

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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