THE RARE PLANTS OF TONGA

by

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Manu Pomelile displaying the fruits
of *Citrus maxima* (pomelo)

1. INTRODUCTION

The Kingdom of Tonga (Fig. 1) is located in the South Pacific Ocean at latitude 15–23º S, and longitude 173–177º W, nearly straddling the International Date Line. The nearest island and archipelagoes are Fiji lying WNW of the main island (Tongatapu); the Samoan archipelago laying NNE; and the island of Niue lying ENE. The Kingdom comprises about 150 islands, with a total area of 697 km^2 (269 mi^2), but only about 36 of the islands are currently inhabited. The estimated population in 2009 was nearly 104,000; many other Tongans have emigrated to New Zealand, Australia, and the United States. The archipelago is basically a double chain of islands running in a north-south direction with small, high, volcanically active islands on the west, and lower, larger, raised corals islands on the east. Four main geographical groups can be distinguished: Tongatapu-ʻEua; Haʻapai (including the volcanic islands of Kao and Tofua); Vavaʻu; and the Niuas.

Tongatapu, the largest of the Tongan islands and the site of the capital Nukuʻalofa is a low, flat limestone island covered with a thick layer of volcanic ash and uplifted on the south coast where it reaches a maximum elevation of about 80 m (260 ft). It has an area of 257 km^2 (99 mi^2). The island's rich soil is under extensive cultivation to support the large population of the island, and very little remains of the native vegetation. Lying just a few km to the SE is ʻEua. This island, which is Tonga's geologically ancient island, has a volcanic base mostly overlain by limestone. It has an area of about 87 km^2 (34 mi^2) and a maximum elevation of 330 m (1090 ft). Because of its comparatively small population and rugged topography, a relatively large amount of its native vegetation remains. This results in ʻEua having more native plant species than any other island in Tonga.

North of these islands lies Haʻapai, comprising numerous small, scattered, uplifted but low-lying limestone islands, most of which are just a few meters above sea level. Two of them, however, are high, geologically recent, volcanic cones: Tofua, which is sparsely and perhaps seasonally inhabited, and Kao, which is uninhabited. Kao has an area of 13 km^2 (5 mi^2) and a maximum elevation of 1030 m (3400 ft). Tofua has an area of 47 km^2 (18 mi^2) and a maximum elevation of 530 m (1750 ft). Farther north lies Vavaʻu, a deeply dissected, raised coral island with an area of 90 km^2 (35 mi^2) and a maximum elevation of about 204 m (670 ft). Vavaʻu is actually the largest of a cluster of raised limestone islands comprising the Vavaʻu group. These numerous islands and the well-protected harbor of Neiafu make Vavaʻu one of the most scenic places in the South Pacific. However, nearly all of its native vegetation has been destroyed, except along the sea cliffs and on some other smaller, uninhabited outlying islands. Several uninhabited, volcanic islands are found to the west of Vavaʻu, including Late and Fonualei.

The fourth of the geographical island groups of Tonga is "the Niuas," which comprise three small, inhabited volcanic islands: Niuatoputapu and the adjacent Tafahi, and some distance away, Niuafoʻou. These islands are actually closer to Samoa than to Tonga, and differ from the rest of Tonga because the residents are descendents of a people who spoke a language different than the Tongan spoken in the rest of the archipelago (and closer to Samoan). Niuatoputapu has an area of 21 km^2 (8 mi^2) and a maximum elevation of 150 m (495 ft). Tafahi has an area of 3 km^2 (1 mi^2) and a maximum elevation of 530 m (1750 ft). Niuafoʻou has an area 15 km^2 (6 mi^2) and a maximum elevation of 260 m (860 ft).

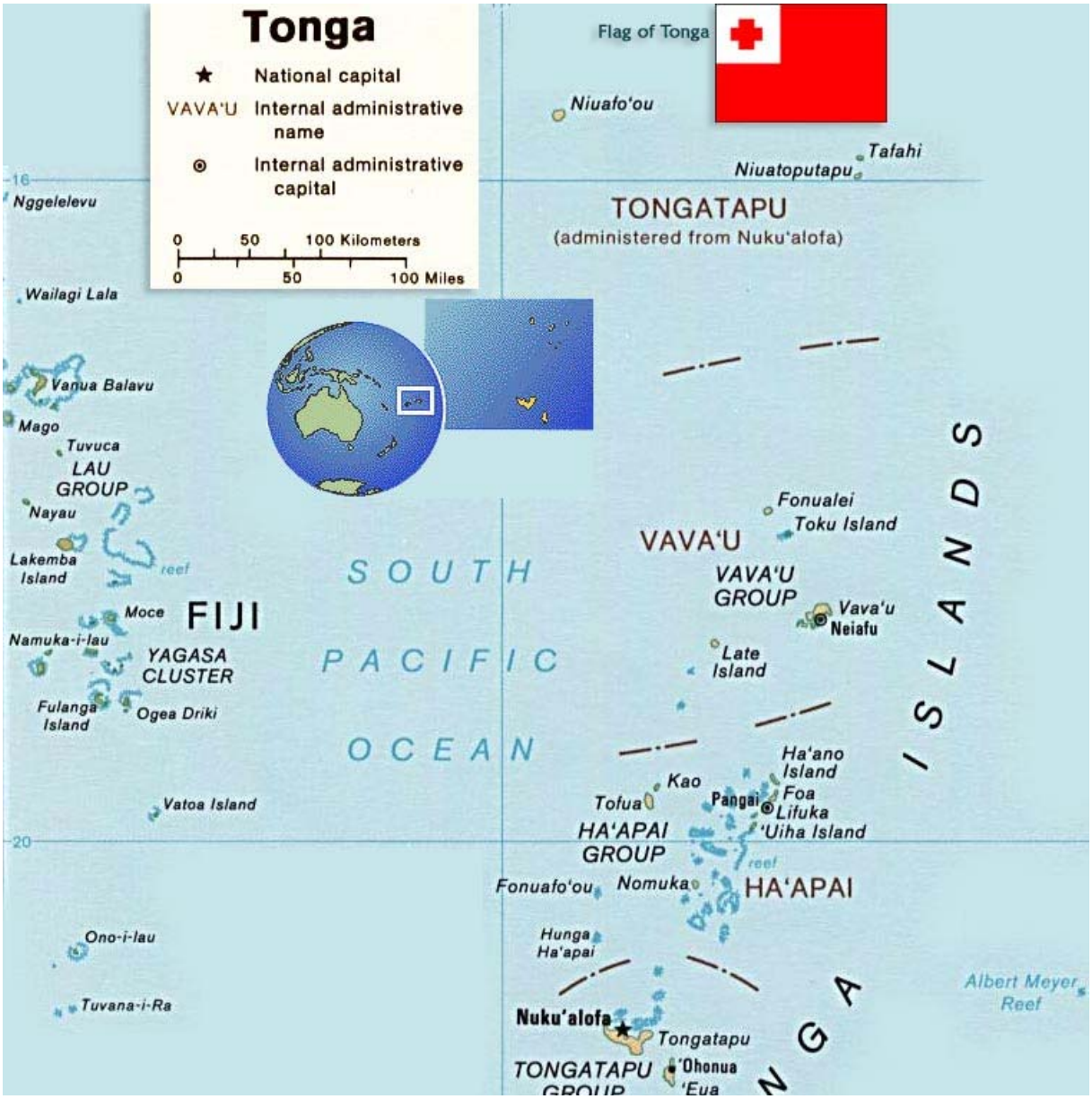

Fig. 1. Map of the Kingdom of Tonga.

1.1. The Flora of Tonga

The "flora" of an area is usually thought of as a list (or book) that includes all the plants occurring in that area. This list can include all flowering plants, all vascular plants (flowering plants, gymnosperms, and ferns), or all plants (including algae, lichens, etc.). Together the flowering plants, gymnosperms, and ferns are often referred to as "higher plants," a category known scientifically as Tracheophyta. The higher plants are divided into two main groups (called "divisions," which together comprise the "plant kingdom")—ferns, which are placed in the Pteridophyta (individually called pteridophytes), and seed plants, which are placed in the

Spermatophyta (individually called spermatophytes). Between the ferns and seed plants, but typically included in the pteridophytes, is a heterogeneous assemblage of plants called "fern allies," which in Tonga comprises the genera *Psilotum* (2 species), *Selaginella* (2), and *Lycopodium* (4), all of them small plants. These are usually studied separately from the seed plants by botanists who specialize in ferns, and are beyond the scope of this study. The seed plants are divided into two groups: Gymnospermae (called gymnosperms, or sometimes, conifers), and Angiospermae (flowering plants). Only two native gymnosperms are found in Tonga, the endemic *Podocarpus pallidus* (Podocarpaceae) and the indigenous *Cycas seemannii* (Cycadaceae). Consequently this study comprises the flowering plants (the angiosperms) and the two gymnosperm species. However, neither of the two latter gymnosperms is rare.

The angiosperms are divided into two groups: monocots and dicots. These two groups (as well as other plants) are further divided into groups called "orders," and orders are divided into "families," which range in size from a single species to thousands of species. Orders are not commonly used, but families are. All family names can be identified by the ending "-ceae." For example, the orchid family, the largest one in Tonga, is called the Orchidaceae, and the largest dicot family, the coffee family, is called Rubiaceae. In the past, there were eight exceptions to this ending, but these eight are now given different names with the standard "-ceae" ending: the carrot family Umbelliferae (now called Apiaceae); the sunflower family Compositae (Asteraceae); the mustard family Cruciferae (Brassicaceae); the mangosteen family Guttiferae (Clusiaceae); the pea family Leguminosae (Fabaceae); the mint family Labiatae (Lamiaceae); the palm family Palmae (Arecaceae); and the grass family Gramineae (Poaceae).

Plant species can be classified by their distribution: they are either *native*, i.e., they occur naturally in the area having arrived by non-human transport, or they are *alien*, i.e., they are introduced species having arrived by direct or indirect human transport. Alien species can be further divided into species introduced by the Polynesians (i.e., they were brought in prior to ca. 1773, and called *Polynesian introductions*) and those introduced in modern times (i.e., after ca. 1773, and called *modern introductions*) by Europeans or by Polynesians traveling by means of western transport (boats, and nowadays, planes). Alien plants can also be divided another way into *intentional introductions* (plants brought intentionally, usually useful plants) and *unintentional introductions* (plants accidentally arriving in Tonga, typically weeds).

Native plants can be divided into two categories, *endemic* and *indigenous*. Endemic means restricted to a certain area; plants endemic to Tonga are found only in Tonga. Indigenous, in its current usage, refers to native species with a wider distribution (i.e., those naturally found in Tonga as well as elsewhere). These terms are relative, because their meaning depends upon how the "area" is defined. For example, a plant occurring in Samoa and Tonga can be referred to as endemic to western Polynesia, but then it would be indigenous to these two areas when they are treated individually. However, in practical usage endemism is usually applied to countries, archipelagoes, or islands.

Floristically, Tonga is part of the "Fijian Region" that extends from the Santa Cruz Islands and Vanuatu to Niue (Takhtajan 1969). Lying in the eastern portion of this region, Tonga has a smaller native flora than the Melanesian islands to the west, which lie closer to the Indo-Malaysian source area. The flora of Tonga is very similar to that of the adjacent islands and archipelagos, particularly Samoa. It is estimated to comprise 340 native angiosperm species, only 3% (15 species) of which are thought to be endemic to the archipelago (Table 1). No genera are endemic to Tonga. These figures are much lower than for the adjacent Samoa, which

has about 550 native species of flowering plants (Whistler, pers. research) and an endemism rate of 30%. The reasons for the relatively small flora and low endemism rate are several. Most significantly, Samoa is a much larger country with much higher elevation. All other things being equal, larger and higher islands have larger floras than smaller, lower islands.

Table 1. Endemic Plants of Tonga

Species	Family	Distribution[1]
Aglaia heterotricha A.C. Sm.	Meliaceae	E
Arytera bifoliata Whistler	Sapindaceae	E
Atractocarpus crosbyi (Burk.) Puttock	Rubiaceae	V
Casearia buelowii Whistler	Flacourtiaceae	V
Connarus sp. Nova[2]	Connaraceae	E, V
Discocalyx listeri (Stapf) Mez & Stapf	Myrsinaceae	E
Dysoxylum tongense A.C. Sm.	Meliaceae	E
Guioa lentiscifolia[2] Cav.	Sapindaceae	T, E, K, To, V, L
Phyllanthus amicorum Webster	Euphorbiaceae	E
Pittosporum yunckeri A.C. Sm.	Pittosporaceae	T, E
Podocarpus pallidus[2] N.E. Gray	Podocarpaceae	E, V
Polyalthia amicorum[3] A.C. Sm.	Annonaceae	T, E
Robiquetia tongensis[2] Cribb & Ormeod	Orchidaceae	T, E
Syzygium crosbyi[2] (Burkill) Whistler	Myrtaceae	E, To, K, V, Nf, L
Xylosma smithiana[2] Fosberg	Flacourtiaceae	T, E, V, Ta, L

[1]Distribution: T =Tongatapu; E = ‘Eua; K = Kao; To = Tofua; V = Vava‘u; L = Late; Ta = Tafahi; Nf = Niuafo‘ou.
[2]Not on the present rare plant list.
[3]Known in cultivation only, possibly endemic to Tongatapu.

1.2. Botanical Collections in Tonga

The first Western botanical collections in Tonga, which date to the Captain Cook South Pacific expeditions, include specimens collected by J.R. and G. Forster (the second Cook expedition in 1773 and 1774) and D. Nelson (the third Cook expedition in 1777). Apparently some other members of the expedition collected specimens anonymously as well (Smith 1979), and these specimens are cited as “Cook” in the present species profiles. Unfortunately, the Cook expeditions’ specimens, which are stored at the British Museum in London, with lesser numbers at the Kew Herbarium near London and elsewhere, include very little data on site of collection (or even island of collection). The next collection of the flora was made in 1827 and 1838 during the two South Pacific expeditions of Dumont d’Urville. The collections of the second expedition, made by J.B. Hombron, H. Jacquinot, and E. Le Guillou, as well as those of the first expedition, are stored at Paris, but virtually nothing has been published about them. The next large collection in Tonga was made by the U.S. Exploring Expedition (USEE) that visited Tonga

in 1840. All of the collections of this expedition were apparently made on Tongatapu by W.D. Brackenridge, W. Rich, and C. Pickering, and are stored at the Smithsonian Institution in Washington D.C., with a partial duplicate set at the Gray Herbarium at Harvard University. A description of the specimens collected, along with other details of the visit, was recorded by Pickering (1876). Unfortunately, these specimens have very little data on them, and in general the collections of the USEE were poorly curated. So poorly, in fact, that some Samoan specimens were incorrectly attributed to Tahiti. However, there do not appear to be any obvious problems with the Tongan collections.

A number of smaller collections were made in Tonga between 1826 and 1888. Capt. J. Beechy gathered specimens in Tonga during his visits in 1826, but only a few are known to exist. A man named Matthews collected in Tonga in 1830, but most of his specimens—some numbered, some not—are without further locality in Tonga. The inclusion of *Serianthes melanesica* suggests at least some of the specimens, which are stored at Kew, were collected in Vava‘u. In 1840, the H.M.S. *Sulphur* visited Tonga, where the ship’s collector G. Barclay gathered a number of specimens, probably mostly from Vava‘u. These unnumbered specimens are now stored at Kew. In 1852, The *Calliope* under the command of Capt. J.E. Home, visited Tonga. Home apparently collected mostly on Tongatapu (at least 33 specimens), but a few (ca. 3) are reported from Vava‘u and another few (ca. 3) are without locality of collection. These unnumbered specimens are stored at the British Museum. In 1852, W. Harvey collected in Tonga, mostly or entirely on Vava‘u (Yuncker lists a few specimens without locality and a couple from Ha‘apai). These unnumbered specimens are stored at the British Museum, with duplicates at Kew and the Gray Herbarium. The Swiss physician E. Graeffe visited Tonga in the early 1860’s and collected a number of specimens on Tongatapu. (A few are listed from Vava‘u, possibly incorrectly, and a few without further locality.) At least 80 Graeffe specimens are recorded from Tonga, but some of the specimens are apparently mislabeled. (Smith [1979] noted the labeling problems of Graeffe specimens in general.) For example, *Plerandra* sp. (Graeffe 271) is noted as being from Tonga, but the genus is Fijian rather than Tongan. His specimens are stored mostly at the Melbourne Herbarium in Australia. In 1874, the botanist H.N. Moseley visited Tonga and collected specimens, at least 71, probably only from Tongatapu. These unnumbered specimens are stored mostly at Kew. In an unknown year, a man named Cartwright visited and collected in Tonga. His unnumbered specimens are noted by Yuncker, and number at least 22, but are without numbers or locality. An unknown source also lists an unnumbered “Macrae” specimen (*Cordia subcordata*) in Tonga without further locality.

