figure 8. Savanna, looking towards Nimitz Hill Overlook. Asan Inland unit, War in the Pacific National Historical Park, Guam.

A 13.3-ha (32.9-ac) section of this savanna was recovering from a human-set fire that had occurred one and a half months prior (Minton 2005). In this area, the fire had removed a significant portion of the vegetation cover and exposed the soil to the elements. Grasses such as *Panicum maximum*, *Saccharum spontaneum*, and *Miscanthus floridulus* that had been burned, as evidenced by charred culms (i.e., branch stalks), were resprouting. Herbs and ferns such as *Curculigo orchioides* and *Lygodium microphyllum* began emerging as root sprouts after the heavy rains in June 2004 as they do every year after heavy rains. The new establishment of these species was especially obvious in the burned areas, where there was very little vegetation remaining.

Mixed limestone forest

The vegetation in the limestone forest reflects the long history of human occupation in the Asan and Bacuna villages with its associated plantings and overall habitat degradation in adjacent areas (Figure 9). The limestone forest in this area is characterized by various native trees such as *Intsia bijuga*, *Pandanus dubius*, *Psychotria mariana*, *Pouteria obovata*, and *Hernandia sonora* and non-native trees such as *Averrhoa bilimbi*, *Bambusa vulgaris*, and *Heterospatha elata*. It extends from 30 to 165 m (100 to 540 ft) in elevation. There is an obvious subcanopy layer at 1.5 to 2.4 m (five to eight feet), characterized by immature or short-stature trees and mature shrubs such as *Colubrina asiatica*, *Leucaena leucocephala*, *Morinda citrifolia*, and *Triphasia trifolia*. Vines climbing on trees included *Abrus precatorius* and *Piper betle*. The latter were growing primarily on *Heterospatha elata*, a non-native and invasive palm that was a dominant tree in disturbed areas of this forest type. The substrate in this mixed forest type is limestone soil, comprised of a thin layer of volcanic soil over limestone with scattered limestone rock outcroppings. This well-drained and moist substrate supports a lush groundcover of non-native ferns such as *Nephrolepis* spp. and other herbs such as *Alocasia macrorrhizos*. The limestone forest in the northeastern quarter of the Asan Inland unit contains a diverse mix of native and non-native vegetation not observed in other parts of the unit or the

park. This includes *Barringtonia asiatica*, *Eugenia reinwardtiana*, *Piper betle*, and *Cayratia trifolia*. *Buddleia asiatica* was observed only in this unit; however, because of its ubiquitous and invasive nature, it is likely to occur in other park units as well.



Figure 9. Mixed limestone forest behind Asan and Bacuna villages. Asan Inland unit, War in the Pacific National Historical Park, Guam.

Mixed ravine forest

Perennial streams and rivers emerge from springs at the headwaters within this unit, giving rise to unique ravine communities. We observed two basic plant communities associated with gulch systems in the Asan Inland unit. One type was found in gulches that included transition vegetation from the savanna to riparian systems along rivers and streams, hereafter called ravine forest (Figure 10). Trees such as non-native *Heterospatha elata*, native shrubs such as *Melochia villosissima* var. *villosissima* and *Jasminum marianum*, and a variety of indigenous grasses (e.g., *Miscanthus floridulus*, *Phragmites karka*) characterize this ravine forest. A large population of *Tripsacum laxa*, a tall non-native grass, was observed in the lower reaches of the east branch of the Asan River.

One especially significant find was a single striking individual of *Cerbera dilitata*. This 5.2-m (17-ft) fertile individual grows in a subgulch of the west branch of Asan River at 37 m (120 ft) elevation. It was growing in soil upslope from the river's edge. This Mariana Islands endemic was the only individual observed in the park. Its attractive plumeria-like flowers and glossy green leaves make this species an often-collected ornamental and vulnerable to overcollection.



Figure 10. Ravine forest adjacent to savanna and limestone forest. Asan Inland unit, War in the Pacific National Historical Park, Guam.

The other ravine forest community was associated with habitation and reflected recent, and possibly historical, plantings of noninvasive ornamentals such as *Heliconia bihai*, *Alpinia purpurata*, *A. zerumbet*, *Costus speciosus*, *C. woodsonii*, and *Musa* sp. Although not obviously maintained, these plants grow in close proximity to houses (within 60 m [200 ft]) and may be harvested from time to time. This heavily altered ravine community also included other fruit trees, *Mangifera indica* and *Cocos nucifera*, growing along the river's edge.

Riverine community

The Asan River watershed comprises the majority of the Asan Inland unit and, therefore, supports an extensive riverine community (Figure 11), especially in the many tributaries of the west and east forks of Asan River. There are plants that thrive in the moist conditions, some of which are uniquely adapted to the periodic flooding patterns of the river (*Hemigraphis reptans*, *Blechum pyramidatum*, *Centella asiatica*, *Flemingia strobilifera*, *Centosteca lappacea*, *Oplismenus compositus*, and a variety of sedges). Riverine communities also occur along the Matgue River on the western boundary of the unit and in the smaller stream system at the western base of Chorrito Cliff. There we discovered non-native *Teramnus labialis* vines; it was the only site within the park that this plant was found. The riverine community also supported an array of interesting mollusks, crustaceans, and vertebrates such as nerites, water-borne slugs, freshwater prawns locally called "shrimp," and freshwater eels. A few images of the stream fauna observed within this unit are provided in the accompanying photo CD (image filenames: ai.07122004.13 [slugs], ai.07122004.26 [shrimp]).



Figure 11. Riverine community. Asan Inland unit, War in the Pacific National Historical Park, Guam.

Fonte Plateau Unit (15 ha [38 ac])

We spent three field days (23.5 person hours) in the Fonte Plateau unit (Figure 12). Results from this survey, searches of the literature, and herbarium reviews revealed a total of 131 plant taxa in this relatively small 15 ha (38 ac) unit, which reflects the unit's remarkable plant diversity. Of the 131 taxa, 48 are native, representing 37% nativity within the unit. Fonte Plateau comprises three primary regions and corresponding vegetation types: the non-operational quarry, limestone forest, and forest in volcanic soil. The initial field survey of this region took place two days after tropical storm Tinting; much of the vegetation was windswept and suffered substantial damage. Many of the plants were stripped of leaves and their fragile reproductive parts (i.e., flowers, fruits), making plant identification somewhat difficult for a few taxa. Whenever possible, specimens were collected and images taken to document the findings.

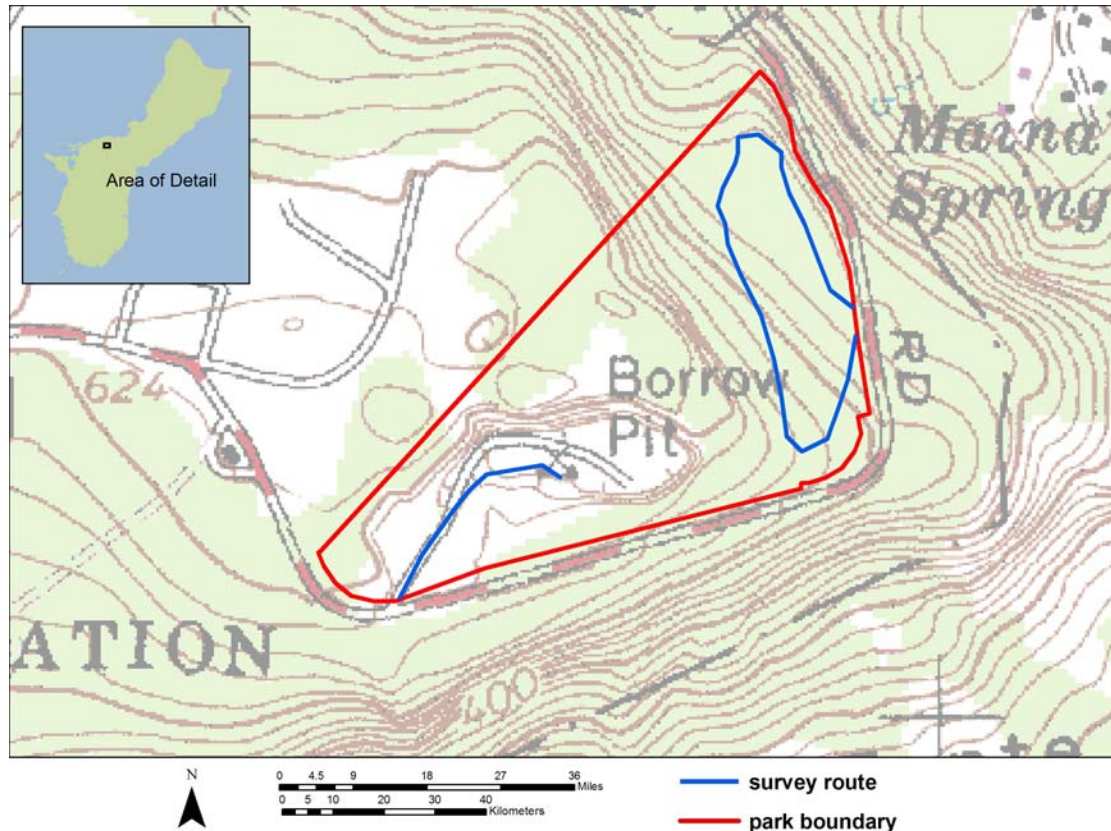


Figure 12. Map of field survey routes in the Fonte Plateau unit, War in the Pacific National Historical Park, Guam.

Non-operational quarry

The post World War II quarry is overgrown with large tracts of *Leucaena leucocephala* and various naturalized, non-native trees (Figure 13). It was once an area contiguous with or part of a Guam Experimental Station planting area (L. Raulerson, personal communication, October 20, 2005) with some historical plantings remaining. Although highly disturbed, the quarry contains an interesting assortment of native trees and shrubs such as *Macaranga thompsonii*, *Phyllanthus marianus*, and more common *Premna obtusifolia*, *Pandanus tectorius*, *Casuarina equisetifolia*, *Cocos nucifera*, *Entada phaseoloides*, and *Colubrina asiatica*, and the native grass *Miscanthus floridulus*. It was in this quarry that we discovered the only known individuals of *Phyllanthus marianus* in the park. Although not considered rare, this indigenous plant is an attractive native that would be an excellent choice for use in interpretive literature highlighting Guam's native flora.

We observed a few large trees of non-native *Colubrina arborescens* in the central part of the quarry. This is an uncommon tree in Guam and occurs only in this unit in the park. A collection from a plant historically planted at the Guam Experimental Station is housed at the Bishop Museum on Oahu and may be a collection from this site; no voucher is presently available at the University of Guam herbarium. In addition, large trees of non-

native flowering and fruiting *Catalpa longissima* were observed. These robust plants have 0.3 m- (foot-) long, thin pods that split at maturity, releasing winged seeds that are carried by wind to other sites. Although not highly invasive, this species has the potential to naturalize in other limestone habitats.



Figure 13. View of northeastern wall of the quarry. Fonte Plateau unit, War in the Pacific National Historical Park, Guam.

Limestone forest

The limestone forest upon Nimitz Hill (Figure 14) remains relatively intact and continues to support a wide variety of indigenous and endemic species: *Aglaia mariannensis*, a few *Ficus* species (*F. microcarpa*, *F. prolixa*, and *F. tinctoria*), *Hernandia sonora*, *Maytenus thompsonii*, *Neisosperma oppositifolia*, *Pandanus dubius*, *P. tectorius*, *Pouteria obovata*, and *Xylosma nelsonii*. This limestone forest supports a dense population of *Neisosperma oppositifolia*, a species that we also found in the rather inaccessible limestone forest of Mount Alifan unit. The abundance of fertile plants, seedlings, and saplings suggests the population is self-supporting. Although the rugged terrain of this limestone forest makes surveying difficult, an additional survey along the peak is recommended because of the large percentage of native species that remain, suggesting additional species may be found there.



Figure 14. View of limestone forest peak from Nimitz Highway. Fonte Plateau unit, War in the Pacific National Historical Park, Guam.

Mixed forest in volcanic soil on limestone

This forest occurs at the overlook and extends uphill, transitioning into limestone forest with increasing elevation. Although this area could be considered an extension of the limestone forest, it is described separately here to distinguish the well-drained dark brown soils that support lush vegetation as seen in the photo of Jenny Drake collecting fern specimens (Figure 15). In this rather vegetatively diverse area, we observed a variety of native plants, some of which were found nowhere else in the park. These native plants included *Ximenia americana*, a short-statured tree in the Olax family (Olacaceae) and a few plants of the ground orchid *Nervilia aragoana*. We found two uncommon natives, which we observed in only one other site in other units: *Polyscias grandifolia* and *Pteris tripartita* (observed in Asan Inland and Mount Alifan units, respectively). The other sites were not easy to access, requiring a substantial hike in difficult terrain. Other common natives observed in the Fonte Plateau unit include *Premna obtusifolia*, *Timonius nitidus*, and *Psychotria mariana*.

The overlook also had interesting plantings of non-native species such as bay rum (*Pimenta racemosa*), various species of *Citrus*, *Cananga odorata*, *Annona reticulata*, *Averrhoa bilimbi*, *Eugenia javanica*, *Bixa orellana*, *Tabebuia pallida*, *Sansevieria trifasciata*, and the vine *Abrus precatorius*. With plantings of these ornamental and fruit-bearing trees, three large cement tables, and bench-style seats scattered along the overlook, we concluded that this area was once a managed site. In this site we found the only representatives of seven plant species in the park (*Pimenta racemosa*, *Cananga odorata*, *Bixa orellana*, *Eugenia javanica*, *Citrus macroptera*, and *Senna alata*). *Telosma cordata*, a non-native vine, was found in only one other unit (Piti Guns). This species apparently escaped from cultivation and naturalized within the park (L. Raulerson,

personal communication, July 16, 2005). Widespread non-native naturalized species typically found in disturbed sites occurred in this area as well.



Figure 15. Jenny Drake collecting *Thelypteris tripartita* in forest with deep volcanic soils, about 160 m (520 ft) elevation. Fonte Plateau unit, War in the Pacific National Historical Park, Guam.

Piti Guns Unit (40 ha [98 ac])

We spent two field days (30 person hours) surveying the Piti Guns unit; the first day was spent in the southern half of the unit and the second day in the northern half (Figure 16). Results from this survey, literature search, and herbarium reviews show a total of 146 plant taxa in this unit. Of these, 50 are native, representing 34% nativity within the unit. The majority of the unit is comprised of savanna and mahogany forest. The Taguag River flows through the northeastern part of the Piti Guns unit. The vegetation associated with the river is highly disturbed.

