

**Botanical Survey of Diego Garcia
Chagos Archipelago, British Indian Ocean Territory**

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Appendix E1

BOTANICAL SURVEY
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1. INTRODUCTION

Diego Garcia is the main and the only inhabited island in the Chagos Archipelago in the Indian Ocean. It lies at a latitude of 7° S and a longitude of 72° E, southwest of India and east of the Seychelle Islands. The atoll is formed by a long, footprint-shaped sand island that surrounds a large central lagoon. The 35-mile long island (from northwest tip to northeast tip) is discontinuous only at the northern end, where several small isles bridge the gap between the west and east arms. The vast majority of Diego Garcia is under 3 m in elevation, and the highest point is less than 10 m. The total land area of the atoll is approximately 30 km² (Stoddart and Taylor 1971).

The climate at Diego Garcia is constantly hot and humid, with high daytime temperatures usually between 80 and 85° F. It is in an area of high rainfall, with an average 3700 mm of precipitation a year, making it the wettest of the coral islands in the Indian Ocean (Stoddart and Taylor 1971). Rain falls throughout the year, but is more concentrated from December to February. Southeast trade winds occur through most of the rest of the year, and because the island is close to the equator, serious hurricanes ("cyclones") are uncommon.

The first botanical observations of the island were made by Hume in 1883 (Hemsley 1887). Subsequent visits, observations, and plant collections were made in 1885 (Bourne 1886), 1905 (Willis and Gardiner 1931), and 1939 (Wiehe 1939). In 1967, an extensive study was carried out on the island and the results were published in a series of articles comprising a single volume of Atoll Research Bulletin (Stoddart and Taylor 1971). This included a description of the vegetation (Stoddart 1971) and an annotated checklist of the flora (Fosberg and Bullock 1971), which serve as important baseline studies for comparison with the present study. Another, more recent checklist of the flora by J.M.W. Topp (published in 1988 as Atoll Research Bulletin No. 313) gives valuable information on the date of introduction of alien species.

2. METHODOLOGY

Diego Garcia was visited by a two-person botanical survey team from Isle Botanica from the 16th to the 31st of March 1995. Two aspects of the botany of the island were studied—the taxonomy and the vegetation ecology. Prior to the field survey, a review of the literature was made. From this information, a checklist of the flora was prepared and was constantly updated as new species were found. Species not located in the early stages of the field survey were targeted for scrutiny, and the literature was frequently consulted for indications of where these hard-to-find species had previously been collected.

Most of the plant identifications were done in the field, since most of the species on Diego Garcia are common and well known. To assure accuracy, voucher specimens were made of all the native and naturalized plants, as well as a few of the ornamentals whose identity was not certain. Sets of these voucher specimens will be distributed to the

Smithsonian Institution, Kew Gardens (England), and the National Tropical Botanical Garden (Hawai'i). Species still unidentified at the end of the field work were later studied at the Bishop Museum (Honolulu) herbarium and matched with the collections there.

The vegetation study involved an initial reconnaissance on the roads and trails of the island to determine what plant communities were present. This, along with subsequent field work, led to the recognition of seven plant communities (see the vegetation section below). All of these communities were studied, but those with the most native species were singled out for more scrutiny. Checklists of each area and community were prepared, along with notes on the frequency and dominance of the component species. Plants that might be considered threatened, endangered, or rare were given special attention.

Although the survey was officially concerned only with that part of the atoll used by the U.S. Navy part (west side), it was apparent that by comparing the west and east sides of the island, the current Navy impact on its environment on the west side of the island could better be assessed. Although the three small islets at the north end of the atoll are not in the Navy sector of the island, and are off limits to visitors, including the field survey team, their vegetation is of interest because of the absence of predators (cats and possibly rats) and limited recent disturbance (although they were occupied in the last century). Consequently, these islands were surveyed offshore from a boat and observations made with binoculars to determine the vegetation and species present.

Following the field work, a rough draft of the descriptions of some of the plant communities was prepared, and these were field-checked during the last two days of the survey to assure accuracy. A rough map of the vegetation was drawn during the survey. However, because no recent aerial photos were available, these maps offer only an approximation of the vegetation patterns. Also, because of the indistinct boundaries between the communities, particularly between littoral shrubland and littoral forest, the only units recognized on the maps were managed land, wetlands, and the other types of somewhat natural vegetation (littoral forest, littoral shrubland, coconut woodland, *Casuarina* woodland, and *Premna* shrubland).

3. THE FLORA OF DIEGO GARCIA

The flora of Diego Garcia comprises all the plants found on the island. These plants are either native (species arriving by natural means, usually before human occupation) or alien (species arriving by accidental or intentional transport). Native species can be further divided into "endemic" species that are restricted to that area (i.e., are found only in the Chagos Archipelago or Diego Garcia) and "indigenous" species that are widespread and found in other areas. Alien species can be further divided into cultivated plants, which are usually intentionally introduced, and weeds, which in most cases are accidentally introduced. Although some plants, such as ornamental plants that "escape" and become weeds, do not fit very well into this scheme, it is useful for discussion purposes to create categories. Consequently, the vascular plants found on Diego Garcia are discussed in three

categories below: native species, weedy species, and cultivated species.

The total number of native and naturalized species in the flora is calculated here to be 166 (Table 1). However, this figure cannot be determined exactly, for several reasons: (1) some cultivated plants become naturalized, but the boundary between ornamental plant and weed is not always clear; (2) there are some questions about the identification of specimens in the early collections; and (3) some of the weedy species noted by early collectors have not been found in the more recent botanical surveys and collections, and may now be extinct on Diego Garcia.

A. Native Species

There are about 36 native vascular plant species on Diego Garcia (see below). The number can only be estimated because the status of some plants cannot be determined for certain. There are at least three reasons for this: (1) the first comprehensive collections were not made on the island until over a hundred years after plantations became established on the island; (2) some plants that native to the adjacent islands have only recently been collected on Diego Garcia, and may have been intentionally introduced, such as *Canavalia cathartica*; and (3) there is difference of opinion among botanists as to the status of some species.

The low number of native species is not unusual, since atolls throughout the tropics have small floras, due mainly to the small size, low elevation (which precludes multiple habitats), and harsh environmental conditions of atolls that are detrimental to all but the most highly adapted species. None of the 36 species is endemic. This is to be expected on an island like Diego Garcia, since native plants found on atolls throughout the world tend to have wide distributions. This is partly due to the means of distribution of most species (except ferns)—seawater flotation and to a lesser extent, attached to the feathers of birds—which facilitate long distance dispersal.

There are about 12 native tree species, which are shown below. However, some of these may have been ancient or early introductions that are now naturalized. Three other trees, *Casuarina equisetifolia* (ironwood), *Hibiscus tiliaceus* (beach hibiscus), and *Pipturus argenteus*, could also be native, but are judged here to have been introduced. *Casuarina* is an ancient introduction throughout Polynesia (from the Australia region), and although it was noted by Hemsley (1887) to be native, it is probably an early introduction to Diego Garcia. *Hibiscus* was noted by Hemsley to be absent from Diego Garcia (prior to 1887). *Pipturus* is a widespread tree native to many Pacific islands, and although it appears to be native, it was not collected on Diego Garcia until this century. The twelve native tree species are listed below:

- *Barringtonia asiatica* (fish-poison tree)
- *alophyllum inophyllum* (Alexandrian laurel)
- *Cocos nucifera* (coconut)

- *Cordia subcordata*
- *Guettarda speciosa*
- *Intsia bijuga* (ifil tree)
- *Hernandia nymphaeifolia* (Chinese lantern tree)
- *Morinda citrifolia* (Indian mulberry)
- *Neisosperma oppositifolium*
- *Pisonia grandis*
- *Terminalia catappa* (tropical almond)
- *Tournefortia argentea* (beach heliotrope)

There are only five native shrub species on Diego Garcia, as listed below:

- *Caesalpinia major* (gray nickers)
- *Pemphis acidula*
- *Premna serratifolia*
- *Scaevola taccada* (scaevola)
- *Suriana maritima*

There are seven native dicot herb species on Diego Garcia. Two other widespread littoral plants, *Wollastonia biflora* and *Vigna marina*, appear to have been introduced, the latter one in 1984. The seven native dicot herbs are listed below:

- *Achyranthes canescens*
- *Bacopa monniera* (water hyssop)
- *Boerhavia albiflora*
- *Portulaca australis*
- *Sida parviflora*
- *Thalassodendron ciliatum* (a sea grass)
- *Triumfetta procumbens*

There are three native grass and sedge species on Diego Garcia. Two other species, *Eleocharis geniculata* and *Paspalum vaginatum* (marsh grass) are common in native habitats, but were not found by the early collectors, and hence were probably introduced. Several other species—*Vernonia cinerea* (ironweed), *Ageratum conyzoides* (ageratum), *Striga asiatica*, *Lippia nodiflora* (lippia), *Chamaesyce hirta* (garden spurge), *Phyllanthus amarus*, *Acalypha indica*, *Cyperus ligularis*, and *Digitaria radicata*—were listed by Hemsley (1887) as being native, but these are typical weeds that are rarely found in native habitats. It is likely that many of them may have been introduced as early as 1786, when soil was imported from India by the first English settlers. The three native grasses and sedge are *Fimbristylis cymosa*, *Lepturus repens* and *Stenotaphrum micranthum*.

There are four native vine species on Diego Garcia. However, *Canavalia cathartica* was not found until recently, and may have been introduced. The four native vines are listed below:

- *Canavalia cathartica* (St. Thomas bean)
- *Cassytha filiformis*
- *Ipomoea pes-caprae* (beach morning-glory)
- *Ipomoea macrantha*

And finally, there are five fern species that are presumably native to Diego Garcia. Hemsley (1887) lists another species, *Pteris marginata*, as native, but this is unlikely since it does not appear to occur in native habitats. Two other species, *Amphineuron opulentum* and *Pteris tripartita* were not found in the earliest collections, and hence are probably of recent introduction. The five native fern species are listed below:

- *Asplenium longissimum*
- *Asplenium macrophyllum*
- *Asplenium nidus* (bird's-nest fern)
- *Cyclosorus interruptus* (marsh fern)
- *Psilotum nudum* (a fern ally)

All 36 native species were found during the current survey, including *Pemphis acidula*, a shrub never before collected on the island, but noted to occur there by Topp (1988). No new native plants were encountered during the survey, which attests to the thoroughness of the previous botanical collections on the island.

B. Weedy Species

At the time of the present survey, approximately 134 species of plants could be classified as weedy or naturalized alien species. The number is very approximate for two main reasons. First, there is a problem in the identification of some species in the previously prepared checklists (Hemsley 1887; Willis and Gardiner 1931; Fosberg and Bullock 1971; Topp 1988), which makes it difficult to correlate all the names. And second, it is difficult to draw the line between ornamental species that have survived in abandoned living areas and those that are naturalized and spreading. For example, *Syzygium samarangense* grows in the abandoned East Point Plantation, but apparently is not spreading; *Tabebuia heterophylla* was also found there, and although originally an ornamental, it has spread so much that it has become a pest on the island.

The vast majority of the weedy species on Diego Garcia were unintentionally introduced plants rather than escaped ornamentals or crop plants. Prior to 1995, about 102 weedy species were recorded from Diego Garcia, and another 32 were added during the present survey. This indicates that new plants are being introduced at a rapid rate (32 new records in the past decade). However, a number of the new plants recorded during the present survey were quite restricted in distribution, and it remains to be seen if they will spread or will disappear.

Of the 102 previously recorded weedy species, only 16 were not found during the present survey—*Cyperus iria*, *Cyperus rotundus* (nut sedge), *Cyperus sphaclatus*, *Digitaria horizontalis*, *Digitaria radicata*, *Lolium perenne*, *Panicum maximum* (Guinea grass), *Pennisetum polystachyon* (feathery pennisetum), *Aerva lanata*, *Amaranthus viridis* (amaranth), *Centella asiatica* (Asiatic pennywort), *Acalypha indica*, *Ricinus communis* (castor bean), *Albizia lebbek* (sirir tree), *Ocimum gratissimum* (wild basil), and *Plantago major* (plantain). The reason for the absence of these during the present survey may be due to any of several reasons: (1) the plants are probably extinct now on the island, like *Amaranthus* and *Ipomoea*, which have not been found in the last three surveys; (2) the plants were so rare, or were restricted to one area (*Albizia*) that they were not found; and (3) the early records were based on misidentifications (possibly *Digitaria horizontalis*).

C. Cultivated Species

A total of 96 cultivated plants have been recorded from the island. These comprise food plants such as papaya, beans, squash and sweet potato, and ornamentals such as red hibiscus and croton. Of the 96 species, 29 were recorded as new during the present survey, while 26 previously recorded species were not found. The reason for the relatively high number of new species is that contract workers and military personnel commonly bring in, officially or surreptitiously, new ornamental and crop plants to cater to their culinary or aesthetic desires. The failure to record the 26 missing species during the field work was due to their local extinction (especially food plants, such as squash, sweet potato, etc., that were cultivated in the plantation days), their current rarity, or because they never made it past the seed stage (a few of them were listed by Topp as introduced seeds that were to be planted for experimentation purposes).

The ornamental plants are not of much relevance to the Natural Resource Management Plan of Diego Garcia, except when a species becomes naturalized, as *Tabebuia heterophylla* has. Some of the ornamentals are grown only in pots, since they would not flourish in the coralline soil. Others, such as *Episcia cupreata*, are house plants that are grown in pots, and only indoors. A complete listing of the ornamentals found on Diego Garcia is shown in Table 2.

4. VEGETATION ECOLOGY

The vegetation ecology on Diego Garcia has been heavily impacted by the activities of man. Prior to the European discovery of the islands by the Portuguese in late 15th or early 16th century, the islands were uninhabited (but may have been visited by sailors from India or other adjacent countries). It was not until 1786, however, that the islands were first officially inhabited, originally by the English for several months, followed by the French on a permanent basis. Under the French, the island became devoted to the harvesting and cultivation of coconuts. This plantation agriculture dominated the island until the demise of the industry in 1971.

Following the end of active plantation agriculture, a new kind of disturbance became prominent—the development of the west half of the atoll into a U.S. Navy base beginning in 1971. This involved extensive construction and bulldozing, destroying much of the vegetation on that part of the island. It also led to an increase in the number of alien species that have since become established on the island.