A half century passed after the main exploring expeditions before further major collections were made in Tonga—by J.J. Lister, who botanized mostly on ‘Eua and Tongatapu (and perhaps on Ha‘apai) in 1888–1891, and C.S. Crosby who botanized in Vava‘u in about 1892. Lister collected at least 186 specimens, which are stored at Kew and were listed by Hemsley (1894). Crosby collected 276 plus specimens that are stored at Kew; they were listed by Burkill (1901). Another large collection was made in 1926 by H.E. Parks (often with W.A. Setchell), who botanized on Tongatapu and ‘Eua (and Setchell collected briefly by himself on Vava‘u). Their collections, listed in Appendix 4 as “Parks,” include about 1225 specimens (nos. 15175–16400), which are stored at Kew, the University of California Berkeley Herbarium, and the Bishop Museum Herbarium in Honolulu. They have only been partially published (Yuncker 1959).

Five of the six largest Tongan collections (which include between 900 and 3300 specimens) have been made in the last sixty years. The first of these was in 1953 by T.G. Yuncker, who, on

the basis of his specimens and those of an earlier collector (Hurlimann in 1951), published a flora, *Plants of Tonga*, in 1959. Yuncker's collections, numbering perhaps 1260 specimens (nos. 15003–16256, at least, but this needs to be researched), are stored at the Bishop Museum, with smaller duplicate sets at the Smithsonian and Gray Herbarium. Hurlimann collected on ʻEua, Tongatapu, Niuatoputapu, and Tafahi. His collections, numbering about 650 specimens (nos. 1–649), are stored at the Smithsonian Institution. Another major Tongan collection was made by M. Hotta in 1961, but the manuscript of his work (Hotta 1962) was never published. His specimens, numbering about 1677 (nos. 4001–5677), are stored in the Kyoto University Herbarium in Japan.

The modern period of collection in Tonga, as defined here, began with the work of G. Buelow, who worked in Tonga from 1977 to 1983, and compiled by far the largest collection of any botanist working in Tonga (ca. 3300 numbers; however, so far only about 1050 specimens of native and naturalized species have been located by the author). He collected throughout Tonga, but his work has never been published. His specimens are stored at the Christchurch Herbarium in New Zealand, and the Bishop Museum. At about the same time (1977 and 1978) another significant, but smaller, collection was made by W.R. Sykes on ʻEua, Vavaʻu, and Late. His collections are a basis for his fern study of ʻEua (Sykes 1977) and a vegetation study of Late (Sykes 1981). However, Sykes' collections, which probably number over 900 (nos. 1 to 903), are stored at Christchurch, but have never been published. A complication in the counting of Buelow and Sykes' specimens exists because they collected together on Vavaʻu and Late, with their "Buelow & Sykes" numbers numbering about 286 specimens, starting from "1."

The most recent large collection of Tongan plants was made by the present author during his work in Tonga (1984–present). Information from these collections and his fieldwork in Tonga are the basis of a comparison of the vegetation of Tonga with that of Samoa (Whistler 1992), but little taxonomic work has been done on these specimens. His collections, which number about 1514 (nos. 4973–4983, 5940–6779, 7103–7502, 9873–9874, 10542–10734, 11339–11354, 11674–11705, 11778–11784, 12165–12178), are stored in the author's personal collection at the University of Hawaiʻi Joseph F. Rock herbarium, with numerous duplicates in various other herbaria. In addition to these large collections, a relatively small collection of about 181 specimens (nos. 169–349) by P. Kirch and the larger, previously noted one of Hurlimann were used as a basis for a checklist of the flora of Niuatoputapu (H. St. John 1977).

Other small and basically unstudied collections were made by McKern in 1921–1922 (ʻEua); MacDaniels in 1927 (Tongatapu and Vavaʻu); Soakai in 1958–1959 (Tongatapu, Haʻapai, Vavaʻu, and Niuafoʻou); Lawrence in 1958–1959 (mostly Tongatapu, but a few specimens from ʻEua and Ata); Ilolahia in 1959 (Tongatapu); Krauss in 1966 and 1977 (Tongatapu, ʻEua, Haʻapai, and Vavaʻu); M. Bristol in 1967 (ʻEua); Scarth-Johnson in 1967 (Tongatapu, ʻEua, and Tofua); Wright in 1977 (ʻEua); Palmer in 1980 (Tongatapu and ʻEua); and P. Cox in 1989 on ʻEua. These specimens are scattered through various herbaria.

1.3. Reasons for Rarity

There are a number of reasons why plants are rare in Tonga, some of them due to the activities of man, some to chance, and some to natural causes. These reasons can be put into several categories: (1) loss of habitat; (2) competition, especially from introduced invasive species; (3) herbivory; (4) abandonment of cultigens; and (5) natural rarity. Plants that have died

off over their entire range are referred to as extinct. Species that have died off in only part of their range are referred to as extirpated from those places.

Loss of habitat after the arrival of the first Polynesian settlers about 3000 years ago is probably the most serious cause of plants becoming rare in Tonga. After the original settlement, the population expanded and started utilizing the environment, especially the lowland forest that covered nearly all of Tongatapu. Forests were cut down for housing sites and plantations, and marshes were utilized for growing taro. A major cause of habitat destruction has undoubtedly been the indiscriminate use of fire, which has long been integral to the Tonga shifting agricultural system. Fire favors grasses and the spread of grassland over forest, especially favoring introduced grasses like *Panicum maximum*, which not only covers a very significant area of Tongatapu and most of the islands of Ha'apai, but when dry, further encourages the use of fire, the destruction of trees, and remaining stand of forest and associated understory and other plants species that live there. Species already uncommon in the lowlands, and restricted to there, were soon threatened, and some of them have probably already gone extinct, especially during the European era when much of the remaining lowland forest was planted during commercial activities, foremost of which was the expansion of monoculture coconut plantations for the production of coconut oil and copra for export. It is possible that the endemic tree *Polyalthia amicorum* was found only in lowland forests of Tongatapu; this may account for the tree now being restricted only to cultivation—its only habitat' native forest, was destroyed, with just a few cultivated trees remaining.

Competition is perhaps the second most important cause of rarity of Tongan plant species. Tongan native plants developed together in the archipelago environment over thousands and even millions of years, and each of them developed traits that allowed them to survive in the little-changing habitat. However, the first Polynesian settlers arriving in Tonga brought with them alien plant species that changed the vegetation dynamics. Some of these species were cultigens that do not reproduce naturally by themselves, but some were adventive species that produces seeds and naturally spread into the native habitats. Even more serious was the changes wrought by the more numerous and aggressive alien weedy species brought to Tonga after the arrival of Europeans beginning in about 1773. Some native plant species were probably dependent upon natural forest clearings and open sunny conditions for their seedlings to grow and development. But the arrival of so many new weedy species (about 200 of them so far) has caused these clearings to now be rapidly covered with a smothering growth of alien weeds that can block out the sunlight needed by the native species. This kind of competition may have led to the extirpation from Samoa of the Polynesian-introduced herb *Dichrocephala integrifolia* in the sunflower family Asteraceae. It is also probably the major cause of extirpation of Polynesian weeds that were unable to compete with the more recent arrivals in Tonga (see Table 2 for rare Polynesian weeds).

Herbivory has been a major problem for native Pacific species ever since the introduction of alien mammals by the Polynesians. Prior to the arrival of the first settlers, there were no native terrestrial mammals present in Polynesia other than bats. Tonga has one apparently native fruit bat that is more helpful to native plants than it is harmful, since fruit bats are major seed dispersers. Polynesians brought three mammals with them—the Polynesian rat (*Rattus exulans*), the dog, and the pig. The Polynesian rat's influence on the native flora of Polynesia is only now being understood. They are major seed consumers, particularly of palms, and are now thought to have lead to the extinction, extirpation, and drastic population reduction of palms in places such

widely dispersed place as Easter Island, Hawai‘i, and Fiji (see Shiels 2010). At the present time, however, there are no certain rat seed predation effects on the one native Tongan palm (*Pritchardia thurstonii*) or other species, but this is a subject that needs further study. An intriguing idea is that perhaps the palm *Pritchardia pacifica*, which is not known anywhere in the wild (it is known in cultivation in Fiji and western Polynesia), may have been endemic to the lowland rainforest of Tongatapu and was extirpated from its native habitat. It otherwise appears to be a Polynesian introduction to Tonga, but from where it came is unknown.

Pigs have had serious effects in many places in Polynesia, including most of the main islands of Tonga, because of their rooting habits and taste for some native species. However, severe pig damage by herbivory may be less of a problem in Tonga than in Samoa, where pigs are known to inhabit the highest elevations. Dogs and cats have little effect on the native flora, since they are carnivores. Deer, goats, cattle, horses, and sheep have caused extensive damage in some parts of Polynesia, but these either have not been introduced to Tonga or are of only minor significance. Horses and cattle have historically been responsible for the widespread destruction of crops and probably also indigenous terrestrial plants, especially herbaceous species.

The abandonment of cultigens is probably the major reason for the extirpation or near extirpation of some ancient Polynesian cultivated plants from Tonga. The ancient Polynesians carried throughout Polynesia the plants that were useful to them, and maintained these plants by cultivation. However, in the European era many new and better species were introduced, which led to some of the “canoe plants” no longer being cultivated. A good example of this is the Polynesian tomato ***touloku*** (*Solanum ferox*), which in ancient times was cultivated for its tomato-like fruits. However, with the introduction of the more prolific and tastier tomatoes, Tongans apparently lost interest in cultivating ***touloku***, which led to its extirpation from Tonga. (Although it is not an endemic species and hence is also found elsewhere, it has been extirpated throughout most of its Polynesian range and is in danger of extinction.) A second example is ***hea*** (*Parinari insularum*), which in ancient times was used to produce a varnish for tapa cloth and as a fragrance plant. These uses have been discontinued, and the plant is now found in only a few places in Tonga. It is probably on its way to extirpation unless something is done to preserve it.

Some species are probably naturally rare in Tonga, for a variety of reasons. The most common one is probably the chance recent arrival of species that have not had enough time to spread. A good example of this might be *Capparis cordifolia* (no Tongan name), that is restricted to just a few littoral habitats on Tongatapu and ‘Eua. Perhaps it is only a recent arrival that has not had time to spread yet to other sites. This appears to be the case for *Crateva religiosa* (***pualiki***), which is currently known only from Tafahi (but with one old record from Tongatapu, in cultivation), and *Portulaca lutea* (***tamole***), a littoral herb that is known in Tonga from only two collections, none since 1951. These may be considered to be “vagrants” that reached Tonga by accident, but stayed rare because of limited suitable habitat or other reasons.

1.4. Classifications of Rarity

The definitions of the terms “rare,” “threatened,” and “endangered” are viewed in different ways in different places. The United States Interior Department’s Fish and Wildlife Service (FWS) has primary responsibility for terrestrial and freshwater plants, as provided for in the Endangered Species Act (ESA) of 1973. Under the ESA, plant species may be listed as either “endangered” or “threatened.” Endangered means a species is in danger of extinction throughout

all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future. As of March 2008, the FWS had listed 1,925 species worldwide as endangered or threatened, 1,351 of which occur in the U.S. The term "rare" has no legal meaning, but is used in this report to mean "difficult to find," a more general term.

The main international agency in charge of rare plants is the International Union for the Conservation of Nature (IUCN), which produces a list of these species called the "Red List". Based upon frequency and distribution, the IUCN system divides plants into nine categories: Extinct (EX); Extinct in the Wild (EW); Critically Endangered (CR); Endangered (EN); Vulnerable (VU); Near Threatened (NT); Least Concern (LC); Data Deficient (DD); and Not Evaluated (NE). Assigning plants to these somewhat complicated categories is based upon a lot of data, data that is almost entirely lacking in Tonga. The definitions of these IUCN categories can be seen in Appendix 2.

New Zealand, which has a very active program for protecting its rare plants, uses its own system of classification. Townsend et al. (2008) has developed the New Zealand Threat Classification System so that every native organism existing in the wild in New Zealand can be assigned a threat status. The species on the list are divided into two main groups: those that are able to be evaluated and those that cannot. Those that cannot be evaluated, for whatever reason, are assigned the category "Data Deficient" (as on the IUCN Red List). The categories with sufficient data for evaluation are as follows.

1. Extinct—Plants that are, without a doubt, no longer found in New Zealand. This actually includes plants that are extinct (no longer exist on the planet) and extirpated (no longer exist in New Zealand). As de Lange et al. (2010) note, it is nearly impossible to prove that a plant is extinct, and there are plant species that have been listed thus and subsequently rediscovered. Species extinct in the wild but remaining in cultivation are not included in this category, nor are species that arrived by chance but did not become established ("vagrants").
2. Threatened—Plants that are on the road to extinction. This category is subdivided into several smaller categories based upon the population size and the current and predicted decline rate for the taxon: (1) Nationally Critical; (2) Nationally Endangered; and (3) Nationally Vulnerable. Sixteen additional qualifiers are used in this system, such as "extinct in the wild," "range restricted," and "island endemic."
3. At Risk—Plants that are at some risk of extinction but are not as yet directly threatened.
4. Not Threatened—Species that have been evaluated but have been determined not to be endangered or threatened in the country.

Virtually no work has been done on the rare plants of Tonga. The IUCN included four species on its Red List (IUCN 2008) in Tonga. These are *Aglaia heterotricha* (***langakali***?), *Aglaia saltatorum* (***langakali***), *Calophyllum neo-ebudicum* (***tamanu***), and *Podocarpus pallida* (***uhiuhi***). However, it is not clear why these plants were selected. *Aglaia saltatorum* is a common cultivated alien species; *Calophyllum neo-ebudicum* is a common lowland forest tree; and *Podocarpus pallida* is not uncommon in the native forests of ʻEua and Vavaʻu. Only *Aglaia heterotricha*, which is endemic to ʻEua, is included on the present list of rare Tongan plants. Consequently, the current Red List is entirely unsatisfactory for Tonga, and there is currently no accurate list of plants that should be considered rare, threatened, or endangered. The only other work done on the rare plants of Tonga was done by the author writing about the unique plants of

Tonga (Whistler 1989). The author recommended 26 plant species in that article as candidates for endangered plant status. Nothing has ever been done about this list. All but three of the 26 species he listed are on the current list of the 97 "rare" plants of Tonga presented here.

A survey of the rare plants was recently prepared for American Samoa (Whistler 2004B). For that study a rare plant was defined as a species that is currently difficult to find. The list included 108 rare species, including some Polynesian cultigens and weeds as well as the native species. The inclusion of non-native plants (the weeds and cultigens) was done so that cultural plants that were once a part of Samoan culture could be included. Twenty of the 108 species were recommended for further consideration as "threatened" or "endangered" in American Samoa. The project also incorporated GIS data to represent the location of collection sites. A database was developed and integrated with a web portal to present the data to the general public (www.cieer.org/efloras/samoa/). Unfortunately, since publishing the report there has been no response or effort to protect the identified species, and at the moment (February 2011) the site lacks the ability to show the collection sites on maps. A similar study was carried out for independent Samoa (Whistler 2010), but the final report has only recently been issued and no provisions have been made yet to put it on the Internet. The purpose of the present report is the same as the two Samoa reports—to list plants that are rare or currently hard to find in Tonga. From the plants selected (97 species) and the resulting recommendations in the Conclusions section at the end of the present report, botanists and conservationists can make educated decisions as to what species should be included on the sorely needed revision of IUCN's Red List of Tongan plants.