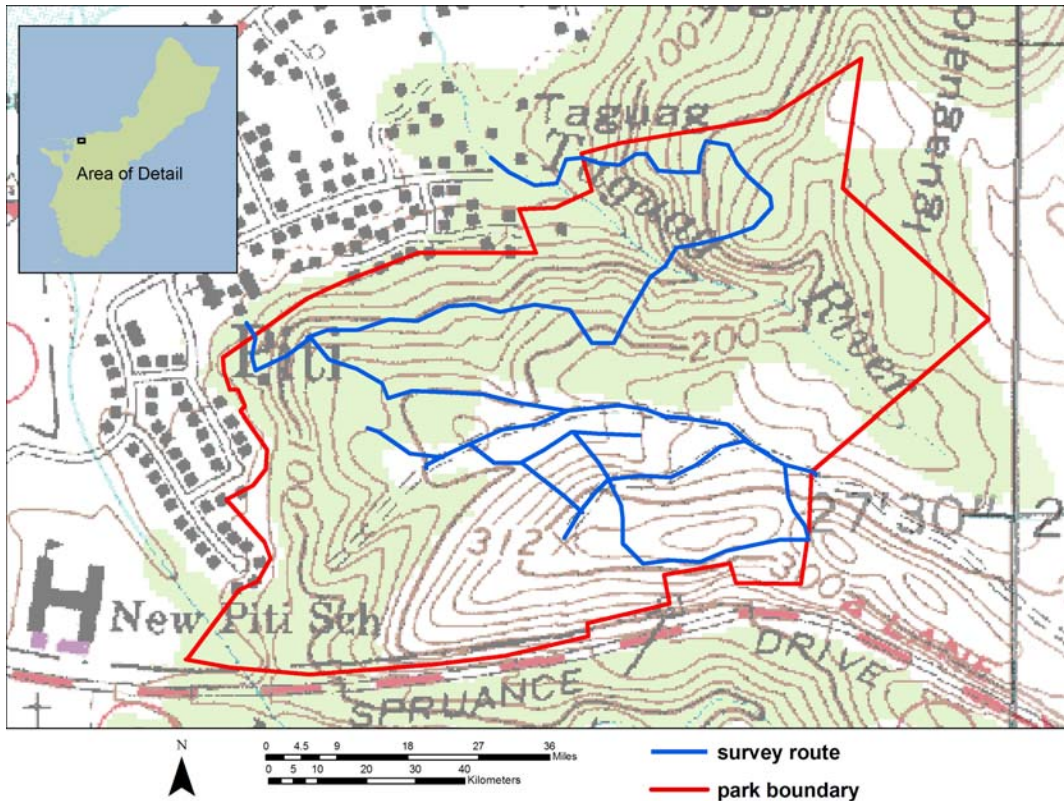


Figure 16. Map of field survey routes in the Piti Guns unit, War in the Pacific National Historical Park, Guam.

Mahogany (*Swietenia macrophylla*) forest

The public-access trail runs through mahogany forest as part of a self-guided historical tour of the three Japanese guns. Various ornamental plants and fruit trees that had been historically planted along the trail still persist today and, as a result, are only found in this park unit. These include *Eugenia uniflora*, *Dieffenbachia maculata*, *Dioscorea esculenta* var. *tiliaefolia*, and *Jatropha integerrima*.

The mahogany forest located in the southwestern quarter of the unit is fairly monotypic due to its dense canopy and resultant shady understory. This forest structure supports a dense groundcover of shade-tolerant ferns, both native and non-native, and a sparse subcanopy of short-stature native and non-native trees and shrubs. Some typical fern species include *Nephrolepis biserrata*, *Christella parasitica*, *Phymatosorus grossus*, and *Thelypteris opulenta*. Other groundcover plants include *Cyperus* spp. and many *Leucaena leucocephala* seedlings. The subcanopy is comprised of the endemic *Glochidion marianum* and indigenous *Scaevola sericea* in shaded areas with the non-native grasses *Saccharum spontaneum* and *Panicum maximum* occupying light gaps.

Not unexpectedly, the transition areas between the mahogany forest and savanna reveal a diverse assemblage of non-native and native species (Figure 17). In this transition area, we observed a flowering example of *Tacca leontopetaloides* and the grass *Imperata*

conferta, flowering and fruiting *Timonius nitidus* trees, *Morinda citrifolia*, *Casuarina equisetifolia*, and *Leucaena leucocephala*. One common leguminous tree grows in association with mahogany. The branches were too high to collect, and, as a result, its identity was not confirmed. Collecting fertile branches of this plant is a high priority for future surveys. We found another unidentified species along the trail to the first gun at 42.7 m (140 ft) elevation. This 12 m (40 ft)-tall tree with compound leaves comprised of nine leaflets was identified to generic level (*Derris* sp. [Fabaceae], Collection number 216-1, 216-2; NPS Accession No. WAPA-00268; NPS Catalog No. WAPA 3133) based on specimens at the Bishop Museum. Neither the University of Guam herbarium nor Bishop Museum has a specimen of this species in their collections. This area was part of the Guam Experimental Station and has a long history of non-native plantings; it is possible the two plants described above were from these experimental plantings. Additional surveys may reveal more species from historical plantings.



Figure 17. Mahogany plantation in background (dark green) with transition vegetation adjacent to savanna. Piti Guns unit, War in the Pacific National Historical Park, Guam.

Savanna complex

Roughly three-quarters of the Piti Guns unit is savanna, with large scattered *Casuarina equisetifolia* trees, *Scaevola sericea* shrubs, and a complement of non-native and native grasses that are observed in savanna communities in other park units (Figure 18). Some common grass, sedge, and shrub species include *Saccharum spontaneum*, *Pennisetum polystachya*, *Sporobolus diander*, *Miscanthus floridulus*, *Chrysopogon aciculatus*, *Cenchrus echinatus*, *Rhyncospora rubra*, *Fimbristylis tristachya*, *Hyptis capitata*, *H. suaveolens*, *Dianella saffordiana*, *Arundina graminifolia*, *Spathoglottis plicata*, and others. Interestingly, we found *Lantana camara* only in this unit. While this species is often invasive on other islands of the Pacific, at WAPA it appears to be relatively limited in distribution. We observed only three plants in the park, all of which were confined to a

0.2 ha (half-acre) area in this unit. This savanna is unique in that several plants of the uncommon native shrub *Dodonaea viscosa* occur on ridge crests and the powerline road that crosses the unit along the summit ridge; this species was not observed in other units.



Figure 18. Savanna complex. Piti Guns unit, War in the Pacific National Historical Park, Guam.

Riparian community

The riparian plant community in the Piti Guns unit is not as extensive nor as diverse as the riparian systems in the Asan Inland or Mount Alifan units. The flora in this unit is highly disturbed. With the exception of native grasses, it does not harbor extensive tracts of native plants. However, as seen in Figure 19, some native trees and grasses, such as *Pandanus tectorius*, *Hibiscus tiliaceus*, and *Miscanthus floridulus* persist. Non-native plants such as *Eupatorium odoratum* and *Mikania micrantha* are also common along the river's edge.

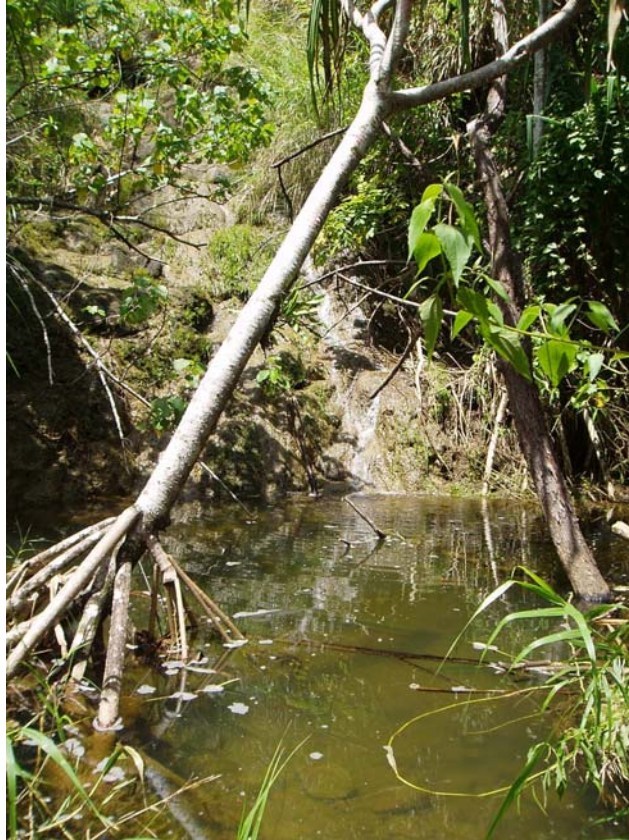


Figure 19. Riparian community. Piti Guns unit, War in the Pacific National Historical Park, Guam.

Mount Chachao-Mount Tenjo Unit (18 ha [45 ac])

We spent a single field day (18 person hours) in the Mount Chachao-Mount Tenjo unit (Figure 20); cool weather allowed surveying throughout the day. Results from this survey, the literature search, and herbarium reviews show a total of 117 plant taxa in this unit. Of these, 66 are native, representing 56% nativity within the unit. The survey was conducted on national park property following the summit jeep trail from the last house on a residential road off Nimitz Highway to about three-fourths the way to Mount Tenjo—approximately 1.5 km (0.9 mi). The jeep trail was followed along the summit ridge which traverses park property. We recorded the vegetation on either side of the roadway, then surveyed along a foot path to Mount Tenjo and the summit ridge to the peak as well as in the gulches. The majority of the unit is comprised of savanna and a substrate of red clay soil. Remnant ravine forest remains in the headwaters of Yling River below the slope of Mount Tenjo. The field survey in this unit was conducted during a thunder squall.

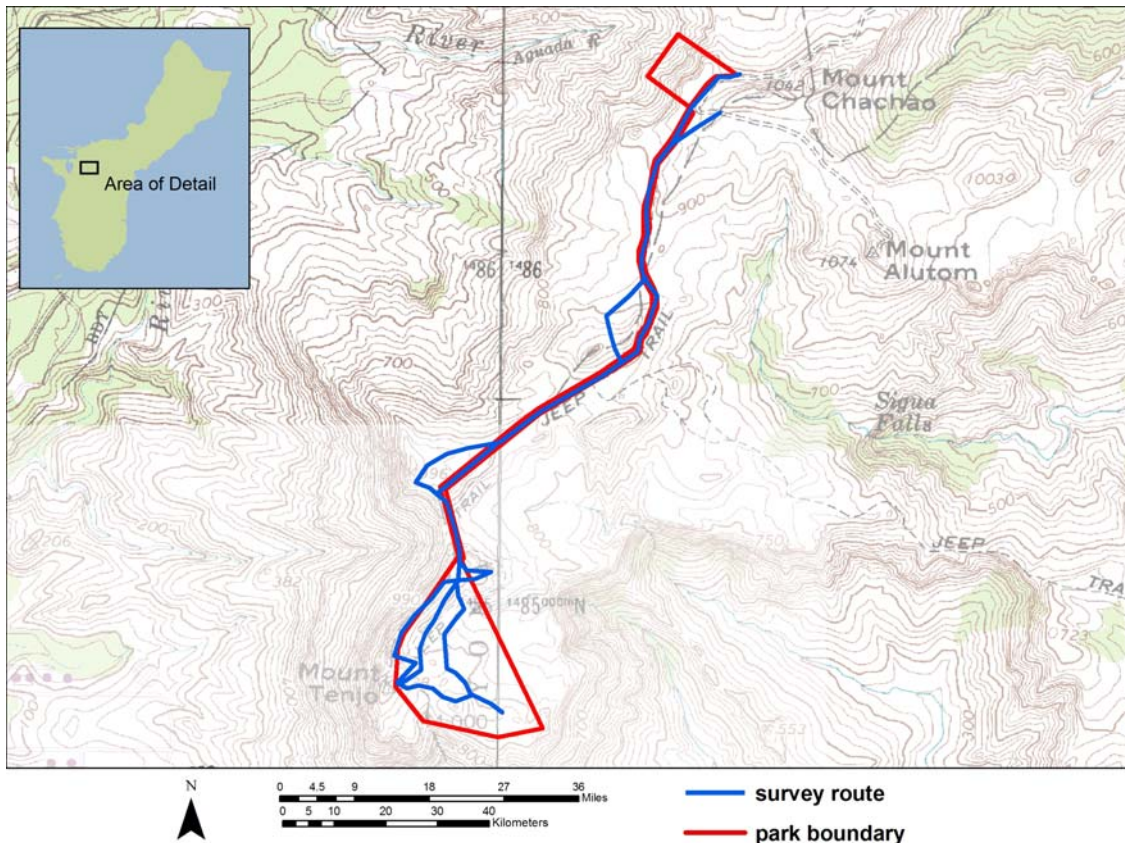


Figure 20. Map of field survey routes in the Mount Chachao-Mount Tenjo unit, War in the Pacific National Historical Park, Guam.

Savanna

The summit savanna region is primarily comprised of common grasses such as *Chrysopogon aciculatus*, *Paspalum ciliatifolium*, *Saccharum spontaneum*, *Pennisetum polystachyon*, *Sporobolus diander*, *Eragrostis amabilis*, *Phragmites karka*, *Miscanthus floridulus*, *Dimeria chloridiformis*, and low-growing sedges, *Mariscus mariscoides* and *Rhynchospora rubra*. Native shrubs such as *Glochidion marianum*, *Timonius nitidis*, *Premna obtusifolia*, *Scaevola sericea*, and *Morinda citrifolia* occur in scattered clusters throughout the grass-dominated landscape (Figure 21). In Figure 21, Mount Chachao is seen along the horizon, in the middle of the photo. The peak with radio towers, located at the right side of the photo, is Mount Alutom. Both peaks are outside of the park unit.



Figure 21. View of Mount Chachao along the horizon in the middle of the photograph, and survey area along summit trail/jeep road, in foreground. Mount Chachao-Mount Tenjo unit, War in the Pacific National Historical Park, Guam.

Creeping native plants, *Lycopodiella cernua* and *Cassytha filiformis*, are also common savanna species. The interior areas of the savanna (regions closer to Mount Tenjo) support a greater diversity of native shrubs. For example, *Melastoma malabathricum* var. *mariannum*, *Decaspermum fruticosum*, *Myrtella bennigseniana*, and *Phyllanthus saffordii* are common near Mount Tenjo but are uncommon in other parts of the unit. Figure 22 shows some plants typically found in this area.



Figure 22. Endemic shrubs *Myrtella bennigseniana* and endemic grass *Dimeria chloridiformis*. Mount Chachao-Mount Tenjo unit, War in the Pacific National Historical Park, Guam.

Other common, low-growing species found along the narrow trail between Mount Chachao and Mount Tenjo include *Atylosia scarabaeoides*, *Alysicarpus vaginalis*, *Bidens alba*, *Crotolaria retusa*, *Elephantopus mollis*, *Leucaena leucocephala*, *Lindsaea ensifolia*, *Lygodium microphyllum*, *Mimosa pudica*, *Nephrolepis hirsutula*, *Passiflora foetida*, *Polygala paniculata*, *Scleria lithosperma*, *S. polycarpa*, *Spathoglottis plicata*, *Stachytarpheta jamaicensis*, and *Waltheria indica*.

This unit is located at a higher elevation than the other units of WAPA, ranging from 250 to 320 m (830 to 1042 ft); the plant composition reflects this elevational difference. For example, we observed five native shrubs and ferns in the savanna that we found in no other unit of WAPA. Two plants of *Hedyotis laciniata* were observed in full sun in this habitat. This Mariana Islands endemic is also found on Alamagan, Anatahan, Saipan, and Rota in the Northern Mariana Islands in similar habitats. On Guam, this plant does not appear to be abundant. The plants' close proximity to the jeep roads make them especially vulnerable to inadvertent trampling or damage by off-road vehicles.

Desmodium umbellatum (image filename: desumb.mt.07062004.1-4) is an indigenous member of the pea family (Fabaceae). We often found this species growing in the road and thus subject to repeated trampling; one healthy individual was found on the slopes of Mount Tenjo. *Geniostoma micranthum* have fruit that dehisce (split) to reveal seeds in a bright orange pulp. These Mariana Islands indigenous shrubs were also found next to the jeep trail, at risk for damage by vehicles. *Blechnum orientale* is an indigenous fern that has fronds 22 to 130 cm (8.7 to 51.2 in) long (Australian Biological Resources Study, n.d.) that emerge from a stump or stalk. Although these ferns are primarily found along the roadside and in intact regions in the savanna, one particularly large individual was observed in the Yling Gulch on the east side of Mount Tenjo with fronds that extended over 130 cm (4.2 ft) in length (image filename: bleori.mt.07062004.4). We discovered a single, small, damaged plant of *Sphenomeris chinensis* as well (image filename: sphchi.mt.07062004.3). This fern persisted on a slight 0.5 m (20 in) incline in the middle of the jeep trail, apparently because the plant grew in a place that off-road vehicle tires did not pass. This fern is not considered rare on Guam, but is considered uncommon in this unit. Although we only noted one individual, more plants will likely be found with additional surveys.