Today the vegetation consists of several "plant communities" that can be grouped into two categories—disturbed vegetation and native vegetation. The former consists of four communities: managed land vegetation; coconut woodland; *Premna* shrubland; and *Casuarina* woodland. The latter category consists of three communities: Littoral Shrubland; Littoral Forest; and Marsh. The marsh community is further divided into three associations, which are based on their dominant species—mixed species marsh, cattail marsh, and *Paspalum* salt-marsh. The littoral forest is divided into six associations, *Hernandia* littoral forest, *Calophyllum* littoral forest, *Barringtonia* forest, *Cordia* forest, *Pisonia* forest, and *Guettarda* forest. Although all the plant communities are technically disturbed to some extent today, the ones that are dominated by native species and appear to have little recent disturbance will be referred to here as belonging to native vegetation.

The seven plant communities are discussed below. This is the same number recognized by Stoddart (1971), but the communities of this and Stoddart's report do not otherwise entirely correspond. Wiehe (1939) recognized only three types, beach vegetation, coconut groves, and marshes, but this division fails to distinguish some of the more subtle variation in the vegetation of the island.

While it is sometimes easy to identify the seven plant communities distinguished, they tend to grade into each other, making some areas difficult to assign to an exact community. However, it is useful to recognize these communities, even if the boundaries that separate them from one another are not always clear.

A. Managed Land Vegetation

This community comprises all the land that is actively managed by man, and in Diego Garcia, is mostly concentrated on the northern half of the west side of the atoll (Fig. 1). Some of this land is covered with buildings, runways, and roads, but most is covered with lawns and ornamental plantings. It is the same community that was identified by Stoddart (1971) as "settlement vegetation."

Large areas around buildings and along roadsides are regularly mowed, which maintains these areas in low, herbaceous vegetation largely dominated by alien species. The most common species in these lawns are *Stenotaphrum secundatum* (buffalo grass), *Cynodon dactylon* (Bermuda grass), and *Fimbristylis cymosa*. The first two of these are alien grass species that grow low and are not adversely affected by the regular mowing. The third species is a native sedge that is particularly common in areas of poor soil and in

places near the sea. Other species common in lawns include *Digitaria longiflora*, *Eleusine indica* (goose grass), *Eragrostis brownei*, and *Paspalum setaceum*, which are all grasses, and *Bidens alba* (beggar's-tick), *Tridax procumbens* (coat buttons), *Conyza canadensis* (Canadian fleabane), *Vernonia cinerea* (ironweed), *Chamaesyce hirta* (garden spurge), *Phyllanthus amarus*, *Hedyotis corymbosa*, *Spermacoce assurgens*, *Buchnera floridana*, *Dentella repens*, *Lippia nodiflora* (lippia), *Stachytarpheta jamaicensis* (Jamaica vervain), and *Sida pusilla*. All except for the last species are introduced weeds. As noted above, a total of about 134 alien species are naturalized on the island (see Table 1).

Diego Garcia is well landscaped, and a number of hardy ornamental plants are used for this purpose, the most common of which are the herbs *Catharanthus roseus* (periwinkle), *Alocasia macrorrhiza* (giant taro), *Zephyranthes roseus* (zephyr lily), *Scadoxus multiflorus* (blood lily), and *Pedilanthus tithymaloides* (slipper flower), the shrubs *Hibiscus rosa-sinensis* (red hibiscus), *Codiaeum variegatum* (croton), and *Pandanus tectorius* (screwpine), and the tree *Tabebuia heterophylla* (mayflower tree). The latter species is particularly common in the cantonment area, but has become naturalized and is a problem species on the east side of the atoll.

In addition to these, several native species or early introductions are also commonly used in plantings, or are left where they were already growing. The advantage of using these plants is that since they are native or long-established introductions to Diego Garcia, they are already adapted to the harsh atoll conditions. The most commonly cultivated of these species are *Calophyllum inophyllum* (Alexandrian laurel), *Terminalia catappa* (tropical almond), *Tournefortia argentea* (beach heliotrope), *Cocos nucifera* (coconut), *Casuarina equisetifolia* (ironwood), and *Cordia subcordata*.

It is often difficult to draw a boundary between ornamental plantings and other plant communities, such as coconut woodland and *Casuarina* woodland, since these two trees are sometimes left standing as a part of the landscaping, particularly along roadsides and near buildings.

Another type of managed land vegetation consists of areas that have recently been bulldozed, either for construction or for sand mining. If the bulldozing goes deep, standing water may form, which in its early stages may just constitute a pond, but which eventually will be vegetated with wetland plants; at this later stage it would be called a marsh. If the bulldozing does not go very deep or below the water table, then the area may eventually become a lawn, or if not managed, a *Casuarina* woodland.

In a few places on the island, the shrub or small tree *Leucaena leucocephala* (wild tamarind) forms dense thickets. The best example of this is at Point Marianne just across the road from the cemetery. The tree does not do well on coralline soil, but in this area the soil appears to be richer. If left alone long enough, *Leucaena* thickets such as this one would probably be replaced by littoral forest. Most of them contain small littoral trees which will eventually grow to shade out the much shorter, light-loving. Another tree,

Hibiscus tiliaceus, also sometimes forms thickets in areas near former habitations.

B. Coconut Woodland

It is not certain if the coconut is native to Diego Garcia, but recent studies that prove it was present far into Polynesia before the advent of man in the region support the idea that it is native to atolls like Diego Garcia. If it is not native, then it was an pre-Portuguese introduction that is entirely naturalized on the island. Stoddart (1971) called coconut woodland by the same name, but he further divided his community into three subtypes, "coconut plantation," "cocos bon-dieu," and "mixed coconut woodland."

Coconuts were cultivated in plantations for nearly two centuries on Diego Garcia, but the plantations were abandoned in 1971 (Edis 1993). However, large areas of the island, especially on the eastern part, are still covered with coconuts. It is hard to actually draw boundaries around the coconut woodland community, because all the other community types also have a small to large number of the palms.

The delineation of coconut woodland is further complicated by the fact that when the plantations were abandoned, the weeding that maintained them ceased. This has allowed tree species, such as *Hernandia nymphaeifolia*, *Guettarda speciosa*, and *Neisosperma oppositifolium* to become established beneath the palms. In open sunny areas, *Pipturus argenteus* is also sometimes common. This type of coconut forest with littoral forest species mixed in is what Stoddart (1971) identified as the subtype "coconut woodland." Eventually, the littoral forest trees will probably take over and coconuts will become a minor component or even disappear. This is what appears to have happened at Minni Minni, which was abandoned long ago. Directly behind the plantation houses is a forest of *Hernandia* with a few old coconuts mixed in, which is all that is left of what was probably once a coconut plantation. If the plantations were still managed, this community would probably be classified in the "managed land vegetation" community discussed above, or coconut woodland. However, they have been abandoned for long enough for them to change in species composition and structure.

When coconut plantations are maintained, the canopy is not very dense, allowing for a dense ground cover. However, the plantation is weeded or mowed (or grazed) to facilitate the picking of coconuts and to eliminate competition from saplings that will eventually become trees. In abandoned plantations, the ground is sometimes covered with germinating coconuts. In some places without these dense patches of coconuts seedlings, the bird's-nest fern, *Asplenium nidus*, may be common. In other relatively open plantations, the ground vegetation may be comprised of a mixture of native herbs such as *Boerhavia albiflora*, *Fimbristylis cymosa*, and *Stenotaphrum micranthum*, alien herbs such as *Rivina humilis*, *Kalanchoë pinnata*, and *Cyperus ligularis*, and native and alien ferns such as *Psilotum nudum*, *Pteris tripartita*, and *Amphineuron opulentum*. In some relatively shady plantations two other native ferns are sometimes found, *Asplenium macrophyllum* and *Asplenium longissimum*, but these are usually found on dead, decaying

coconut stumps, on rocks, or at the base of bird's-nest ferns (*Asplenium nidus*).

In one area coconut woodland seems to be remaining in coconuts instead of being invaded by littoral forest trees. The area immediately around the wells at the north end of the island is comprised almost entirely of coconuts with very little ground cover other than germinating coconuts. This is not managed, but is probably the result of the wet soil in the area that prevents the other less hydrophytic trees from becoming established there.

In some places, particularly in the south part of the island east of the GEODSS site, the palms trees are scattered, and between them is a dense layer of shrubs, mostly *Morinda citrifolia*, *Pipturus argenteus*, *Guettarda speciosa*, *Suriana maritima*, and, especially, *Scaevola taccada*. This variation was identified by Stoddart (1971) as "cocos bon-dieu," which is named after the original coconut variety that has a relatively large husk with a relatively small "nut" inside. This variation is probably not a distinct type of vegetation, however, just coconuts mixed in with littoral shrubland.

C. *Premna* Shrubland

This type of vegetation seems to be intermediate between *Paspalum* salt-marsh and *Casuarina* woodland. The component plants are mostly not wetland indicator species, i.e., are not plants that are characteristic of wetlands, and the most conspicuous part of the vegetation is the scattered shrubs, mostly *Premna serratifolia*, up to 2 m or more in height. Sometimes scattered *Casuarina equisetifolia* are found here as well.

A good example of marshy shrubland is found to the north of the helipad, where the vegetation is dominated by small trees and shrubs of *Premna serratifolia*, lesser amounts of *Scaevola taccada* and several other species. Both of these shrubs are littoral rather than wetland species. Between them is a dense ground cover of several herbaceous species, such as *Fimbristylis cymosa*, *Pycreus polystachyos*, and *Stenotaphrum secundatum*, which are marginal wetland species, *Ipomoea pes-caprae*, which is typically a littoral vine, and *Stachytarpheta jamaicensis*, which is not typically associated with wetlands. Many other species, mostly non-wetland herbs, are also found here.

D. *Casuarina* Woodland

It is uncertain whether or not *Casuarina equisetifolia* is native to Diego Garcia. It is definitely native to the Australia region, but was an aboriginal introduction eastward into Polynesia, and most botanists believe it was introduced westward rather than naturally spreading in that direction. This is the same type of vegetation, and the same name that is used by Stoddart (1971) for the community.

Casuarina woodland is found mostly in disturbed areas on Diego Garcia, particularly on the north half of the west arm of the island (Fig. 2), and is characterized by the dominance of the ironwood tree, *Casuarina equisetifolia*. The tree produces small

seeds that are readily dispersed, and it easily becomes established in disturbed areas. It appears to occur mostly in areas of past disturbance when all the native vegetation has been removed. The tree is not a shade-tolerant species, and it apparently does not become a common or dominant species in areas where there is a canopy, i.e., in coconut plantations and littoral forest.

In its purest form, it comprises mono-dominant woodlands with no other associated trees and relatively few shrubs. When the tree is thus concentrated, the forest floor is covered with a dense layer of dead "needles" that inhibits the germination of other species. Usually, however, a number of shrubs occur in this forest, typically *Morinda citrifolia* and *Premna serratifolia*, and in some places, *Scaevola taccada* as well. When the "needles" are not so dense, the ground cover is dominated by herbaceous species, such as *Fimbristylis cymosa*, and to lesser extent, *Lipia nodiflora*, *Pycreus polystachyos*, *Passiflora suberosa*, and many other weedy plants.

When the trees thin out, either because of chance factors or habitat differences (i.e., wetter soil), the shrubs and ground cover herbs may be the conspicuous plants, with only a few scattered trees in the area. In this case, the land would be classified as a marsh (discussed below) or as *Premna* shrubland (discussed above). In many places, the *Casuarina* trees share dominance with coconut trees and/or *Calophyllum inophyllum*, a vegetation type that could then be classified as littoral forest or coconut plantation, depending upon the relative dominance of these other two species. There are many areas of forest dominated by these three trees, *Casuarina*, coconut, and *Calophyllum*, in and around the housing area, and some of them might even be classified as managed land because they may be maintained to some degree.

The east, restricted side of Diego Garcia has much less *Casuarina* than does the developed west side. This is probably because ironwood trees become established and thrive in areas that have been heavily disturbed, particularly by complete clearing of the vegetation for construction and sand mining. The minimal disturbance on the eastern part of the island, which has been left alone since it was abandoned as coconut plantation, probably accounts for the paucity of *Casuarina* there. This unequal distribution of ironwood trees was also noted by Stoddart (1971) during his visit in 1967.

E. Littoral Shrubland

This type of vegetation is characterized by the dominance of shrubs. Littoral shrubland is not uniform in origin, and several variations of habitat and even some kinds of disturbance can create it. Part of the "shoreline vegetation" recognized by Stoddart (1971)—"scrub community of seaward beach," "lagoon shore *Scaevola* community," and "dune scrub communities"— corresponds to the littoral shrubland described here. (The other two types he recognized are mentioned in the littoral forest community section below).

Littoral shrubland lines nearly the entire seaward shore of the island, probably because in this situation, other types of vegetation cannot tolerate the strong sea wind and occasional waves that come from the sea. It also lines some of the lagoon shore of the island, especially at the northeast tip. Littoral shrubland is almost always dominated by *Scaevola taccada*, and begins at the top of the beach slope above the hightide mark. It grows to a height of 2–5 m and forms a zone mostly 5 to 100 m in width, depending upon the exposure of the area and other factors, such as the distance of the reef from shore and disturbance (Fig. 4). On its seaward margin, *Tournefortia argentea* and *Suriana maritima* are also common, along with the vine *Ipomoea macrantha*, which climbs over the low shrubs, and sometimes extends out across the sand towards the sea. However, for reasons that are not apparent, *Suriana* is not found on the west seaward coast of the island (Fig. 5).

Coconuts are also usually present in littoral shrubland, growing low on the beach margin (and most probably dying in the sapling stage), or as scattered taller individuals away from the immediate shore (but sometimes leaning over it). On the lagoon margin, particularly in disturbed places, it may grow directly on the shore. In some places on the east but not the west coast, small indentations of uncertain origin have formed on the seaward margin of the littoral shrubland, and these are dominated by *Lepturus repens*, and to a lesser extent, *Fimbristylis cymosa*, or in some places, *Triumfetta procumbens*.

Inland from the margin, *Scaevola* becomes even more dominant, with few other species being able to survive in its dense tangle, which is penetrated only with great difficulty (or more easily with a machete). The few species that do occur here are mostly scattered trees of *Guettarda speciosa*, coconuts, and the vine *Ipomoea macrantha*, and in more open spots, herbaceous plants such as *Lepturus repens*, *Triumfetta procumbens*, and *Cyperus ligularis*.

On the lagoon side of the island, littoral shrubland as a distinct zone is conspicuously absent (Fig. 6), but is often present as a fringe, in which it often shares dominance with various species of trees, especially *Cordia subcordata*, some of whose branches hang out over the edge of the water. On the rocky soil around the "barachois" (mudflat) at the southern end of the lagoon, *Suriana maritima* is often the dominant species, along with *Scaevola* and *Tournefortia argentea*. In some places, at the southwest corner of the island near the beginning of the restricted sector, the *Scaevola* is quite low, and has scattered coconut trees (Fig. 7). This is probably an area that was previously disturbed, and the *Scaevola* is slowly recolonizing it.