1.5. Criteria Used Here for Rare

Some degree of fixed criteria is desirable in determining if a species should be considered to be rare in Tonga. The most tangible or countable of these criteria is the number of times a species has been collected in Tonga. The number of collections from Tonga for each species can partly be determined by a literature search, especially Yuncker (1959), Hemsley (1898), and Burkill (1901). Also important are the unpublished manuscript of Hotta (1962) and the unpublished collection data of the author, who has worked in Tonga over the last 26 years. Another important way to find specimen records is search herbaria housing Tongan collections, particularly for specimens that have not been listed in the literature. This includes the collections of the Cook South Pacific expeditions, the USEE, Hotta, Sykes, and Buelow, which are widely dispersed in a number of herbaria in Europe, the U.S., and New Zealand. The following criteria, based on the recorded herbarium specimens and experience of the author, were used to compile the list of rare Tongan plants presented here. Inclusion in the list required the plant to be in at least one of the following four categories.

1. Rarity of collections—This category includes species that have been collected less than six times (an arbitrary number). However, some rarely collected plants are common species that may not have been collected because of the difficulty of making them into specimens (e.g., coconut), and these are usually excluded from consideration.
2. Rarity of modern collections—This category includes species collected three times or less in the modern era (since 1962). Their lack of modern collections is a possible indicator that they are becoming rare and in need of protection.

3. Restriction to threatened habitats—This category includes plants that are found mostly in habitats that are under pressure from development and agriculture. It most commonly applies to lowland marshes and lowland rainforest, two of the most damaged habitats in Tonga.
4. Restricted distribution in Tonga—This category includes plants found on only one island. It applies to all endemic species found on only one island (hence are found nowhere else in the world), but not to indigenous species if they are very common on the one island. Extensive disturbance in these relatively small areas can have serious consequences on the rare plants found there.
5. Field experience of the author—The author has been working in Tonga for the last 26 years and has collected about 90% of the native flowering plants known from the archipelago. His experience helps qualify him to understand which of the species are rare rather than just under-collected. His experience was sometimes the final arbiter in borderline cases.

Typically threatened or endangered plants are usually native species, most commonly endemic ones. However, two other types of species are included on this list of rare Tongan plants—rare Polynesian cultigens and rare Polynesian adventives. The Polynesian cultigens comprise traditionally cultivated plant species that were brought by the ancient voyagers. These plants often are unable to produce and spread by themselves, and need care by humans (e.g., weeding, planting, etc.) in order to survive in places where they have been introduced. During the modern period, many new cultigens have been introduced, and many of these are so superior to the older cultigens that cultivation of the latter group has diminished or ceased. Because of the absence of the care needed by these species to survive, they have gradually disappeared. A good example of this is the Polynesian melon *Cucumis melo* (***ʻatiu***). It was one of the few edible fruits cultivated by Polynesians, but is inferior when compared to the more recently introduced fruits that are more prolific and/or tastier. Consequently, its cultivation apparently became unimportant and it disappeared from Tonga. This change of cultigens also occurs at the varietal level when new, more prolific or better tasting varieties of traditional Polynesian cultigens have been introduced, and the less prolific or less tasty ones have been abandoned. These disappearing varieties are not addressed in the present paper since they are only varieties, not species.

Rare Polynesian adventives (weeds) comprise plants unintentionally introduced to Tonga before the European era, but which have become rare or have disappeared because of competition from more recently introduced weeds. An example of this is *Dichrocephala integrifolia* (no Tongan name known), a weed of ancient introduction to Tonga. Prior to the European era, it was probably a common weed of disturbed places, and was possibly used medicinally (as it currently is in the Society and Cook Islands). It has apparently now entirely disappeared from Tonga (last collected there in 1840), probably because of its inability to compete with the legions of weeds introduced in modern times (since 1773). These ancient weeds are often not treated in the literature in the same way as native species. They are ignored because they are widespread, but they may be disappearing over their whole range, and thus slip under the radar. Plants belonging to these two categories of non-native plants are included here because they have been a part of Tongan culture since before the European era, and although perhaps not disappearing everywhere, they are becoming lost to Tongan cultural practices.

The conservation status of the 97 plant species included in this report is listed under each species entry in the section below entitled Appendix 4, Profiles of the Rare Plants of Tonga. The

most important category referring to their status is "rare endemic," which signifies rare species found only in Tonga. The second most important category is "rare indigenous," and comprises native species that are rare in Tonga but occur elsewhere as well. It comprises the bulk of the rare plants listed here, since nearly 97% of native Tongan plants are indigenous rather than endemic. The third and fourth categories, rare Polynesian cultigen and rare Polynesian adventive, are of lesser importance since they comprise alien (non-native) species.

For the purposes of discussion, the plants selected as "rare" in Tonga are divided into several categories because they have different characteristics and origins. They are listed among the 97 rare species because they rare (difficult to find), restricted geographically, restricted in habitat, or have become rare in recent times. The categories as used in the individual species profiles are summarized as follows: 1. Rare Polynesian adventive. 2. Rare Polynesian cultigen; 3. Rare indigenous; and 4. Rare endemic.

2. METHODOLOGY

The first task in this study was to go through the author's flora data and prepare a preliminary checklist of species that might be included in this report. The flora data is based primarily upon collection data (specimens collected in Tonga) and the author's personal experience with the flora during his 26 years of work in the archipelago. The collection data was divided into old collections (those gathered before 1962) and modern collections (those gathered after that date). The reason these two divisions are utilized is because numerous old collections followed by fewer recent collections may indicate that the plant is disappearing from Tonga.

After considering the available data, the author established criteria for inclusion on the list of rare plants. In the end, five criteria were used: (1) rarity of collections; (2) rarity of modern collections; (3) restriction to threatened habitats; (4) restricted distribution in Tonga; and (5) field experience of the author. These are explained in more detail in the "Criteria Used Here for Rare" section above.

Once the species were selected for the rare plant list, a species profile was prepared for each (see Appendix 4). This included the following preliminary information: (1) species name; (2) botanical family to which the species belongs; (3) author(s) of the species name; (4) synonyms of the species name, and their authors; (5) Tongan name (if any); (6) English name (if any); (7) status (e.g., rare endemic); (8) reason for listing as a rare plant; and (9) suggested action for protecting the species. This was followed by information about the range, habitat, distribution (in and out of Tonga), frequency, and any ethnobotanical uses. Then a botanical description was written for each species, using previous literature, field descriptions made by the author, and descriptions based on botanical collections stored in the Bishop Museum and the University of Hawai‘i Joseph F. Rock herbaria, as well as live material collected in the field. Finally, the sites of collection of all known specimens of the rare plants were recorded. Doubtful species records are shown in Appendix 3.

The sites of collection data for the 97 rare plants are found on hundreds of herbarium specimens and some visual records (the latter lack voucher specimens). The location data for many of the herbarium specimens is found in the publications of Yuncker (1959), and Hotta (1962). The specimens of the Cook South Pacific expeditions, the USEE, Lister, and Crosby are mostly lacking specific location of collection (sometimes not even the island on which they were collected). Specimens not cited in those publications can be found in various herbaria,

particularly the Bishop Museum Herbarium in Honolulu. Second in importance is the herbarium of the Botany Department of the University of Hawai‘i, which is the main depository for the specimens of the author (his personal collection). Other important collections are found in the Christchurch Herbarium, Kew Herbarium, and a poorly curated and threatened collection in the now abandoned agriculture research station at Vainī, Tongatapu. The author has seen nearly all of the above noted specimens at their respective herbaria, but he recorded only the species identification and collection number, not collection data. The data from these specimens were kindly provided by the staff of the Auckland Museum Herbarium, the Christchurch Herbarium, and the University of California, Berkeley Herbarium.

The author then visited Tonga and presented a week-long workshop arranged by Tonga Trust. In the mornings, PowerPoint presentations on the flora of Tonga, the rare species, the vegetation, collecting methods, taxonomy and nomenclature, Internet literature on the flora of Tonga, and other topics were presented. This was followed in the afternoons (Monday to Wednesday) by fieldwork with trainees recruited by Tonga Trust from the Ministry of Environment, local schools, and other interested individuals. Nine trainees attended the class, and all nine showed up every day. In order to simplify transportation, the field trips were carried out around Tongatapu. During the field trips, four rare species were encountered: *Garcinia pseudoguttifera* (***mo‘onia***), *Capparis cordifolia* (no Tongan name), *Nicotiana fragrans* (no Tongan name), and *Lycium sandwicense* (no Tongan name). The final day of the workshop comprised a public lecture on rare plants of Tonga that was attended by about 35 people. After the present report is finished, it will be submitted to Conservation International and Tonga Trust. It includes the general report, and an appendix with several tables, including profiles of each of the rare species. It also includes color photos of nearly all the species. (A few of the species have probably never been photographed; for these, photos of herbarium specimens were utilized) The whole report will be prepared for posting on the Internet so that it can easily be accessed by anyone. Once approved, the whole report, along with the species profiles and photographs, will be put on line on a site dedicated to the flora of Tonga (www.floraoftonga.com). The final step, which is not a part of this project, can be done by GIS programmers, who can take the collection data and put it onto a map of Tonga.

3. RESULTS

3.1. Distribution of Rare Plants

The rare plants are not randomly distributed, because the number of them present on any one island is determined by several factors, such as size, elevation, isolation, and disturbance. The island with the highest number of rare species is ‘Eua, which has 43 of them. This is to be expected because ‘Eua has the largest area of remaining undisturbed Tongan forest and it is the second largest island in the archipelago. Tongatapu is second with 31 species, which is somewhat surprising because it is the island with the most disturbed vegetation. This inflated number is probably due to Tongatapu being the largest island in the archipelago (three times larger than the next largest island). Third in the number of rare species is Vava‘u with 28. Its placement in third is not surprising since it is the third largest island. The isolated islands of Kao and Tofua are next with 20 species each, which is probably also to be expected since they are relatively high islands (with an elevation of over 1000 m, Kao is the highest island in Tonga).

Tafahi, also a high island at over 600 m elevation, is next with 18 species. The islands with the fewest species are Niuafo‘ou (11 species), Ha‘apai (10), and Niuatoputapu (9). The uninhabited island of Late, which is not shown in the tables here, has two, and other uninhabited islands, e.g., Fonualei, may have rare species, but few collections have been made on these minor islands.

The plants that have been determined to be rare are arranged into three groups: (1) Rare Polynesian Introductions; (2) Rare Indigenous Species (some of which are rare elsewhere in their natural range, some not); and (3) Rare Endemic Species. The first category is further divided into Rare Unintentional Polynesian Introductions (mostly weeds) and Rare Intentional Introductions (Polynesian cultigens), which are cultivated plants that have become rare in the European (post-contact) era that began in 1773. The other two categories are subdivided into orchids and non-orchids.

3.2. Rare Polynesian Introductions

Whether a species is native or alien is sometimes difficult to determine, but several factors have to be considered in ascertaining this: (1) method of dispersal (especially whether or not it produces seeds); (2) known range outside of Tonga; (3) whether or not there is a natural habitat for it to occupy in Tonga; and (4) and if the plant has disappeared in recent times. A plant with no natural means of dispersing across the ocean to Tonga is almost certainly an alien species. A good example of this is the Tahitian chestnut (***ifi***, *Inocarpus fagifer*), which has large fruits that cannot be carried by wind or animals, and do not survive immersion in seawater for long; hence it is an alien species (Polynesian introduction). If a plant is not found on adjacent islands (e.g., Tonga and Fiji), but much farther away (e.g., Australia), is it is most likely an alien species (and usually of modern introduction). Prior to the arrival of Polynesians, most of Tonga was covered with a dense tropical rainforest. Disturbed habitats in pre-Polynesian Tonga were minimal and occurred mostly after drastic climatic events (e.g., cyclones, volcanic eruptions). Hence light-loving inland species had relatively little area to colonize, and most of those found in the plentiful disturbed habitats in Tonga today are alien species. Alien plant species are often unable to compete with native species in undisturbed habitats, but may be common in disturbed habitats because they are planted there. When these plants are no longer desired or cultivated, they may eventually disappear. This is nearly the case for *Parinari insularum* (***hea***), which was frequently collected by the early botanists, but has now nearly disappeared from Tonga. (Most of the remaining individuals are found in Vava‘u.) Consequently, useful plants present before the European era, but which have become uncommon in recent times, are usually alien species (mostly Polynesian cultigens).

The Polynesian introductions considered to be rare in Tonga are divided into two groups for further discussion—weedy species that are mostly of unintentional introduction, and useful species that are mostly of intentional introduction. Because they are alien species, they would not normally be considered for “red-listing,” i.e., alien species are rarely considered to be threatened or endangered. However, a case can be made for some of them being considered for Tonga’s red list because they may be threatened throughout their range. In the discussion they are included in a list of “plants of concern,” so that other botanists studying them in other islands can be aware that they may be disappearing in Tonga if not elsewhere.

Rare Unintentional Polynesian Introductions includes alien species that were accidentally or unintentionally introduced prior to the European era in Tonga. Such plants are sometimes

referred to as Polynesian weeds. Not all weeds are alien species because some are fairly certain to be native (e.g., the liana *Merremia peltata*, is a weed but is almost certainly native). Whether a plant is of ancient or modern introduction is not always clear, and like distinguishing alien from native species, several factors have to be considered: (1) first date of collection; (2) known range outside Tonga; and (3) whether or not the plant has a local name. Weedy species, especially common ones, not collected by early botanists (i.e., those working in the 18th and 19th centuries) are most likely to be modern rather than Polynesian introductions. Virtually all weedy species originally native to tropical America are modern introductions. Weeds that were common in ancient Tonga most likely had names because very few weedy species were present then, and they would have been much more noticeable and a topic of discussion (hence, they would need a name). Eight now-rare species that are thought to have been Polynesian introductions are shown in Table 2 below. The species are arranged in alphabetical order by scientific name, and their distribution in the archipelago is noted, including the number of times they have been collected. Their last date of collection is also noted (which is an indication of whether they are likely to have been extirpated or not).

A plant that was possibly a weed but which is not included on the list, *Blumea milnei*, appears to be native to Tonga. It has been collected in Tonga only in modern times, but its only islands of collection, Kao and Tofua, were not visited by the early collectors, and it has a natural habitat (disturbed montane forest) that existed before the arrival of the Polynesians. It is found in the table of indigenous species (Table 6).

Table 2. Rare Polynesian Weeds and Number of Collections.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Adenostemma lavenia		1	--	--	2	1	--	--	--	--	1983?	2/4
Dichrocephala integrifolia		1?	--	--	--	--	--	--	--	--	1840	0/1
Kyllinga nemoralis		7	4	--	1	--	3	--	1	--	1983?	1/17[4]
Laportea interrupta		4	--	1	--	2	1	--	1	--	1987	2/10
Rorippa sarmentosa		7	6	2	1	--	2	--	--	1	1987	5/16
Senna sophera		3	3	--	--	--	--	1	2	--	1987	4/9
Sida samoensis		2	2	--	--	--	2	--	--	--	1987?	2/7
Uraria lagopodioides		3	3	2	--	--	1	2	1	--	1990	2/12

[1]T = Tonga; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou.
[2]Date of last collection.
[3]Number of Number of modern collections/all collections.
[4]Includes one specimen without island locality.

Only one of the species included on the list is likely to have been extirpated from Tonga, *Dichrocephala integrifolia*. It was apparently collected during the Cook expeditions (ca. 1773) and again in 1840 by the USEE, but never again. It was also reported from Samoa in 1839, but if that record is correct, it is the only one from Samoa. The plant still persists in eastern Polynesia

(Society and Cook Islands), where it is probably uncommon but used as a medicinal plant. *Adenostemma lavenia* is only known from areas of open native vegetation on Kao and Tofua, but was probably once a common or at least a more widespread weedy species. One species, the prostrate woody herb *Sida samoensis*, is problematical because it is a littoral species of limited distribution (Fiji and western Polynesia), but occurs only in disturbed sandy habitats. Two of the weedy alien species are probably used in traditional medicine (*Rorippa sarmentosa* and *Laportea interrupta*) and these may be better known than the others. However, they are nevertheless becoming hard to find. The other three species are inconspicuous weeds, only one of which, *Senna sophera*, had a Tongan name (***matui***). The sedge *Kyllinga nemoralis* and the legume *Uraria lagopodioides* are probably disappearing without anyone taking notice, since they do not have Tonga names and hence would not be recognized or talked about. Interestingly, the *Kyllinga nemoralis* is apparently still common over the rest of its range (especially in Samoa). For more detailed information about each species, see the individual species profiles in Appendix 4.