We also found single populations of non-native plants that were not observed in other units. A single population of the non-native sedge, *Eleocharis dulcis*, grew in a moist depression in the savanna. A pubescent and robust form of *Stylosanthes guianensis* (image filename: stygui.mt.07062004.1-2) was observed and collected. Unlike the smaller and more herbaceous *Stylosanthes guianensis* in disturbed, low elevation sites, these plants bore long white hairs along the stems and leaves and possessed larger leaves and sturdier stems. Dr. Lynn Raulerson (personal communication, July 16, 2005) suggested that these plants represent a unique, currently unnamed species. These plants did not have fertile parts at the time of the observation, so a collection with reproductive parts should be obtained in the future.

Ravine forest

The ravine forest within the Mount Chachao-Mount Tenjo unit is limited to the upper elevation headwaters of Yling River, on the slopes of Mount Tenjo, from 250 to 275 m (830 to 900 ft) elevation. Although somewhat disturbed, many species of uncommon natives grow along the gulch sides: *Angiopteris evecta*, *Belvisia spicata*, *Casuarina equisetifolia*, *Cycas circinalis*, *Davallia solida*, *Ficus tinctoria* var. *neoebudarum*, *Ficus prolixa*, *Flagellaria indica*, *Hibiscus tiliaceus*, *Melochia villosissima* var. *villosissima*, *Pandanus tectorius*, *Phymatosorus grossus*, and *Thelypteris opulenta*. Some common non-natives include *Eupatorium odoratum*, *Heterospathe elata*, *Mikania micrantha*, and *Vitex parviflora* (Figure 23).



Figure 23. Remnant ravine forest, upper headwaters of Yling River. Mount Chachao-Mount Tenjo unit, War in the Pacific National Historical Park, Guam.

A notable species observed in this unit was *Schefflera* sp. Surveyors discovered this plant growing in a relatively monotypic *Phragmites karka* plant community. Jenny Drake collected a single leaf of this plant since no fertile parts were present. The palmately compound leaf was rather large, 88.5 cm (34.8 in) long, with five leaflets. The terminal leaflet possessed the longest petiolule (15.5 cm [6.1 in]) and longest blade (39.2 cm [15.4 in]). Unfortunately, I was unable to find a corresponding specimen at the University of Guam and Bishop Museum herbaria so this specimen remains unidentified and is currently part of the WAPA herbarium collection (Collection No. 694-1, 694-2; NPS Accession No. WAPA-00268; NPS Catalog No. WAPA 3638). A collection of a fertile specimen is needed for a definitive identification. Another non-native plant, *Cestrum diurnum*, was observed on the slopes of Mount Tenjo about 12 m (40 ft) below the peak. This species was not found in any other park unit.

Agat Unit (Apaca Point, Gaan Point, Bangi Point) (15 ha [37 ac] land area)

We spent two field days (18.5 person hours) surveying the three terrestrial subunits of Agat unit: Apaca Point, Gaan Point, and Bangi Point (Figure 24). We developed a separate species list for each subunit. The three subunits represent a small percentage of the unit, as most of the unit is located offshore. The survey was conducted two days after Tropical Storm Tinting, so a significant amount of sand and debris obscured parts of the beach strand vegetation, especially in the Apaca and Gaan subunits. In addition, much of the vegetation along the shore suffered a great deal of physical and salt damage. Bangi Point subunit included residential houses and lean-tos that were apparently within the park boundary. About 1.6 ha (four acres) of Bangi Point, including Bangi Island, is privately owned. Some house sites were abandoned as evidenced by standing hollow-tile house shells.

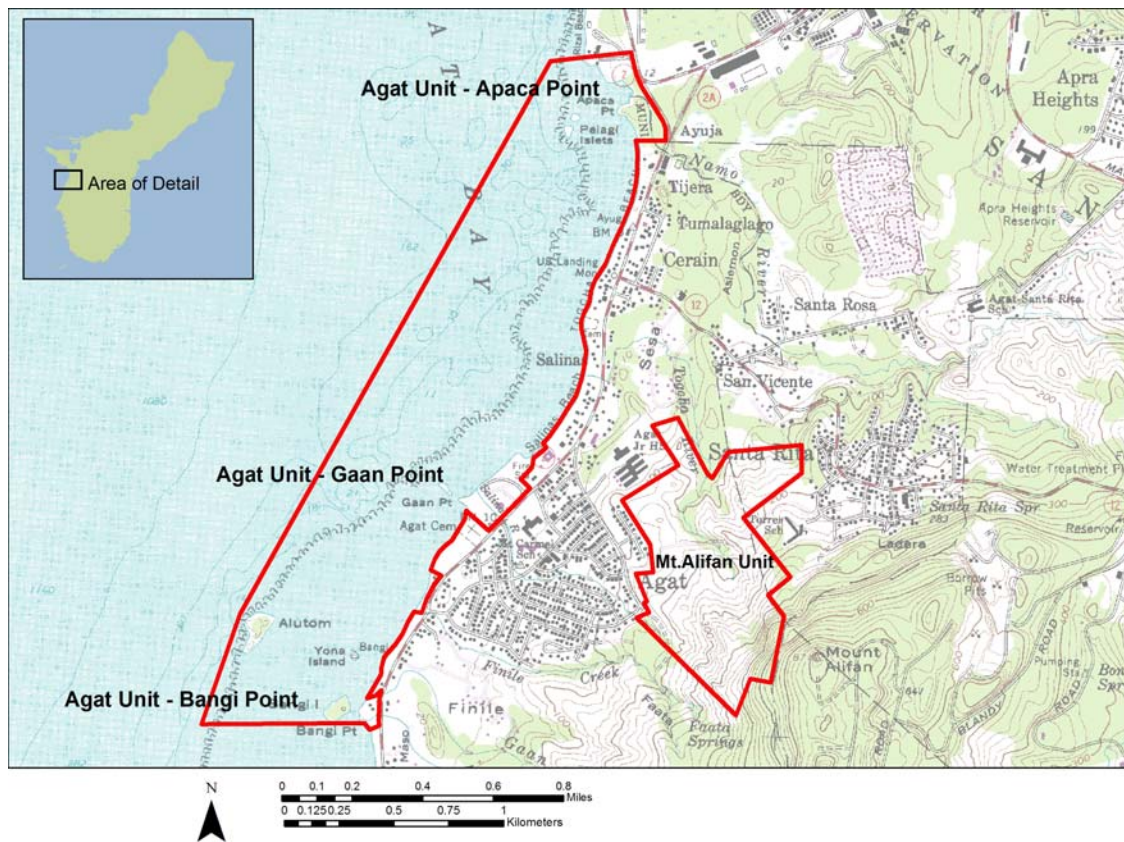


Figure 24. Map of Agat unit, War in the Pacific National Historical Park, Guam.

Apaca Point was surveyed first on June 30, 2004, including the lawn, parking area, and near-shore beach strand areas. This survey also included the large lawn and surrounding vegetation on the south side of the driveway that leads to the pavilion at Rizal Point (south of Rizal Beach) within the park boundary (Figure 25). Since the survey was conducted shortly after Tropical Storm Tinting, some areas of Apaca Point were still under water (Figure 26). The beach grasses closest to the ocean suffered the greatest damage as shown in Figure 27. These conditions made plant identification somewhat difficult. Despite this, the results from this survey, literature searches, and herbarium

reviews show a total of 89 plant taxa from this unit. Of these, 35 are native, representing 39% nativity within the Apaca Point subunit. A subsequent field survey conducted in 2005 revealed three additional species that had not been observed in 2004 (*Crotolaria pallida*, *Canavalia rosea*, and *Digitaria ciliaris*). Several attractive indigenous trees were planted on the grounds of Apaca Point, including *Heritiera littoralis*, *Cocos nucifera*, *Casuarina equisetifolia*, and *Hibiscus tiliaceus*.

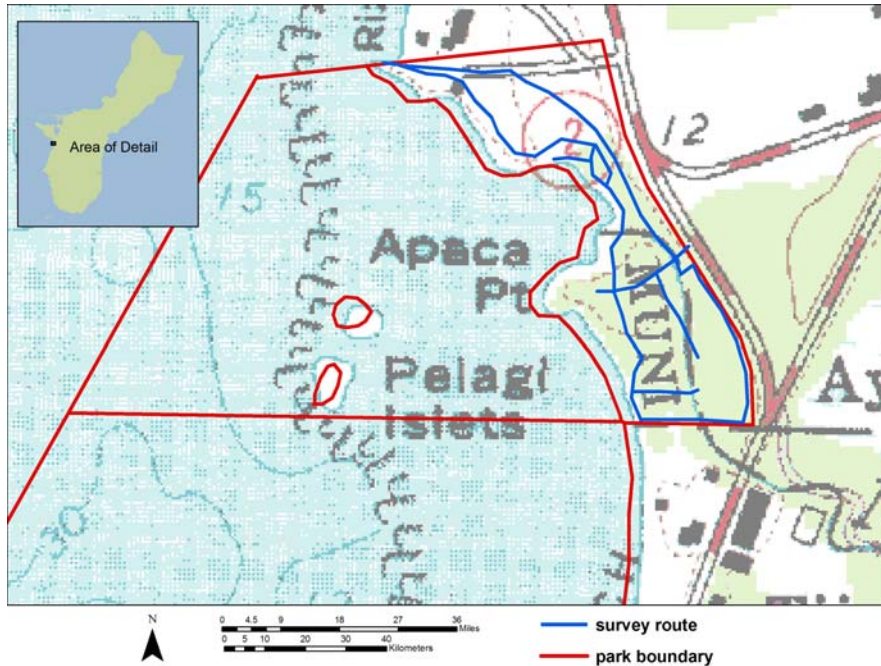


Figure 25. Map of field survey routes in the Agat unit—Apaca Point subunit, War in the Pacific National Historical Park, Guam.



Figure 26. View of parking area with submerged lawn, two days after Tropical Storm Tinting. Agat unit—Apaca Point subunit, War in the Pacific National Historical Park, Guam.



Figure 27. View of salt-damaged beach strand grasses at mouth of Namo River. Agat Unit—Apaca Point subunit, War in the Pacific National Historical Park, Guam.

Like the Apaca Point subunit, the Gaan Point subunit also includes mowed lawn and beach habitats. We surveyed these areas including the areas adjacent to Agat Cemetery (Figure 28). A great deal of manmade and natural debris covered the beach and lawn area after Tropical Storm Tinting in July 2004 (Figure 29). Figure 30 reveals the same beach cleared of debris a year later, in July 2005. Vegetation recovery after a year was very robust as demonstrated by new growth on trees and shrubs. However, non-native plants such as *Crotalaria pallida* and various grasses that were not observed during the 2004 survey have become established in these coastal sites since then.

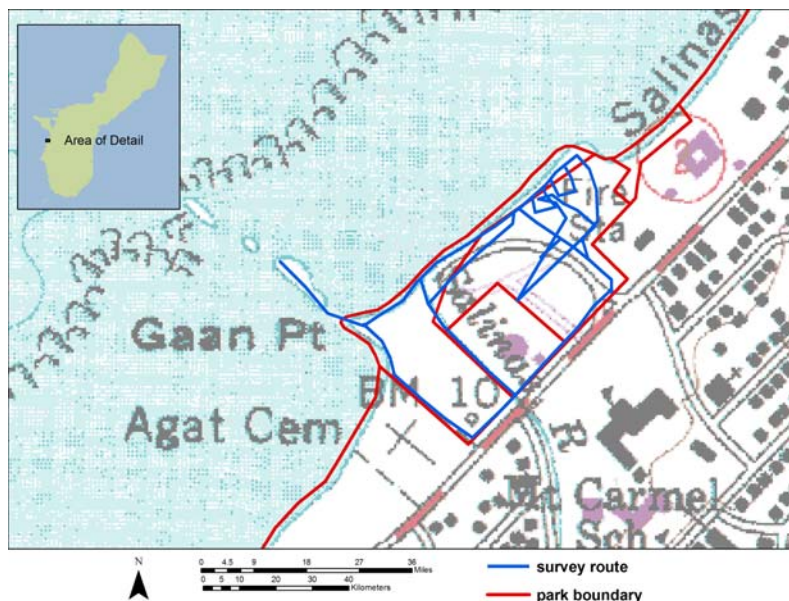


Figure 28. Map of field survey routes in the Agat unit—Gaan Point subunit, War in the Pacific National Historical Park, Guam.



Figure 29. Joan Yoshioka amongst storm debris two days after Tropical Storm Tinting, 2004. Agat unit—Gaan Point subunit, War in the Pacific National Historical Park, Guam.



Figure 30. View of the beach strand in July 2005. Agat unit—Gaan Point subunit, War in the Pacific National Historical Park, Guam.

Results from this survey and the literature and herbarium reviews show a total of 96 plant taxa in the Gaan subunit of Agat unit. Of these, 26 are native, representing 27% nativity within the subunit. In 2004, the lawn habitat consisted of a variety of common grasses and other non-native herbs. Some of the most common grasses included *Axonopus compressus*, *Cenchrus echinatus*, *Chloris barbata*, *Chrysopogon aciculatus*, *Cynodon dactylon*, *Dactyloctenium aegypticum*, *Dichanthium bladhii*, *Digitaria violascens*, *Eleusine indica*, *Panicum germinatum*, *Thuaria involuta*, and others. Non-native herbs such as *Desmodium triflorum* and *Phyla nodiflora* were also found in the frequently mowed lawn. There are several ornamental species in the lawn area of Gaan Point that provide shade for visitors. These include common plants such as *Mangifera indica*, *Pithocellobium dulce*, *Cocos nucifera*, and *Averrhoa bilimbi*. Less common are *Moringa oleifera* and *Citrus aurantium*; we found neither of these species in other park units. Other ornamentals found in and around the parking area include *Cyperus alternifolius*, *C. ligularis*, *Ocimum tenuiflorum*, and *Hymenocallis littoralis*.

The Agat Sewage Treatment Plant is located adjacent to the lawn area and surrounded by a chain link fence upon which *Luffa aegyptiaca* grows. The southern quarter of the subunit remains unmanaged and non-native vegetation such as *Panicum maximum* and *Leucaena leucocephala* persist there. Pockets of standing water, especially near Agat Cemetery, support *Lindernia antipoda* and other water-tolerant annuals. *Pemphis acidula* and *Casuarina equisetifolia* are common woody plants found on the jetty off the southern end of the park boundary.

Two interesting limestone knolls are also found at Gaan Point, the larger of which has an encasement that housed a 75 mm gun during World War II. A grass-lined trail leads visitors to the top of this knoll and the encasement. The photo of the beach and jetty beyond (Figure 30) was taken from the top of this prominence. The limestone knoll supports plants typically found on limestone in other disturbed areas, including non-native *Triphasia trifolia*, *Leucaena leucocephala*, and native *Premna obtusifolia*. The smaller limestone knoll was also home to similar plants. Some uncommon trees that grow around the limestone prominences are *Hernandia sonora* and *Ficus tinctoria* var. *neoebudarum*.

The Bangi Point subunit of Agat unit includes a narrow strip of land that stretches approximately 210 m (690 ft) in length and lies between the high tide mark and Highway 2 that runs parallel to the ocean (Figure 31). The remainder of the subunit lies offshore and includes the islets of Bangi, Alutom, and Yona. These islets were not surveyed in 2005 because Dr. Lynn Raulerson previously surveyed them in 2001. Data from the 2001 surveys were incorporated into the checklist. Results from the 2004 survey as well as literature and herbarium reviews show a total of 81 plant taxa in this subunit. Of these, 35 are native, representing 43% nativity within the subunit. No surveys were conducted in 2005.