F. Littoral Forest

Littoral forest is the plant community that occurs on the seashore and which is dominated by large trees that are largely restricted to this habitat. On atolls, nearly all of the land is on or near the seashore, and consequently, all of the natural forests there can be defined as littoral forest. Prior to the arrival of the first inhabitants of the island, much of the island was probably covered with this forest, but during the plantation days and

probably before, most of it was replaced with plantations of the cultivated, large-fruited coconut. Stoddart (1971) identified the littoral forest community as "broadleaf woodland," as well as the "lagoon-shore *Calophyllum-Barringtonia* community" and "lagoon-shore mixed woodland," which he included in the community he labeled "shoreline vegetation."

Six subtypes of littoral forest can be recognized, but some forests appear to be intermediate between two or more types. The situation may be best described as a "mosaic" of small units, which makes mapping of the different littoral forest types virtually impossible.

(1) *Hernandia* Forest

Before the arrival of humans, probably most of the forest on the island belonged to this type of littoral forest. It is dominated by the Chinese-lantern tree, *Hernandia nymphaeifolia*. The best areas of this remaining on Diego Garcia are found near Minni Minni, in the area southwest of the well area (where it is often mixed with coconut woodland), and on the south coast of the island just south of Barachois Sylvain (Fig. 8). In addition to *Hernandia*, coconut palms are sometimes present, especially when the area is an old abandoned coconut plantation. Other species found in this forest include *Terminalia catappa*, at least near cultivated areas or abandoned habitations (such as Minni Minni), and smaller trees, such as *Morinda citrifolia*, and to a lesser extent, *Guettarda speciosa* and *Neisosperma oppositifolium*.

When the forest is undisturbed, the forest floor may be dominated by *Asplenium nidus*, the bird's-nest fern, and sometimes little else. These huge ferns also grow as epiphytes on the *Hernandia* trees. When coconuts are also present in the forest, coconut seedlings are sometimes common under the palms, but these usually die before growing into adult trees. Weeds, such as *Kalanchoë pinnata*, *Rivina humilis* and *Passiflora suberosa* may also be found here. On stumps of old coconuts, the native fern *Asplenium longissimum* and *Psilotum nudum* are sometimes common. *Pteris tripartita* and *Amphineuron opulentum* are occasionally found in sunny places in this forest.

(2) *Calophyllum* Forest

This forest is found in several areas throughout the island, but is concentrated in the area between East Point Plantation and Minni Minni on the east part of the island (Fig. 9), and in various patches of forest in and around the Navy base. It is dominated by *Calophyllum inophyllum* (Alexandrian laurel), which can grow to trunk diameters in excess of 2 m. This tree may actually be an introduced species, since it is missing from many atolls in the Pacific. It is a very attractive tree that grows to a huge size, and is favored as a shade tree in villages. It often forms nearly pure stands, with little ground cover because of the dense shade of its canopy. When it occurs on the lagoon shore, its branches sometimes extend out over the lagoon water.

(3) *Barringtonia* Forest

This forest is very similar to the *Calophyllum* littoral forest, but is instead dominated by *Barringtonia asiatica* (fish-poison tree), which can similarly grow to huge size. Like *Calophyllum inophyllum*, it has branches that may extend out over the ocean on the lagoon side of the island (Fig. 10), especially at East Point Plantation, where it is the dominant tree on the shore. This tree may also be an introduced species on Diego Garcia, for although it is a littoral tree, in the Pacific it is mostly restricted to volcanic islands rather than atolls. Also, it is virtually absent from the west half of the atoll except where it is cultivated as a shade tree in the housing area and in a small area south of the airport, which indicates it was introduced a long time ago to the eastern half of the island as a shade tree, or perhaps for its fruit, which can be used as a fish poison. In the one area of *Barringtonia* forest seen (at Minni Minni), the forest floor was mostly devoid of ground-cover vegetation, due to the dense canopy of the forest, and perhaps to the layer of large leaves that covers the forest floor and inhibits seedling germination.

(4) *Cordia* Forest

This littoral forest is dominated by *Cordia subcordata*, a large tree with ascending to arching trunks (Fig. 11) that superficially forms a forest that looks like a thicket of *Hibiscus tiliaceus*, but which is not nearly as dense. The tree is found mostly along the lagoon side on the southern part of the island, particularly from the Barachois Sylvain up to the Donkey Gate, and is rarely seen north of the southern end of the airport.

Sometimes this type of littoral forest is nearly pure and is dominated only by *Cordia*, but in other places it shares dominance with *Hernandia nymphaeifolia*. Also common in this forest, when it is mixed with other trees, are *Neisosperma oppositifolium* and *Morinda citrifolia*, which are much smaller trees. *Cordia* forest seems to alternate with *Hernandia* forest, perhaps occupying areas with a shallower, wetter soil. In some places, it even roots in and extends out over the inner lagoon.

The forest floor may be dominated by clumps of *Asplenium nidus*, but more typically there is very little ground cover and *Asplenium* is almost entirely absent. This may be because the bird's-nest fern is unlikely to become an epiphyte on this species of tree (and subsequently fall to the ground and continue to grow there), or it may be unable to develop on the wet soil that is characteristic of this forest.

(5) *Pisonia* Forest

This forest is dominated by *Pisonia grandis*, a tree that can form trunks in excess of 2 m in diameter. The tree is often associated with seabird colonies, either because its sticky seeds are dispersed by sea birds, or because it can tolerate the mineral rich soil (guano) that is associated with the colonies. The tree is uncommon on Diego Garcia, and according to Topp (1988) single and multiple trees can be found on the main island as well

as on East Island and Middle Island, where it was observed as a dominant tree (along with coconuts). The tree probably disappears from areas where there is human disturbance causing sea birds move away.

(6) *Guettarda* Forest

This type of littoral forest is dominated by *Guettarda speciosa* a subcanopy tree that is common in other types of littoral forest and in overgrown coconut plantation. It does not form large areas of forest, but where it does occur it may just be part of the inner margin of the littoral shrubland zone that has become overgrown with *Guettarda* trees. The best example of this is found at the northwest tip of the island between the old cannons and the sewage ponds, along a coastal path (Fig. 12). Here *Guettarda* is the dominant tree, along with lesser amounts of *Neisosperma oppositifolium*. Towards the southern end of this forest, *Hernandia nymphaeifolia* assumes dominance.

The floor of this forest is dominated by clumps of *Asplenium nidus* and low mats of *Lepturus repens* and *Triumfetta procumbens*, as well as the weedy herb *Rivina humilis*. Also present is the woody herb *Achyranthes canescens*, a native plant otherwise uncommon on the island.

G. Coastal Marsh

Several wetlands are found on Diego Garcia, some probably of natural occurrence, but most artificially created by construction activities. These are classified as marshes, since they are dominated by herbaceous plants. The characteristic plant species in marshes are sometimes referred to as "wetland indicator species," which means they have the ability or the need to grow in areas of wet soil. Consequently, their presence in an area usually indicates that the place should be classified as a "wetland." The wetland indicator species, as determined by Reed (1988), found on Diego Garcia are as follows: *Bacopa monniera*, *Typha domingensis*, *Eleocharis geniculata*, *Cyclosorus interruptus*, and *Ipomoea aquatica*, which are "obligate wetland species" (species virtually restricted to wetlands); *Paspalum vaginatum* and *Commelina diffusa*, which are "facultative wetland species" (species that are usually but not always found in wetlands); and *Kyllinga brevifolia* and *Pycreus polystachyos*, which are "facultative species" (species that are often found in wetlands).

The marshes of Diego Garcia are all similar in that they are found in areas of saline or brackish water. Some are on constantly wet soil, some are covered with shallow standing water, and some contain distinct ponds of undetermined depth. There is also much variation in species composition of these marshes, but it is difficult to group the marshes into distinct types. Adding to the difficulty is the tendency of the component species to form distinct zones that exclude all other species. This zonation may be caused by subtle differences in salinity or seasonality, or by accidental factors such as chance dispersal or failure of dispersal to that marsh or pond. However, it is useful to try to classify

them in order to show some of the differences that exist between them, and four types are recognized below. Stoddart recognized two types of marshy vegetation, "inland marsh," which corresponds to the first two types of marshes noted below, and "barachois vegetation," which partially corresponds to the *Paspalum* salt-marsh.

(1) Mixed-Species Marsh

This type of marsh is dominated by low-growing aquatic species, principally *Bacopa monniera*, *Eleocharis geniculata*, *Commelina diffusa*, and, to a lesser extent, *Ipomoea aquatica*. However, there is still much variation in species composition among the mixed-species marshes found on Diego Garcia. The largest marshy area on the island is found in the well area in the northern portion of the west side of the island (Fig. 13). The area is reported to be of 80 acres in extent (Anon. 1986), and comprises several marshes with coconut woodland around them. Some of them may be of natural origin, but most are bordered by embankments that appear to be artificially constructed. The coconut woodlands are almost entirely dominated by coconut palm, and the wet soil of the forest floor is covered with germinating coconuts.

The most natural-appearing of these marshes are characterized by shallow standing water and are dominated by *Bacopa monniera*, *Eleocharis geniculata*, *Cyclosorus interruptus*, and *Stenotaphrum secundatum*. The first three of these plants are native "obligate wetland species," the latter one is an introduced species that probably should be ranked as a "facultative" species. They are arranged in patches, some of which are monospecific (dominated by a single species). Scattered across this marsh are some shrubs or small trees of *Morinda citrifolia* and, to a lesser extent, *Premna serratifolia*.

The adjacent marshes in the area are very similar, and appear to have an artificial origin because of their distinct borders and the presence of a large antenna over them. They are dominated by the same species, but with considerably less of the marsh fern *Cyclosorus interruptus*. A large, rectangular area with similar embankment borders is found just southwest of the fire station. It is currently a shallow pond (Fig. 14) with little vegetation other than algae, and appears to have been recently excavated for sand mining or a similar purpose. In time, it can be expected to become vegetated with *Bacopa monniera*, *Eleocharis geniculata*, and other aquatic species, and become similar to the marsh under the antenna mentioned above.

A variation of this type of marsh is found in various lawns in the managed land of the base. These marshes appear to form in low areas of lawns that are regularly mowed, which prohibits other types of vegetation (e.g., littoral shrubland) from forming (Fig. 15). A good example of this type of wetland is found just to the south of the sewage ponds. The low areas of these wetlands often have shallow standing water and are dominated by *Eleocharis dulcis*, *Bacopa monniera*, and *Paspalum vaginatum*. Away from the center, these species become less dominant and are replaced by more mesic species such as *Pycreus polystachyos*, *Fimbristylis cymosa*, *Lippia nodiflora*, and *Stenotaphrum*

secundatum.

Another variation of the mixed-species marsh is notable for the presence *Commelina diffusa* (apparently misidentified by Topp as *C. benghalensis*) and *Ipomoea aquatica*, in addition to *Bacopa monniera*, and the apparent absence of *Eleocharis geniculata*. The first two species appear to be new arrivals in Diego Garcia, and apparently are restricted at present to the area south of the northern end of the airport. *Bacopa* and *Ipomoea* form mats that grow prostrate on the ground, or may float across the surface of the water (Fig. 17). *Commelina* is, perhaps, less water tolerant, and often forms a dense, irregular surface over the marsh margins (Fig. 18). On the margins of these wetlands, other species, such as *Kyllinga brevifolia* and *Pycneus polystachyos*, are also common and sometimes dominant. One of these marshes at the south end of the airport appears to be what was referred to as a "pristine" marsh (Anon. 1986). However, nothing quite fitting the description of "pristine" or a "screen of ironwood trees that prevent the intrusion of the rapidly-growing *scaevolla* [sic] plant" was seen during the present survey.

(2) Cattail Marsh

This type of wetland is dominated by *Typha domingensis*, a cattail up to 2 m in height that forms dense clumps in standing water and on the edges of ponds and ditches (Fig. 18). This sedge-like plant was apparently introduced in about 1976 (Topp 1988). It is often associated with *Bacopa monniera*, which may form a border around it (since it cannot penetrate into the dense stand of *Typha*). At present, *Typha* is restricted to the airport area, principally in the artificially created ponds that form a discontinuous border along the east side of, and parallel to, the runway, in the roadside drainage ditch just north of it, in a large basin just south of the small boat harbor, and on the edges of a several ponds east of the airport.

(3) *Paspalum* Salt-Marsh

A third kind of marsh is dominated by *Paspalum vaginatum*, with or without other associated species. Northeast of the helipad to the east of the airport, there is a low, homogeneous marsh (Fig. 19), which at the time of the survey, after several rainless days in a row, had no standing water. It is dominated by *Paspalum*, with an admixture of *Fimbristylis cymosa* and a few other species of lesser importance.

Paspalum is very salt tolerant and sometimes forms a marsh that extends into the salt water of the lagoon, without any other associated species, and this can be seen on the sand flats of the barachois west of Turtle Cove, as well as on the southern edge of the Air Force cantonment east of the airport. At high tide, reef sharks and stingrays were seen swimming in the area of *Paspalum*, which attests to the salinity of the water. A related type of wetland discussed above, *Premna* shrubland, appears to be formed in areas that are transitional in soil water and/or salt concentration.

5. DISCUSSION

There are two aspects of the botany of Diego Garcia that must be addressed, sensitive types of vegetation and threatened or endangered plant species. Also to be discussed is the impact of introduced plant species on the atoll.

A. Sensitive Vegetation

Two types of vegetation are of concern on Diego Garcia, the marshes and the littoral forest. Some of the marshes are artificial in origin, but some may be at least partly natural. Those dominated by *Bacopa monniera* (water hyssop), *Eleocharis geniculata*, *Cyclosorus interruptus* (marsh fern), and *Paspalum vaginatum* (marsh grass) may be in the former category, while those dominated by *Typha domingensis* (cattail), *Commelina diffusa*, and *Ipomoea aquatica* (swamp cabbage) are in the latter. However, no matter their origin, these are wetlands that, if they occurred in the U.S., would be entirely protected because of their value for water purification, as a habitat for aquatic birds, and other reasons.

The best of the marshes are the ones associated with the well sites. The main danger to these is construction of roads and more antennas, and over-pumping of water that may lower the water table and drain them, especially in an unusually dry year.