Rare Intentional Introductions (Polynesian Cultigens) includes "canoe plants" that were intentionally brought to Tonga by ancient voyagers for the purpose of cultivation, but in modern times have fallen into disuse and have or nearly have disappeared. The ancient Polynesians had a limited number of useful plants to cultivate, partly because few if any of the native species are very useful. Thus all the cultivated species had to have been carried by them when they started their eastward migrations into Polynesia, or they were picked up along the way. The arrival of Europeans (starting in 1773 in Tonga) opened a whole new avenue for cultivated plants from all over the world. Many of these alien species, such as mango, proved to be very popular and are now commonly cultivated. Concurrently, many of the ancient useful species quickly lost popularity and their cultivation diminished and eventually ended. If these species were entirely dependent upon people to propagate them, they eventually became rare or disappeared. A good example of this is the wax gourd *Benincasa hispida*. Its only recorded use was as a small gourd for storing scented coconut oil. When Europeans arrived, they brought disposable bottles that were easily obtainable by Tongans, making the less useful and more attention-requiring gourds obsolete. Nowadays, the gourd is rare but still persists in a few places. Another example is the Polynesian tomato *Solanum ferox* (***touloku***), noted earlier. No collections of this species are known from Tonga since 1926, but its native name was found in the earliest Tongan dictionary (Rabone 1845).

The species considered to be rare Polynesian cultigens are shown in Table 3. These are arranged in alphabetical order by scientific name, and their distribution in the archipelago is noted, including the number of times they have been collected in Tonga on each of the islands. Their last date of collection is also noted (which is an indication of whether they are likely to have been extirpated or not). Three of the species on the list have apparently already disappeared (i.e., have been extirpated) from Tonga. The Polynesian melon *Cucumis melo* (***'atiu***) was collected by the USEE in Tonga in 1840, but never again. Its disappearance from Tonga is not unexpected since it has apparently disappeared from independent Samoa (Whistler 2010) and is rare in American Samoa (Whistler 2004B). *Metrosideros collina* was last collected in Tonga in 1852, but during an ethnobotanical study of Tonga, Whistler (1991) found the dead root of the plant buried next to the doorstep of a house on "Mt. Zion" on Tongatapu. The third intentional Polynesian introduction that has apparently been extirpated from Tonga, *Solanum ferox* (***touloku***), is discussed above.

Table 3. Rare Polynesian Cultigens and Number of Collections.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Amorphophallus paeoniifolius		2	2	--	--	1	1	1	1	--	1977	4/9[4]
Atuna racemosa		4	2	--	--	--	4	1	1	--	1987	2/12
Benincasa hispida		1	1	--	--	--	2	--	--	--	1990	2/4
Cucumis melo		1	--	--	--	--	--	--	--	--	1840	0/1
Garcinia pseudoguttifera		4	3	--	--	--	1	--	--	--	2010	5/8
Gyrocarpus americanus		1	1	3	--	--	1	1	--	1	2010	4/8
Manilkara dissecta		3	--	1	--	--	3	2	--	--	1987	6/9
Metrosideros collina		1	--	--	--	--	1	--	--	--	1852	0/2
Parinari insularum		1	--	--	--	--	6	--	--	1	2004	5/8
Schizostachyum glaucifolium --		1	--	--	--	--	--	1	--		1987	1/2
Solanum ferox		--	1	--	--	--	--	--	--	--	1926	0/1
Syzygium neurocalyx		1	1	--	--	--	1	1	--	--	1987	2/4

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

[4]Includes one specimen without island locality.

The other nine species have been collected in recent times (since 1962), but are slowly disappearing. Buelow in ca. 1977 made the last known collection of *Amorphophallus paeoniifolius* (***teve***), but the species is probably still to be found in Tonga. The other eight species have all been collected by the author during his work in Tonga from 1984 to 2010. *Atuna racemosa* (***pipi fai lolo***) has traditionally been cultivated for its large seed, which is used to scent coconut oil. *Garcinia pseudoguttifera* (***moʻonia***) was collected as recently as 2010. While it is still found in Tonga, it is probably decreasing in frequency due to the use of perfumes instead of locally made scented coconut oil. *Gyrocarpus americana* (***pukovili***) is native to Polynesia, but is known in Tonga only in cultivation. It was most recently seen on ʻEua in 2010, but is apparently often planted as a living fence post today in Ha'apai (Thaman, pers. comm.). *Manilkara dissecta* (***pani***), which is apparently native to Fiji and Samoa, is probably restricted to cultivation in villages for its use in local medicines, and is probably disappearing when it is not replanted. Two very old well-known trees are still present in village houseyard gardens in Ma'ufanga in Nuku'alofa and in Hihifo Village on Pangai Island in Ha'apai in early 2011 (Thaman pers. comm.). *Parinari insularum* (***hea***), which is in the same family as ***pipi fai lolo***, has a fruit that was likewise used to make scented coconut oil, but is currently becoming rare and is perhaps now mostly restricted to a few places in Vavaʻu. The last species, *Syzygium neurocalyx* (***koli***) also fits the category of fragrant-fruited tree whose cultural use is declining. For more detailed information about each of the eleven species, see the individual species profiles in Appendix 4.

3.3. Rare Indigenous Species

Indigenous species differ from endemic species mainly in their extent of distribution: an endemic species is restricted to a single area (typically an island, archipelago, or country) while indigenous species are found in more than one place. (Some are pantropic, i.e., found throughout the tropics.) The more important of the two, in terms of rare plants, is the endemic category because if they are rare in one place (i.e., the place to which they are native), they are rare globally. Indigenous species can be rare in some places and common in others, but some are rare throughout their range (and these are the ones of particular concern).

An indigenous plant can be rare for a number of reasons. The species may be at its geographical limit, and is rare because it is a recent natural arrival without much time to spread, or because it is at its climatic limit (e.g., it may require a wetter or drier, or a colder or warmer climate than that found in Tonga in order to flourish). It may also be rare because of edaphic factors, e.g., it may thrive only on lava flows, which are absent from the main islands of Tonga. The indigenous species included here can be divided into three groups: orchids, littoral species, and all others. Orchids are best treated separately from other rare species in Tonga because they are such a large and unique group of plants. Littoral species likewise are different because of their coastal distribution and seawater mode of dispersal. The indigenous category comprises 71 wide-ranging species that are rare in Tonga. Of these, six are littoral species discussed separately below, and 17 orchids treated likewise.

The term "littoral" refers to plants occurring on the seashore (Latin: *litoris* = shore), and whose presence and distribution are affected either directly or indirectly by the sea. Their area of occurrence, often called "littoral strand," occupies a very narrow area on the immediate coast, and typically exhibits zonation into several bands that run roughly parallel to the coastline. Littoral vegetation occurs on nearly all undisturbed shores of Tonga, typically from just above the high-tide mark up to 5 or 10 m elevation, but sometimes to over 100 m on steep, exposed slopes.

3.3.1. Rare Indigenous Littoral Species

Littoral species are usually dispersed by seeds or fruits that float long distances in seawater, or they have barbed fruits that can stick to the feathers of seabirds. These dispersal characteristics account for the wide distributions of most littoral species: few Pacific littoral species are endemic to any one island group, and none in Tonga are. Most of the rare Tongan littoral plant species are common elsewhere in the Pacific, and their rarity in Tonga can often be attributed to absence of their preferred substrate there, or to the simple fact that they may be recent arrivals that have not had time to spread. The rare littoral species are arranged in alphabetical order by scientific name in the two categories in Table 4, and their distribution in the archipelago is noted, including the number of times they have been collected in Tonga.

The rare littoral species occur on six of the main Tongan islands. *Capparis cordifolia* (no Tongan name) was collected as recently as 2010, but is very rare in littoral habitats on ʻEua (collected twice) and Tongatapu (also twice). *Caesalpinia bonduc* (***talatala ʻamoa***) has been collected a total of five times on three islands, as recently as 1987. *Dalbergia candenatensis* has likewise been collected a total of five times on three islands, but not since 1953. *Corchorus torresianus* has also been collected five times on two islands (Tongatapu and Haʻapai), but not

since 1962. *Portulaca lutea* (***tamole***) is a common littoral herb elsewhere in the Pacific, but in Tonga it has been collected only twice on two islands (Tafahi and Tongatapu), and not since 1951. *Lycium sandwicense* (no Tongan name) is known from six collections from Tongatapu and one from ʻEua, but was collected during the 2010 fieldwork on the former island.

The three littoral species of most concern are *Nicotiana fragrans* (no Tongan name), the burr grass *Cenchrus caliculatus* (***hefa***), and *Sesbania coccinea* (***ʻohai***). The tobacco relative has been collected five times on Tongatapu (most recently in 2010), but is rare elsewhere in the Pacific, where it known only from Niue and New Caledonia. Burr grass has been collected 13 times on 4 islands, but only four of those collections are modern (since 1962), indicating that it is disappearing from Tonga. It has also been disappearing throughout its Pacific range (e.g., it has apparently been extirpated from the Samoan archipelago; Whistler 2010 and 2004A), possibly because of competition with weedy species, or perhaps because of the loss of habitat for their method of dispersal, seabirds. *Sesbania* has been collected on three small islands in the Vavaʻu group, and is of limited distribution elsewhere in the Pacific. One species not included in this category of rare indigenous plants is *Sida samoensis*. It is usually a littoral species, but is unusual in that it only seems to be found in villages and disturbed places, and hence was included in this discussion under rare Polynesian weeds. For more detailed information about each of the nine species, see the individual species profiles in Appendix 4.

Table 4. Rare Indigenous Littoral Species and Number of Collections.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Caesalpinia bonduc		2	--	1	--	--	--	2	--	--	1987	2/5
Capparis cordifolia		2	2	--	--	--	--	--	--	--	2010	2/4
Cenchrus caliculatus		3	8	3	--	1	2	--	--	--	1990	7/17
Corchorus torresianus		3	--	2	--	--	--	--	--	--	1962	0/5
Dalbergia candenatensis		1	--	1	--	--	3	--	--	--	1953	2/5
Lycium sandwicense		6	1	--	--	--	--	--	--	--	2010	4/7
Nicotiana fragrans		5	--	--	--	--	--	--	--	--	2010	2/5
Portulaca lutea		1	--	--	--	--	--	--	1	--	1951	0/2
Sesbania coccinea		--	--	--	--	--	6	--	--	--	2001	5/6

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

3.3.2. Rare Indigenous Orchid Species

Forty-four orchid species are native to Tonga, which represents about 13% of the native vascular flora of the archipelago. Only one orchid species is endemic to Tonga, *Robiquetia*

tongensis, but this species it is not threatened or endangered, and is hence not discussed here. Seventeen species are included here on the list of rare indigenous orchids, making up 17% of the rare plants of Tonga. Ecologically, orchids can be divided into two main groups, epiphytes and terrestrials, and these should also be treated differently from each other. Epiphytes are particularly difficult to monitor, because they can be virtually invisible high in the trees in closed canopy forest. Because of this, the apparently rare species listed here may not actually be rare, just rarely collected (i.e., they are hard to find, not rare). Terrestrial species, however, are much easier to find when present, but when forests are disturbed, the terrestrials are more threatened than the epiphytes because the ground is the part of the forest that suffers the most. A number of the terrestrials have been collected fairly frequently in the past, but not in the last 25 years, which is a cause of concern. Globally, orchids as a group are also threatened, because many of them are prized by commercial and local amateur collectors, which means they need protection from over-collecting. However, instances of native orchids being collected in excess in Tonga are not known.

Table 5. Rare Indigenous Orchids.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Acanthephippium splendidum		--	--	--	1	2	--	--	2	--	1982	4/5
Bulbophyllum longiscapum		--	--	--	--	--	--	--	4	--	1987	3/4
Crepidium latisegmentum		--	--	--	2	1	--	--	--	--	2010	2/3
Crepidium taurinum		--	--	--	--	--	--	--	1	--	1978	1/1
Dendrobium dactylodes		--	--	--	--	--	--	--	4	--	1987	3/4
Erythrodes oxyglossa		--	--	--	3	2	--	--	--	--	1997	5/5
Erythrodes purpurascens		--	--	--	2	2	--	--	--	--	1997	4/4
Eulophia pulchra		--	--	--	1	--	1	--	--	--	1987	3/3[4]
Eulophia spectabilis		--	1?	--	1	1	--	--	--	--	1977	2/3?
Hetaeria whitmeei		--	6	--	--	--	--	--	--	--	1997	1/6
Liparis laydardii		--	--	--	2	2	--	--	--	--	1997	4/4
Peristylus novoebudarum		--	1	--	1	--	--	--	--	1	1979	3/3
Phaius amboinensis		--	--	--	1	--	--	--	2	--	1978	3/3
Phaius robertsii		--	--	--	--	2	--	--	--	--	1997	2/2
Phreatia matthewsii		--	--	--	--	--	--	--	3	--	1987	3/3
Vrydagzynea vitiensis		--	--	--	--	--	--	--	3	--	1978	2/3
Zeuxine stenophylla		--	--	--	3	--	--	--	1	--	1982	4/4

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

[4]Includes one specimen without island locality.

All Tongan orchids are on the CITES (Convention on the International Trade in Endangered Species) list, so nothing else much needs to be done to protect them at the moment, other than simply enforcing existing legislation and protecting the native forests in which they occur. All but one of the seventeen occurs on the isolated islands Kao, Tofua, and/or Tafahi. The orchids on the first two of these islands are probably secure, since the islands are relatively undisturbed and likely to remain so. However, those found only on Tafahi are threatened because of the extensive cultivation of kava on this tiny but high island.

The species are arranged in alphabetical order by scientific name in Table 4, and their distribution in the archipelago is noted, including the number of times they have been collected. All are terrestrial, with the exception of *Bulbophyllum longiscapum* and *Dendrobium dactylodes*. Their last date of collection is also noted (which is an indication of whether they are likely to have been extirpated or not). All of them have been collected at least once since 1977, mostly because of the extensive collections of Whistler and Buelow in the high volcanic islands (Kao, Tofua, and Tafahi) that house most of these species. For more detailed information about each of the seventeen species, see the individual species profiles in Appendix 4.

3.3.3. Other Rare Indigenous Species

In contrast to littoral species, inland species are dispersed mostly by seeds being carried internally by forest birds that have consumed the fruits, or by being carried in wind currents. Wind-borne species are usually very small, or have wings or plumes that allow them to be carried for long distances in the wind. They usually occur inland from the shore because they are not adapted to the bright sunny and saline littoral conditions found on the shore. The 42 species considered to be rare in Tonga are shown in Table 6. The species are arranged in alphabetical order by scientific name, and their distribution in the archipelago is noted, including the number of times they have been collected in Tonga. Their last date of collection is also noted (which is an indication of whether they are likely to have been extirpated or not).

Most of the rare indigenous species are lowland forest plants, but five of them, *Centipeda minima*, *Eleocharis geniculata*, *Lepironia articulata*, and *Limnophila fragrans* are wetland plants. The lowland forest species comprise a variety of habitats. Some, such as *Aneilema vitiense*, *Lagenophora pumila*, *Plectranthus forsteri*, and *Plumbago zeylanica,* are terrestrial herbs, but one, *Peperomia tutuilana*, is an epiphytic herb. One, *Blumea milnei*, is between a shrub and an herb. Some, such as *Carruthersia latifolia*, *Luffa cylindrica*, *Mucuna glabra*, *Operculina turpethum*, *Passiflora aurantia*, *Tylophora samoensis*, and *Ventilago vitiense*, are vines. Others, such as *Croton microtiglium*, *Deeringia amaranthoides*, *Scaevola gracilis*, *Myoporum sandwicense*, and *Psychotria leiophylla*, are shrubs. Still others, such as *Crateva religiosa* (***pualiki***), *Gyrocarpus americanus* (***puko vili***), *Heritiera littoralis*, *Mammea odorata*, *Ochrosia vitiensis*, *Pittosporum brackenridgei* (***masikona***), *Serianthes melanesica* (***mohemohe***), and *Sterculia fanaiho* (***fanakio***), are trees. One, *Pritchardia thurstonii*, is a palm.