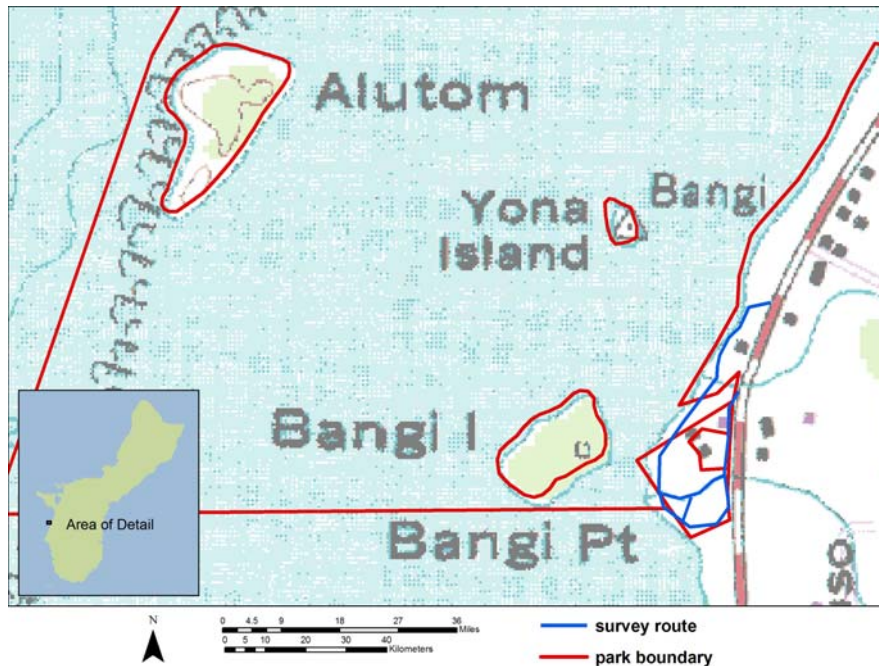


Figure 31. Map of field survey routes in the Agat unit—Bangsi Point subunit, War in the Pacific National Historical Park, Guam.

Some of the plants observed in the terrestrial inland portion are ornamental shrubs, vines, and terrestrial herbs (e.g., *Capsicum frutescens*, *Clerodendrum quadriloculare*, *Delonix regia*, *Epipremnum pinnatum*, *Ficus elastica*, *Graptophyllum pictum*, *Hymenocallis littoralis*, *Musa* sp.) that appeared to be remnant plantings as they were found in unmanaged, disturbed sites. These plants did not seem associated with established house sites because no traces of structures were found. Most of these cultivated plants did not appear to be naturalized as they were single plants or apparent root sprouts. The beach strand is homogeneous, with native grasses lining the beach. Like other beach strand areas at Apaca and Gaan points, *Sporobolus virginicus* and other grasses in this subunit suffered severe damage from the storm (Figure 32). Other common grasses in protected sites include *Bidens alba*, *Carica papaya*, *Cocos nucifera*, *Derris trifoliata*, *Eupatorium odoratum*, *Heliotropium procumbens*, *Hibiscus tiliaceus*, *Ipomoea pes-caprae*, *Mikania micrantha*, *Pithocellobium dulce*, *Sphagneticola trilobata*, *Syngonium angustatum*, and many native and non-native species such as *Euphorbia heterophylla*, *Mimosa pudica*, *Phragmites karka*, and other grasses. *Achyranthes aspera* var. *aspera*, indigenous to the Mariana Islands, is only recorded from this subunit in the park, although it is found in other coastal regions of Guam. This is an uncommon species at Bangsi Point.



Figure 32. Storm-damaged grasses along shore, pictured here in the foreground, two days after tropical storm Tinting. Agat unit—Bangi Point subunit, War in the Pacific National Historical Park, Guam.

Mount Alifan Unit (64 ha [158 ac])

We spent four field days (54 person hours) in the Mount Alifan unit (Figure 33). Results from this survey and the literature and herbarium reviews show a total of 156 plant taxa in this unit. Of these, 83 are native, representing 53% nativity within the unit.

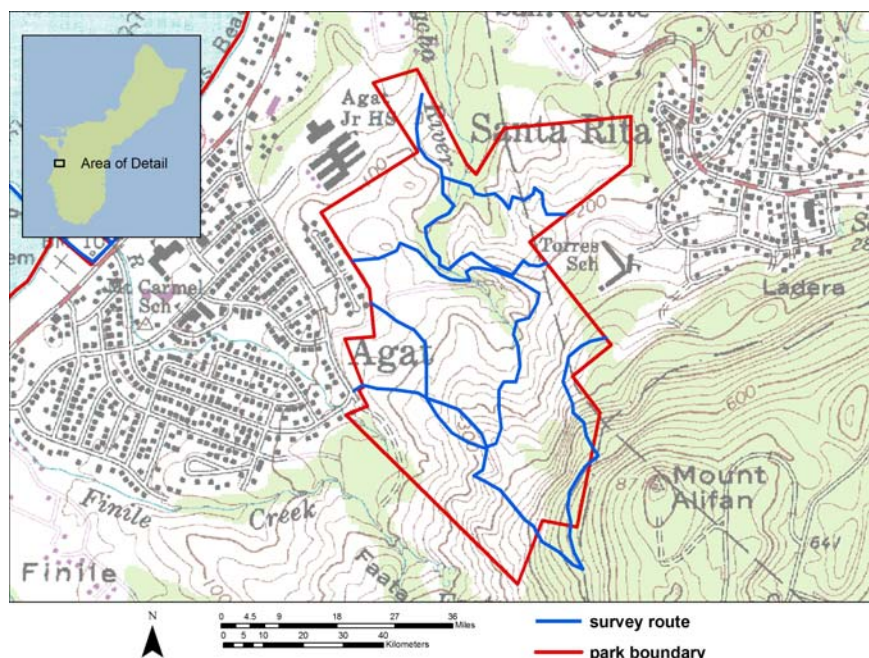


Figure 33. Map of field survey routes in the Mount Alifan unit, War in the Pacific National Historical Park, Guam.

Limestone forest

The inland areas (i.e., upper slopes of Mount Alifan) are comprised of limestone forests dominated by native trees, shrubs, vines, and ferns (Figure 34). While much of the intact forest is located close to the summit of Mount Alifan on navy lands, there remains a finger of forest along the southeast boundary of the park where typical, native-dominated limestone forest remains. The vegetation there is characterized by a mix of non-native *Leucaena leucocephala* and several species of native trees such as *Aglaia mariannensis*, *Guamia mariannae*, *Guettarda speciosa*, *Intsia bijuga*, *Ixora triantha*, *Neisosperma oppositifolia*, *Premna obtusifolia*, *Psychotria mariana*, and a forest of *Pandanus dubius* trees. Common native shrubs and lianas include *Colubrina oppositifolia*, *Entada phaseoloides*, *Freycinetia reinecki*, *Piper guahamense*, and *Scaevola sericea*. The Mount Alifan unit supports an interesting assortment of native species that were not observed in any other unit: *Freycinetia reinecki*, *Guamia mariannae*, *Guettarda speciosa*, *Ixora triantha*, and the epiphytic fern *Vittaria incurvata*. The transition area between the savanna and more intact limestone forest is comprised of *Bidens alba*, *Leucaena leucocephala*, *Miscanthus floridulus*, and *Scaevola sericea*. The gulch and ravines are shallow and do not support extensive ravine habitats as were found in the Asan Inland unit.



Figure 34. Native-dominated limestone forest. Mount Alifan unit, War in the Pacific National Historical Park, Guam.

In 2004, we observed two plants of *Cycas circinalis* (syn: *C. micronesica*) in the savanna and several plants in the limestone forest of the Mount Alifan unit. At the time of the observation, all of the plants were in good health and two of the female plants in the limestone forests were fertile. Interestingly, *Cycas circinalis* is the only native gymnosperm on Guam and a dominant tree in the northern half of the island. Unfortunately, a recent introduction of diaspidid scales (*Aulocaspis yasumatsui* Takagi, Asian cycad scales) to Guam could result in the demise of the one million plants on the island. The scales, imported on infected *C. revoluta* plants in December 2003, have spread throughout the northern two-thirds of the island (Brooke 2005). Although we observed no scales on the plants in July 2004, it is possible that scales have already infected these plants in the park. The insecticide Distance (pyriproxifen) is being used to treat infected plants on Guam but may be ineffective for large-scale control of the scale (Moore 2005). Entomologists from the Cooperative Extension Service, Agriculture and Natural Resources Division at the University of Guam are testing the effectiveness of a biological control agent, lady beetles (*Rhyzobius lophanthae*), at the Guam Wildlife Refuge. Tests are preliminary, and it is uncertain whether the beetle will serve as an effective control. Other biological control agents for the Asian cycad scale are currently being sought (Campbell 2005).

A single 20 to 25 m (70 to 80 ft)-tall tree of *Elaeocarpus joga* towered over the shorter-statured canopy of the limestone forest in the Mount Alifan unit. This particular tree grows in the southeast corner of the unit, near the park boundary. A collection of an *Elaeocarpus* sp. was also made in this unit (Collection 608.1, 608.2; NPS accession number WAPA-00268, catalog number WAPA 3546). Unlike the typical oblong leaves of *E. joga*, the leaves from this specimen were larger, ovate in shape, and had fewer veins that ended about one-third from the leaf margin. No fertile parts were found at the time of collection. However, domatia-like glands present in the vein axils confirmed the genus.

Riverine community

The Mount Alifan unit includes the headwaters of Togcha River, located in the northern third of the unit. The water flows freely from the inland reaches of the tributaries, reaching a depth of one meter (three feet) in some parts of the river (Figure 35). The vegetation that lines the river system is similar to that found in the Asan Inland unit, with a few exceptions. In the Mount Alifan unit, we discovered *Ixora finlaysoniana*, *Jasminum multiflorum*, and *Zingiber zerumbet* in a rather moist section of the river. We did not observe these species in any other park unit. We also found several large, fertile examples of *Angiopteris evecta* along the riverbank with young plants restricted to the vertical soil-covered banks close by. The moist, shady areas sustain *Belvisia spicata*-covered coconut trees and a variety of shade-tolerant grasses. The low-lying marshy areas of this river system support dense *Phragmites karka* grassland. *Bambusa vulgaris* is a common bamboo found along the banks of Togcha River.



Figure 35. Riverine community along Togcha River. Mount Alifan unit, War in the Pacific National Historical Park, Guam.

Savanna

The lower-elevation areas of Mount Alifan unit are comprised of savanna with remnant forest and shrubs in the gulches (Figure 36). The vegetation community there is very similar to that found in savanna regions in other park units. Some of the commonly observed native savanna plants include *Dicranopteris linearis*, *Dimeria chloridiformis*, *Fimbristylis tristachya*, *Miscanthus floridulus*, *Phragmites karka*, *Premna obtusifolia*, *Scaevola sericea*, and *Timonius nitidus*. Non-native plants such as *Hyptis capitata*, *Pennisetum polystachyon*, and *Waltheria indica* were also present. Common isolated trees of *Leucaena leucocephala* and *Casuarina equisetifolia* grew in the savanna as well. Less common shrub species observed in Mount Alifan unit include the Mariana Island endemic *Phyllanthus saffordii* and the indigenous species *Melastoma malabathricum* var. *mariannum* and *Myrtella bennigseniana*. We observed *Phyllanthus saffordii* in the upper elevation parts of the savanna in isolated clusters of a few to dozens of individuals. *Melastoma malabathricum* var. *mariannum* and *Myrtella bennigseniana* were both uncommon species growing in the upper elevations of the savanna.



Figure 36. Western slope of Mount Alifan, view of savanna and limestone forest in the upper elevation areas. Mount Alifan unit, War in the Pacific National Historical Park, Guam.

We discovered non-native plants, including *Dioscorea alata* and *Dioscorea rotundifolia*, and one native plant that we observed only in this unit. One unidentified individual of *Dioscorea* sp. was observed in the moist areas of the savanna and a photo of it was taken (image filename: diosp.ma.07092004.jpg). We observed *Dioscorea rotundifolia* along the northeastern boundary of the park adjacent to a residence. We included it here because of the potential for it to spread in the park as observed on other Pacific Islands (Herbarium Pacificum 1996, Space and Flynn 2000, Space et al. 2000, Space et al. 2003). Not far from the boundary, we observed a few trees of the non-native legume, *Albizia lebbek*, in a depression in a small side-gulch (subgulch) of Togcha River. While walking uphill toward the peak of Mount Alifan, we found a patch of *Sorghum halepense* growing in clay soil in the transition area between savanna and limestone forest. This is the only unit where we found this species. A single individual of langayao, or swamp fern (*Acrostichum aureum*), was found in a wet depression near a spring opening along the upper edge of the savanna, just downslope from the limestone forest. Again, this was the only individual of this native fern that we observed during the survey.

A few plants of an uncommon indigenous aster, *Glossocardia tenuifolia*, were discovered only on a savanna ridge inland from Oceanview Middle School, where large sections of the ridge had eroded away. The plants were of short stature, not more than 23 cm (nine inches) tall, and growing in full sun on the edge of erosional scars where competitive grasses appeared to be less abundant. Because of the potential for taller, more aggressive

grasses to outcompete *Glossocardia tenuifolia* in its native habitat, the careful elimination of competitive species is recommended.

The Mount Alifan unit is located adjacent to a number of villages. The entire region has seen a long history of human use and the national park boundary for this unit is not obvious. Thus, it was not surprising to find plantings of food plants and ornamentals such as *Annona muricata*, *Ananas cosmosus*, *Cucurma longa*, *Cocos nucifera*, and *Allamanda cathartica* in the low-elevation parts of the unit. The three former species were found only in this park unit.

DISCUSSION

The botanical inventory of WAPA revealed the average nativity of its park units (45%) is comparable to that found in the rest of Micronesia (55%; Fosberg et al. 1979, 1982, 1986). The survey identified three areas of limestone forest that held the most significant botanical resources (Mount Alifan, Fonte Plateau, and Asan Inland units). These hotspots of diversity at WAPA comprise a small percentage of limestone forest on Guam, and although the remnant limestone forests in WAPA are important for preserving biological diversity within park units, they have a limited contribution towards the overall conservation of that unique habitat on Guam. The value, however, is reflected in the NPS mission "...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (National Park Service Organic Act, 16 U.S.C.1.). The native-dominant limestone forest portions of Fonte Plateau forest hold an array of unique species not found elsewhere in the park and its value as an interpretive site is discussed in the Natural Resources Interpretation section below.

Qualitative assessments of survey findings infer survey success, though it is possible that not all species that could be detected were found, for a number of reasons. Some reasons include the surveyors' unfamiliarity with Guam's flora, inclement weather that made locating plants difficult, the lack of fertile plant parts to make a definitive identification, and the fact that not all areas could be surveyed within the time frame or due to inaccessibility. Additionally, the surveys were conducted in the summer months of June and July, and it is likely that plants that flower at other times of the year were missed. Since this is a preliminary survey of the park's vegetation, it is probable that additional species will be discovered with further survey. As additional species are discovered, vouchers should be collected and placed in the WAPA herbarium collection for documentation.

This initial survey provides interested parties with the most current and complete plant species list for WAPA and represents a basis for the development of short- and long-term monitoring programs for WAPA. Some general recommendations about additional collections, additional surveys, and management directives follow.

SUMMARY AND RECOMMENDATIONS

Additional Collections

As indicated in this report, fieldwork was conducted in the rainiest month of 2004 in recorded history in Guam and followed in the wake of two tropical storms. It was sometimes difficult to collect plants with undamaged and complete plant parts. Plant collections were made during a short time period between mid-June and mid-July, when not all plants were reproductively active or were out of season. Therefore, collections of undamaged, fertile plant specimens during different times of the year are highly recommended. Collections made at different times of the year will also allow researchers to obtain a complete phenological picture of the plant species on Guam.

For several plant taxa, neither specimen nor image vouchers were obtained. While not considered the highest priority because a reported sighting exists, it is important to have voucher specimens, especially for empirical documentation and educational purposes. Table 3 lists the species for which collection of vouchers are recommended, the unit(s) in which the plants were observed, and notes regarding the observation(s) to facilitate future collections.

Table 3. Species for which collection of vouchers is recommended.