Prior to human occupation, littoral forest covered most of Diego Garcia, but this was largely replaced by coconut plantation and urban area over the last two centuries. The best remaining areas of littoral forest, which are largely dominated by *Hernandia nymphaeifolia*, are found on the westernmost point of the northwest part of the island, the south part of the island, and in the area around and north of East Point Plantation in the restricted sector. There is the uncommon type of littoral forest, *Pisonia* forest, on the small islets at the north part of the atoll, West Island, Middle Island, and East Island, but because of restrictions on landing, which are meant for the protection of these two areas, the survey crew was not able to actually land and survey them.

B. Threatened and Endangered Plant Species

There are no recognized threatened or endangered plant species on Diego Garcia. This is partly because all the native plants found on the atoll are wide-ranging species. However, there are several species that are of concern locally. One of these is *Achyranthes canescens*. This woody herb, which is native eastward into Micronesia, is rare on Diego Garcia. Several of its relatives, such as *Achyranthes splendens* and *A. atollensis*, are extinct, threatened, or endangered in Hawai'i. *Achyranthes canescens* is usually found in littoral shrubland, and its distribution is tied to the distribution by sea birds. However, since the advent of man on the island, and the spread of rats and cats which are fatal to ground-nesting birds, the depletion of sea birds may decrease the frequency of *Achyranthes canescens*. It may be more common on East, Middle, and West Islands, but

these two reef islets could not be visited during the survey.

Another species may have a similar problem. *Pisonia grandis* is a large littoral tree that has sticky fruits that are distributed by adhering to birds' feathers. Although the tree is typically common, and even dominant, on uninhabited islands or islets of tropical islands, it is uncommon on Diego Garcia. This was noted by Topp (1988), who remarked that the bark of the few trees he saw appeared to have been gnawed, which he attributed to either donkeys or rats. The tree has edible leaves, which are used for pig food in some places in the Pacific.

Another tree species, *Intsia bijuga* (ifil tree), is uncommon on Diego Garcia. It has been noted only from the area between East Point Plantation up to Minni Minni and perhaps farther north of that. This species is questionably native, since it is not typically an atoll plant. It is one of the finest timber trees in the Pacific islands, where it has been excessively logged and is endangered over much of its range. Wiehe (1939) noted the presence of a forest of *Intsia* on a nearby Chagos Archipelago island (Salomon Atoll) that was cut down in 1825, so if the tree is not native, it is probably an early introduction to the island.

Three other native species are also uncommon on Diego Garcia—*Caesalpinia bonduc* (gray nickers), *Canavalia cathartica* (St. Thomas bean), *Portulaca australis*, and *Pemphis acidula* (Fig. 21). The latter tree was noted from only two individuals on the southeast coast (which was also noted by Topp 1988). However, all three are widespread species (the first two of them are pantropic) and are not of any global or regional concern.

C. The Introduction of Alien Species

The introduction of alien plant species is a widespread problem, especially in island ecosystems. This problem is somewhat mitigated on Diego Garcia because most introduced plants are unable to germinate and/or survive in the harsh atoll conditions, and native plants, which are adapted island conditions, can usually compete successfully against introduced plants.

Despite the relative resistance of atolls to invasive species, the problem of alien species on Diego Garcia is obvious. During the present survey, 31 new species of weeds were recorded, which is an increase in the number of naturalized and alien species of about 31 percent over the last nine years (since Topp's list in 1988). With all these alien species coming in, it is possible that more harmful species may be introduced in the future. In fact, one species found during the present survey, *Mimosa invisa*, is a terrible weed in many Pacific islands. The weeds are probably introduced as seeds in Navy equipment, which arrives from all over the world. However, near the Air Force cantonment in the "batch" there are piles of sand that have reportedly been imported from Malaysia. Nine new weed species were recorded from these piles and the area in the "batch," and nowhere else on the island. The introduction of seeds of alien species is a "time bomb" that should

be defused.

Finally, there is one particular alien species that is cause for immediate concern. This is an ornamental tree *Tabebuia pentaphylla* (mayflower tree), which was first reported on the island about ten years ago (Topp 1988). It was originally introduced as an ornamental, and is a common shade tree in the downtown area. However, it is a prolific seed producer, and these "winged" seeds are readily spread by the wind. Seedlings can be found all over the downtown area, sometimes dominating the ground cover, especially underneath the adult trees.

Behind the East Point Plantation, the mayflower tree has become a terrible pest. It is the dominant forest tree that excludes almost all other tree species (Fig. 20). This is probably the area with the best soil on the island, and it is now largely covered with this alien species. Normally, this area would be covered with a native littoral forest, perhaps (if it is native) the *Intsia bijuga*, (ifil tree) which has valuable timber.

6. RECOMMENDATIONS

The plant life on Diego Garcia is generally in good condition, especially when compared with that of inhabited atolls elsewhere in the tropics. The British effort to preserve the eastern half of the island is praiseworthy and should be continued. However, the following recommendations aim to preserve the relatively pristine environment of the island.

- **Monitor the wetlands in the well area.**

This is the best marsh on the island, and perhaps the only natural one outside of the *Paspalum* salt-marshes found on the lagoon shores of the island. Water is being pumped out of this area, which may damage this wetland. Also, construction in this area should be severely limited. Continue present monitoring efforts focusing on any possible changes in the species composition and extent of the marshes.

- **Control the introduction of new weedy species.**

Strictly monitor to control the unintentional introduction of alien species. Environmentally, it is not a good idea to introduce sand from other places, because of the weed seeds it may contain. A better alternative should be found, or perhaps the sand should be sterilized before it arrives on the island.

- **Control the population of pest trees.**

The mayflower tree (*Tabebuia heterophylla*) is becoming a pest around the inhabited areas (although it is a good shade tree otherwise), and completely dominates the good soil area at East Point Plantation, land that could be a prime habitat for native littoral

forest, including the valuable, possibly native ifil tree (*Intsia bijuga*). Some people on the island have also complained about the ironwood tree (*Casuarina equisetifolia*). This tree is probably not native, but has been on the island for a long time. It reportedly cracks sidewalks in the downtown area, and is an invasive tree. However, unless the disturbance to a site is severe, the tree does not usually form mono-dominant forests, and its seedlings are shaded out by the other native littoral forest trees. So no control for this tree is recommended at this time, other than removing offending trees in town.

- **Do not introduce landscape plants that may be a threat to the environment.**

Ornamentals have aesthetic value (an attractive environment) and practicality (shade) in and around the base. However, trees that have a potential to spread (i.e., ones with easily dispersed seeds) should not be introduced, because they may escape and become weedy. Native trees, such as coconuts, *Tournefortia argentea*, *Terminalia catappa*, *Calophyllum inophyllum*, *Guettarda speciosa*, and *Barringtonia asiatica* make a viable alternative, and, in fact, are commonly used for this purpose now. Although they may be slow growing, they are perfectly adapted to atoll conditions. Two other trees that may be useful are *Artocarpus altilis* (breadfruit) and *Artocarpus mariannensis* (Micronesian breadfruit). These become large, attractive trees on many Micronesian islands, and produce a edible fruit (breadfruit).

- **Study the vegetation on West, Middle, and East Islands.**

The vegetation on these islets should be studied and compared with that on the main part of the island. If the islets are rat- and cat-free, the vegetation may be indicative of what the natural vegetation on the main part of the atoll originally was, and what it could be like if cats and rats were eliminated from the island (possibly an impractical or impossible task). In any case, these islands should remain off-limits to visitors other than scientists.

- **Protect the remaining forests.**

An effort should be made to protect the remaining forests on the island, especially those dominated by large native trees (but not *Casuarina equisetifolia*). This can be done by avoiding construction of facilities within these areas. The forest southwest of the well site is particularly good, as is the forest between the cannons and the sewage ponds (especially because it has a "nature trail" (or perhaps it is actually a mountain bike trail now) through it, and is one of the places on the island where *Achyranthes canescens* (Fig. 22) was found during the survey. Also, the eastern half of the atoll should remain protected and visitors monitored.

7. NATIVE AND NATURALIZED PLANTS

The native and naturalized plants listed in Table 1 are arranged in three groups: (1)

Pteridophytes; (2) Monocots; and (3) Dicots. Within these groups, the species are listed in families arranged in alphabetical order, and within the families the species are in alphabetical order. The species names generally follow those of Brownlie (1977) for the ferns, and A.C. Smith (1979–1991) for the gymnosperms and angiosperm.

In the status column, "X" equates to alien and weedy; "N" identifies native plants. The collectors column identifies Stoddart (1971) as "S", Topp (1986) as "T", and Whistler (1995) as "W". Parentheses around the "S" indicates that being noted by Stoddart from earlier sources (usually Wiehe), but not seen.

Table 1: Native and Naturalized Plants Checklist

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
PTERIDOPHYTES (Ferns and Fern Allies)						
ADIANTIACEAE						
<i>Pteris tripartita</i> Sw.		-	X	S	T	W
<i>Pteris vittata</i> L.		-	X	-	-	W
ASPLENIACEAE						
<i>Asplenium longissimum</i> B1.		-	N	S	T	W
<i>Asplenium macrophyllum</i> Sw.		-	N	S	T	W
<i>Asplenium nidus</i> L.		bird's-nest fern	N	S	T	W
PSILOTACEAE						
<i>Psilotum nudum</i> (L.) Beauv.		psilotum	N	S	T	W
THELYPTERIDACEAE						
<i>Cyclosorus interruptus</i> (Willd.) H. Ito		marsh fern	N	S	T	W
<i>Amphineuron opulentum</i> (Kaulf.) Holtt.		-	X	S	T	W
ANGIOSPERMAE: MONOCOTS						
AMARYLLIDACEAE						
<i>Scadoxus multiflorus</i> (Martyn) Raf.		blood lily	X	S	T	W
<i>Zephyranthes rosea</i> (Spreng.) Lindl.		zephyr lily	X	S	T	W
ARACEAE						
<i>Alocasia macrorrhiza</i> (L.) Schott		giant taro	X	S	T	W
ARECACEAE						
<i>Cocos nucifera</i> L.		coconut	N?	S	T	W
COMMELINACEAE						
<i>Commelina diffusa</i> Burm. f.		dayflower	X	(S)	T	W
CYPERACEAE						
<i>Cyperus compressus</i> L.		-	X	S	-	W
<i>Cyperus difformis</i> L.		-	X	-	-	W
<i>Cyperus dubius</i> Rottb.		-	X	S	T	W
<i>Cyperus iria</i> L.		-	X	-	T	-
<i>Cyperus ligularis</i> L.		-	X	S	T	W
<i>Cyperus rotundus</i> L.		nutgrass	X	S	T	-
<i>Cyperus cf. sphacelatus</i> Rottb.		-	X	-	T	-

FAMILY Species	Common Name	Status (1)	Collectors (2)
<i>Cyperus cf. surinamensis</i> Rottb.	-	X	? T W
<i>Eleocharis geniculata</i> (L.) R. & S.	-	X?	S T W
<i>Fimbristylis cymosa</i> R. Br.	-	N	S T W
<i>Kyllinga brevifolia</i> Rottb.	-	X	- - W
<i>Kyllinga nemoralis</i> (Forst.) Dandy	-	X	S T W
<i>Kyllinga polyphylla</i> Willd. ex Kunth	Navua sedge	X	- T W
<i>Pycnus polystachyos</i> (Rottb.) Beauv.	-	X	- T W
POACEAE			
<i>Cenchrus echinatus</i> L.	bur grass	X	- T W
<i>Chloris barbata</i> (L.) Sw.	finger grass	X	- T W
<i>Cynodon dactylon</i> (L.) Pers.	Bermuda grass	X	- T W
<i>Dactyloctenium ctenoides</i> (Steud.) Bosser	crowfoot grass	X	- ? W
<i>Dichanthium annulatum</i> (Forssk.) Stapf	-	X	- ? W
<i>Dichanthium bladhii</i> (Retz.) Clayton	-	X	- T W
<i>Digitaria ciliaris</i> (Retz.) Koel.	-	X	- - W
<i>Digitaria horizontalis</i> Willd. (?)	-	X	S T -
<i>Digitaria cf. fuscescens</i> (Presl) Henr.	-	X	- T W
<i>Digitaria radicata</i> (Presl) Miq.	-	X	S W
<i>Digitaria violascens</i> Link	-	X	- - W
<i>Eleusine indica</i> (L.) Gaertn.	goose grass	X	S T W
<i>Eragrostis atrovirens</i> (Desf.) Trin.	-	X	- - W
<i>Eragrostis brownii</i> (Kunth) Nees	-	X	- - W
<i>Eragrostis ciliaris</i> (L.) R. Br.	-	X	- - W
<i>Eragrostis tenella</i> (L.) Beauv.	love grass	X	S T W
<i>Eriochloa procera</i> (Retz.) C.E. Hubb.	cup grass	X	- - W
<i>Eustachys petraea</i> (Sw.) Desv.	-	X	- - W
<i>Leptochloa uninervia</i> (Presl) Hitchc. & Chase	-	X	- T W
<i>Lepturus repens</i> (Forst.) R. Br.	-	N	S T W

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
<i>Lolium perenne</i> L.		Perennial rye grass	X	-	T	-
<i>Panicum maximum</i> Jacq.		Guinea grass	X	-	T	-
<i>Paspalum setaceum</i> Michx.		-	X	-	?	W
<i>Paspalum vaginatum</i> Sw.		knot grass	X	S	T	W
<i>Pennisetum polystachyon</i> (L.) Schult.		feathery pennisetum	X	S	T	-
<i>Rhynchelytrum repens</i> (Willd.) C. E. Hubb		Natal redtop	X	-	-	W
<i>Sorghum halepense</i> (L.) Pers.		Johnson grass	X	-	T	W
<i>Sporobolus diander</i> (Retz.) Beauv.		dropseed	X	-	-	W
<i>Stenotaphrum secundatum</i> (Walter) Kuntze		buffalo grass	X	S	T	W
<i>Stenotaphrum micranthum</i> (Desv.) C.E. Hubb		-	N	S	T	W
POTAMOGETONACEAE						
<i>Thalassodendron ciliatum</i> (Forsk.) den Hart		sea grass	N	S	T	W
TYPHACEAE						
<i>Typha domingensis</i> Pers.		cattail	X	-	T	W
ANGIOSPERMAE: DICOTS						
ACANTHACEAE						
<i>Hemigraphis alternata</i> (Burm. f.) T. Anderson		metal leaf	X	S	T	W
AMARANTHACEAE						
<i>Achyranthes canescens</i> R. Br.		-	N	S	T	W
<i>Aerva lanata</i> Juss.		-	X	S	T	-
<i>Amaranthus viridis</i> L.		amaranth	X	(S)	-	-
APIACEAE						
<i>Centella asiatica</i> (L.) Urb.		Asiatic pennywort	X	-	T	-
<i>Hydrocotyle bonariensis</i> Lam.		-	X	-	T	W
APOCYNACEAE						
<i>Catharanthus roseus</i> (L.) G. Don		periwinkle	X	S	T	W
<i>Neisosperma oppositifolium</i> (Lam.) Fosb. & Sachet		-	N	S	T	W