Most of these species have been collected in the modern area of Tonga plant collections (since 1962). Some of the species are rare because they are on small islands where botanical collections are few. This includes *Acalypha grandis* (***kalakala ‘a pusi***) that has been collected only on Niuafo‘ou; *Blumea milnei* (Kao and Tofua); *Crateva religiosa* (***pualiki***) (Tafahi, with an old record in cultivation on Tongatapu); *Eleocharis geniculata* (Kao); *Heritiera ornithocephala* (Kao and Tofua); *Lagenophora pumila* (Kao, once only); *Passiflora aurantia* (Kao and Tofua);

Table 6. Rare Indigenous (Non-Orchids and Non-Littoral Species) and Number of Collections.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Acalypha grandis		1	--	--	--	--	--	--	--	4	2010	4/6[4]
Acalypha repanda		--	7	--	--	--	--	--	--	--	2010	5/7
Aneilema vitiense		--	--	--	--	--	--	--	3	1	1979	3/4
Antirhea inconspicua		--	3	--	--	--	--	--	--	--	2010	3/3
Blumea milnei		--	--	--	5	3	--	--	--	--	1997	8/8
Capparis quiniflora		--	1	--	--	--	1	--	--	--	1979	2/2
Carruthersia latifolia		--	4	--	--	--	--	--	--	--	1990	4/4
Centipeda minima		1	2	--	--	--	--	--	--	--	1979	2/3
Crateva religiosa		1	--	--	--	--	--	--	6	--	1987	4/7
Croton microtiglium		--	2	--	--	--	3	--	--	--	1987	3/5
Deeringia amaranthoides		--	4	--	--	--	--	--	--	--	1990	4/4
Eleocharis geniculata		--	--	--	2		--	--	--	--	1982	1/2
Heritiera ornithocephala		--	--	--	1	4	--	--	--	--	1997	2/5
Heteropogon contortus		--	1	1	--	--	4	--	--	--	1988	2/6
Lagenophora pumila		--	--	--	1	--	--	--	--	--	1977	1/1
Lepironia articulata		--	--	--	--	--	4	--	--	--	1987	1/4
Limnophila fragrans		--	3	--	--	--	1	--	--	--	1979	3/4
Luffa cylindrica		2	--	1	--	--	2	1	--	1	1987	2/7
Mammea odorata		--	1	--	--	--	--	--	--	--	2010	1/1
Mucuna glabra		--	2	--	--	--	--	--	--	2	1990	2/4
Myoporum sandwicense		--	1	--	--	--	--	--	--	--	2002	1/1
Ochrosia vitiensis		--	--	--	--	--	6	--	--	--	2002	4/6
Operculina turpethum		4	--	--	--	--	1	1	--	--	1978	1/7[4]
Osteomeles anthyllidifolia		--	8	--	--	--	--	--	--	--	2010	3/8
Passiflora aurantia		--	--	--	2	3	--	--	--	--	1997	3/6[4]
Peperomia pallida		--	--	--	--	--	1	1	3	--	1987	4/5
Piper macropiper		--	--	--	--	--	--	--	4	--	1987	4/4
Pisonia umbellifera		--	3	--	--	--	--	--	--	--	1990	3/3
Pittosporum brackenridgei		--	--	--	--	--	2	--	--	--	2002	1/2
Plectranthus forsteri		--	2	--	--	--	--	--	--	--	1979	1/2
Plumbago zeylanica		--	--	--	--	--	1?	--	1	--	1978	1/2?
Polyscias samoensis		--	--	--	--	--	--	--	--	2	1987	2/2
Pritchardia thurstonii		--	3	--	--	--	--	--	--	--	1977	1/3
Psychotria leiophylla		--	5	--	--	--	--	--	--	--	1990	5/5
Salacia pachycarpa		--	6	--	--	--	--	--	--	--	1990	6/6
Sapindus saponaria		1	3	--	--	--	--	--	--	--	1990	3/4
Scaevola gracilis		--	--	--	3	5	--	--	--	--	1997	5/8
Serianthes melanesica		1	--	--	--	--	7	--	--	--	2002	6/10[4]
Sterculia fanaiho		--	--	1	--	--	--	--	--	4	1987	3/5

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Syzygium quadrangulatum		--	3	--	--	--	--	--	--	--	2002	2/3
Tylophora samoensis		--	5	--	--	--	--	--	--	--	1990	3/5
Ventilago vitiensis		--	2	--	--	--	1	--	--	--	1990	3/3

[1]T =Tongatapu; E = ‘Eua; H = Ha‘apai; K = Kao; T = Tofua; V = Vava‘u; N = Niuatoputapu; T = Tafahi; and N = Niuafo‘ou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island-by-island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

[4]Includes one specimen without island locality, an in one case, from Late Island.

Polyscias samoensis (Niuafo‘ou); and *Scaevola gracilis* (Kao and Tofua). The probable reason for the other species being rare is mostly loss of habitat; only a relatively small percentage of native lowland forest remains in Tonga. For more information about each of the rare indigenous, non-orchid species, see the individual species profiles in Appendix 4.

3.4. Rare Endemic Species

This category includes species that are endemic to Tonga, i.e., species found nowhere else in the world. The rate of endemism of native vascular plants in Tonga is about 3%, with 15 endemic species. Only nine of these are considered to be rare here. The other six endemic species not considered rare occur on at least two islands. Endemic species that occur on only a single island automatically makes the rare list. This includes three species—*Discocalyx listeri*, *Dysoxylum tongense* (***mo‘ota kula***), and *Phyllanthus amicorum*. Although they have been collected many times (14 to 16), they are listed because of their small natural range. Another often collected species (12 times), *Pittosporum yunckeri*, occurs on Tongatapu (one old collection) and ‘Eua, and was included because it is restricted mostly to the cliffs of ‘Eua, a very small and narrow habitat. Two other species are endemic to and uncommon on ‘Eua—*Aglaia heterotricha* (***langakali***?) and *Arytera bifoliata*, and another two—*Atractocarpus crosbyi* and *Casearia buelowii*—are endemic to Vava‘u. The ninth species, *Polyalthia amicorum* (***motelolo***), is somewhat of an enigma. Although it has sometimes been identified as belonging to a Fijian species, it appears to be different than any found in the latter archipelago. However, it is known only from cultivation, and so may have been native to lowland forest on Tongatapu, a vegetation that has virtually all been destroyed.

The main threat to rare endemic species is habitat destruction. All nine of these are probably lowland forest species, a habitat that has been decimated in Tonga. Endemic species are more threatened than indigenous species, since if they disappear from Tonga, they disappear forever, i.e., they become extinct. Indigenous species have the luxury of occurring in other archipelagoes.

Table 7. Rare Endemic Species.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Aglaia heterotricha		--	7	--	--	--	--	--	--	--	2010	2/7
Arytera bifoliata		--	6	--	--	--	--	--	--	--	1990	6/6
Atractocarpus crosbyi		--	--	--	--	--	11	--	--	--	2002	8/11
Casearia buelowii		--	--	--	--	--	3	--	--	--	2004	2/3
Discocalyx listeri		--	16	--	--	--	--	--	--	--	2002	9/16
Dysoxylum tongense		--	14	--	--	--	--	--	--	--	2010	4/14
Phyllanthus amicorum		--	16	--	--	--	--	--	--	--	2010	10/16
Pittosporum yunckeri		1	11	--	--	--	--	--	--	--	2010	5/12
Polyalthia amicorum		7	1	--	--	--	--	--	--	--	1987	5/8

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

For more information about each of the rare endemic species, see the individual species profiles in Appendix 4.

4. DISCUSSION

From the list of 97 rare flowering plant species recognized here for Tonga, 30 species have been selected for recommendation for inclusion on the Red List of Tonga plants produced by the IUCN. These are discussed in more detail below, arranged in the following categories: Tongan endemics, represented by six species; indigenous non-orchid species, represented by 19 species; and indigenous orchid species, represented by five species. These are shown in Table 8. Additionally, eight non-native species have also be selected for recommended for inclusion on the Red List. These species should also be considered for some kind of status, since these are either ancient Polynesian weeds possibly threatened over their entire range, or traditional cultigens possibly threatened over their entire range. They are divided into Polynesian adventives, represented by three species; and Polynesian cultigens, represented by five species. For details on the 30 recommended species, see their complete write-ups in the species profiles in Appendix 4.

4.1. Tongan Endemic Species

Sixteen endemic species are recognized in Tonga (Table 1), but not all of them are rare or threatened in the archipelago. Some of them are quite common in fact, such as *Dysoxylum tongense* (***moʻota kula***), which is dominant in some forests on ʻEua. Nine of the Tongan

Table 8. Native Tongan Plant Species Recommended for the IUCN's Red List.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Endemic												
Aglaia heterotricha		--	7	--	--	--	--	--	--	--	2010	2/7
Arytera bifoliata		--	6	--	--	--	--	--	--	--	1990	6/6
Atractocarpus crosbyi		--	--	--	--	--	11	--	--	--	2002	7/11
Casearia buelowii		--	--	--	--	--	3	--	--	--	2004	2/3
Pittosporum yunckeri		1	11	--	--	--	--	--	--	--	2010	5/12
Polyalthia amicorum		7	1	--	--	--	--	--	--	--	1987	5/8
Indigenous (Non-Orchids)												
Blumea milnei		--	--	--	5	3	--	--	--	--	1997	8/8
Capparis quiniflora		--	1	--	--	--	1	--	--	--	1979	2/2
Cenchrus caliculatus		3	8	3	--	1	2	--	--	--	1990	7/17
Corchorus torresianus		3	--	2	--	--	--	--	--	--	1962	0/5
Crateva religiosa		1	--	--	--	--	--	--	6	--	1987	4/7
Lagenophora pumila		--	--	--	1	--	--	--	--	--	1977	1/1
Lepironia articulata		--	--	--	--	--	4	--	--	--	1987	1/4
Limnophila fragrans		--	3	--	--	--	1	--	--	--	1979	3/4
Lycium sandwicense		6	1	--	--	--	--	--	--	--	2010	4/7
Myoporum sandwicense		--	1	--	--	--	--	--	--	--	2002	1/1
Nicotiana fragrans		5	--	--	--	--	--	--	--	--	2010	2/5
Operculina turpethum		4	--	--	--	--	1	1	--	--	1978	1/7[4]
Osteomeles anthyllidifolia			--	8	--	--	--	--	--	--	--	2010 3/8
Plectranthus forsteri		--	2	--	--	--	--	--	--	--	1979	1/2
Pritchardia thurstonii		--	3	--	--	--	--	--	--	--	1977	1/3
Psychotria leiophylla		--	5	--	--	--	--	--	--	--	1990	5/5
Scaevola gracilis		--	--	--	3	5	--	--	--	--	1997	5/8
Serianthes melanesica		1	--	--	--	--	7	--	--	--	2002	6/10[4]
Sesbania coccinea		--	--	--	--	--	6	--	--	--	2001	5/6
Indigenous (Orchids)												
Crepidium taurinum		--	--	--	--	--	--	--	1	--	1978	1/1
Eulophia pulchra		--	--	--	1	--	--	--	--	1	1987	3/3[4]
Eulophia spectabilis		--	1?	--	1	1	--	--	--	--	1977	2/3?
Peristylus novoebudarum		--	1	--	1	--	--	--	--	1	1979	3/3
Phaius robertsii		--	--	--	--	2	--	--	--	--	1997	2/2

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up. [2]Date of last collection. [3]Number of modern collections/all collections.
[4]Includes one specimen without island locality, an in one case, from Late Island.

endemics are considered rare here, but only six of these are recommended for inclusion on the Red List of threatened or endangered plant species for Tonga. The six are as follows.

(1) *Aglaia heterotricha* (***langakali***?)—This understory tree is restricted to ʻEua, where it is uncommon to occasional in lowland forest. It is recommended here to be included on the Tongan Red List because it is an endemic species found only on one island, and is not very common there. See the complete profile in Appendix 4.

2) *Arytera bifoliata*—This shrub or small tree is known only from one island, ʻEua, where it appears to be restricted to the cliffs on the east side of the island. Nothing like it is known from anywhere else, especially because of its unique compound leaves comprising two leaflets (all other members of the genus have many more). It is recommended here for inclusion on the Tongan Red List because of its limited range (one island) and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(3) *Atractocarpus crosbyi*—This shrub is endemic to Vavaʻu, where it has been collected ten times in lowland forest. It is the only member of its genus in western Polynesia, and has attractive white flowers that may make it idea as an ornamental plant, if it can be brought into cultivation. It is recommended here for inclusion on the Tongan Red List because of its limited range (one island) and infrequency. See the details in the species profile in Appendix 4.

(4) *Casearia buelowii*—This small tree is known from only three collections, all three of which are from the Mt. Talau, a promontory on the west side of Neiafu Harbor on Vavaʻu. Not only is it restricted to one island, it is so far known from only one location, which are the reasons why it is recommended here for inclusion on Tongan Red List. See the details in the species profile in Appendix 4.

(5) *Pittosporum yunckeri*—This shrub or small tree, except for an old (1953) record from Tongatapu, is found only on the liku cliffs on the east side of ʻEua. This shrub or small tree hangs from the cliffs there to get the sunlight it needs to grow. The flowers are very attractive, and this species might be a good candidate for an ornamental plant. It is recommended here for inclusion on the Tongan Red List because of its limited range and limited habitat. See the details in the species profile in Appendix 4.

(6) *Polyalthia amicorum* (***motelolo***)—This tree, which is grown for its fragrant fruits and flowers, is not known from the wild. A possible explanation is that it was a lowland forest species endemic to the forests of Tongatapu, but when this forest was virtually removed from the now heavily developed island, the native habitat of ***motelolo*** was destroyed. It is recommended here for inclusion on the Tongan Red List because of its being an endemic species now limited to cultivation. See the details in the species profile in Appendix 4.

4.2. Tongan Indigenous Non-Orchids

Nineteen species of herbs, shrubs, vines, grasses, sedges, and herbs are recommended here for inclusion on the Tonga's Red List of plants. While most of them are probably more common elsewhere in their range, some appear, based on preliminary evidence, to be of concern in other parts of the Pacific. The nineteen are as follows.

(7) *Blumea milnei*—This woody herb, which ranges from New Guinea to Samoa and Tonga, is known in Tonga only from Kao and Tofua, where it has been collected several times. It appears to be a native forest weed that is unable to compete with more recently introduced alien weedy species, and apparently has been extirpated from both sides of the Samoan archipelago (Whistler 2004B, 2010). It may also be disappearing from the rest of its native range. At the moment it appears to be doing all right on Kao and Tofua, but its existence there may become perilous if some particularly invasive weedy species find their way to these two small islands. It is recommended here for inclusion on the Tongan Red List because of its limited range and disappearance from elsewhere in Polynesia. See the details in the species profile in Appendix 4.

(8) *Capparis quiniflora*—This scrambling shrub or vine, which is native from Australia and the Celebes to Tonga, has been collected only twice in Tonga, on two islands, and not since 1979. These two specimens are the only ones known from Polynesia, and the species may also be uncommon in Fiji. It is recommended here for inclusion on the Tongan Red List because of its infrequency of collection (the author has never seen this species) and unknown status over the rest of its range. See the details in the species profile in Appendix 4.