Species	WAPA Unit(s)	Notes
<i>Calophyllum inophyllum</i>	Agat, Asan Beach	Indigenous species; A common landscape plant at WAPA
<i>Canavalia cathartica</i>	Asan Beach	Plants destroyed in Tropical Storm Tinting in 2004; No individuals observed in 2005
<i>Cocos nucifera</i>	All units, except Mt. Chachao-Mt. Tenjo	Indigenous species; A common landscape plant at WAPA
<i>Cucurbita</i> sp.	Asan Inland	Individual apparently mowed; No individuals observed in 2005
<i>Dypsis lutescens</i>	Asan Beach	Cultivated palm
<i>Eupatorium odoratum</i>	All units	Common non-native plant
<i>Euphorbia cyathophora</i>	Fonte Plateau	Observed on inaccessible cliffs
<i>Ipomoea indica</i>	Asan Beach	Common non-native plant
<i>Miscanthus floridulus</i>	Asan Inland, Fonte Plateau, Mt. Alifan, Mt. Chachao-Mt. Tenjo, Piti Guns	Common non-native plant
<i>Nephrolepis multiflora</i>	Asan Beach	Common fern
<i>Nerium oleander</i>	Agat	Cultivated tree
<i>Persea americana</i>	Asan Inland, Mt. Alifan	Cultivated tree

Species	WAPA Unit(s)	Notes
<i>Plumeria obtusa</i>	Agat, Asan Inland	Cultivated tree
<i>Tabebuia rosea</i>	Fonte Plateau	Cultivated tree
<i>Tradescantia spathacea</i>	Asan Inland	Cultivated herb

During the course of the survey, Jenny Drake and I observed and collected plants that we were unable to identify. Many of these plants were unidentifiable because they lacked reproductive structures crucial for their identification. Table 4 lists the unidentified species for which collections of fertile specimens are recommended. Because I was unable to find examples of these plants at the University of Guam or Bishop Museum herbaria, collections of these plants are considered a high priority. Dr. Lynn Raulerson at the University of Guam, botanists at Bishop Museum, or taxon experts throughout the world can assist park staff in making definitive identifications in the future.

Table 4. Unidentified species for which additional collections are recommended.

Taxon	WAPA Unit	Collection No. (specimens) or Image file name (images)	NPS Accession No.	NPS Catalog No.
<i>Crinum</i> sp.	Asan Beach	crisp.ab.06192004.jpg	N/A	N/A
<i>Derris</i> sp.	Piti Guns	216-1, 216-2	WAPA-00268	WAPA 3133
<i>Dioscorea</i> sp.	Mt. Alifan	diosp.ma.07092004.jpg	N/A	N/A
<i>Elaeocarpus</i> sp.	Mt. Alifan	608-1, 608-2	WAPA-00268	WAPA 3546
<i>Schefflera</i> sp.	Mt. Chachao-Mt. Tenjo	694-1, 694-2	WAPA-00268	WAPA 3638
Unidentified sp22	Fonte Plateau	unidentifiedsp22.fp.06252004.3.jpg	N/A	N/A
Unidentified sp29	Fonte Plateau	461	WAPA-00268	WAPA 3392
Unidentified sp36	Piti Guns	unidentifiedsp36.pg.06242004.1.jpg	N/A	N/A

Given the location of Guam within the typhoon belt, sending duplicate specimens to other herbaria that specialize in the flora of the Pacific, such as the Bishop Museum on Oahu, to avoid the loss or damage of collections is important. The presence of Guam plant specimens at other herbaria is also useful to researchers, plant taxonomists, and others studying the distribution and/or genetic or morphological variability of the taxa. Therefore, sending the Bishop Museum or another repository duplicate specimens of plants collected on Guam is highly recommended.

Although vegetation maps were not a product of this report, vegetation maps are an important tool for natural and cultural resource managers. These maps may be created using remote sensing now available at the I&M office and ground truthed by field staff if additional funding can be secured.

Management Suggestions

Natural Resource Protection

Several relatively intact natural areas at WAPA warrant protection. Of particular note are the limestone forests of Mount Alifan, Fonte Plateau, and Asan Inland units that would benefit from active management, including maintenance and enhancement. The Mount Chachao-Mount Tenjo unit supports the greatest percentage of native species in the park (56%, 66 natives out of 117 total). We found significant plant species there that do not occur elsewhere in WAPA. The plants in this unit are subject to trampling and damage by off-road vehicles, especially species confined to the clay soils along the ridge trail and jeep road. The most pressing threats to the plants within this unit are discussed in the following Threat Management and Monitoring section.

WAPA is also home to several plant species that are relatively uncommon, rare, or particularly vulnerable to animal and human threats. *Intsia bijuga* (ifit, ifil) is the territorial tree of Guam. It is an uncommon indigenous tree found in the limestone forests of Mount Alifan, Asan Inland, and Fonte Plateau units and rare in the Asan Beach unit. Ifit is a culturally significant species and warrants protection in the park, especially in the Mount Alifan unit where large, fertile trees still exist. The wood of this species is highly prized on Guam for its rich-colored bark and is often used in local woodcarvings. This tree produces one of the most valuable timbers in Southeast Asia. The species has been exploited so intensively that very few natural stands remain, and it is considered Threatened in Indonesia, Vulnerable in the Philippines, and Extinct in other regions (Tree Conservation Information Service 2005). Its large, caesalpinoid flowers make it an excellent candidate for use in landscaping.

Interestingly, Guam's territorial flower is *Bougainvillea spectabilis* (puti tai nubio), which is not native to Guam, but is a commonly planted roadside ornamental. Individuals of this species were found in Agat (Gaan Point subunit), Asan Beach, Asan Inland, and Piti Guns units, although they were uncommon. Because of its cultural significance, this plant will likely continue to be used as a landscape ornamental, essentially ensuring its preservation.

A single plant of *Cerbera dilitata* was discovered in a subgulch in the west branch of Asan River in the Asan Inland unit. Although this Mariana Island endemic grows in other parts of Guam, it is an uncommon species. We did not identify any direct threats to this individual, except fire (discussed below). Because it is the only example of this species in the park, the individual warrants protection.

Threat Management and Monitoring

Fire

Through direct habitat destruction, fire exposes soils to the elements, which results in the erosion of topsoil (Minton 2005). The savanna grasses on Guam provide enough fuel to support vegetation-altering fires. Since a large percentage of the WAPA units is savanna, especially in the Asan Inland, Piti Guns, Mount Chachao-Mount Tenjo, and Mount

Alifan units, fire is potentially the most destructive habitat modifier at present. Preventing intentional or unintentional human-set fires would do much to preserve the native plants in the savanna as well as plants found in ravine forests, which are also exposed to fires along their edges. Plants such as *Cerbera dilitata*, a Mariana Island endemic in the Asan Inland unit, and unique plants found along the summit ridge in the Mount Chachao-Mount Tenjo unit are especially vulnerable to fires. Monitoring and mitigating the effects of fire and subsequent erosion in the savannas should be a high priority. Monitoring fire impacts in the park should be conducted in such a way that the results can be extrapolated to other parts of the island, as fire and erosion are also severe problems elsewhere on Guam. The National Park Service might consider active restoration of burned areas if natural revegetation is unlikely.

Ungulates

We did not observe pigs (*Sus scrofa*) during the survey, although we saw and heard evidence of them. During the 2004 surveys, we discovered pig wallows in two park units, Fonte Plateau and Piti Guns (Figure 40). The hoof prints suggested single adult pigs visited the wallows. As shown in Figure 40, pigs root groundcover, exposing soils to erosion. Although these wallows covered a relatively small area compared to soils exposed by fire, they have a direct impact on vegetation and warrant further monitoring. We heard large animals in the underbrush but were unable to determine if they were pigs or monitor lizards (*Varanus indicus*). Although Philippine deer (*Cervus mariannus*, binadu) have been periodically sighted in the park (D. Minton, personal communication, Sept 20, 2005), none were observed during the survey.



Figure 40. Pig wallow. Piti Guns unit, War in the Pacific National Historical Park, Guam.

Non-native plants

The majority of the plant taxa at WAPA are non-native, although percent nativity differs among units. There are 214 non-native plant taxa at WAPA (units combined), which represents over half (55%) of the total plant taxa in the park. A few of the non-native plant species that we observed, such as *Leucaena leucocephala* and *Panicum maximum*, were widespread and appeared to be aggressive occupiers of disturbed habitat. We observed robust individuals of these species in limestone forests, though their distributions were limited to light gaps and other open, disturbed areas. Individuals of *Leucaena leucocephala* were found in shaded sites but those examples were spindly and did not appear to thrive. Two non-native vines, *Antigonon leptopus* and *Passiflora foetida*, were the only widely distributed species that occupied disturbed sites as well as relatively intact areas. These species were primarily limited to the canopies of native and non-native trees with frequent and intense exposure to sun and were rarely observed in the subcanopy. *Cestrum diurnum* is a non-native plant that was observed in the Mount Chachao-Mount Tenjo unit. Although it is common in other areas of Guam, only a single individual was observed on Mount Tenjo. It is considered invasive on this island and in Hawaii and should be removed.

The management of well-established non-native plants can be expensive and time-consuming as demonstrated by control programs across the country. It would behoove the NPS to eliminate incipient populations of invasive species (both plant and animal) as the costs are significantly less and require substantially less time than extirpating established populations. To identify and remove any new populations of invasive plants before they become a problem in the park, monitoring new introductions is highly recommended.

Typhoons

Typhoons repeatedly disturb and destroy vegetation cover and are particularly destructive to Guam's native vegetation in limestone forests. Although the native plants on Guam may be uniquely adapted to such repeated devastating stochastic events, they are susceptible to displacement by aggressive non-native plants after a typhoon or tropical storm. Light gaps (large openings in vegetation cover), created by falling trees during a typhoon, may provide suitable conditions for aggressive non-native plants to effectively out-compete natives in areas of forest they may not normally inhabit. Therefore, monitoring the effects of typhoons on native and non-native plant cover is recommended.

Unexploded ordnance

It is likely that unexploded ordnance, like the one discovered during the survey, remain on the slopes of Mount Alifan bordering the U.S. Naval Magazine. Care should be taken not to approach, kick, step on, or touch metal objects when surveying this and other units of the park. If suspect objects are observed, record the location, obtain a GPS coordinate, flag the site with flagging tape (if appropriate), and notify park authorities. The limestone forest in the Mount Alifan unit remains fairly intact, as demonstrated by the percent of native species that were observed. The proximity to the naval magazine, presence of unexploded ordnance, and relative inaccessibility, however, may prevent this area from being widely utilized by the public or may limit management actions. This area should be considered off-limits to the public and untrained national park staff until Explosive Ordnance Detachment personnel can clean the area of unexploded bombs and other

hazardous debris. After the cleanup, restoration of the forest through the removal of invasive non-native plants and animals would be appropriate as vegetation in this area has the greatest potential for recovery of any unit in the park.

Lack of pollinators

With the demise of Guam's native bird and fruit bat populations through predation by brown tree snakes and other factors, the native plants of Guam may have lost important pollinators or dispersal mechanisms. Research on pollination syndromes is necessary to determine the effects of these losses.

Visitor impacts

Visitor impact on the vegetation at Asan Beach, Piti Guns, and Agat units is likely to be minimal because visitor traffic appeared to be limited to the WWII monuments and artifacts. In addition, there were no significant or sensitive species at any of those sites. For the other units, however, there is a high potential for impact, especially at the Mount Chachao-Mount Tenjo unit where recreational off-road vehicle traffic could crush native plants. During the survey, we observed off-road vehicle trails through the vegetation alongside established jeep roads as drivers presumably attempted to avoid the slippery mud in the road. These newly established trails are likely to expand the erosional scars that already exist and further degrade the habitat in this unit. Limiting off-road vehicle access to the summit road, along which many of the uncommon native plants grow, should reduce the direct damage to plants and the indirect negative impacts from erosion, dispersal of aggressive non-native plants, unintentional fires from vehicle catalytic converters, etc. A sign at the trailhead, identifying the route to Mount Tenjo as part of the national park, might help deter some damaging activities in the area. The other units (Asan Inland, Fonte Plateau, and Mount Alifan) do not share the same recreational use as Mount Chachao-Mount Tenjo unit. However, visitor impacts in these units might include inadvertent trampling of uncommon indigenous or endemic species and illegal collection of attractive or culturally useful natives.

Incompatible development

Park staff has documented construction of homes on national park land in recent years (D. Minton, personal communication, July 2, 2004). During our survey we discovered private structures on park property, some of which were inhabited. Although some legally held private land is within park boundaries, not all of these dwellings are legal. I suggest monitoring to prevent such illegal, incompatible development.

Natural Resource Interpretation

Of the seven park units, the Fonte Plateau unit is, by far, the most promising area for interpretation of WAPA's natural terrestrial resources. This unit's diverse limestone forest holds an array of unique species not found elsewhere in the park. The area also supports interesting native plants in the relatively flat area in the northeast corner of the unit. The substrate there is primarily of volcanic soils over limestone. This area could accommodate a nature trail meandering to the limestone forest in the steeper parts of the unit. The overlook offers a fantastic and clear view of Maina, the US Naval Hospital, and the village of Hagatna beyond. Alupat Island, Oka Point, and Tamuning can be seen in the distance as well (Figure 41). Besides the rich botanical resources there, the site

already supports the infrastructure for a visitor destination. There are established landscape trees and sturdy benches in good condition. The unit itself is located in the center of the island and accessible via a short drive for most visitors. The unit is within a five-minute drive from Hagatna, the business center of the island. The interpretive function of this site would enhance the interpretation of the cultural resources of the Fonte Plateau unit located about 750 m (0.5 mi) away.



Figure 41. Fonte Plateau Overlook. Fonte Plateau unit, War in the Pacific National Historical Park, Guam.