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
ASCLEPIADACEAE						
<i>Asclepias curassavica</i> L.		milkweed	X	S	T	W
ASTERACEAE						
<i>Ageratum conyzoides</i> L.		ageratum	X	S	T	W
<i>Bidens alba</i> (L.) DC.		beggar's tick	X	?	T	W
<i>Chromolaena odorata</i> (L.) King & Robin.		-	X	-	-	W
<i>Conyza canadensis</i> (L.) Cronq.		Canadian fleabane	X	-	T	W
<i>Eclipta alba</i> (L.) Hassk.		false daisy	X	-	T	W
<i>Mikania scandens</i> (L.) Willd.		mile-a-minute	X	S	T	W
<i>Pluchea carolinensis</i> (Jacq.) D. Don		pluchea	X	-	T	W
<i>Synedrella nodiflora</i> (L.) Gaertn.)		nodeweed	X	S	T	W
<i>Tridax procumbens</i> L.		coat buttons	X	S	T	W
<i>Vernonia cinerea</i> (L.) Less.		ironweed	X	S	T	W
<i>Wollastonia biflora</i> (L.) DC.		beach sunflower	X?	S	T	W
BARRINGTONIACEAE						
<i>Barringtonia asiatica</i> (L.) Kurz		fish-poison tree	N	S	T	W
BIGNONIACEAE						
<i>Tabebuia heterophylla</i> (DC.) Britton		mayflower tree	X	-	T	W
BORAGINACEAE						
<i>Cordia subcordata</i> Lam.		-	N	S	T	W
<i>Heliotropium procumbens</i> Mill.		heliotrope	X	-	T	W
<i>Tournefortia argentea</i> L. f.		beach heliotrope	N	S	T	W
CAMPANULACEAE						
<i>Hippobroma longiflora</i> (L.) G. Don		star of Bethlehem	X	S	T	W
CASSYTHACEAE						
<i>Cassytha filiformis</i> L.		-	N	S	T	W
CASUARINACEAE						
<i>Casuarina equisetifolia</i> L.		ironwood	X	S	T	W
CLUSIACEAE						
<i>Calophyllum inophyllum</i> L.		Alexandrian laurel	N?	S	T	W
COMBRETACEAE						
<i>Terminalia catappa</i> L.		tropical almond	N?	S	T	W

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
CONVOLVULACEAE						
<i>Ipomoea aquatica</i> Forssk.		swamp cabbage	X	-	T	W
<i>Ipomoea macrantha</i> Roem. & Schult.		-	N	S	T	W
<i>Ipomoea pes-caprae</i> (L.) R. Br.		beach morning glory	N	S	T	W
<i>Ipomoea triloba</i> L.		little bell	X	-	-	W
CRASSULACEAE						
<i>Kalanchoë pinnata</i> (Lam.) Pers.		air plant	X	S	T	W
CUCURBITACEAE						
<i>Cucumis melo</i> L.		wild melon	X	?	T	W
EUPHORBIACEAE						
<i>Acalypha indica</i> L.		-	X	S	T	-
<i>Breynia disticha</i> Forst.		snow bush	X	S	T	W
<i>Chamaesyce hirta</i> (L.) Millsp.		garden spurge	X	S	T	W
<i>Chamaesyce hypericifolia</i> (L.) Millsp.		-	X	-	-	W
<i>Chamaesyce prostrata</i> (Ait.) Millsp.		prostrate spurge	X	S	T	W
<i>Chamaesyce thymifolia</i> (L.) Millsp.		thyme-leafed spurge	X	-	T	W
<i>Euphorbia cyathophora</i> Murr.		wild poinsettia	X	-	T	W
<i>Euphorbia heterophylla</i> L.		-	X	-	-	W
<i>Phyllanthus amarus</i> Sch. & Thon.		-	X	S	T	W
<i>Phyllanthus maderaspatensis</i> L.		-	X	S	T	W
<i>Phyllanthus urinaria</i> L.		-	X	-	?	W
<i>Ricinus communis</i> L.		castor bean	X	-	T	-
FABACEAE						
<i>Aeschynomene</i> sp.		-	X	-	-	-
<i>Albizia lebeck</i> (L.) Benth.		siris tress	X	S	T	-
<i>Alysicarpus vaginalis</i> (L.) DC.		alysicarpus	X	-	-	W
<i>Canavalia cathartica</i> Thous.		St. Thomas bean	N?	S	T	W
<i>Caesalpinia bonduc</i> (L.) Roxb.		gray nickers	N?	-	T	W
<i>Calopogonium mucunoides</i> Desv.		-	X	-	-	W
<i>Crotalaria pallida</i> Aiton		rattlepod	X	-	-	W

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
<i>Crotalaria cf. zanzibarica</i> Benth.		-	X	-	-	W
<i>Desmanthus virgatus</i> (L.) Willd.		-	X	-	-	W
<i>Desmodium tortuosum</i> (Sw.) DC.		Florida beggarweed	X	-	-	W
<i>Desmodium triflorum</i> (L.) DC.		-	X	-	-	W
<i>Intsia bijuga</i> (Colebr.) Kuntze		ifil	N	S	T	W
<i>Leucaena leucocephala</i> (Lam.) de Wit		wild tamarind	X	S	T	W
<i>Macroptilium lathyroides</i> (L.) Urb.		phasey bean	X	-	-	W
<i>Mimosa invisa</i> Mart. ex Colla		giant sensitive plant	X	-	-	W
<i>Mimosa pudica</i> L.		sensitive plant	X	S	T	W
<i>Senna occidentalis</i> (L.) Roxb.		coffee senna	X	S	T	W
<i>Sesbania cannabina</i> (Retz.) Pers.		-	X	-	-	W
<i>Vigna marina</i> (Burm.) Merr.		beach pea	X	-	T	W
GOODENIACEAE						
<i>Scaevola taccada</i> (Gaertn.) Roxb.		scaevola	N	S	T	W
HERNANDIACEAE						
<i>Hernandia nymphaeifolia</i> (Presl) Kub.		Chinese lantern tree	N	S	T	W
LAMIACEAE						
<i>Ocimum gratissimum</i> L.		wild basil	X	S	-	-
LYTHRACEAE						
<i>Pemphis acidula</i> Forst. f.		pemphis	N	-	T	W
MALVACEAE						
<i>Hibiscus tiliaceus</i> L.		beach hibiscus	X	S	T	W
<i>Malvastrum coromandelianum</i> (L.) Garcke		false mallow	X	(S)	(T)	W
<i>Sida acuta</i> Burm. f.		-	X	S	T	W
<i>Sida pusilla</i> Ca.		-	N	S	T	W
<i>Sida rhombifolia</i> L.		Cuba jute	X	-	-	W
MORACEAE						
<i>Ficus benghalensis</i> L.		Indian banyan	X	S	T	W
NYCTAGINACEAE						
<i>Boerhavia cf. tetrandra</i> Forst. f.		-	N	S	T	W

FAMILY Species	Common Name	Status (1)	Collectors (2)		
<i>Pisonia grandis</i> R. Br.	pisonia	N	S	T	W
OXALIDACEAE <i>Averrhoa bilimbi</i> L.	bilimbi	X	S	T	W
PASSIFLORACEAE <i>Passiflora suberosa</i> L.	-	X	S	T	W
PHYTOLACCACEAE <i>Rivina humilis</i> L.	coral berry	X	S	T	W
PLANTAGINACEAE <i>Plantago major</i> L.	plantain	X	-	T	-
PORTULACACEAE <i>Portulaca cf. australis</i> Endl.	-	N	S	T	W
<i>Portulaca oleracea</i> L.	purslane	X	S	T	W
RUBIACEAE <i>Dentella repens</i> . Forst	-	X	-	T	W
<i>Guettarda speciosa</i> L.	-	N	S	T	W
<i>Hedyotis corymbosa</i> (L.) Lam.	-	X	-	T	W
<i>Morinda citrifolia</i> L.	Indian mulberry	N	S	T	W
<i>Spermacoce assurgens</i> Ruiz & Pavon	-	X	S	T	W
<i>Spermacoce bartlingiana</i> (DC.) Hemsl.	-	X	-	-	W
RUTACEAE <i>Triphasia trifolia</i> (Burm. f.) P. Wils.	limeberry	X	-	T	W
SAPOTACEAE <i>Mimusops cf. coriacea</i> (DC.) Miq.	-	X	S	T	W
SCROPHULARIACEAE <i>Bacopa monnieri</i> (L.) Wettst.	water hyssop	N	S	T	W
<i>Buchnera floridanus</i> Sm.	-	X	-	-	W
<i>Striga asiatica</i> (L.) Kuntze	-	X	S	T	W
<i>Torenia polygonoides</i> Benth.	-	X	-	-	W
SOLANACEAE <i>Solanum americanum</i> Mill.	black nightshade	X	(S)	T	W
<i>Solanum torvum</i> Sw.	-	X	-	-	W
STERCULIACEAE <i>Melochia pyramidata</i> L.	-	X	S	T	W

Species	FAMILY	Common Name	Status (1)	Collectors (2)		
<i>Waltheria indica</i> L.		-	X	-	T	W
	SURIANIACEAE					
<i>Suriana maritima</i> L.		suriana	N	S	T	W
	TILIACEAE					
<i>Corchorus aestuans</i> L.		-	X	-	-	W
<i>Triumfetta procumbens</i> Forst.		-	N	S	T	W
	TUNERACEAE					
<i>Turnera ulmifolia</i> L.		yellow alder	X	S	T	W
	URTICACEAE					
<i>Pilea microphylla</i> (L.) Liebm.		rockweed	X	S	T	W
<i>Pipturus argenteus</i> (Forst.) Wedd.		-	X?	S	T	W
	VERBENACEAE					
<i>Lippia nodiflora</i> L.		lippia	X	S	T	W
<i>Premna serratifolia</i> L.		-	N	S	T	W
<i>Stachytarpheta jamaicensis</i> (L.) Vahl		Jamaica vervain	X	S	T	W
<i>Stachytarpheta urticaefolia</i> (Salisb.) Sims		blue rat's-tail	X	-	T	W

(1) N = Native; X = alien and weedy.

(2) S = Stoddart (1971); T = Topp (1988); W = Whistler (1995).

Parentheses around the "S" indicates that it was noted by Stoddart from earlier sources (usually Wiehe), but not seen by him.

8. CULTIVATED PLANTS

The cultivated plants listed in **Table 2** are arranged in three groups: (1) Gymnosperms; (2) Monocots; and (3) Dicots. Within these groups, the species are listed in families arranged in alphabetical order, and within the families the species are in alphabetical order. The species names generally follow those of A.C. Smith (1979–1991) for the gymnosperms and angiosperms. Species preceded by "@" are also naturalized.

Collectors are identified by "S" for Stoddart (1971) or (S) when cited by Stoddart from earlier authors, but not seen by him; "T" for Topp (1986); and "W" for Whistler (1995).

Table 2: Cultivated Plants Checklist

Species	FAMILY	Common Name	Collectors (1)		
CONIFERS (GYMNOSPERMAE)					
ARAUCARIACEAE					
<i>Araucaria columnaris</i> (Forst. F.) Hook.		Cook pine	S	T	W
CUPRESSACEAE					
<i>Thuja orientalis</i> L.		oriental arbovitae	-	T	W
ANGIOSPERMAE: MONOCOTS					
AGAVACEAE					
<i>Cordyline fruticosa</i> (L.) Chev.		ti plant	-	-	W
<i>Sansevieria trifasciata</i> Prain		mother-in-law's tongue	-	T	W
AMARYLLIDACEAE					
<i>Allium</i> sp.		onion	-	T	W
<i>Crinum asiaticum</i> L.		crinum lily	-	T	W
<i>Crinum latifolium</i> L.		—	S	T	W
@ <i>Scadoxus multiflorus</i> (Martyn) Raf.		blood lily	S	T	W
<i>Hippeastrum puniceum</i> (Lam.) Urb.		Barbados lily	-	T	W
<i>Hymenocaulis littoralis</i> (Jacq.) Salisb.		spider lily	S	T	W
@ <i>Zephyranthes rosea</i> (Spreng.) Lindl.		zephyr lily	S	T	W
ARACEAE					
<i>Aglaonima commutatum</i> Schott (?)		aglaonima	-	-	W
@ <i>Alocasia macrorrhiza</i> (L.) Schott		giant taro	S	T	W
<i>Alocasia plumbea</i> van Houtte		-	S	T	W
<i>Caladium bicolor</i> (Ait.) Vent.		caladium	-	-	W
<i>Colocasia esculenta</i> (L.) Schott		taro	-	-	W
<i>Epipremnum pinnatum</i> (L.) Engl.		pothos	-	-	W
<i>Philodendron</i> sp.		dumb cane	-	-	W
<i>Syngonium angustatum</i> Schott (?)		syngonium	-	-	w
ARACACEAE					
<i>Hyphaene</i> sp.		—	S	T	W
<i>Phoenix</i> sp.		date palm	S	T	-

Species	FAMILY	Common Name	Collectors (1)		
<i>Roystonea elata</i> (Bartr.) Harper		—	-	T	W
	COMMELINACEAE				
<i>Rhoeo spathacea</i> (Sw.) Stearn		oyster plant	-	-	W
<i>Zebrina pendula</i> Schnizl.		wandering Jew	-	T	W
	DIOSCOREACEAE				
<i>Dioscorea</i> sp.		yam	-	-	W
	LILIACEAE				
<i>Asparagus setaceus</i> (Kunth) Jessop		asparagus fern	-	-	W
	MUSACEAE				
<i>Musa x paradisiaca</i> L.		banana	S	T	W
	ORCHIDACEAE				
<i>Vanilla planifolia</i> Jackson		vanilla	-	T	W
	PANDANACEAE				
<i>Pandanus tectorius</i> Park.		screwpine	S	T	W
	POACEAE				
<i>Bambusa vulgaris</i> Schrad. ex Wendl.		bamboo corn	S	T	W
<i>Zea mays</i> L.		corn	S	T	-
	ZINGIBERACEAE				
<i>Zingiber spectabile</i> Griff..		—	-	T	W
	ANGIOSPERMAE: DICOTS				
	ACANTHACEAE				
@ <i>Hemigraphis alternata</i> (Burm.f.) Anders.		metal leaf	S	T	W
	AMARANTHACEAE				
<i>Amaranthus</i> sp.		—	-	-	W
<i>Lagresia micrantha</i> (Bak.) Schniz		—	-	T	-
	ANACARDIACEAE				
<i>Mangifera indica</i> L.		mango	S	T	W
	APIACEAE				
@ <i>Hydrocotyle bonariensis</i> Lam.		—	-	T	W
	APOCYNACEAE				
@ <i>Catharanthus roseus</i> (L.) G. Don		periwinkle	S	T	W
<i>Nerium oleander</i> L.		oleander	-	T	-
<i>Plumeria rubra</i> L.		frangipani	-	T	W
	ARALIACEAE				
<i>Polyscias</i> sp.		panax	-	-	W