(9) *Cenchrus caliculatus* (***hefa***)—This large, littoral grass was probably once common in Polynesia (it ranges from New Caledonia to the Society Islands), especially near seabird colonies, since its seeds are apparently dispersed by adhering to seabird feathers. However, it seems to be unable to compete with newly introduced weeds. It may also be harmed by the disappearance of seabird colonies due to the advent of Polynesians and then Europeans, who have killed the birds for food and moved into their former nesting areas. The grass has apparently been extirpated from both sides of the Samoan Archipelago (Whistler 2004B, 2010), and is becoming rare over most of the rest of its Polynesian range. It is recommended here for inclusion on the Tongan Red List because of its widespread disappearance in Polynesia and its being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(10) *Corchorus torresianus*—This littoral shrub, which ranges from New Caledonia and the Marianas to the Tuamotus, has been collected on two Tongan islands, for a total of three times, but none of them have been since 1962. It is also rare throughout the rest of its Polynesian range. It is recommended here for inclusion on the Tongan Red List because of its limited range and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(11) *Crateva religiosa* (***pualiki***)—This tree, which ranges from northern India to the Society Islands, is apparently now restricted in Tonga to the small volcanic island of Tafahi, where it occurs in native forest. (There is a 1953 record of its collection on Tongatapu, probably as a planted tree.) It is rare or has been extirpated from other islands in its Polynesian range, including both American and independent Samoa (Whistler 2004B, 2010), but is cultivated as a minor food plant in Micronesia, where it much more common. It is particularly endangered in Tonga, since the only island on which it occurs is small and most of the native forest there has been cut down for the cultivation of kava. It is recommended here for inclusion on the Tongan Red List because of its limited range and threats to its only known habitat in Tonga (Tafahi rainforest). See the details in the species profile in Appendix 4.

(12) *Lagenophora pumila*—This small herb was collected only once in Tonga, on Kao in ca. 1977. It is native to New Zealand and some of its offshore islands, as well as the

Kermadecs. It may be a vagrant species that has only recently arrived on Kao, and has not had time to spread. However, its probable preferred habitat, recent volcanic soil, is limited in Tonga, and most of the islands where this might occur are distant from Kao, so thus it may always limited by limited available habitat. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga (one island) and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(13) *Lepironia articulata*—This leafless sedge, which ranges from Madagascar to Tonga, is so far known from only one marsh on Vava‘u (Ngofe). It is also very restricted in Fiji, where it is known only from wetlands at 600 to 900 m elevation on Taveuni (Smith 1979). It is found nowhere else in Polynesia, and in Tonga is vulnerable because of its very limited distribution, and also because marshes are very few in Tonga, where they are a threatened habitat. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga and Fiji, and being restricted to a limited and threatened habitat. See the details in the species profile in Appendix 4.

(14) *Limnophila fragrans*—This small fragrant herb is known from a marsh (or two marshes) on ‘Eua and one on Vava‘u (Ngofe). It has probably been adversely affected in Tonga by aggressive, recently introduced weeds, and is particularly threatened because it occurs in a threatened habitat (wetlands). It was also recommended for red-listing in independent and American Samoa (Whistler 2004B, 2010), and is probably uncommon, rare, or extirpated from virtually all of its Polynesian range. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga and being restricted to a limited and threatened habitat. See the details in the species profile in Appendix 4.

(15) *Lycium sandwicense*—This prostrate shrub is endemic to Polynesia, and perhaps is common nowhere within this range. The location of nearest population outside Tonga is the Austral Islands, which is a long distance away. It is of concern in Tonga because it is occurs in only few locations on the southwest coast of Tongatapu and one on ‘Eua, and only in a very restricted habitat (littoral strand). It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(16) *Myoporum sandwicense*—This shrub, which is also found in Hawai‘i (where it is common) and the Cook Islands, is known in Tonga from a single recent (2002) collection from the exposed cliffs of ‘Eua. This is its only known location in western Polynesia. It is possible that because of its distance of the Tongan population to the nearest one outside Tonga, the Cook Islands, it may be different at least to the subspecies level, but it has not been studied by an expert. It is also of concern because its only known habit, exposed cliffs, is so restricted in Tonga (only on the eastern side of ‘Eua). It is recommended here for inclusion on the Tongan Red List because of its rarity in Tonga, its limited range in Polynesia, and its being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(17) *Nicotiana fragrans*—This small littoral herb is found only in Tonga, Niue, and the Isle of Pines (New Caledonia). It known from only a few locations in Tonga, on the southwest coast of Tongatapu. It is of concern because of its limited distribution, limited habitat available (littoral limestone cliff coast), and its limited distribution globally. It is recommended here for inclusion on the Tongan Red List because of its limited range globally, and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(18) *Operculina turpethum*—This vine, which ranges from east Africa to the Society Islands, was probably a common native prior to the arrival of the first inhabitants Tonga, but it appears not to have fared well in competition with more recently introduced weeds during the European era. It has, in fact, been collected only once since 1962. This situation is complicated because another species of the same genus, *Operculina ventricosa*, appears to have naturally arrived in Tonga sometime before 1890, and there are 17 collections of this from Tonga since 1962. It also appears that the two species can hybridize, further confusing the situation. It is recommended here for inclusion on the Tongan Red List because of its apparent recent decrease in population numbers. See the details in the species profile in Appendix 4.

(19) *Osteomeles anthyllidifolia*—This prostrate shrub is a Polynesian endemic, and outside of Tonga occurs in Hawai‘i, Rarotonga, Rapa, and Pitcairn Island. It is known in Tonga only from exposed cliffs of ‘Eua. It may be a different species that the other Polynesian populations, at least the one in Hawai‘i, since the Tongan plants have much smaller leaves and other differences. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, and being restricted to a limited habitat. See the details in the species profile in Appendix 4.

(20) *Plectranthus forsteri*—This herb, which ranges from New Caledonia to Tonga, has only been collected twice in Tonga, both times on limestone cliffs on the east side of Tonga. Elsewhere it a probably more common in Fiji (where the author has seen it). It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, and being restricted to a limited habitat (limestone cliffs). See the details in the species profile in Appendix 4.

(21) *Pritchardia thurstonii* (***piu***)—This palm was thought to be endemic to the Lau Islands of Fiji, but a reexamination of specimens from the cliffs on the east side of ‘Eua has resulted in the reassignment of this population to *P. thurstonii* instead of *P. pacifica*. With this reassignment, the native habitat of the latter species is again unknown, since today it is known only from cultivation in Fiji, Samoa, Tonga, and other islands in the region. *Pritchardia thurstonii* is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, its restriction to a limited habitat (limestone cliffs), and its small native range (a few of the Lau islands). It is also threatened by rats, which feed on the seeds and have been known elsewhere to cause the disappearance and even extinction of palm species.

(22) *Psychotria leiophylla*—This small tree is native to Fiji and Tonga, and in Tonga is known only from the limestone forests of ‘Eua. Smith (1993) classified the Tongan population as this species, which he said also occurs in Samoa. However, the Samoan and Tongan populations belong to separate species, because the Samoan individuals have red fruits and the ‘Eua individuals have distinctively purple ones. Consequently, the Tongan population may belong to an endemic species (if the Samoan and Fijian ones are the same). It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, its infrequency of collection, and the possibility that it is an endemic species. See the details in the species profile in Appendix 4.

(23) *Serianthes melanesica* (***mohemohe***)—This large tree is found in Vanuatu, Fiji, and Tonga, and some authors recognize the Tongan population as belonging to an endemic subspecies, *yunckeri*. In Tonga it is found only on Vava‘u, with the exception of a single record from

Late Island. Most of the recent collections come from a single population on Pangai. The tree's good quality timber has probably caused it to be harvested to near extirpation. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, its infrequency of collection sites, and potential to be over-harvested to extirpation. See the details in the species profile in Appendix 4.

(24) *Sesbania coccinea* (***ofai***)—This shrub or small tree is found on the Isle of Pines, the Loyalty Islands, the Lau Islands of Fiji, and Tonga. It is rare in Tonga, where it is known from only three small limestone islands south of the main island of Vava'u—Maninita, Mounu, and Taunga). Its pretty red flowers give it potential to make it a desirable ornamental. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga and its limited area of distribution elsewhere. See the details in the species profile in Appendix 4.

(25) *Scaevola gracilis*—This prostrate shrub is found only on the Kermadecs and Tonga, and in Tonga is known only from Kao and Tofua. It occurs in open areas on volcanic soil, a type of habitat that is limited in extent in Tonga. It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga, and because outside of these two islands it is known in only one small island group. See the details in the species profile in Appendix 4.

4.3. Tongan Indigenous Orchids

Five species of indigenous orchids are recommended here for inclusion on the Tonga's Red List of plants. All of them are terrestrial species, and only two of them are known from elsewhere in Polynesia, the others being species found in Fiji and westward. The five species are as follows.

(26) *Crepidium taurinum*—This small ground orchid, which ranges from New Caledonia to Samoa, is known in Tonga from only a single collection from the forest of Tafahi. It is also listed as rare in independent Samoa (Whistler 2010). It is recommended here for inclusion on the Tongan Red List because of its limited range in Tonga (one island) on which the native forest is extremely threatened, its infrequency of collection (once), its being a terrestrial orchid, and its being listed as rare in independent Samoa. See the details in the species profile in Appendix 4.

(27) *Eulophia pulchra*—The large ground orchid ranges from tropical Africa to Tonga. It is known in Tonga from only two islands (Kao and Niuafo'ou), with only a single collection from both of them. It is recommended here for inclusion on the Tongan Red List because of its infrequency of collection, its being a terrestrial orchid, its not being found anywhere else in Polynesia, and the possibility of its being collected by commercial collectors because of its attractive flowers. See the details in the species profile in Appendix 4.

(28) *Eulophia spectabilis*—This large ground orchid ranges from Sri Lanka and Palau to Tonga. It is known from Tonga from only three islands, each is a single collection. It is recommended here for inclusion on the Tongan Red List for the same reasons as the species above—because of its infrequency of collection, its being a terrestrial orchid, its not being found anywhere else in Polynesia, and the possibility of its being collected by commercial

collectors because of its attractive flowers. See the details in the species profile in Appendix 4.

(29) *Peristylus novoebudarum*—This small terrestrial orchid is found in New Caledonia, Vanuatu, and Tonga. It is known from Tonga from only three islands (‘Eua, Kao, and Tofua), each with a single collection. It is recommended here for inclusion on the Tongan Red List because of its infrequency of collection, its being a terrestrial orchid, and its not being found anywhere else in Polynesia. See the details in the species profile in Appendix 4.

(30) *Phaius robertsii*—This large ground orchid ranges from New Caledonia to Tonga. It is known in Tonga only from a single island, Tofua. It is recommended here for inclusion on the Tongan Red List for the same reasons as the species above—because of its infrequency of collection, its being a terrestrial orchid, its not being found anywhere else in Polynesia, and the possibility of its being collected by commercial collectors because of its attractive flowers. See the details in the species profile in Appendix 4.

4.4. Tongan Non-Native Traditional Plants

As noted earlier, in addition to the native species that can be added to the Red List of Tongan plants, there are a number of traditional plants that either been inadvertently introduced by the early Tongans, or were intentionally introduced by them. The first are known as Polynesian weeds. Nine species were noted as being rare in Tonga (see Table 2), and of these three have been selected here for special emphasis, since they are becoming rare or are already extirpated from Tonga. Normally alien plants like this would not be further considered, but these species may be threatened elsewhere in its range, and their rarity in Tonga should be noted, even though they may not qualify for red-listing. The three weedy species are shown in Table 9 and are as follows.

(1) *Dichrocephala integrifolia*—This small herbaceous species, which is probably native to somewhere in Asia or Africa, was reportedly collected only once in Tonga in ca. 1773, by “Cook,” which may be some unidentified member of his crew other than the official botanists. The species, if it was actually collected in Tonga, has almost certainly been extirpated from the archipelago, the same as in Samoa if it was actually collected there too. The plant certainly must have been found in one or both of these archipelagoes, since it has to have been present there to have been carried to eastern Polynesia in ancient times. The plant is apparently still found in the Cook and Society Islands, where it is used medicinally, but it might be disappearing from there as well because of competition from more recently introduced, more aggressive weeds.

(2) *Senna sophera* (***matui***)—This small woody subshrub, which is probably native to Asia or Indo-Malaysia, has been collected nine times in Tonga on four islands, but only four of these collections are in modern times (i.e., since 1962), and it thought to have disappeared from some of its Tongan range. The plant may have been used medicinally for ringworm, since its leaves contains prussic acid that is an effective treatment for the fungus. The plant has apparently been extirpated from both American and independent Samoa (Whistler 2004B, 2010), probably in competition with more recently introduced, more aggressive weeds in modern times.

(3) *Sida samoensis*—This small prostrate woody herb, which is native to Fiji and/or western Polynesia, has been collected on four islands a total of seven times, but only two of these collections are modern. This plant is somewhat enigmatic, since nearly all of its collections are from disturbed places, making its native habitat difficult to determine. It is rare in both American and independent Samoa (Whistler 2004B, 2010). This fact, combined with a small native range and probable inability to compete with more recently introduced weeds, make this plant particularly vulnerable to extirpation and even extinction.

Table 9. Non-Native Tongan Plant Species Recommended for Further Consideration.

Species	Islands[1]	T	E	H	K	T	V	N	T	N	Last Coll.[2]	Mod. Coll.[3]
Polynesian Adventives												
Dichrocephala integrifolia		1?	--	--	--	--	--	--	--	--	1840	0/1
Senna sophera		3	3	--	--	--	--	1	2	--	1987	4/9
Sida samoensis		2	2	--	--	--	2	--	--	--	1987?	2/7
Polynesian Cultigens												
Amorphophallus paeoniifolius		2	2	--	--	1	1	1	1	--	1977?	4/9
Benincasa hispida		1	1	--	--	--	2	--	--	--	1990	2/4
Cucumis melo		1	--	--	--	--	--	--	--	--	1840	0/1
Manilkara dissecta		3	--	1	--	--	3	2	--	--	1987	6/9
Solanum ferox		--	1?	--	--	--	--	--	--	--	1926	0/1

[1]T =Tongatapu; E = ʻEua; H = Haʻapai; K = Kao; T = Tofua; V = Vavaʻu; N = Niuatoputapu; T = Tafahi; and N = Niuafoʻou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), and consequently the totals for the island by island row do not always add up.

[2]Date of last collection.

[3]Number of modern collections/all collections.

(4) *Amorphophallus paeoniifolius* (***teve***)—This monocot herb, which is native somewhere between Madagascar and Indo-Malaysia, was an intentional Polynesian introduction to the Pacific as far east as the Marquesas. It was originally brought in as a famine food, and probably was casually cultivated or at least encouraged, but with the coming of a modern economy to Tonga, the plant has fallen into disuse and is apparently disappearing. It it known from nine collections on six islands in Tonga, but only four of these collections are modern. It is likely disappearing throughout Polynesia for the same reason.

(5) *Benincasa hispida* (***fangu***)—This vine, which is probably native to Southeast Asia or Malaysia, was an ancient intentional introduction eastward across Polynesia to the Society Islands. In former time, its small gourd fruits were used as containers for scented coconut oil. However, with the advent of the Europeans into Tonga, its probably quickly lost utility as introduced throw-away bottles would serve the same purpose. The vine has been collected only three times, on three different islands. This plant is probably disappearing from all its Polynesian range, and has not been collected in Fiji for over a century.

(6) *Cucumis melo* (***ʻatiu***)—This vine, which is native to somewhere between tropical East Africa and India, was an ancient intentional introduction eastward across Polynesia to the Marquesas. It was probably cultivated and naturalized in the area, and was used as a minor food source and for making fragrant leis. However, after the advent of Europeans into Tonga, it was probably not able to compete with the aggressive weeds that came along with them. Also, many new food crops were introduced, making this small fruit superfluous and no longer worthy of cultivation. The plant has been collected only once in Tonga, and that was in 1840. It is has probably been extirpated from Tonga, as well as in independent Samoa. It is included on the rare plants list of both American and independent Samoa (Whistler 2004B, 2010).

(7) *Manilkara dissecta* (***pani***)—This tree, which ranges from New Caledonia to Samoa, has been collected only nine times in Tonga, six of them since 1962. It appears to be native to Samoa, but was probably an ancient introduction to Tonga, where it is known only from cultivation as a dye plant. It is probably slowly disappearing from the archipelago as aging trees are not replaced. It is included on the list of rare plants of both American and independent Samoa (Whistler 2004B, 2010).