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APPENDIX. PLANT CHECKLIST FOR WAPA

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)							
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT

FERN ALLIES

LYCOPODIACEAE

Lycopodiella cernua (L.) Pic. Serm.	Lycopodium cernuum L.	staghorn clubmoss	I						C		C	C	
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PSILOACEAE

Psilotum nudum (L.) Beauv.		whisk fern	I					U	U		U		U
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FERNS

ASPLENIACEAE

Asplenium nidus L.		bird's nest fern, galak	I						C		U		
Asplenium polyodon G. Forst.		sicle spleenwort	I							U			

BLECHNACEAE

Blechnum orientale L.			I									U	
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DENNSTAEDIACEAE

Microlepia speluncae (L.) T. Moore		limpleaf fern	I						R				
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DRYOPTERIDACEAE

Tectaria crenata Cav.			I						U		U		
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GLEICHENIACEAE

Dicranopteris linearis (Burm.) Underwood		mana	I						C		C	C	C
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LINDSAEACEAE

Lindsaea ensifolia Sw.		graceful necklace fern	I						C			C	C
Sphenomeris chinensis (L.) Maxon			I									U	

MARATTIACEAE

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)										
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG		
<i>Angiopteris evecta</i> (J.R. Forst.) Hoffmann		Giant fern, Madagascar tree fern, mule's foot, oriental vessel fern	I									U	U	

NEPHROLEPIDACEAE

<i>Nephrolepis biserrata</i> (Sw.) Schott		giant swordfern	I						C	C				C
<i>Nephrolepis hirsutula</i> (J.R. Forst.) K. Presl		scaly swordfern	I						C	C	C	C		
<i>Nephrolepis multiflora</i> (Roxburgh) C.V. Morton		Asian sword fern	I				C							
<i>Nephrolepis multiflora</i> X <i>biserrata</i>			I								C			

POLYPODIACEAE

<i>Acrostichum aureum</i> L.		Swamp fern, golden leatherfern, langayao	I									R		
<i>Antrophyum plantagineum</i> (Cav.) Kaulf.			I						U		U			
<i>Belvisia spicata</i> (Linnaeus f.) Mirbel ex Copeland	<i>Belvisia mucronata</i> (Fee) Copeland		I									U	U	
<i>Davallia solida</i> (Forster f.) Swartz		pugua-machena	I						C	C	U	U	U	
<i>Phymatosorus grossus</i> (Langsd. & Fisch.) Brownlie	<i>Polypodium scolopendria</i> Burm. f.	monarch fern	I	C	C		C	C	C	C	C	C	C	C
<i>Polypodium punctatum</i> (L.) Swartz		bird's nest fern, galak	I						U		U			
<i>Pyrrhosia lanceolata</i> (L.) Farw.			I	+	U	U	C	U	U	C	U			

PTERIDACEAE

<i>Adiantum philippense</i> L.			I						C					
<i>Adiantum tenerum</i> Sw.		fan maidenhair	N						C					C
<i>Cheilanthes tenuifolia</i> (Burm. f.) Swartz			I						U		C	U	U	
<i>Pityrogramma calomelanos</i> (Linnaeus) Link			I						+	?	*			

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Pteris ensiformis</i> Burm. f.		slender brake	I								U	U	
<i>Pteris quadriaurita</i> auct. non Retz.	<i>Pteris plumula</i> Desv.		I					C			U	U	
<i>Pteris spinescens</i> Presl.			I					C			U	U	
<i>Pteris tripartita</i> Sw.		giant brake	I						U	U			
<i>Pteris vittata</i> L.		Chinese brake, ladder brake	N	+	*		U		U	U	U		U

SCHIZAEACEAE

<i>Lygodium auriculatum</i> (Will.) Alston			I						U				R
<i>Lygodium microphyllum</i> (Cav.) R. Br.		Old World climbing fern, small leaf climbing fern	I						C		C	C	U

THELYPTERIDACEAE

<i>Christella parasitica</i> (L.) H. Lev.	<i>Thelypteris parasitica</i> (L.) Fosberg	parasitic maiden fern	I						C		U	C	C
<i>Cyclosorus interruptus</i> (Willd.) H. Ito	<i>Thelypteris interrupta</i> (Willd.) K. Iwats.		I						U				
<i>Thelypteris guamensis</i> (Holttum) Fosberg & Sacht	<i>Christella guamensis</i> Holtt.		I						U			U	
<i>Thelypteris opulenta</i> (Kaulfuss) Fosberg		jeweled maiden fern	I						U	U	U	C	C
<i>Thelypteris torresiana</i> (Gaudichaud) Alston			I						+	*			
<i>Thelypteris unita</i> (L.) C.V. Morton			I						U			U	

VITTARIACEAE

<i>Vittaria incurvata</i> Cavanilles			I								R		
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GYMNOSPERMS

CYCADACEAE

<i>Cycas circinalis</i> L.	<i>Cycas micronesica</i> KD Hill	cycad, fadange, federico,	I	U							U	U	
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Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
		queen sago											

DICOTYLEDONS

ACANTHACEAE

<i>Asystasia gangetica</i> (L.) T. Anderson		Chinese violet, coromandel	N		R								
<i>Blechum pyramidatum</i> (Lam.) Urban	<i>Blechum brownei</i> Juss. f. <i>puberulum</i> Leonard		N		U	C	C	U					
<i>Graptophyllum pictum</i> (L.) Griff.		caricature plant, San Francisco	N	U									
<i>Hemigraphis reptans</i> (G. Forst.) T. Anders.		redflame	N					C		U			U

AMARANTHACEAE

<i>Achyranthes aspera</i> L. var. <i>aspera</i>		chichitun, devil's horsewhip, lasagado, lasocata, prickly chafflower	I	U									
<i>Gomphrena serrata</i> L.		arrasa con todo	N		C	A	C	C					

ANACARDIACEAE

<i>Mangifera indica</i> L.		mangga, mango	N			U		C	C	U			U
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ANNONACEAE

<i>Annona muricata</i> L.		languana, laguanaha, soursop	N								U		
<i>Annona reticulata</i> L.		annonas, Bullocks heart, custard apple	N			U	C	U	C	U			
<i>Annona squamosa</i> L.			N	+	*								U
<i>Cananga odorata</i> (Lam.) J.D. Hook & Thomson		alangilang, ilangilang, lenileng	N						C				

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
Guamia mariannae (Saff.) Merr.		paipai, pacpac	E								C		

APIACEAE

Centella asiatica (L.) Urban			I						U		U	U	
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APOCYNACEAE

Allamanda cathartica L.	Allamanda hendersonii Bull ex Dombrain	allamanda	N						U		U		C
Cerbera dilitata Markgraf		chiute	E						R				
<i>Neisosperma oppositifolia</i> (Lam.) Fosb. & Sachet (locally accepted scientific name)	Ochrosia oppositifolia (Lamarck) K. Schumann; Cerbera oppositifolia L.	fago, fagot	I							U	C		
Nerium oleander L.		adelfa, oleander, rosa-laurel	N			U							
Plumeria obtusa L.		frangipani, plumeria, Singapore graveyard flower	N			U			C				

ARALIACEAE

Polyscias grandifolia Volk.		pepega	I						U	U			
Schefflera sp.			U									R	

ASCLEPIADACEAE

<i>Telosma cordata</i> (N.L. Burman) Merrill		rubbervine, Chinese violet, fragrant telosma, tonkin creeper	N							U			U
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ASTERACEAE

<i>Bidens alba</i> (L.) DC.		beggar tick, Guam daisy, romerillo, Spanish needle	N	C	A	A	C	C	C	C	C	C	C
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Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
Calyptocarpus vialis Lessing			N	Enc*									
Conyza canadensis (L.) Cronq.		Canadian horseweed, horseweed, horseweed fleabane, mares tail	N				U	U				U	C
Cyathillium cinereum (L.) H. Rob.	Vernonia cinerea (L.) Less.	Asian ironweed, little ironweed, purple fleabane	N	C	C	C	C						
Eclipta prostrata (L.) L.	<i>Eclipta alba</i> (L.) Hassk.	titima	N		U	U	U						
Elephantopus mollis Kunth		papago halomtano, papago vaca	N		C	C		C				C	C
Emilia sonchifolia (L.) DC.		lilac tasselflower	N				U	U				U	
Epaltes australis Lessing			N						+	*			
Erigeron bellioides de Candolle			N	Enc*									
Eupatorium odoratum L.	<i>Chromolaena odorata</i> (L.) King & H.E. Robins.	Eupatorium, Jack in the bush, masigsig, Siamweed	N	C	A		C	C	C	C	C	U	C
Glossocardia tenuifolia (Labill.) Cassini	<i>Glossogyne tenuifolia</i> (Labill.) Cass. ex. Less.		I									R	
Mikania micrantha Kunth	Mikania scandens (L.) Willd.	bittervine, Chinese creeper, kwalo koburu, liane americaine, mile-a-minute	N	C	C	C	C	C	C	C	C	C	C
Pluchea carolinensis (Jacq.) G. Don			N							R			
Pluchea indica (L.) Less.		Indian camphorweed, Indian fleabane, Indian	N				U						

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
		pluchea											
Sphagneticola trilobata (L.) Pruski	<i>Wedelia trilobata</i> (L.) A.S. Hitchc.	bay biscayne creeping-oxeye, wedelia	N	C	C	C	C	C	C	C	U		C
Synedrella nodiflora (L.) Gaertn.		saigon	N			C	C						U
Tridax procumbens L.		coat-buttons, tridax, wild daisy	N				C	C	C				C

BIGNONIACEAE

<i>Catalpa longissima</i> (Jacq.) Dum.-Cours.		Haitian catalpa, yokewood	N							U			
Spathodea campanulata Beauv.		African tulip tree	N					C	C				C
<i>Tabebuia pallida</i> (Lindley) Miers	<i>Tabebuia heterophylla</i> (DC.) Britt.		N					U	U	U			C
<i>Tabebuia rosea</i> (A. Bertoloni) A.P.de Candolle	<i>Tabebuia pentaphylla</i> (DC.) Hemsl.	pink tabebuia, rosy trumpet tree	N										U
<i>Tecoma stans</i> (Linnaeus) Jussieu ex Humboldt, Bonpland, & Kunth		yellow-elder	N	R*									

BIXACEAE

<i>Bixa orellana</i> L.		achiote, anatto, lipstick plant	N							U			
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BOMBACACEAE

<i>Ceiba pentandra</i> (L.) Gaertn.		algodon de manila, Kapok tree	N						U				R
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BORAGINACEAE

<i>Cordia subcordata</i> Lam.		niyoron	I				U						
<i>Heliotropium procumbens</i> P. Mill.		four-spike heliotrope, huning-tasi	N	C		C	C						
<i>Tournefortia argentea</i> L. f.		hunig, velvetleaf soldierbush	I				U						

BROMELIACEAE

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
Ananas cosmosus (L.) Merrill		pina, pineapple	N								R		

BUDDLEJACEAE

Buddleia asiatica Lour.		putting, dogtail	N						R				
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CACTACEAE

Nopalea cochenillifera (L.) Salm-Dyck			N				R						
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CAMPANULACEAE

Hippobroma longiflora (L.) G. Don		madamfate, star-of- Bethlehem	N						U	U	C		
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CARICACEAE

Carica papaya L.		papaya, pawpaw	N	C		C	C	C	C	C	U		C
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CASUARINACEAE

Casuarina equisetifolia L.		Australian pine, gago, gagu, ironwood	I			C	C	C	C	C	C	U	C
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CELASTRACEAE

Maytenus thompsonii (Merr.) Fosb.		luluhut	E							U			
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CLUSIACEAE

Calophyllum inophyllum L.		Alexandrian laurel, da'og, da'ok, palomaria	I	R	C		C						
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COMBRETACEAE

Conocarpus erectus L.			N		En c*								
Terminalia catappa L.		talisai	I	U					C	C	U		

CONVOLVULACEAE

<i>Ipomoea indica</i> (Burm. f.) Merr.		blue morning glory	I				C						
<i>Ipomoea littoralis</i> Blume		lagun-tasi, whiteflower beach morning glory	I						C		C		

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Ipomoea obscura</i> (L.) Ker-Gawl.		obscure morning glory	N			C	C	U					C
<i>Ipomoea pes-capre</i> (L.) R. Br.		alalag-tasi, beach morning glory	I	C	C	C	C				U		C
<i>Ipomoea triloba</i> L.		fofgu-sabana, littlebell, three-lobed morning glory	N		C	C	C				C	C	C
<i>Merremia gemella</i> (Burmans filis) Hallier filis			N					Enc*					
<i>Operculina ventricosa</i> (Bertero) Peter		alalag	N					C	U	U			
<i>Stictocardia tiliifolia</i> (Desr.) Hallier f.		abubo, spottedheart	N					C	C	U			C

CUCURBITACEAE

<i>Cucurbita</i> sp.			U						U				
<i>Luffa aegyptiaca</i> P. Mill.	<i>Luffa cylindrica</i> (L.) M. Roemer	pachodag, vegetable sponge	I		U	U		C					
<i>Momordica charantia</i> L.		almagosa, atmagoso, balsam-apple, bitter melon	N				C	C	C				C

ELAEOCARPACEAE

<i>Elaeocarpus joga</i> Merrill		yoga	I								R		
<i>Elaeocarpus</i> sp.			U								U		

EUPHORBIACEAE

<i>Chamaesyce hirta</i> (L.) Millsp.		golondrina	N	C	C	A	C		C			U	C
<i>Chamaesyce hypericifolia</i> (L.) Millsp.		graceful sandmat, graceful spurge	N		C	C	C		C				C
<i>Chamaesyce prostrata</i> (Ait.) Small		bodulagas-chaca, prostrate sandmat, prostrate spurge	N				U						

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)										
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG		
<i>Chamaesyce thymifolia</i> (L.) Millsp.		gulf sandmat	N		C	C								C
<i>Codiaeum variegatum</i> (L.) Blume		buena vista, croton, leston puyitos, San Francisco	N				U	U						C
<i>Euphorbia cyathophora</i> Murr.		dwarf poinsettia, fire on the mountain	N							U				
<i>Euphorbia heterophylla</i> L.		Mexican fireplant, painted euphorbia	N	C		U	C	C	C					C
<i>Glochidion marianum</i> Muell.-Arg.		abas duendes, chosga, chosgo	E				C	C	C	C	C	C	C	C
<i>Jatropha integerrima</i> Jacq.		peregrina	N											U
<i>Macaranga thompsonii</i> Merrill		pengua	E							U				
<i>Manihot esculenta</i> Crantz		cassava, mendioka, tapioca	N						U	C	U			C
<i>Melanolepis multiglandulosa</i> (Reinwardt) Reichb. f. & Zoll. var. <i>glabrata</i> (Muell.-Arg.) Fosb.		alom	I				U	U	U	U				
<i>Phyllanthus acidus</i> (L.) Skeels		iba, Tahitian gooseberry	N				+							
<i>Phyllanthus debilis</i> Klein ex Willd.	<i>Phyllanthus amarus</i> Schumacher	carry me seed, maigo-lalo	N	C	C	C	C			C	U			C
<i>Phyllanthus marianus</i> Muell.-Arg.		gaogao-uchan	I	+						U				
<i>Phyllanthus saffordii</i> Merrill			E								C	U	U	
<i>Phyllanthus virgatus</i> Forst. f.			I		C									

FABACEAE

<i>Abrus precatorius</i> L.		coralbean, crab's eye, kolales halomtano, prayerbead	I							U	U			C
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Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Adenanthera pavonina</i> L.		coral bean tree, false wiliwili, kolales	N						U				
<i>Aeschynomene americana</i> L.		shyleaf	N		U	U	+				U	U	U
<i>Albizia lebeck</i> (L.) Benth.			N								U		
<i>Alysicarpus vaginalis</i> (L.) DC.		white moneywort	N		A	C	A	C	C	C	C	C	C
<i>Atylosia scarabaeoides</i> (L.) Benth.	<i>Cantharospermum scarabaeoides</i> (L.) Baillon		N								U	U	U
<i>Bauhinia monandra</i> Kurz		orchid tree, St. Thomas tree	N					C	C				C
<i>Calopogonium mucunoides</i> Desvaux												Enc *	
<i>Canavalia cathartica</i> Thou.			I				U						
<i>Canavalia rosea</i> (Sw.) DC.		akangkang-tasi, baybean, seabean	I	+	U		C	U					
<i>Crotalaria pallida</i> Aiton		smooth rattlepod	N		C	C							
<i>Crotalaria retusa</i> L.		rattleweed	N					C	U	C	C	C	C
<i>Cynometra ramiflora</i> L.		cynometra, gulos	I					R					
<i>Delonix regia</i> (Bojer ex Hook.) Raf.		arbol-del-fuego, flamboyant, flametree, poinciana	N	U	U					C	U		
<i>Derris elliptica</i> (Wallich) Benth.		bagin, derris, oiltree, tuba	N					U			U		
<i>Derris</i> sp.			U										U
<i>Derris trifoliata</i> Loureiro		bagin, threeleaf derris	I	C	C	C							
<i>Desmanthus pernambucanus</i> (L.) Thell.	<i>Desmanthus virgatus</i> (L.) Willd.	wild tantan	N	U			U		U	U			U