FAMILY	Common Name	Collectors (1)		
Species				
ASTERACEAE				
<i>Bidens sulpherea</i> (Cav.) Sch.-Bip.	—	S	-	-
<i>Eupatorium triplinerve</i> Vahl.	—	(S)	-	-
<i>Gaillardia pulchella</i> Foug.	gaillardia	-	-	W
<i>Helianthus annus</i> L.	sunflower	-	-	W
<i>Tagetes</i> sp.	marigold	-	T	-
<i>Zinnia</i> sp.	zinnia	-	-	W
BALSAMINACEAE				
<i>Impatiens balsamina</i> L.	garden balsam	S	-	W
BIGNONIACEAE				
@ <i>Tabebuia heterophylla</i> (DC.) Britton	mayflower tree	-	T	W
BOMBACAEAE				
<i>Ceiba pentandra</i> (L.) Gaertn.	kapok	S	T	W
BRASSICACEAE				
<i>Brassica</i> sp.	—	-	-	W
CAMPANULACEAE				
@ <i>Hippobroma longiflora</i> (L.) G. Don	star of Bethlehem	S	T	W
CARIACEAE				
<i>Carica papaya</i> L.	papaya	S	T	W
CONVOLVULACEAE				
<i>Ipomoea batatas</i> (L.) Lam.	sweet potato	(S)	T	-
CUCURBITACEAE				
<i>Cucurbita maxima</i> Duch.	autumn squash	(S)	-	-
<i>Cucurbita moschata</i> (Duch.) Poir.	winter squash	-	T	-
<i>Luffa acutangula</i> (L.) Roxb.	loofah	-	-	W
EUPHORBIACEAE				
@ <i>Breynia disticha</i> Forst.	snow bush	S	T	W
<i>Codiaeum variegatum</i> (L.) Bl.	croton	S	T	W
<i>Pedilanthus tithymaloides</i> (L.) Poit.	slipper flower	-	T	W
FABACEAE				
<i>Albizia lebeck</i> (L.) Benth.	siris tree	S	T	-
<i>Delonix regia</i> (bojer ex Hook.) Raf.	flamboyant	-	T	W
<i>Enterolobium cyclocarpum</i> (Jacq.) Grieseb.	elephant's ear	-	T	-

FAMILY Species	Common Name	Collectors (1)		
<i>Erythrina variegata</i> L.	coral tree	-	T	-
<i>Pithecellobium dulce</i> (Roxb.) Benth.	Manila tamarind	S	T	W
<i>Samanea saman</i> (Jacq.) Merr.	monkey pod	-	T	-
<i>Sesbania grandiflora</i> (L.) Pers.	sesban	-	T	-
<i>Vigna</i> sp.	bean	-	T	W
GESNERIACEAE <i>Episcia cupreata</i> (Hook.) Hanst.	episcia	-	-	W
LAMIACEAE <i>Mentha</i> sp.	mint	S	-	-
<i>Ocimum americanum</i> L.	basil	S	-	-
LAURACEAE <i>Persea americana</i> L.	Avocado	-	T	-
MALVACEAE <i>Abutilon indicum</i> (L.) Sw.	—	S	T	W
<i>Gossypium hirsutum</i> L.	cotton	S	T	-
<i>Hibiscus manihot</i> L.	tree spinach	S	-	-
<i>Hibiscus rosa-sinensis</i> L.	red hibiscus	S	T	W
MYRTACEAE <i>Syzygium samarangense</i> (Bl.) Merr. & Perry	—	S	-	W
MORACEAE <i>Artocarpus altilis</i> (Park.) Fosb.	breadfruit	S	T	W
@ <i>Ficus benghalensis</i> L.	Indian banyan	S	T	W
<i>Ficus religiosa</i> L.	scared banyan	S	T	-
<i>Ficus</i> sp.	banyan	S	-	W
NYCTAGINACEAE <i>Bougainvillea</i> sp.	bougainvillea	-	T	W
<i>Mirabilis jalapa</i> L.	four-o'clock	-	-	W
OXALIDACEAE @ <i>Averrhoa bilimbi</i> L.	bilimbi	S	T	W
RUBIACEAE <i>Ixora</i> sp.	ixora	-	T	W
<i>Pentas lanceolata</i> (Forssk.) Schum.	pentas	S	-	-

FAMILY Species	Common Name	Collectors (1)		
RUTACEAE <i>Citrus aurantium</i> L.	orange	S	T	W
<i>Citrus aurantifolia</i> (Christm.) Swingle	lime	S	T	-
SAPOTACEAE @ <i>Mimusops coriacea</i> (DC.) Miq.	—	S	T	W
SOLANACEAE <i>Capsicum frutescens</i> L.	chili pepper	S	T	W
<i>Lycopersicon esculentum</i> Mill.	tomato	-	T	-
<i>Solanum melongena</i> L.	egg plant	-	T	-
<i>Solanum tuberosum</i> L.	potato	-	T	-
TURNERACEAE @ <i>Turnera ulmifolia</i> L.	yellow alder	S	T	W
URTICACEAE <i>Pilea depressa</i> (Sw.) Wedd.	baby's tears	-	-	W

- (1) S - Stoddart (1971); (S) - cited by Stoddart from earlier authors, but not seen by him; T - Topp (1988); W - Whistler (1995).

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Figure 1. Managed land vegetation



Figure 2. Premna shrubland



Figure 3. Casuarina Woodland



Figure 4. Littoral shrubland, east ocean side

**Figures 1 – 4
BOTANICAL SURVEY**

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997



Figure 5. *Littoral shrubland, northwest ocean side*



Figure 6. *Littoral shrubland, south lagoon side*



Figure 7. *Low littoral shrubland, southwest corner of the island*

**Figures 5 – 7
BOTANICAL SURVEY**

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997

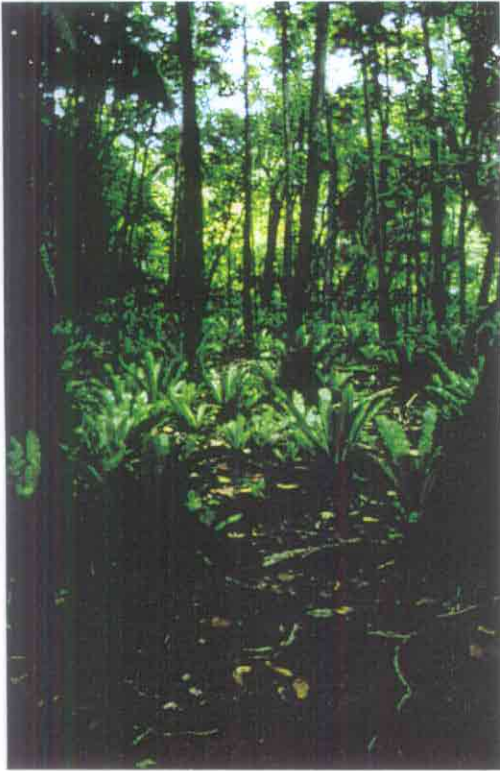


Figure 8. *Hernandia littoral* forest



Figure 9. *Calophyllum littoral* forest



Figure 10. *Barringtonia* trees

Figures 8 – 10
BOTANICAL SURVEY

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997



Figure 11. *Cordia littoral* forest



Figure 12. *Guettarda littoral* forest



Figure 13. Coastal marsh



Figure 14. Artificial pond

Figures 11 – 14
BOTANICAL SURVEY

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997



Figure 15. Artificial marsh



Figure 16. Pond with *Ipomoea aquatica* growing over its surface



Figure 17. Coastal marsh dominated by *Commelina diffusa*



Figure 18. Cattail marsh

**Figures 15 – 18
BOTANICAL SURVEY**

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997



Figure 19. *Paspalum* salt marsh



Figure 20. *Tabebuia* secondary forest

**Figures 19 and 20
BOTANICAL SURVEY**

Diego Garcia
Natural Resource Management Plan
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Figure 21. *Pemphis acidula*



Figure 22. *Achyranthes canescens*

**Figures 21 and 22
BOTANICAL SURVEY**

Diego Garcia
Natural Resource Management Plan
Prepared by Belt Collins Hawaii, April 1997

**BOTANICAL SURVEY UPDATE OF DIEGO GARCIA,
CHAGOS ARCHIPELIGO, BRITISH INDIAN OCEAN TERRITORY**

Prepared by Julie Rivers
Naval Facilities Engineering Command, Pacific

July 2004

Appendix E2

INTRODUCTION

Botanical surveys have been conducted on Diego Garcia several times over the last century. These surveys include those conducted in the Chagos Archipelago between 1993-1998 for the book “Ecology of the Chagos Archipelago” and some funded specifically by the Navy on Diego Garcia. The most recent Navy-funded survey before this one occurred in 1995 in support of the Navy’s Natural Resources Management Plan (NRMP).

This botanical survey update was conducted to support the preparation of the 2004 Integrated Natural Resources Management Plan (INRMP). Specific goals were to document any significant changes in the species composition, search for rare and protected species, new invasive species, and to map the vegetation types using Global Positioning System (GPS).

The main island of the atoll (Diego Garcia) was surveyed, along with the three small islands that are located at the mouth of the atoll: East, Middle and West islands.

METHODS

Botanical Survey:

Since there have been several comprehensive surveys resulting in species lists over the past century, a new species list was not generated for the main atoll. Rather, the areas were surveyed in a reconnaissance method over a two-week period for significant changes in vegetation type, threatened and endangered species, significant native species and invasive species. A species list was generated for East, Middle and West islands (see Table 1) since species lists for these islands had not been documented for many years.

The plant communities of the main atoll were divided into ten categories:

- *Calophyllum* Forest
- Cocos Forest
- Cocos-*Hernandia* Forest
- Cocos-*Guettarda*
- *Hernandia*
- *Premna* shrubland
- Littoral Scrub
- Maintained
- Mixed Native Forest
- Marshes (Wetland, Mixed Species, Cattail)

See Figures for photos of vegetation types. Cultivated plants were not assessed for this survey although general observations were made.

Vegetation mapping:

Vegetation types were classified in the field based upon dominant canopy species. In addition to this classification, a listing was made of other dominant species in the forest. Once an area was classified, it was mapped using a GPS unit (Trimble GeoExplorer CE) and a map was created using Arc Map. Additionally, species of management concern were also mapped.

RESULTS

Diego Garcia

Native species:

The species composition on Diego Garcia is typical of a tropical atoll. None of the plants were identified as endemic, but they are predominantly indigenous (meaning native to the atoll, but also found elsewhere). The exception to this is in the maintained and developed areas, which contain many non-native species. There were no new plant species observed during this survey.

Pisonia grandis is one indigenous tree species of particular interest. It is prevalent on East, West and Middle islands and near Barton Point. There are also scattered individual trees on the rest of Diego Garcia. Near Barton Point and on West, East and Middle islands, it is the dominant tree forming the littoral edge. (Figure 1a and 1b)

Several small groves of ifil (*Intsia bijuga*), a valuable hardwood, were also found. Previous descriptions suggest that this plant is a “probable native” to Diego Garcia (Sheppard, C.S. 1999, Whistler, 1995). (Figure 2)

Invasive Species:

There were several invasive species found during this survey that may be problematic for tropical island ecosystems such as Diego Garcia. These are wild tamarind or tangantangan (*Leucaena leucocephala*), sensitive plant (*Mimosa invisa*), Star of Bethlehem (*Laurentia longiflora*) and coral berry (*Ravina humilis*). All of these species had been found on previous surveys. The Star of Bethlehem appears to be isolated to the plantation area, but is a concern since it’s milky sap is very poisonous if ingested.

Vegetation Types:

Calophyllum Forest: This forest type is found in several areas throughout the island, but is mostly concentrated on the eastern, undeveloped side of the atoll near Minni Minni and East Point plantation. It is dominated by Alexandrian laurel or tamanu (*Calophyllum inophyllum*) with a trunk that can grow in excess of 2 meters. This forest often contains other species such as *Hernandia sonora* (lantern tree), *Cocos nucifera* (coconut) and *Guettarda speciosa* (panao) with a *Premna obtusifolia* edge. When found on the beaches, *Calophyllum* often extends over the lagoon water and supports nesting red-footed boobies, as does *Barringtonia asiatica* (fish-poison or rose tree).

Cocos Forest: *Cocos nucifera* forest is almost entirely monotypic. The canopy species is *Cocos* and the understory is *Cocos* seedlings. (Figure 3)

Cocos-Hernandia Forest: This forest is dominated by two canopy species *Cocos nucifera* and *Hernandia sonora*. (Figure 4)

Cocos-Guettarda Forest: This forest has two dominant canopy species, *Cocos nucifera* and *Guettarda speciosa*. The understory is comprised of a mix of *Neisosperma oppositifolium*, with *Scaevola taccada* and *Tournefortia argentea* (beach heliotrope) on the beach edge. (Figure 5)

Hernandia Forest: This forest type is dominated at the canopy level by *Hernandia sonora*. The most representative areas of this forest type are on the eastern, undeveloped part of the atoll. *Calophyllum inophyllum* and *Cocos nucifera* are often present. Understory species in this forest are often *Morinda citrifolia* (Indian mulberry or noni), *Cocos* seedlings and *Asplenium nidus* (bird's nest fern). Occasionally, *Neisosperma oppositifolium* and *Guettarda speciosa* (guettarda) are also found in this forest type. (Figure 6)

Premna shrubland: This vegetation type seems to occur between marshy areas and forested areas. The most conspicuous vegetation is primarily *Premna obtusifolia*, with ironwood and *Scaevola taccada* (scaevola or naupaka) on the margins. The dense groundcover consists of species such as *Fimbristylis cymosa*, *Ipomea pes-caprae* (morning glory) and *Triumfetta procumbens*. Premna shrubland appears mostly adjacent to the developed areas of the atoll, particularly in the well areas. (Figure 7)

Littoral Scrub: This type of vegetation lines almost the entire shore of the islands – both on the seaward side and lagoon side. It is dominated by *Scaevola taccada*, which sometimes exceeds 10 m in height, but also contains scattered coconut trees, *Guettarda speciosa* and *Pisonia grandis*. On the seaward side, it also contains *Tournefortia argentea* and *Suriana maritima*. On the lagoon side, it may also be comprised of *Lepturus repens*, *Triumfetta procumbens* and *Cyperus ligularis*. There are also large pockets of *Barringtonia asiatica* on the eastern edge of the lagoon near Minni Minni and the Plantation.