(8) *Solanum ferox* (***touloku***)—This subshrub, which is native to somewhere in Melanesia, was an ancient Polynesian introduction to Tonga and eastward to the Marquesas, apparently being derived from a wild Melanesian species by selection of spineless individuals. It was formerly cultivated for is tomato-like fruits, but probably was ignored when more prolific fruits like tomatoes were introduced in the European era. The plant has apparently been collected once in Tonga, in 1926 on ʻEua, but the name ***touloku*** was recorded in the first Tongan dictionary (Rabone 1845). The species has probably been extirpated from Samoa and perhaps parts of eastern Polynesia, but is still found in Fiji, Niue, and perhaps the Cook Islands.

5. RECOMMENDATIONS

The author would like to make several recommendations for future research involving the plants of Tonga.

1. Outer island botanical surveys.

Relatively few plant collections have been made on the outer islands of Tonga. This includes the uninhabited volcanic islands of Late and Fonualei, as well as the many uninhabited limestone islands of Vavaʻu. Also included here is the island of Ata, which lies south of Tongatapu; the author knows of only one specimen listed as collected from that small uninhabited island. Most of the other islands have been fairly well collected by Yuncker, Buelow, Hotta, and Whistler.

2. Completion of a flora of Tonga.

A complete flora of Tonga has nor been. Yuncker (1959) published a book with that title (Flora of Tonga), but it has several shortcomings. First, it was published over 50 years ago and is now woefully out of date. Most of the largest collections (Sykes, Buelow, Hotta, and Whistler)

have been made after its publication and thus many native and even more, recently introduced adventive species are not included. Second, Yuncker's flora lacks all but elementary descriptions of the species. And third, it has no taxonomic keys that can be used to identify the species. Smith has published a number of articles on the flora of the Fiji-Samoa-Tonga area, but these articles, which include descriptions and keys, are relatively inaccessible. A new flora would include information from these more recent articles, as well as a list of all specimens collected in Tonga (the author has tried to keep such a list). While the flora should be published, it is nowadays more desirable to develop an electronic flora that is more easily accessible and updatable than a printed copy. Such an online flora has been done or places like Hawai'i and the Marquesas, and is being planned for Samoa.

3. Red-Listing of Tongan Plant Species.

The work in this report is only preliminary. The present report provides the frequency data of 97 species that are "rare" in Tonga, and 31 of these have been recommended for inclusion in the IUCN Red List of Tongan plants. To do this, a panel of experts should collaborate and determine which of the species should be listed. Some of the species would not qualify, since they are only rare in Tonga, but common elsewhere. (Particularly the several rare littoral species that are sometimes put in the "vagrant" category because they exist only in few and small populations, since their favored habitat is not found in Tonga.) Currently only four species are on the IUCN's Red List of Tongan plants, and three of the four, selected for unknown reasons, should be removed because they are not appear to be rare in Tonga, based upon the present work. The recommendations for Red List plants are only the first step, since some countries have a plethora of data to go along with each species. The only information specific to the rare plants of Tonga is found in the present report, and this is only preliminary research. With more research, additional species may be determined to be rare, and the Red List may be augmented with these.

4. Geo-reference rare plant specimens.

Geo-referencing of collection records was incorporated into the study of the rare plants of American Samoa (Whistler 2005; www.efloras.org). The species records that are treated this way show up on maps of the individual islands and for the whole archipelago. This is very helpful in visually showing where all the records of a rare species occur, and which areas have the most rare species. (However, due to technical difficulties, the geo-referencing of the American Samoa was not working correctly at the time of the present report, February 2011.)

5. Establishment of a secure national herbarium for Tonga.

The only herbarium in Tonga is found at the Ministry of Agriculture and Forestry's research station at Vainī on Tongatapu. Most of the approximately 2000 specimens were collected by Yuncker (in 1953), Hurlimann (in 1951), Soakai (in 1958 and 1959), and Buelow (in 1977–1983), and are very valuable. The purpose of a national herbarium is as a reference collection for viewing by local and visiting botanists. However, at the time of the visit of the authors (November 2010), the research station was virtually abandoned with only a few caretakers left behind and the power turned off. Because the existing herbarium specimens are not currently in

sealed cabinets in air-conditioned rooms that prevent damaging insects and fungi out, these are now in danger of being destroyed. In what little time they had at the research station, the authors inventoried, reorganized, and re-shelved the collections in their original (but substandard) cabinets. Moth balls were added to the cabinets, but this is only a temporary fix. The specimens are in dire need of immediate attention.

One of the authors (Thomas) met with the librarian at the University of the South Pacific (USP) in Tonga, who indicated her willingness to take over the management of herbarium collections, at least temporarily, and to have them housed in the USP library. This is perhaps the ideal immediate solution for these specimens, since the University has outside funding (it is a regional university based in Fiji) and the library has air conditioning. The absence of air-conditioning (i.e., humidity) and closed cabinets permits damage by molds, fungi, and insects (cigarette, drugstore beetles, and book lice) to the specimens, which can eventually destroy them.

What is needed is a secure air-conditioned room (such as the USP library), new air-tight cabinets in which to store the specimens, and one or more people who have been trained to maintain the collection. Once these conditions are met, the current collections will be protected, and new specimens collected during future botanical surveys can be deposited locally. Also, they will be available for local viewing.

6. Establishment of a botanical garden to conserve rare plants.

A botanical garden should be set up in Tonga to grow rare native plants and cultigens. There is currently a botanical garden at Vava‘u, but the authors have not visited this privately owned garden. Its being privately rather than publicly owned makes it problematical for the public to visit (an admission fee is charged). A new botanical garden would need land, staffing, and a management plant. A garden like this would serve the dual purpose of saving rare plants (both native and cultural) and educating visitors about the native flora and traditional plant uses. It is also advisable to set up an exchange of plants with regional or global botanical gardens under the Botanical Gardens Conservation International (BGCI) program to make sure that the native species and cultigens do not disappear. Botanical gardens like the National Tropical Botanical Garden and the Lyon Arboretum in Hawai‘i have established programs.

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7. APPENDIX 1. CHECKLIST OF RARE PLANTS OF TONGA

Species FAMILY	Status[1]	Distribution[2]									Modern Collections[3]
		T	E	H	K	T	V	N	T	N	
DICOTYLEDONAE											
AMARANTHACEAE											
Deeringia amaranthoides (Lam.) Merrill	I	--	4	--	--	--	--	--	--	--	4/4
ANNONACEAE											
Polyalthia amicorum A.C. Sm.	E/C	7	1	--	--	--	--	--	--	--	5/8
APOCYNACEAE											
Carruthersia latifolia Gillespie	I	--	4	--	--	--	--	--	--	--	4/4
Ochrosia vitiensis (Markgraf) Pichon	I	--	--	--	--	--	4	--	--	--	3/5
ARALIACEAE											
Polyscias samoensis (A. Gray) Harms	I	--	--	--	--	--	--	--	--	2	2/2
ASCLEPIADACEAE											
Tylophora samoensis A. Gray	I	--	5	--	--	--	--	--	--	--	3/5
ASTERACEAE											
Adenostemma lavenia (L.) Kuntze	W?	1	--	2	--	1	--	--	--	--	2/4
Blumea milnei Seem.	I	--	--	--	5	3	--	--	--	--	8/8
Centipeda minima (L.) A. Braun & Aschers.	I?	1	2	--	--	--	--	--	--	--	2/3
Dichrocephala integrifolia (L. f.) Kuntze	W	1?	--	--	--	--	--	--	--	--	0/1
Lagenophora pumila (Forst. f.) Cheeseman	I	--	--	--	1	--	--	--	--	--	1/1
BRASSICACEAE											
Rorippa sarmentosa (DC.) Macbride	W?	7	6	2	1	--	2	--	--	1	5/16
CAPPARACEAE											
Capparis cordifolia Lam.	I	2	2	--	--	--	--	--	--	--	2/4
Capparis quiniflora DC.	I	--	1	--	--	--	1	--	--	--	2/2
Crateva religiosa Forst. f.	I	1	--	--	--	--	--	--	6	--	4/7
CELASTRACEAE											
Salacia pachycarpa A. C. Sm.	I	--	6	--	--	--	--	--	--	--	6/6
CHRYSOBALANACEAE											
Atuna racemosa Raf.	C	4	2	--	--	--	4	1	1	--	2/12
Parinari insularum A. Gray	C	1	--	--	--	--	6	--	--	1	5/8
CLUSIACEAE											
Garcinia pseudoguttifera Seem.	C	4	3	--	--	--	1	--	--	--	5/8
Mammea odorata (Merr.) Kostermans	I	--	1	--	--	--	--	--	--	--	1/1
CONVOLVULACEAE											
Operculina turpethum (L.) A. Silva Manso	I	4	--	--	--	--	1	1	--	--	1/7
CUCURBITACEAE											
Benincasa hispida (Thunb.) Cogn.	C	1	1	--	--	--	2	--	--	--	2/4
Cucumis melo L.	C	1	--	--	--	--	--	--	--	--	0/1
Luffa cylindrica (L.) Roehmer	I	2	--	1	--	--	2	1	--	1	2/7

Species FAMILY	Status[1]	Distribution[2]									Modern Collections[3]
		T	E	H	K	T	V	N	T	N	
EUPHORBIACEAE											
Acalypha grandis Benth.	I?	1	--	--	--	--	--	--	--	4	4/6
Acalypha repanda Muell. Arg.	I	6	--	--	--	--	--	--	--	--	4/6
Croton microtiglium Burk.	I	--	2	--	--	--	3	--	--	--	3/5
Phyllanthus amicorum Webster	E	--	16	--	--	--	--	--	--	--	10/16
FABACEAE											
Caesalpinia bonduc (L.) Roxb.	I	2	--	1	--	--	--	2	--	--	2/5
Dalbergia candenatensis (Dennstaedt) Prain	I	1	--	1	--	--	3	--	--	--	2/5
Mucuna glabra (Rein.) Dear-Wilmot	I	--	2	--	--	--	--	--	--	2	2/4
Senna sophera (L.) Roxb.	W	3	3	--	--	--	--	1	2	--	4/9
Serianthes melanesica Fosb.	I	1	--	--	--	--	7	--	--	--	6/10
Sesbania coccinea (L. f.) Poir.	I	--	--	--	--	--	6	--	--	--	5/6
Uraria lagopodioides (L.) Desv.	W	3	3	2	--	--	1	2	1	--	2/12
FLACOURTIACEAE											
Casearia buelowii Whistler	E	--	--	--	--	--	3	--	--	--	2/3
GOODENIACEAE											
Scaevola gracilis Hook. f.	I	--	--	--	3	5	--	--	--	--	5/8
GYROCARPACEAE											
Gyrocarpus americanus Jacq.	I?	1	1	3	--	--	1	1	--	1	4/8
LAMIACEAE											
Plectranthus forsteri Benth.	I	--	2	--	--	--	--	--	--	--	1/2
MALVACEAE											
Sida samoensis Rech.	W?	2	2	--	--	--	2	--	--	--	2/7
MELIACEAE											
Aglaia heterotricha A.C. Sm.	E	--	4	--	--	--	--	--	--	--	2/4
Dysoxylum tongense A.C. Sm.	E	--	14	--	--	--	--	--	--	--	4/14
MYOPORACEAE											
Myoporum sandwicense A. Gray	I	--	1	--	--	--	--	--	--	--	1/1
MYRSINACEAE											
Discocalyx listeri (Stapf) Mez and Stapf	E	--	16	--	--	--	--	--	--	--	9/16
MYRTACEAE											
Metrosideros collina A. Gray	C	1	--	--	--	--	1	--	--	--	0/2
Syzygium neurocalyx (A. Gray) Christoph.	C	1	1	--	--	--	1	1	--	--	2/4
Syzygium quadrangulatum (A. Gray)	I	--	3	--	--	--	--	--	--	--	2/3
Merr. & Perry											
NYCTAGINACEAE											
Pisonia umbellifera (Forst. f.) Seem.	I	--	3	--	--	--	--	--	--	--	3/3
PASSIFLORACEAE											
Passiflora aurantia Forst. f.	I	--	--	--	2	3	--	--	--	--	3/6

Species FAMILY	Status[1]	Distribution[2]									Modern Collections[3]
		T	E	H	K	T	V	N	T	N	
PIPERACEAE											
Peperomia pallida (Forst. f.) Dietr.	I	--	--	--	--	--	1	1	3	--	4/5
Piper macropiper Pennant	I	--	--	--	--	--	--	--	4	--	4/4
PITTOSPORACEAE											
Pittosporum brackenridgei A. Gray	I	--	--	--	--	--	2	--	--	--	1/2
Pittosporum yunckeri A.C. Sm.	E	1	11	--	--	--	--	--	--	--	5/12
PLUMBAGINACEAE											
Plumbago zeylanica L.	I	--	--	--	--	--	1?	--	1	--	1/2?
PORTULACACEAE											
Portulaca lutea Sol. ex. Forst. f.	I	1	--	--	--	--	--	--	1	--	1/2
RHAMNACEAE											
Ventilago vitiensis A. Gray	I	--	2	--	--	--	1	--	--	--	3/3
ROSACEAE											
Osteomeles anthyllidifolia (J.E. Smith) Lindley	I	--	8	--	--	--	--	--	--	--	3/8
RUBIACEAE											
Antirhea inconspicua (Seem.) Christoph.	I	--	3	--	--	--	--	--	--	--	3/3
Atractocarpus crosbyi (Burk.) Puttock	E	--	--	--	--	--	11	--	--	--	7/11
Psychotria leiophylla Merr. & Perry	I	--	5	--	--	--	--	--	--	--	5/5
SAPINDACEAE											
Arytera bifoliata Whistler	E	--	6	--	--	--	--	--	--	--	6/6
Sapindus saponaria L.	I	1	3	--	--	--	--	--	--	--	3/4
SAPOTACEAE											
Manilkara dissecta (L.f.) Dubard	C?	3	--	1	--	--	3	2	--	--	6/9
SCROPHULIARIACEAE											
Limnophila fragrans (Forst.) Seem.	I	--	3	--	--	--	1	--	--	--	3/4
SOLANACEAE											
Lycium sandwicense A. Gray	I	6	1	--	--	--	--	--	--	--	4/7
Nicotiana fragrans Hooker	I	5	--	--	--	--	--	--	--	--	2/5
Solanum ferox L.	C	--	1	--	--	--	--	--	--	--	0/1
STERCULIACEAE											
Heritiera ornithocephala Kostermans	I	--	--	--	1	4	--	--	--	--	2/5
Sterculia fanaiho Setchell	I	--	--	1	--	--	--	--	--	4	3/5
TILIACEAE											
Corchorus torresianus Gaud.	I	3	--	2	--	--	--	--	--	--	0/5
URTICACEAE											
Laportea interrupta (L.) Chew	W	4	--	1	--	2	1	--	1	--	2/10
MONOCOTYLEDONAE											
ARACEAE											
Amorphophallus paeoniifolius (Dennst.) Nicolson	C	2	2	--	--	1	1	1	1	--	4/9

Species FAMILY	Status[1]	Distribution[2]									Modern Collections[3]
		T	E	H	K	T	V	N	T	N	
ARECACEAE											
Pritchardia thurstonii F. Muell. & Drude	I	--	3	--	--	--	--	--	--	--	1/3
COMMELINACEAE											
Aneilema vitiense Seem.	I	--	--	--	--	--	--	--	3	1	3/4
CYPERACEAE											
Eleocharis geniculata (L.) Roemer & Schultes	I	--	--	--	2		--	--	--	--	1/2
Kyllinga nemoralis (Forst.) Dandy ex Hutch. & Dalz.	W	7	4	--	1	--	3	--	1	--	1/17
Lepironia articulata (Retz.) Domin	I	--	--	--	--	--	4	--	--	--	1/4
ORCHIDACEAE											
Acanthephippium splendidum J.J. Smith	I	--	--	--	1	2	--	--	2	--	4/5
Bulbophyllum longiscapum Rolfe	I	--	--	--	--	--	--	--	4	--	3/4
Crepidium latisegmentum (C. Schweinf.) M.A. Clem. & D.L. Jones	I	--	3	--	2	1	--	--	--	--	5/6
Crepidium taurinum (Rchb. f.) Szlach.	I	--	--	--	--	--	--	--	1	--	1/1
Dendrobium dactylodes Rchb. f.	I	--	--	--	--	--	--	--	4	--	3/4
Erythrodes oxyglossa Schltr.	I	--	--	--	3	2	--	--	--	--	5/5
Erythrodes purpurascens Schltr.	I	--	--	--	2	3	--	--	--	--	5/5
Eulophia pulchra (Thou.) Lindl.	I	--	--	--	1	--	--	--	--	1	3/3
Eulophia spectabilis (Dennst.) C. R. Suesh	I	--	1?	--	1	1	--	--	--	--	2/3?
Hetaeria whitmeei Rchb. f.	I	--	6	--	--	--	--	--	--	--	1/6
Liparis laydardii F. Muell.	I	--	--	--	2	2	--	--	--	--	4/4
Peristylus novoebudarum F.v. Muell.	I	--	1	--	1	--	--	--	--	1	3/3
Phaius amboinensis Bl.	I	--	--	--	1	--	--	--	2	--	3/3
Phaius robertsii Muell.	I	--	--	--	--	2	--	--	--	--	2/2
Phreatia matthewsii Rchb. f.	I	--	--	--	--	--	--	--	3	--	-- 3/3
Vrydagzynea vitiensis Rchb. f.	I	--	--	--	--	--	--	--	3	--	2/3
Zeuxine stenophylla (Rchb. f.) Benth. & Hook. f. ex Drake	I	--	--	--	3	--	--	--	1	--	4/4
POACEAE											
Cenchrus caliculatus Cav.	I	3	7	2	--	--	2	--	--	--	4/13
Heteropogon contortus (L.) Beauv. ex Roemer & Schultes	I?	--	1	1	--	--	4	--	--	--	2/6
Schizostachyum glaucifolium (Rupr.) Munro	C	--	1	--	--	--	--	--	1	--	1/2

[1] E = Endemic; I = Indigenous; C = Polynesian cultigen; W = Polynesian weed.