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)											
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG			
<i>Desmodium tortuosum</i> (Sw.) DC.		dixie tick trefoil, Florida beggarweed	N												U
<i>Desmodium triflorum</i> (L.) DC.		agsom, apsom, threeflower ticktrefoil	N	C	C	A	C	C	C				U		C
<i>Desmodium umbellatum</i> (L.) DC.		palaga hilitai	I				C						U		
<i>Entada phaseoloides</i> (L.) Merr.	Entada pursaetha De Candolle	bagogo, bayogon dagkulo, gayi, goye, lodusong, snuffbox-bean	I						+*	U	U				
<i>Erythrina variegata</i> L.		coral-tree, gabgab, gaogao, tiger's claw	I				U	U							
<i>Flemingia strobilifera</i> (L.) Ait. & Ait. f.		wildhops	N					U							C
<i>Indigofera suffruticosa</i> P. Mill.		anil de pasto, aniles, indigo, indigobush	N								U				R
<i>Intsia bijuga</i> (Colebr.) O. Kuntze		ifit, ifil, ipil	I	+*			R	U	U	U					
<i>Leucaena leucocephala</i> (Lam.) de Wit		tangan-tangan	N	C	A	A	C	C	C	U		C		C	
<i>Macroptilium atropurpureum</i> (Moc. & Sessé ex DC.) Urban		purple bush-bean	N			C	C								
<i>Mimosa pudica</i> L.		sensitive plant, shameplant	N	C	C		C	C	C	C	C	C	C		U
<i>Peltophorum pterocarpum</i> (DC.) Backer ex K. Heyne		copperpod, yellow flamboyant, yellow poinciana	N						C		U				C
<i>Pithecellobium dulce</i> (Roxb.) Benth.		kamachile	N	C		U	C	C	U	U					C
<i>Pueraria lobata</i> (Willd.) Ohwi			I					U							
<i>Samanea saman</i> (Jacq.) Merr.	Pithecellobium saman (Jacq.) Benth.	monkeypod, raintree	N		U		U		U	U					

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Senna alata</i> (L.) Roxb.		aculpulco, andodose. Candlebush, emperor's candlesticks, take-biha	N							U			
<i>Senna surattensis</i> (Burm. f.) Irwin & Barneby		glossy shower	N						R				
<i>Stylosanthes guianensis</i> (Aubl.) Sw.	<i>Stylosanthes erecta</i> Beauv.	Nigerian stylo	N		A		C	C	C			C	
<i>Teramnus labialis</i> (L. f.) Sprengel			N	U*					U				
<i>Zornia gibbosa</i> Span.			N									Enc*	

FLACOURTIACEAE

<i>Xylosma nelsonii</i> Merrill			E					U	U	U			
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GOODENIACEAE

<i>Scaevola sericea</i> Vahl	<i>Scaevola taccada</i> (Gaertn.) Roxb.	beach naupaka, nanaso	I		+			C	C	C	C	C	C
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HERNANDIACEAE

<i>Hernandia sonora</i> L. (locally accepted scientific name)	<i>Hernandia nymphaeifolia</i> (C. Presl) Kubitzki	nonag, nonak, oschal	I					U		C	U		
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LAMIACEAE

<i>Hyptis capitata</i> Jacq.		botones, false ironwort	N						U		C	U	C
<i>Hyptis pectinata</i> (Linnaeus) Poitier		mumutun lahi (male), m. palaoan (female), m. ademelon	N	+									
<i>Hyptis suaveolens</i> (L.) Poit.		mumutun, pignut, wild spikenard	N						C		U		C
<i>Ocimum tenuiflorum</i> L.	<i>Ocimum sanctum</i> L.	sacred basil, yerba buena	N				R						

LAURACEAE

<i>Cassytha filiformis</i> L.		agace, agase, agasi, mayagas	I						C	C	C	C	C
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Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Persea americana</i> P. Mill.		alegata, avocado	N						U		U		

LECYTHIDACEAE

<i>Barringtonia asiatica</i> (L.) Kurz		putting	I						U				
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LENTIBULARIACEAE

<i>Utricularia bifida</i> L.		bladderwort	I						+				
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LOGANIACEAE

<i>Geniostoma micranthum</i> A. DC.	<i>Geniostoma rupestre</i> J.R. & G. Forster	anasser, majlocjayo	I									U	
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LYTHRACEAE

<i>Ammannia multiflora</i> DC. var. <i>parviflora</i> Koehne			N			U							
<i>Pemphis acidula</i> Forst. & Forst.		nigas	I		+	U	U						

MALVACEAE

<i>Abelmoschus moschatus</i> Medik.	<i>Hibiscus abelmoschus</i> L.	kamang, musk okra	N									U	U
<i>Abutilon indicum</i> (L.) Sweet		No common name	N	+									
<i>Hibiscus rosa-sinensis</i> L.		gumamela, red hibiscus	N				C	U					C
<i>Hibiscus tiliaceus</i> L.		pago, hau (Hawaiian), sea-hibiscus	I	C	C	C	C	C	C	C	C	U	C
<i>Malvastrum coromendelianum</i> (L.) Garcke		three-lobed false mallow	N			U	U						
<i>Sida acuta</i> Burm. f.		common wireweed, escobilla adumelon, escobilla papago	N	C	C	U	C					U	
<i>Sida rhombifolia</i> L.		escobilla adumelon, escobilla apaka, escobilla dalili	N										U U

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Thespesia populnea</i> (L.) Soland. ex Correa		banalo, kilulu, kuluk, milo	I	C	C		C	C					
<i>Urena lobata</i> L.		dadangsi, dadangsi apaka, dadangsi machingat	N					U		U	U		

MELASTOMATACEAE

<i>Dissotis rotundifolia</i> (Sm.) Triana		pinklady	N								R		
<i>Medinilla rosea</i> Gaudichaud	<i>Medinilla medinilliana</i> (Gaud.) Fosb. & Sacht		E									U	
<i>Melastoma malabathricum</i> L. var. <i>marianum</i> (Naudin) Fosb. & Sacht (ined.)		gafau	I					U		C	C	U	

MELIACEAE

<i>Aglaiia mariannensis</i> Merrill		mapunao, mapunyao	E					U	U	U			
<i>Swietenia macrophylla</i> King		Broad-leaved mahogany, mahogany	N				C						C
<i>Xylocarpus moluccensis</i> (Lamarck) Roemer		Lalanyok, lalanyog, cannonball- tree	I				+						

MENISPERMACEAE

<i>Tinospora homosepala</i> Diels			E				R						
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MORACEAE

<i>Artocarpus altilis</i> (Parkinson) Fosb.		breadfruit, lemae, rimae	N				C	U		U			
<i>Artocarpus heterophyllus</i> Lam.			N	En c*									
<i>Ficus benjamina</i> L.			N					R					
<i>Ficus elastica</i> Roxb. ex Hornem.		Indian rubber tree, Indian rubber fig, Indian rubberplant	N	R			U						
<i>Ficus microcarpa</i> L. f. var. <i>saffordii</i> (Merr.) Corner	<i>Ficus saffordii</i>	Chinese banyan,	I						C	+	?	*	

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
	Merr.	laurel fig, nunu											
<i>Ficus prolixa</i> Forst. f.		nunu	I	+						U		U	
<i>Ficus tinctoria</i> Forst. f. var. <i>neo-ebudarum</i> (Summerh.) Fosb.		Dyers' fig, hoda, hodda, hotda, tagete	I	R*	U	U	U	U	U			U	

MORINGACEAE

<i>Moringa oleifera</i> Lamarck		Horseradish tree	N			R							
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MYRTACEAE

<i>Decaspermum fruticosum</i> J.R. & G. Forster			I					U				U	
<i>Eugenia javanica</i> Lam.		macupa, wax apple	N			U			U				
<i>Eugenia palumbis</i> Merrill		agatelang	E	+			U						
<i>Eugenia reinwardtiana</i> (Blume) DC.		a'abang	I					U					
<i>Eugenia uniflora</i> L.		pitanga, Surinam cherry	N										U
<i>Myrtella bennigseniana</i> (Volkens) Diels			I					U		C	C		
<i>Pimenta racemosa</i> (Willd.) J.W. Moore		bay rum	N						U				
<i>Psidium guajava</i> L.		abas, guava	N	U*				U	U	U	U	U	U

NYCTAGINACEAE

<i>Boerhavia repens</i> L.			I	+									
<i>Bougainvillea spectabilis</i> Willd.		bougainvillea, putitainubyu	N			U	U	U					U

OLACACEAE

<i>Ximenia americana</i> L.		pi'ut	I						U	U			
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OLEACEAE

<i>Jasminum marianum</i> DC.		banago	I				U	U	U				
<i>Jasminum multiflorum</i> (Burm. f.) Andr.		star jasmine	N							U			

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
OXALIDACEAE													
Averrhoa bilimbi L.		bilimbi, pickle, pikue	N			U		U	U	U			C
Averrhoa carambola L.		carambola, starfruit, bilimbin	N	+	*								
Oxalis corniculata L.		agsom, apsom, yellow wood sorrel	I			U							
PASSIFLORACEAE													
Passiflora foetida L.		fetid passionflower , love-in-a- mist	N	U	*	C		C	C		C	C	C
Passiflora suberosa L.		corky passionflower	N	C		A	A	C	C	C	C	U	C
PIPERACEAE													
Piper betle L.		betel-pepper, pupulu	N						C				
Piper guahamense DC.		pupulu-n- aniti, wild piper	I								U		
POLYGALACEAE													
Polygala paniculata L.		orosne	I			C		U	C		C	U	C
POLYGONACEAE													
Antigonon leptopus Hook. & Arn.		cadena de amor, chain- of-love, love- vine, Mexican creeper	N						C	C			C
PORTULACACEAE													
Portulaca oleracea L.		bodulagas, botdolagas, donkulu, purslane	N			C		U		U			
RHAMNACEAE													
Colubrina arborescens (Mill.) Sarg.		common snakebark	N							R			
Colubrina asiatica (L.) Brongn.		gasoso	I	C		A	C	C	U	C	U		

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	

RUBIACEAE

<i>Aidia racemosa</i> (Cav.) Tirveng		sumag, sumak	I				U	U	U				
<i>Dentella repens</i> Forster			N				R						
<i>Guettarda speciosa</i> L.		mwesor, panao, zebrawood	I								U		
<i>Hedyotis biflora</i> (L.) Lam.			I		C								
<i>Hedyotis corymbosa</i> (L.) Lam.			N				U	+	*				
<i>Hedyotis laciniata</i> Kaneh.			E									U	
<i>Hedyotis megalantha</i> Merrill		No common name	E										+?*
<i>Hedyotis strigulosa</i> (Bartl. ex DC.) Fosberg			I			+	*						
<i>Ixora finlaysonian</i> a Wall.	<i>Ixora chinensis</i> sensu Stone pro parte non Lam		N									R	
<i>Ixora triantha</i> Volk.			I								C		
<i>Morinda citrifolia</i> L.		lada	I	C	C		C	C	C	C	C	C	C
<i>Psychotria mariana</i> Bartl. ex DC.		aplokating	E						U	U	C		
<i>Psydrax odorata</i> (G. Forst.) A.C. Sm. & S.P. Darwin	<i>Canthium odoratum</i> (G. Forster) Seem. var. <i>tinianense</i> (Kaneh.) Fosb.	No common name	I						R*				
<i>Spermacoce assurgens</i> Ruiz & Pavón		woodland false buttonweed	N	C	C	C	C			C			C
<i>Spermacoce ernstii</i> Fosb. & Powell (ined.)			N	C	C				U				C
<i>Tarenna sambucina</i> (Forster) Durand ex Drake		sumac-lada	I										+
<i>Timonius nitidus</i> (Bartl. ex DC.) F.-Vill.		maholoc layu, sumac- lada	E						C	U	C	C	C

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)							
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT

RUTACEAE

<i>Citrus aurantiifolia</i> (Christm.) Swingle		lime, limon	N							U			U
<i>Citrus aurantium</i> L.		kahet, seville orange, sour-orange	N			R							
<i>Citrus limon</i> (Linnaeus) N.L. Burman			N							R	R	R	
<i>Citrus macroptera</i> Montr.			N							U			
<i>Citrus reticulata</i> Blanco		Kahe na kikiki, lalanghita, tangerine, madarin	N	U*									
<i>Triphasia trifolia</i> (Burm. f.) P. Wils.		limeberry, limon-china, limoncito	N	+	C	C	C			C	C	U	C

SAPINDACEAE

<i>Allophylus timoriensis</i> (de Candolle) Blume		sayafe	I	+	+								
<i>Cardiospermum halicacabum</i> L.		balloon vine	N						U				
<i>Dodonaea viscosa</i> (L.) Jacq.		lampuaye	I									+?*	U

SAPOTACEAE

<i>Chrysophyllum cainato</i> L.									En c*				
<i>Pouteria obovata</i> (R. Br.) Baehni		lala, lalahag	I					U	R	U			C

SCROPHULARIACEAE

<i>Bacopa monnieri</i> (L.) Pennell		No common name	I				R		+				
<i>Buchnera floridana</i> Gandog.			N										U
<i>Lindernia antipoda</i> (L.) Alst.			I		U	U							
<i>Scoparia dulcis</i> L.			N						En c*				

SOLANACEAE

<i>Capsicum frutescens</i> L.		chili-pepper, doni-halomtano,	N	U						U			
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Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
		doni-Sali											
<i>Cestrum diurnum</i> L.		inkberry, tinta'n-china	N									U	
<i>Physalis angulata</i> L.		cut-leaf ground-cherry, tomate chaca	N			R				U			

STERCULIACEAE

<i>Heritiera littoralis</i> Dryand.		Ufa, looking glass tree	I		U								
<i>Melochia villosissima</i> var. <i>compacta</i> Fosberg		sayafe	I	U									
<i>Melochia villosissima</i> (Presl) Merrill var. <i>villosissima</i> (Hochr.) Fosb.		atmahayan	I					U				C	
<i>Waltheria indica</i> L.		escobilla sabana	N		C			C		C	C	C	C

THYMELAEACEAE

<i>Wikstroemia elliptica</i> Merrill		gapit atayake	I						U			U	
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TILIACEAE

<i>Corchorus aestuans</i> L.		bilimbines chaka, tuban chaka	N					U		U			
<i>Muntingia calabura</i> L.		calabura, mansanita, manzanilla, manzanita, Panama cherry	N					U	U				
<i>Triumfetta rhomboidea</i> Jacq.		dadangsi, masiksik lahe, Sacramento bur	N							U			

URTICACEAE

<i>Maoutia australis</i> Weddell		Amahadyan, sayafi, rhea	I						+				
<i>Pilea microphylla</i> (L.) Liebm.		rockweed	N		U	U	C			U			
<i>Pipturus argenteus</i> (G. Forster) Weddell		amahadyan, amajahan	I	+									

VERBENACEAE

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Callicarpa candicans</i> (Burm. f.) Hochr.		hamlag, palapa-jalitay, qualitay	I	+	U		U	U					
<i>Clerodendrum inerme</i> (L.) Gaertn.		lodugao	I				U	U		C			U
<i>Clerodendrum quadriloculare</i> (Blanco) Merr.			N	R									
<i>Lantana camara</i> L.		lantana	N										U
<i>Phyla nodiflora</i> (L.) Greene	<i>Lippia nodiflora</i> (L.) Rich.	sawtooth frogfruit, turkey tangle	N	C	A	A	C	C	C			U	
<i>Premna obtusifolia</i> R. Br.		ahgao, premna	I			C	U	U	C	U	C	C	U
<i>Stachytarpheta jamaicensis</i> (L.) Vahl		false verbena, light-blue snakeweed	N	C	C		C	C	C	C	C	C	C
<i>Stachytarpheta urticifolia</i> Sims		nettleleaf velvetberry	N		C	C			C	C			
<i>Tectona grandis</i> L. filius		teak	N										+
<i>Vitex parviflora</i> Juss.		smallflower chastetree	N				U	U	U	U	U		

VITACEAE

<i>Cayratia trifolia</i> (L.) Domin		three-leaf cayratia	N					U					
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MONOCOTYLEDONS

AGAVACEAE

<i>Agave rigida</i> Mill.		sisal	N					U					
<i>Cordyline fruticosa</i> (L.) A. Chev.		Baston de San Jose, ti plant	N						U				U
<i>Dracaena marginata</i> Lamarck		money tree, marginata	N		R								
<i>Sansevieria trifasciata</i> Prain		bowstring-hemp, Mother-in-law's tongue, tigre	N						U	R			U

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)							
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT

ARACEAE

<i>Alocasia macrorrhizos</i> (L.) G. Don	<i>Alocasia macrorrhiza</i> (L.) Schott. (nomenclatural variant)	giant taro, papao-apaka, papao-atolong, elephant's ear, ape (Hawaiian)	N			U		U		U			
<i>Dieffenbachia maculata</i> G. Don	<i>Dieffenbachia picta</i> (Lodd.) Schott	dumb-cane	N										U
<i>Epipremnum pinnatum</i> (L.) Engl.		centipede tonqavine, pothos, taro vine	N	C			U				U		
<i>Syngonium angustatum</i> Schott		fivefingers	N	C				+*	C	U			C

ARECACEAE

<i>Areca catechu</i> L.		betel nut, betel palm, pugua, ugum	I								U		U
<i>Cocos nucifera</i> L.		coconut, niyog	I	C	C	C	C	C	C	C	C		C
<i>Dypsis lutescens</i> (H. Wendland) Beentje & J. Dransfield	<i>Chrysalidocarpus lutescens</i> (Bory) H. Wendl.	Madagascar palm	N				U						
<i>Heterospatha elata</i> Scheffer		palma brava	N				U	C	C			U	C
<i>Veitchia merrillii</i> (Beccari) H.E. Moore		Christmas palm, Manila palm, Merrill palm	N				U	U					

COMMELINACEAE

<i>Tradescantia spathacea</i> Swartz	<i>Rhoeo discolor</i> (L'Heritier) Hance, <i>Rhoeo spathacea</i> (Swartz) Stearn.	boatlily, oyster plant, rhoeo	N						U				
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CYPERACEAE

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Carex fuirenoides</i> Gaud.		No common name	I						+? *				
<i>Cyperus alternifolius</i> L.		papyrus, umbrella plant	N			U							
<i>Cyperus flavidus</i> Retz.			N									U	U
<i>Cyperus ligularis</i> L.			N			U							
<i>Cyperus polystachyos</i> Rottboell		No common name	I						+? *				
<i>Eleocharis dulcis</i> (Burm. f.) Trin. ex Hensch		spikerush, spikesedge	N									R	
<i>Eleocharis geniculata</i> (L.) Roemer & J.A. Schultes		Canada spikesedge, spikerush	I			U			U				U
<i>Fimbristylis autumnalis</i> (L.) Roemer & J.A. Schultes		slender fimbry	I						U		U	U	U
<i>Fimbristylis cymosa</i> R. Br.		tropical fimbry	I	+*	A	A	C	C	C			C	C
<i>Fimbristylis dichotoma</i> (L.) Vahl		forked fimbry	I		C	C	C	C	C			C	C
<i>Fimbristylis littoralis</i> Gaudich.		fimbry	I						U				C
<i>Fimbristylis ovata</i> (Burm. f.) J. Kern			N		C					U		U	
<i>Fimbristylis tristachya</i> R.Br.		fimbry	I						C		A	C	A
<i>Kyllinga nemoralis</i> J.R. & G. Forst.) Dandy ex Hutchinson & Dalziel	<i>Cyperus kyllingia</i> Endl.	botoncillo, chaguan lemae, whitehead spikesedge	N			C							
<i>Kyllinga brevifolia</i> Rottb.	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	short spikesedge	N		U					U	U		
<i>Machaerina mariscoides</i> (Gaud.) J. H. Kern		tropical twigrush	I						C			U	
<i>Rhynchospora corymbosa</i> Britton			I		Un c*								
<i>Rhynchospora rubra</i> Domin		rhynchospora	I						C		A	C	C
<i>Scleria lithosperma</i> (L.) Sw.		Florida Keys nutrush	I						C		C	C	U
<i>Scleria polycarpa</i> Boeck.		nutrush	I						C		C	C	

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				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT

DIOSCOREACEAE

<i>Dioscorea alata</i> L.		dago, dago apaka, water yam, winged yam	N				+				U		
<i>Dioscorea esculenta</i> (Lour.) Burkill var. <i>esculenta</i>	<i>Dioscorea esculenta</i> var. <i>fasciculata</i> (Roxb.) Prain & Burkill	nika, yam	N					U			U		
<i>Dioscorea esculenta</i> var. <i>tiliaefolia</i> (Kunth) Fosberg & Sachet		lesser yam	N										U
<i>Dioscorea</i> sp.			U							U			

FLAGELLARIACEAE

<i>Flagellaria indica</i> L.		bejuco halumtano, false rattan, flagellaria	I						C	U	C	C	U	C
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HELICONIACEAE

<i>Heliconia bihai</i> (L.) L.		Firebird, lobster's claw, macawflower	N							U				
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LILIACEAE

<i>Crinum</i> sp.			U					U						
<i>Curculigo orchioides</i> Gaertn.		golden-eyed grass	I						C		U	C		
<i>Dianella saffordiana</i> Fosb. & Sachet	<i>Dianella ensifolia</i> (L.) DC.		I						C		C	C	U	
<i>Hymenocallis littoralis</i> (Jacq.) Salisb.		lirio, spiderlily	N	C	C	C								U

MUSACEAE

<i>Musa</i> sp.		banana	N	U		U	U	C						
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ORCHIDACEAE

<i>Arundina graminifolia</i> (D. Don) Hochr.		bamboo orchid	N						C		C	C	C	C
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				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Geodorum densiflorum</i> (Lamarck) Schlechter		nodding orchid	I			R	R				U	U	U
<i>Nervilia aragoana</i> Gaudichaud		maisaulu, seiyaihagon, water-root orchid	I							U			
<i>Spathoglottis plicata</i> Blume		Philippine ground orchid	N							C	C	C	U
<i>Taeniophyllum marianense</i> Schltr.		worm orchid, amot-otdon, kamuke-nanofe	I				R	U	U	U			C

PANDANACEAE

<i>Freycinetia reineckeii</i> Warb.	<i>Freycinetia mariannensis</i> Merrill	fianiti	I								U		
<i>Pandanus dubius</i> Sprengel		pahong	I					U	U	C			
<i>Pandanus tectorius</i> Parkinson ex Zucc.		kafu	I	+	C	C	C	C	C	C	C	C	U

POACEAE

<i>Axonopus compressus</i> (Sw.) Beauv.		carpet grass	N			C						U	C
<i>Bambusa blumeana</i> Schultes fils		spiny bamboo, piao lahe, pio titoca, tituka	N						+				
<i>Bambusa vulgaris</i> J.C. Wendl.		common bamboo, piao palaoan	N	U				U	U	C			U
<i>Cenchrus echinatus</i> L.		burgrass, sand-bur	N		C	C	C		C				C
<i>Centosteca lappacea</i> (L.) Desv.			I	+				C		C	U		
<i>Chloris barbata</i> (L.) Sw.	<i>Chloris inflata</i> Link	finger grass	N		C	C	C	C	U				
<i>Chloris radiata</i> (L.) Sw.		plush-grass, radiate fingergrass	N					En c*					C
<i>Chrysopogon aciculatus</i> (Retz.) Trin.		golden beardgrass, golden false beardgrass, inifuk, palaii	I	A	A	A	C	C	C	C	C	C	C
<i>Cynodon dactylon</i> (L.) Pers.		Bermuda grass, grama	N	A	C	A	C					C	C

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<i>Dactyloctenium aegypticum</i> (L.) Willd.		crowfoot grass	N		C	C	C					
<i>Dichanthium bladhii</i> (Retz.) Clayton			N			C	C	A		C		A
<i>Dichanthium caricosum</i> (L.) Camus			N					Enc*				
<i>Digitaria bicornis</i> (Lam.) Roemer & J.A. Schultes ex Loud.		Asian crabgrass	N				C		U			
<i>Digitaria ciliaris</i> (Retz.) Koel.			I		C							
<i>Digitaria insularis</i> (L.) Mez ex Ekman			N						U			
<i>Digitaria setigera</i> Roth			I	+			C					
<i>Digitaria violascens</i> Link		violet crabgrass	N			A	C	C		C		C
<i>Dimeria chloridiformis</i> (Gaud.) K. Shum. & Lauterbach			E (Guam)					C		C	C	C
<i>Echinochloa colona</i> (L.) Link		chaguan-agaga, jungle-rice	N		A	U					U	
<i>Eleusine indica</i> (L.) Gaertn.		goose grass, umog	N		C	A	C		U			C
<i>Eragrostis amabilis</i> (L.) Wight & Arn.	<i>Eragrostis tenella</i> (L.) Beauv. ex Roemer & J.A. Schultes	Lovegrass	I	C	C				C		C	C
<i>Eragrostis atrovirens</i> (Desv.) Trin. ex Steud.		thalia lovegrass	N								U	C
<i>Eragrostis brownei</i> (Kunth) Nees ex Steud.			N						C		U	U
<i>Eriochloa procera</i> (Retz.) Hubb.			I				U					
<i>Eustachys petraea</i> (Sw.) Desv.		pinewoods fingergrass	N				C		U			C
<i>Heteropogon contortus</i> (L.) Beauv. ex Roemer & J.A. Schultes		tanglehead, pili (Hawaiian)	I					C				
<i>Hyparrhenia rufa</i> (Nees) Stapf			N					Enc*				
<i>Imperata conferta</i> (J.S. Presl) Ohwi			N									U

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				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG		
<i>Isachne miliacea</i> var. <i>minutula</i> (Gaudichaud) Fosberg & Sacht		No common name	I						+					
<i>Lepturus repens</i> (G. Forst.) R. Br.		lesaga, Pacific Island thintail	I	U*	+		C							
<i>Miscanthus floridulus</i> (Labill.) Warburg ex Schum. & Lauterb.		Japanese silvergrass, neti, sword grass	I					A	C	A	C	A		
<i>Oplismenus compositus</i> (L.) Beauv.			I					C		U				
<i>Panicum ambiguum</i> Trin.			I			U								
<i>Panicum geminatum</i> Forsk.			N			C	C							
<i>Panicum maximum</i> Jacq.	<i>Urochloa maxima</i> (Jacq.) R. Webster	guinea grass	N	C	C	C	C		C					C
<i>Panicum reptans</i> L.	<i>Urochloa reptans</i> (L.) Stapf	sprawling signalgrass	N			U						U		
<i>Panicum subquadrifarium</i> Trin.	<i>Brachiaria subquadrifaria</i> (Trin.) A.S. Hitchc., <i>Urochloa subquadrifaria</i> (Trin.) R. Webster		N		U		U	U						
<i>Paspalum ciliatifolium</i> Michx.	<i>Paspalum setaceum</i> Michx. var. <i>ciliatifolium</i> Vasey	fringeleaf paspalum, sand paspalum, slender crown grass, thin paspalum	N	C		C	C		U			C		
<i>Paspalum conjugatum</i> Berg.		herbe creole, Hilo grass, muhsrasre, rehn wei, sour grass, ti grass	N		C	C		U		U	U			
<i>Paspalum longifolium</i> Roxb.			I											C
<i>Paspalum paniculatum</i> L.		arrocillo	N		C	A	U	U	C			U	U	

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)									
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG	
<i>Paspalum scrobiculatum</i> L.	<i>Paspalum orbiculare</i> G. Forst.	rice-grass	I								U		U
<i>Pennisetum polystachion</i> (L.) J.A. Schultes		feathery pennisetum, mission grass	N	C	C	C	C	C	C	C	C	C	C
<i>Phragmites karka</i> (Retz.) Trin. ex Steud.		karriso, reed, tall reed	I	A		C					C	C	C
<i>Pogonatherum crinitum</i> (Thunb.) Kunth			I								C	U	C
<i>Polytrias amauro</i> (Büse ex Miq.) Kuntze		Java grass	I		C								
<i>Saccharum spontaneum</i> L.		wildcane	N		C	C	C	C	C	C	C	C	C
<i>Sacciolepis indica</i> (L.) Chase			I								U	U	
<i>Sorghum halepense</i> (L.) Pers. s.f.			N								A		
<i>Sporobolus diander</i> (Retz.) Beauv.		wiregrass	N		A	A	U	C	U	C	C	C	C
<i>Sporobolus farinosus</i> Hosok.			I				C						
<i>Sporobolus fertilis</i> (Steudel) Clayton			I	C		C	U	C				U	
<i>Sporobolus virginicus</i> (L.) Kunth		beach-dropseed, jatopa, salt-grass, seashore dropseed	I	C	C	C	C						
<i>Stenotaphrum micranthum</i> (Desv.) Hubb.			I		C		C						
<i>Thuarea involuta</i> (G. Forst.) Roemer & J.A. Schultes		Kuroiwa grass, las-aga	I	C		A	C						
<i>Tripsacum laxa</i> Nash		gama grass	N					U					
<i>Urochloa mutica</i> (L.) Stapf	<i>Brachiaria mutica</i> (Forsk.) Stapf	para grass	N		C		U	C					
<i>Zoysia matrella</i> (L.) Merr.		Manila temple grass	I		A	C		U		C			

TACCACEAE

<i>Tacca leontopetaloides</i> (L.) Kuntze		arrowroot, gabgab	I					U		U		U
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ZINGIBERACEAE

Plant Taxon ¹	Synonyms	Common Name	Nativity ²	Abundance by Unit ³ (presence indicated by abundance)								
				AG -b	AG -a	AG -g	AB	AI	F P	MA	MT	PG
<i>Alpinia purpurata</i> (Vieill.) K. Schum.		red ginger	N					U				
<i>Alpinia zerumbet</i> (Pers.) Burt & R.M. Sm.		shell ginger	N					C				
<i>Costus speciosus</i> (Koenig) Sm.		canereed, crape ginger	N					U				
<i>Costus woodsonii</i> Maas		scarlet spiral flag	N					U				
<i>Curcuma longa</i> L.		mango halumtano, tumeric	I							U		
<i>Zingiber zerumbet</i> (L.) Sm.		bitter ginger, shampoo ginger	N								R	

* = Taxon information obtained from previously collected vouchers; not observed during this survey.

¹ Nomenclature follows the references below in the order listed (i.e., Wagner et al. was the authority but if a species was not listed in that reference Palmer 2003 was consulted, etc.)

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Raulerson, L., and A. F. Rinehart. 1991. Trees and shrubs of the Northern Mariana Islands. Coastal Resources Management Office of the Governor, Commonwealth of the Northern Mariana Islands, Saipan. 120 pp.

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² Nativity

- E (Endemic) = The plant is native to the park, endemic (unique) to the Mariana Islands
I (Indigenous) = The plant is native to the park, indigenous to the Mariana Islands (native to the Mariana Islands as well as other lands)
N (Non-native) = The plant is not native to the park or the Mariana Islands, introduced either accidentally or intentionally
U (Unknown) = Nativity is unknown relative to the park
NA = Not applicable

³ Abundance by Unit

UNITS:

- AG-a = Agat, Apaca Point
AG-b = Agat, Bangi Point
AG-g = Agat, Gaan Point
AB = Asan Beach
AI = Asan Inland
FP = Fonte Plateau
MA = Mount Alifan
MT = Mount Chachao-Mount Tenjo
PG = Piti Guns

ABUNDANCE CATEGORIES:

- A (Abundant) = Present in park (species' occurrence in the park is documented and assumed to be extant), large number of individuals; wide ecological amplitude or occurring in habitats covering a large portion of the unit.
C (Common) = Present in park unit, large number of individuals predictably occurring in commonly encountered habitats, but not those covering a large portion of the unit.
U (Uncommon) = Present in park unit, few to moderate numbers of individuals; occurring either sporadically in commonly encountered habitats or in uncommon habitats.
R (Rare) = Present in park unit, few individuals, usually restricted to small areas of rare habitat.

- + = Present in park unit, abundance unknown.
- +? = Probably present in park unit (park unit is within species' range and contains appropriate habitat. Documented occurrences of the species in the adjoining region of the park give reason to suspect that it probably occurs within the park).
- Unc
(Unconfirmed) = Included for the park based on weak ("unconfirmed") or no evidence, giving minimal indication of the species' occurrence in the park.
- Enc
(Encroaching) = The species is not documented in the park, but is documented as being adjacent to the park and has potential to occur in the park.