Maintained: These areas are found in developed areas such as buildings, antennae fields and wells. They are regularly groomed and mowed.

Mixed Native Forest: This forest type has a diversity of canopy species with no tree species being dominant.

Marshes: The marshes were divided into three different types: cattail (*Typha domingensis*), wetland and mixed species. Cattail marshes were comprised of almost entirely cattails. These areas are often man-made reservoirs or drainages that have been almost entirely monotypic. Wetlands (Figure 8), as described, were based upon vegetation that occurred in the area; these wetlands were not delineated. Mixed species marshes (Figure 9a and 9b) were highly variable and usually had no standing water.

Additionally, the vegetation in these areas was a mix of typical wetland species and others.

East, West and Middle Islands

West Island

The canopy of the small forest is *Pisonia grandis* with a few *Cocos nucifera*. *Pisonia grandis* also is the predominant plant on the littoral edge, in lieu of the *Scaevola taccada* and a *Tournefortia argentea* hedge that is found on Middle and East Islands and the main island. The rest of the littoral vegetation is *Tournefortia argentea*. The main forest is in the center of the island and also contains a large patch of *Achyranthes aspera*. Other ground cover includes *Portulaca oleracea*, *Cyperus ligularis*, *Stenotaphrum micranthum*, *Dactyloctenium ctenoides*, *Boerhavia repens*, *Sida pusilla*, and *Lepturus repens*. No rats or coconut crabs were observed. However, the ground had many ground nesting Brown Noddies (nests were seen with eggs).

Middle Island

Middle island is also a small island containing a large protected cove on the southern edge. The canopy is predominantly *Pisonia grandis*, with scattered *Cocos nucifera*, several *Guettarda speciosa*, one *Neisosperma oppositifolium* and one *Morinda citrifolia*. The northern corner also has a patch of *Cordia subcordata* that also forms the littoral edge along the high tide line. Other than the one area with *Cordia subcordata*, the littoral vegetation is predominantly *Pisonia grandis* and *Scaevola taccada*. There are patches of *Achyranthes aspera* scattered throughout Middle Island. The main understory in the forest is *Asplenium nidus* and *Cocos* seedlings. Other ground cover includes *Pipturus argentea* seedlings (no adult trees were found), *Boerhavia repens*, *Cyperus ligularis*, *Stenotaphrum micranthum*, *Dactyloctenium ctenoides*, *Sida pusilla*, *Ravina humilis*, *Portulaca oleracea*, and *Lepturus repens*.

East Island

This, the largest of the three offshore islands, had the most species diversity and the most non-native species. It also has the most topsoil and very large coconut crabs. The canopy is comprised predominantly of *Pisonia grandis* and *Cocos nucifera*. Other canopy trees include scattered *Hernandia sonora*, one *Guettarda speciosa* and scattered *Neisosperma oppositifolium*. The center of the forest also includes a large scattered patch of papaya (*Carica papaya*) trees. The midstory contained *Pipturus* and *Tournefortia argentea*. *Scaevola taccada*, *Tournefortia argentea* and *Pisonia grandis* make up the littoral edge. Ground cover is comprised of *Asplenium nidus*, *Portulaca oleracea*, *Cyperus ligularis*, *Stenotaphrum micranthum*, *Dactyloctenium ctenoides*, *Boerhavia repens*, *Sida pusilla*, *Ravina humilis*, and *Lepturus repens*. *Fimbristylis cymosa* was only found on this island on the eastern coast. Interestingly, no *Achyranthes aspera* were found on this island, however, this may be due to limited survey time spent on the island.

DISCUSSION

Overall, the vegetation was the same as was described in the 1995 NRMP. The opportunity to survey the outer three islands provided substantial new information and a species list. The survey team had limited time on the outer islands, however, the species list is thought to be fairly comprehensive.

Cassytha filiformis (Figure 10) has been viewed as problematic on Diego Garcia since it is a parasitic species. It is often seen covering *Scaevola taccada* and other native species, particularly near the shoreline. However, this plant is native to this region and has occurred on species lists for Diego Garcia throughout the century. In fact, on Okinawa it is considered rare enough to list on the Okinawa Prefecture Red-List for protection. While this plant is a part of the natural ecosystem, natural resources managers on Diego Garcia have noticed that in some areas along the shoreline, where *Cassytha* is thick, it has been shown to reduce plant cover to the point where coastal erosion is a concern. In these instances, it is recommended that manual control be used to remove the *Cassytha* at an early stage in its development (e.g. before it is established and has killed its host). It is not recommended to continue control of this native species island-wide.

There are four invasive species for which control and eradication is strongly recommended: 1) tangan-tangan (*Leucaena leucocephala*), 2) mimosa (*Mimosa invisa*), 3) Star of Bethlehem (*Laurentia longiflora*) and 4) coral berry (*Ravina humilis*) (Figure 11). Tangan-tangan is an invasive species that is found in many tropical islands including the Marianas and Hawaii. It thrives in open canopy areas, particularly those that are disturbed by development or clearing. If uncontrolled, this species can completely overtake all other species creating monotypic scrub. It was found only in four relatively small areas (Pt. Marianne and adjacent to a parking lot south of the airport (Figure 12)) and is still in a controllable stage. Additionally, it was surprising to see that pothos vine (*Epipremnum pinnatum*) was being cultivated outside of one of the Bachelors Officer Quarters near the Officer's Club. Pothos can be very invasive in tropical environments. It should be eradicated before it escapes into the forest.

In order to prevent new non-native species from becoming established on Diego Garcia, it is recommended that visitors and returning residents of the island be encouraged to clean their shoes before boarding the plane to the atoll. In addition, the importation of cultivated plants should be closely monitored.

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Table 1
Species list for East, West and Middle islands offshore Diego Garcia

SPECIES	COMMON NAME	ISLAND (W, M, E)	STATUS
<i>Achyranthes aspera</i>		W, M	N
<i>Asplenium nidus</i>	bird's nest fern	M, E	N
<i>Boerhavia repens</i>		W, M, E	N
<i>Carica papaya</i>	papaya	E	X
<i>Cocos nucifera</i>	coconut	W, M, E	N?
<i>Cordia subcordata</i>	hau	M	N
<i>Cyperus ligularis</i>		W, M, E	X
<i>Dactyloctenium ctenoides</i>	crowfoot grass	W, M, E	X
<i>Fimbristylis cymosa</i>		E	N
<i>Guettarda speciosa</i>		M, E	N
<i>Hernandia sonora</i>	lantern tree	E	N
<i>Lepturus repens</i>		W, M, E	N
<i>Morinda citrifolia</i>	noni, Indian mulberry	M	N
<i>Neisosperma oppositifolium</i>		M, E	N
<i>Pipturus argenteus</i>		M, E	N
<i>Pisonia grandis</i>	pisonia	W, M, E	N
<i>Portulaca oleracea</i>	purslane	W, M, E	X
<i>Ravina humilis</i>	coral berry	E	X
<i>Scaevola taccada</i>	scaevola	M, E	N
<i>Sida pusilla</i>		W, M, E	N
<i>Stenotaphrum micranthum</i>		W, M, E	N
<i>Tournefortia argentea</i>	beach heliotrope	W, E	N

Key: Islands: West = W, Middle = M, East = E
Status: Native = native, Non-native/invasive = X



Figure 1a: *Cocos-Guettarda* Forest on eastern side of island south of Plantation.



Figure 1b: *Guettarda speciosa*.



Figure 2: *Cocos* Forest near Canon Point. Note *Cocos* seedlings on forest floor.



Figure 3: *Cocos-Hernandia* Forest on eastern side of island south of plantation.



Figure 4: *Hernandia* Forest on Eastern side of island south of Plantation.



Figure 5: *Premna* shrubland in well area between antenna fields.



Figure 6: Mixed Species Marsh near antenna fields.



Figure 6a: Mixed Species Marsh east of runway.



Figure 7: Wetland “B”. Note that cattails are predominant vegetation.



Figure 8a: *Pisonia grandis* at Barton Point. *Cocos nucifera* and *Scaevola taccada* also in photo.



Figure 8b: *Pisonia grandis*.



Figure 9: *Intsia bijuga*



Figure 10: Thick stand of *Leucaena leucocephala* at POL Drum Storage Area. Storage areas where materials have been imported, are often vectors for invasive species introductions.



Figure 11: *Cassytha filiformis*



Figure 12: *Ravina humilis*

LIST OF THE HIGHER PLANTS OF DIEGO GARCIA

LIST OF THE HIGHER PLANTS ON DIEGO GARCIA.

Source: *Ecology of the Chagos Archipelago*

FAMILY	SCIENTIFIC NAME	COMMON NAME
PTERIDOPHYTES(Fern Family and Fern Allies)		
Adiantaceae	<i>Pteris tripartita</i> <i>Pteris vittata</i>	
Aspleniaceae	<i>Asplenium longissimum</i> <i>Asplenium macrophyllum</i> <i>Asplenium nidus</i>	bird's-nest fern
Psilotaceae	<i>Psilotum nudum</i>	psilotum
Thelypteridaceae	<i>Cyclorus interruptus</i> <i>Amphineuron opulentum</i>	marsh fern
ANGIOSPERMAE (Monocots)		
Amaryllidaceae "Amaryllis or Maguëy Family"	<i>Allium sp.</i> <i>Crinum asiaticum</i> <i>Crinum latifolium</i> <i>Hymenocaulis littoralis</i> <i>Hippeastrum puniceum</i> <i>Scadoxus multiflorus</i> <i>Zephyranthes rosea</i>	onion crinum lily spider lily barbados lily blood lily zephyr lily
Araceae "Arum or Gabi Family"	<i>Aglaonima commutatum</i> <i>Alocasia macrorrhiza</i> <i>Alocasia plumbea</i> <i>Caladium bicolor</i> <i>Colocasia esculenta</i> <i>Epipremnum pinnatum</i> <i>Philodendron sp.</i> <i>Syngonium angustatum</i>	giant taro caladium pothos philodendron syngonium
Arecaceae "Palm family"	<i>Cocos nucifera</i>	coconut
Commelinaceae "Spiderwort Family"	<i>Commelina benghalensis</i> <i>Commelina diffusa</i> <i>Tradescantia zebrina</i> <i>Rhoeo spathacea</i>	diffuse day flower wandering jew (green)
Cyperaceae "Sedge family"	<i>Cyperus compressus</i> <i>Cyperus difformis</i> <i>Cyperus dubius</i> <i>Cyperus eragrostis</i> <i>Cyperus iria</i> <i>Cyperus ligularis</i> <i>Cyperus rotundus</i> <i>Cyperus sphacelatus</i> <i>Cyperus surinamensis</i> <i>Kyllinga brevifolia</i> <i>Kyllinga monocephala</i> <i>Kyllinga memorialis</i> <i>Kyllinga polyphylla</i> <i>Eleocharis geniculata</i>	nut sedge Navua sedge

	<i>Fimbristylis cymosa</i> <i>Pycreus polystachyos</i>	
Lemnaceae "Duckweed Family"	<i>Lemna aequinoctialis</i>	duckweed
Poaceae "Grass Family"	<i>Andropogon bicornis</i> <i>Bambusa bulgaris</i> <i>Brachiara subquadripara</i> <i>Cenchrus echinatus</i> <i>Cynodon dactylon</i> <i>Chloris barbata</i> <i>Dactyloctenium ctenoides</i> <i>Dichanthium annulatum</i> <i>Digitaria horizontalis</i> <i>Digitaria longiflora</i> <i>Digitaria setigera</i> <i>Eleusine indica</i> <i>Eragrostis atrovineus</i> <i>Eragrostis tenella var. insularis</i> <i>Eriochloa procera</i> <i>Eustachys petraea</i> <i>Leptochloa uninervia</i> <i>Lepturus repens</i> <i>Lolium perenne</i> <i>Melinis repens</i> <i>Panicum maximum</i> <i>Paspalum mutans</i> <i>Paspalum vaginatum</i> <i>Pennisetum polystachyon</i> <i>Schizachyrium condensatum</i> <i>Sporobolus pyramidalis</i> <i>Sporobolus virginicus</i> <i>Sorghum halepense</i> <i>Stenotaphrum dimidiatum</i> <i>Stenotaphrum micranthum</i> <i>Zea mays</i>	bur grass bamboo pitted beard grass bermuda grass finger grass crowfoot grass Henry's crabgrass goose grass love grass cup grass perennial rye grass Guinea grass knot grass feathery pennisetum Indian dropseed Sudan sorghum stenotaphrum corn
Potamogetonaceae "Pondweed Family"	<i>Thalassodendron ciliatum</i>	seagrass
Typhaceae "Cattail Family"	<i>Typha domingensis</i>	cattail
ANGIOSPERMAE (Dicots)		
Acanthaceae "Acanthus family"	<i>Hemigraphis alternata</i>	metal leaf
Amaranthaceae "Amaranth family"	<i>Achyranthes aspera var. velutina</i> <i>Aerva lanata</i> <i>Amaranthus viridis</i> <i>Lagrezia micrantha</i> <i>Lagrezia oligomeroides</i>	slender amaranth
Apiaceae "Carrot family"	<i>Hydrocotyle bonariensis</i>	

Apocynaceae "Dogbane family"	<i>Catharanthus roseus</i> <i>Cerbera manghas</i> <i>Neisosperma oppositifolia</i> <i>Nerium oleander</i> <i>Plumeria sp.</i>	adelfa frangipani or graveyard flower
Asclepiadaceae "Milkweed Family"	<i>Asclepias curassavica</i>	milkweed
Asteraceae "sunflower family"	<i>Bidens pilosa</i> <i>Conyza Canadensis</i> <i>Gaillardia pulchella</i> <i>Mikania micrantha</i> <i>Synedrella nodiflora</i> <i>Wollastonia biflora</i>	beggars tick horseweed gaillardia mile-a-minute vine nodeweed or synedrella beach sunflower
Barringtoniaceae "Barringtonia family"	<i>Barringtonia asiatica</i>	fish-poison tree
Bignoniaceae "Jacaranda family"	<i>Tabebuia pallida</i>	mayflower
Boraginaceae "Heliotrope family"	<i>Argusia argentea</i> <i>Cordia subcordata</i> <i>Heliotropium indicum</i> <i>Heliotropium ovalifolium</i>	tree heliotrope cordia
Capparidaceae "Caper Family"	<i>Cleome rutidosperma</i> <i>Cleome viscosa</i>	
Cassythaceae "Cassytha Family"	<i>Cassytha filiformis</i>	dodder/cassytha
Casuarinaceae "Casuarina family"	<i>Casuarina equisetifolia</i>	ironwood
Clusiaceae "Mangosteen family"	<i>Calophyllum inophyllum</i>	true kamani
Combretaceae "Tropical-almond family"	<i>Lumnitzera racemosa</i> <i>Terminalia catappa</i>	umbrella tree
Compositae "Composite Family"	<i>Ageratum conyzoides</i> <i>Helianthus annuus</i> <i>Eclipta prostrata</i> <i>Tagetes sp.</i> <i>Vernonia cinerea</i> <i>Vernonia grandis</i> <i>Zinnia elegans</i>	sunflower marigold zinnia
Convolvulaceae "Morning-glory family"	<i>Ipomoea aquatica</i> <i>Ipomoea batatas</i> <i>Ipomoea pes-tigridis</i> <i>Ipomoea pes-caprae</i> <i>Ipomoea triloba</i> <i>Ipomoea macrantha</i>	water hyacinth sweet potato
Crassulaceae "Stonecrop family"	<i>Kalanchoe pinnata</i>	kalanchoe
Cruciferae "Mustard Family"	<i>Brassica sp.</i>	mustard
Cucurbitaceae "Gourd family"	<i>Cucumis melo</i> <i>Cucurbita moschata</i> <i>Luffa acutangula</i>	bitter melon luffa
Euphorbiaceae	<i>Acalypha indica</i>	

<p>"Spurge family"</p>	<p><i>Breynia disticha</i> <i>Codiaeum variegatum</i> <i>Croton hirtus</i> <i>Euphorbia cyatophora</i> <i>Euphorbia heterophylla</i> <i>Euphorbia hirta</i> <i>Euphorbia hypericifolia</i> <i>Euphorbia prostata</i> <i>Pedilanthus tithymaloides</i> <i>Phyllanthus amarus</i> <i>Phyllanthus maderaspatensis</i> <i>Phyllanthus urinaria</i> <i>Ricinus communis</i></p>	<p>snow bush croton croton wild poinsettia</p> <p>slipper flower</p> <p>castor oil plant</p>
<p>Fabaceae "Pea Family"</p>	<p><i>Albizia lebbek</i> <i>Alysicarpus ovalifolius</i> <i>Alysicarpus vaginalis</i> <i>Caesalpinia bonduc</i> <i>Canavalia cathartica</i> <i>Calopogonium mucunoides</i> <i>Crotolaria pallida</i> <i>Delonix regia</i> <i>Desmodium triflorum</i> <i>Erythrina variegata var. orientalis</i> <i>Indigofera hirsuta</i> <i>Intsia bijuga</i> <i>Leucaena leucocephala</i> <i>Macroptilium lathyroides</i> <i>Mimosa pudica</i> <i>Pithecellobium saman</i> <i>Pithecellobium unguis-cati</i> <i>Senna occidentalis</i> <i>Sesbania bispinosa</i> <i>Sesbania grandiflora</i> <i>Tamarindus indica</i> <i>Vigna marina</i></p>	<p>siris tree</p> <p>alysicarpus gray nickers St. Thomas bean mongo rattlepod fire tree</p> <p>coral tree camantigue ifil</p> <p>wild tamarind cowpea or phasey bean dwarf sensitive plant monkey pod manila tamarind coffee senna</p> <p>sesban/katuray tamarind string bean</p>
<p>Goodeniaceae "Scaevola Family"</p>	<p><i>Scaevola taccada</i></p>	<p>scaevola</p>
<p>Hernandiaceae "Hernandia family"</p>	<p><i>Gyrocarpus americanus</i> <i>Hernandia sonora</i></p>	<p>chinese-lantern tree</p>
<p>Lobeliaceae</p>	<p><i>Laurentia longiflora</i></p>	
<p>Lythraceae "Loosestrife family"</p>	<p><i>Pemphis acidula</i></p>	<p>pemphis</p>
<p>Malvaceae "Mallow family"</p>	<p><i>Abutilon indicum</i> <i>Gossypium hirsutum</i> <i>Hibiscus rosa-sinensis</i> <i>Hibiscus tiliaceus</i> <i>Malvastrum coromandelianum</i> <i>Sida acuta</i> <i>Sida pusilla</i></p>	<p>polynesian cotton hibiscus/gumamela beach hibiscus false mallow broomweed</p>
<p>Mimosoideae "Bean Family"</p>	<p><i>Enterolobium cyclocarpum</i></p>	
<p>Moringaceae</p>	<p><i>Moringa oleifera</i></p>	<p>moringa\malunggay</p>

"Moringa Family"		
Moraceae "Mulberry family"	<i>Artocarpus altilis</i> <i>Ficus religiosa</i> <i>Ficus sp.</i> <i>Merus alba</i>	breadfruit Indian banyan sacred banyan banyan mulberry
Nyctaginaceae "Four-o'clock family"	<i>Boerhavia repens</i> <i>Bougainvillea spectabilis</i> <i>Mirabilis jalapa</i> <i>Pisonia grandis</i>	bougainvillea four-o'clock pisonia
Olacaceae "Olax Family"	<i>Ximenia americana</i>	
Oxalidaceae Wood-sorrel family"	<i>Averrhoa bilimbi</i>	bilimbi
Papilionatae "Bean Family"	<i>Aeschynomene americana var. glandulosa</i>	
Passifloraceae "Passion fruit family"	<i>Passiflora suberosa</i>	passion fruit
Phytolaccaceae "Pokeweed family"	<i>Rivina humilis</i>	coral berry
Piperaceae "Pepper Family"	<i>Peperomia sp.</i>	peperomia
Plantaginaceae "Plantain family"	<i>Plantago major</i>	common plantain
Portulacaceae "Purselane family"	<i>Portulaca olaracea</i>	purselane
Rubiaceae "Coffee family"	<i>Dentella repens</i> <i>Ixora coccinea</i> <i>Guettarda speciosa</i> <i>Morinda citrifolia</i> <i>Oldenlandia corymbosa</i> <i>Pentas lanceolata</i> <i>Spermacoce assurgens</i> <i>Spermacoce hispida</i>	buttonweed red suntan guettarda noni plant pentas
Rutaceae "Citrus family"	<i>Citrus aurantifolia</i> <i>Citrus aurantium</i> <i>Citrus limon</i> <i>Triphasia trifolia</i>	lime kahel lemon
Sapotaceae "Chico Family"	<i>Manilkara zapota</i> <i>Mimusops coriacea</i>	chico
Scrophulariaceae	<i>Bacopa monnieri</i> <i>Buchinera hispida</i> <i>Bulbostylis puberula</i> <i>Mecardonia procumbens</i> <i>Scoparia dulcis</i> <i>Striga asiatica</i>	bacopa floridanus
Solanaceae "Nightshade family"	<i>Capsicum annuum</i> <i>Capsicum frutescens</i> <i>Lycopersicon esculentum</i> <i>Solanum anguivii</i> <i>Solanum melongena</i> <i>Solanum nigrum</i>	christmas/ornamental pepper red pepper tomato eggplant black nightshade

	<i>Solanum tuberosum</i>	potato
Sterculiaceae "Cacao family"	<i>Melochia pyramidata</i> <i>Waltheria indica</i>	
Surianaceae "Suriana family"	<i>Suriana maritima</i>	suriana
Tiliaceae "Linden family"	<i>Corchorus aestuans</i> <i>Triumfetta procumbens</i>	
Turneraceae	<i>Turnera ulminofolia</i>	yellow alder
Umbelliferae "Parseley or Anis Family"	<i>Centella asiatica</i>	
Urticaceae "Nettle family"	<i>Pilea microphylla</i>	rockweed
Verbenaceae "Verbena family"	<i>Lippia nodiflora</i> <i>Lantana camara</i> <i>Premna obtusifolia</i> <i>Stachytarpheta jamaicensis</i> <i>Stachytarpheta utricifolia</i>	lantana premna Jamaica vervain blue rat's tail
CULTIVATED PLANTS		
CONIFERS (GYMNOSPERMAE)		
Araliaceae "Ginseng family"	<i>Polyscias sp.</i>	panax
Aracauriaceae	<i>Araucaria columnaris</i> <i>Araucaria heterophylla</i>	Cook pine Norfolk pine
Cupressaceae	<i>Thuja orientalis</i>	oriental arbovitae
ANGIOSPERMAE		
MONOCOTS		
Amaryllidaceae "Amaryllis Family"	<i>Allium sp.</i> <i>Crinum asiaticum</i> <i>Crinum latifolium</i> <i>Hymenocaulis littoralis</i> <i>Hippeastrum puniceum</i> <i>Scadoxus multiflorus</i> <i>Zephyranthes rosea</i>	onion crinum lily spider lily barbados lily blood lily zephyr lily
Araceae "Arum or Gabi Family"	<i>Aglaonima commutatum</i> <i>Alocasia macrorrhiza</i> <i>Alocasia plumbea</i> <i>Caladium bicolor</i> <i>Colocasia esculenta</i> <i>Epipremnum pinnatum</i> <i>Philodendron sp.</i> <i>Syngonium angustatum</i>	giant taro caladium pothos philodendron syngonium
Aracaceae	<i>Hyphaene</i> <i>Phoenix sp.</i> <i>Roystonea regia</i> <i>Veitchia (Adonida) merrillii</i>	date palm Manila palm
Commelinaceae "Spiderwort Family"	<i>Commelina benghalensis</i> <i>Commelina diffusa</i> <i>Tradescantia zebrina</i> <i>Rhoeo spathacea</i>	diffuse day flower wandering jew (green)
Dioscoreaceae	<i>Dioscra sp.</i>	bitter yam

Liliaceae	<i>Asparagus plumosus</i> <i>Chlorophytum comosum</i> <i>Cordyline fruticosa</i> <i>Dracaena fragrans</i> <i>Dracaena marginata</i> <i>Sansevieria trifasciata</i>	asparagus fern wild ti dracaena dracaena snake plant
Musaceae "Banana family"	<i>Musa sapientum</i>	banana
Orchidaceae	<i>Vanilla planifolia</i>	vanilla
Pandanaceae "Pandanus family"	<i>Pandanus tectorius</i>	screw pine
Poaceae	<i>Bambusa vulgaris</i> <i>Zea mays</i>	bamboo corn
Zingiberaceae "Ginger Family"	<i>Zingiber spectabile</i>	ginger
ANGIOSPERMAE DICOTS		
Acanthaceae "Acanthus family"	<i>Hemigraphis alternata</i>	metal leaf
Anacardiaceae "Mango family"	<i>Mangifera indica</i>	mango
Apiaceae "Carrot family"	<i>Hydrocotyle bonariensis</i>	
Apocynaceae	<i>Catharanthus roseus</i> <i>Nerium oleander</i> <i>Plumeria rubra</i>	periwinkle adelfa frangipani/graveyard flower
Araliaceae	<i>Polyscias sp.</i>	panax
Asteraceae "sunflower family"	<i>Gaillardia pulchella</i> <i>Helianthus annuus</i> <i>Tagetes sp.</i> <i>Zinnia sp.</i>	gaillardia sunflower marigold Zinnia
Balsaminaceae	<i>Impatiens balsamina</i>	balsam
Bignoniaceae	<i>Tabebuia pallida</i>	mayflower
Bombaceae	<i>Ceiba pentandra</i>	kapok
Caricaceae	<i>Carica papaya</i>	papaya
Convolvulaceae	<i>Ipomoea batatas</i>	sweet potato
Cruciferae	<i>Brassica sp.</i>	mustard
Cucurbitaceae	<i>Cucurbita moschata</i> <i>Luffa acutangula</i>	bitter melon luffa
Euphorbiaceae	<i>Breynia disticha</i> <i>Codiaeum variegatum</i> <i>Pedilanthus tithymaloides</i>	snow bush croton slipper flower
Fabaceae "Pea Family"	<i>Albizia lebeck</i> <i>Calopogonium mucunoides</i> <i>Delonix regia</i> <i>Erythrina variegata var. orientalis</i> <i>Indigofera hirsuta</i> <i>Pithecellobium saman</i> <i>Pithecellobium unguis-cati</i> <i>Sesbania grandiflora</i> <i>Tamarindus indica</i> <i>Vigna marina</i>	siris tree mongo fire tree coral tree camantigue monkey pod manila tamarind sesban/katuray tamarind string bean

Gesneriaceae	<i>Saint paulia sp.</i> <i>Episcia cupreata</i>	african violets episcia
Lauraceae	<i>Persea americana</i>	avocado
Malvaceae "Mallow family"	<i>Abutilon indicum</i> <i>Gossypium hirsutum</i> <i>Hibiscus rosa-sinensis</i> <i>Malvastrum coromandelianum</i>	polynesian cotton hibiscus/gumamela false mallow
Moringaceae	<i>Moringa oleifera</i>	moringa\malunggay
Myrtaceae "Myrtle family"	<i>Eugenia javanica</i> <i>Psidium guajava</i>	macopa guava
Moraceae "Mulberry family"	<i>Artocarpus altilis</i> <i>Ficus benghalensis</i> <i>Ficus religiosa</i> <i>Ficus sp.</i> <i>Merus alba</i>	breadfruit Indian banyan sacred banyan banyan mulberry
Nyctaginaceae "Four-o'clock family"	<i>Bougainvillea spectabilis</i> <i>Mirabilis jalapa</i>	bougainvillea four-o'clock
Oxalidaceae Wood-sorrel family"	<i>Averrhoa bilimbi</i>	bilimbi
Piperaceae "Pepper Family"	<i>Peperomia sp.</i>	peperomia
Rubiaceae "Coffee family"	<i>Ixora coccinea</i> <i>Pentas lanceolata</i>	red suntan pentas
Rutaceae "Citrus family"	<i>Citrus aurantifolia</i> <i>Citrus aurantium</i> <i>Citrus limon</i> <i>Triphasia trifolia</i>	lime kahel lemon
Sapotaceae "Chico Family"	<i>Mimusops coriacea</i> <i>Achras sapota</i>	monkey apple chico
Solanaceae "Nightshade family"	<i>Capsicum annum</i> <i>Capsicum frutescens</i> <i>Lycopersicon esculentum</i> <i>Solanum melongena</i> <i>Solanum tuberosum</i>	christmas/ornamental pepper red pepper tomato eggplant potato
Turneraceae	<i>Turnera ulminifolia</i>	yellow alder
Urticaceae	<i>Pilea depressa</i>	baby's tears