[2] T =Tongatapu; E = ‘Eua; H = Ha‘apai; K = Kao; T = Tofua; V = Vava‘u; N = Niuatoputapu; T = Tafahi; and N = Niuafo‘ou. Some specimens listed in the total lack locality data or are found on smaller islands (e.g., Late), so the totals do not always add up.

[3]Modern collections/all collections.

8. APPENDIX 2. IUCN RED LIST CATEGORIES

Extinct (EX)

A taxon is *Extinct* when there is no reasonable doubt that the last individual has died. A taxon is presumed *Extinct* when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Extinct in the Wild (EW)

A taxon is *Extinct in the Wild* when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed *Extinct in the Wild* when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR)

A taxon is *Critically Endangered* when the best available evidence indicates that it meets any of the criteria A to E below, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible, understood, and have ceased, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased, may not be understood, or may not be reversible, based on (and specifying) any of 1a–1e above.
3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of 1b to 1e above.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past

and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of 1a–1e above.

B. Geographic range in the form of either B1 (extent of occurrence) or B2 (area of occupancy) or both.

1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a–c:
   (a) Severely fragmented or known to exist at only a single location.
   (b) Continuing decline, observed, inferred or projected, in any of the following:
      (i) Extent of occurrence
      (ii) Area of occupancy
      (iii) Area, extent and/or quality of habitat
      (iv) Number of locations or subpopulations
      (v) Number of mature individuals
   (c) Extreme fluctuations in any of the following:
      (i) Extent of occurrence
      (ii) Area of occupancy
      (iii) Number of locations or subpopulations
      (iv) Number of mature individuals.
2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a–c:
   (a) Severely fragmented or known to exist at only a single location.
   (b) Continuing decline, observed, inferred or projected, in any of the following:
      (i) Extent of occurrence
      (ii) Area of occupancy
      (iii) Area, extent and/or quality of habitat
      (iv) Number of locations or subpopulations
      (v) Number of mature individuals.
   (c) Extreme fluctuations in any of the following:
      (i) Extent of occurrence
      (ii) Area of occupancy
      (iii) Number of locations or subpopulations
      (iv) Number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
   (a) Population structure in the form of one of the following:
      (i) No subpopulation estimated to contain more than 50 mature individuals, OR
      (ii) At least 90% of mature individuals in one subpopulation.
   (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

Endangered (EN)

A taxon is *Endangered* when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible, understood, and have ceased, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased, or may not be understood, or may not be reversible, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased, may not be understood, or may not be reversible, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation

(e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence), B2 (area of occupancy), or both:

1. Extent of occurrence estimated to be less than 5,000 km^2, and estimates indicating at least two of a-c:

(a) Severely fragmented or known to exist at no more than five locations.

(b) Continuing decline, observed, inferred or projected, in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Area, extent and/or quality of habitat

(iv) Number of locations or subpopulations

(v) Number of mature individuals.

(c) Extreme fluctuations in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Number of locations or subpopulations

(iv) Number of mature individuals.

2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a–c:

(a) Severely fragmented or known to exist at no more than five locations.

(b) Continuing decline, observed, inferred or projected, in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Area, extent and/or quality of habitat

(iv) Number of locations or subpopulations

(v) Number of mature individuals.

(c) Extreme fluctuations in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Number of locations or subpopulations

(iv) Number of mature individuals.

C. Population size estimated to number fewer than 2,500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future), or:

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) No subpopulation estimated to contain more than 250 mature individuals, or:

(ii) At least 95% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

Vulnerable (VU)

A taxon is *Vulnerable* when the best available evidence indicates that it meets any of the criteria A to E for *Vulnerable*, and it is therefore considered to be facing a high risk of extinction in the wild.

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible, understood, and has ceased, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased, may not be understood, or may not be reversible, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
3. A population size reduction of ≥30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation
   (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased, may not be understood, or may not be reversible, based on (and specifying) any of the following:
   (a) Direct observation
   (b) An index of abundance appropriate to the taxon
   (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) Actual or potential levels of exploitation

(e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence), B2 (area of occupancy), or both:

1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a–c:

(a) Severely fragmented or known to exist at no more than 10 locations.

(b) Continuing decline, observed, inferred or projected, in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Area, extent and/or quality of habitat

(iv) Number of locations or subpopulations

(v) Number of mature individuals.

(c) Extreme fluctuations in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Number of locations or subpopulations

(iv) Number of mature individuals.

2. Area of occupancy estimated to be less than 2,000 km^2, and estimates indicating at least two of a–c:

(a) Severely fragmented or known to exist at no more than 10 locations.

(b) Continuing decline, observed, inferred or projected, in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Area, extent and/or quality of habitat

(iv) Number of locations or subpopulations

(v) Number of mature individuals.

(c) Extreme fluctuations in any of the following:

(i) Extent of occurrence

(ii) Area of occupancy

(iii) Number of locations or subpopulations

(iv) Number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer (up to a maximum of 100 years in the future), or:

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) No subpopulation estimated to contain more than 1,000 mature individuals, or:

(ii) All mature individuals are in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1,000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically 5 or less) such that it is prone to effects of human activities

or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming *Critically Endangered* or even *Extinct* in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Near Threatened (NT)

A taxon is *Near Threatened* when it has been evaluated against the criteria but does not qualify for *Critically Endangered*, *Endangered*, or *Vulnerable* now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)

A taxon is *Least Concern* when it has been evaluated against the criteria and does not qualify for *Critically Endangered*, *Endangered*, *Vulnerable*, or *Near Threatened*. Widespread and abundant taxa are included in this category.

Data Deficient (DD)

A taxon is *Data Deficient* when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. *Data Deficient* is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between *Data Deficient* and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Not Evaluated (NE)

A taxon is *Not Evaluated* when it is has not yet been evaluated against the criteria.

9. APPENDIX 3. DOUBTFUL RARE PLANT RECORDS

Several species listed in the literature as native or possibly to Tonga have been excluded from the checklist of the 97 rare plants in Tonga. Two of these appear to have been mistakenly attributed to Tonga because of errors in the literature. A third is an unidentified orchid that needs fertile material for it to be identified. Two other species are grasses that superficially appear to be native, but because of the relatively recent date of their first collection they are more likely alien species. The five species are as follows.

Antiaris bennettii Seem., called "upas tree" or "poison arrow tree," was noted to occur in Tonga by Hemsley (1898: 193), based upon a Home specimen. However, although Yuncker (1953) included the species in his flora, he noted "no specimens of this tree were found and no reference was made to any plant of this description by Tongans, nor have I been able to verify the accuracy of the Hemsley citation." Seemann (1865: 253) noted that Home collected the tree in 'Uvea in 1852, and Harvey collected it in Fiji in 1855. Seemann also noted Dr. George Bennett observed the tree earlier (1830) on Tikopia (a Polynesian outlier probably originally settled by Tongan colonists). Bennett (in Seemann) noted that it was planted "either for dyeing or manufacturing the bark into native cloth." In Fiji, it is been collected only three times, but not since 1875. It was apparently cultivated in villages, but disappeared early in the European era. The sap of the tree was used in Indonesia to poison arrows, but the use of bows and arrows was infrequent in Polynesia and Fiji, so its reason for introduction is more likely for making a tapa cloth, as is reported from Tikopia. Its Fijian name ***mavu ni Tonga*** implies it was introduced from Tonga, but the only reference to its occurrence there may be in error. It if did occur in Tonga, it was probably an ancient introduction from 'Uvea, Tikopia, or Fiji.

Bulbophyllum sp., an unidentified species of orchid, is reported from Tofua (Cribb and Whistler, in press). The sterile specimen at Kew (*Scarth-Johnston s.n.*) "does not fit any of the above species [five others found in Tonga, Niue, and/or the Cook Islands], nor any other that we have seen from the S.W. Pacific islands. It has small clustered pseudobulbs each bearing an oblong, shortly petiolate, erect leaf. Vegetatively it is similar to *Bulbophyllum microrhombos* from the Solomon Islands, but its leaves are more oblong and of a slightly different shape. The specimen may belong to sect. *Hapalochilus* but it bears no flowers or even old inflorescences." The disposition of this record awaits further specimens from Tofua, so for the meantime this record will but be kept in the "doubtful category" (Cribb and Whistler, in press). If and when it is identified, it probably should be added to the list of rare Tongan plants.

Cymbopogon refractus (R. Br.) A. Camus, barbwire grass, is native to Australia, and also appears at first glance to be native to Tonga. However, it was first collected in the Tonga in 1953, and three times subsequent to that. It is unlikely that all the earlier collectors would have missed this grass if it were native. Based upon this late date of collection, this species is tentatively classified as a modern adventive to Tonga.

Macaranga seemannii (Muell. Arg.) Muell. Arg. was reportedly collected from Tongatapu by "Cook" in ca. 1773 and the U.S. Exploring Expedition in 1840, but never again. Pickering (1876) noted a "Nov. gen. (*Tanarius*, bis No. 1 Taheiti to Samoa" which probably refers to a

Macaranga. Hemsley (1894) was apparently the first person to list *M. seemannii* from Tonga, based upon the "Cook" specimen, with no other discussion. The "Cook" designation possibly refers to specimens collected by Captain Cook's crewmembers other than the ships' botanists (i.e., not by the Forsters or Nelson), according to Smith (1979). Yuncker (1959) listed it in his flora based on the "Cook" specimen and one from the U.S. Exploring Expedition described as "growing around plantations," but did not note anything further. What makes this record suspicious is the absence of the common *Macaranga harveyi* from both the Cook and the USEE collections. It would be an amazing coincidence that the early botanists would collect a tree that would subsequently disappear from Tonga (it still occurs in Niue and Fiji), but not the common species (now, and presumably then). The Kew specimen of Cook could not be located by staff there. The Smithsonian was located and examined by Smithsonian staff, and although without mature flowers or fruits, it appears to be *Macaranga seemannii* (Nancy Kahn and Warren Wagner, pers. comm.). This may, however, be a mislabeled specimen that was actually collected in Fiji, since it is known that some of the USEE specimens were mislabeled. (Two Samoan plant species were given scientific names based upon their incorrect location of collection in Tahiti by the USEE, but are now determined to be Samoan endemics.). Consequently, the record of *Macaranga seemannii* once occurring in Tonga is considered here to probably be in error.

Schizachyrium fragilis (R. Br.) A. Camus is a grass that is native to Australia. It also occurs on Tofua, where it was first collected in 1982. It is strange that this species would first appear in Tonga on this isolated island, which is far from most disturbance and alien species. However, it would also be strange if its seeds were carried all the way across the Pacific from Australia by bird transport to become established there. It most likely was carried to the island by human means, but the question remains open.

10. APPENDIX 4. THE RARE TONGAN PLANT PROFILES

The basic requirements for inclusion on this list is one or more of the following; six or less collections (seven for a few that were collected during field work in Tonga in late 2010); three or fewer collections since 1959; indigenous to one island, and not common there; endemic to one island; and/or restricted to a single habitat. See the Methodology section for a full description of how species were selected for this list.

AMARANTHACEAE

1. Deeringia amaranthoides (Lam.) Merrill

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this rare forest scandent shrub other than to protect its habitat in Tonga. In Tonga, it is known only from ʻEua, and the preservation of native forest on this island, especially in the National Park, is very important.

Deeringia amaranthoides (Lau Islands, Fiji)

Deeringia amaranthoides (Lau Islands, Fiji)

Indigenous to Tonga, widely ranging from Southeast Asia to Tonga and Fiji. It is restricted in Tonga to ‘Eua, where it occurs in limestone forest, probably from near sea level to ca. 200 m elevation . No local names or uses have been reported, probably because it is rare and a liana rather than a useful timber species. This is a new record for Tonga, since all the collections have been made in the last 30 or so years.

Scandent shrub climbing into trees, with glabrous stems. **Leaves** simple, alternate; blade ovate to lanceolate, 3–11 cm long, rounded to truncate or subcordate at the base, acuminate and apiculate at the tip; surfaces glabrous; margins entire; petiole 1–3 cm long. **Inflorescence** a terminal, many-flowered panicle with long spicate branches up to 18 cm long borne perpendicular to the rachis. **Calyx** of 5 ovate, convex sepals 2–3 mm long, reflexed at anthesis, on a pedicel 0–1 mm long. **Corolla** absent. **Ovary** superior, 1-celled, with a short style bearing 3 (2) stigma lobes. **Stamens** 5, united at the base, exserted and spreading at anthesis, white. **Fruit** a subglobose red berry 5–7 mm in diameter. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its scandent shrub habit; alternate, mostly ovate leaves; terminal panicle of long, spreading racemose branches; greenish flowers with 5 spreading white stamens; and a red berry.

‘EUA:

Sykes 573—Makatea scrub forest with open canopy at Ha‘aluma on the southwest end of island.
Sykes 766—Near cliff edge in coastal screwpine forest near Vaifefe (Vaingana) at 50 m elevation.
Buelow 1829—Shady forest on limestone rock in dense vegetation next to Vaingana Stream.
Whistler 7277—Edge of a cliff at the end of the terrace at the southeast side of the island just above a small peninsula.

ANNONACEAE

2. Polyalthia amicorum A.C. Sm.

Fissistima [*Fissistigma*] sp. of Hotta
Polyalthia laddiana sensu auct. non A. C. Sm.

Tongan Name: *motelolo*
English Name: none
Reason for Listing: reduction in cultivation
Status: A rare endemic, no longer known from the wild (and original distribution unknown)
Suggestion Action: Effort should be made to propagate this tree, probably from seeds, and encourage Tongans to grow it as a cultural plant. The species is endemic and critically endangered.

Apparently endemic to Tonga, where is now occurs only in cultivation, mostly around cemeteries. It is possibly that it was formerly endemic to Tongatapu, but has disappeared from the wild along with virtually all of the native inland forest on the island. If it were also native to ‘Eua, it would probably still be found in the native forest remaining there. It is tempting to try to call this an ancient introduction from Fiji, but the closest relatives there are different from

Polyalthia amicorum. *Polyalthia laddiana* A.C. Smith occurs in limestone forest in Lau (a similar habitat as occurring on ‘Eua), but its leaves are much bigger than those of the Tongan species. *Polyalthia amygdalina* (A. Gray) Gillespie occurs on Viti Levu and Ovalau, but its fruits are rounder and wider than those of *Polyalthia amicorum*. The fragrant fruits are used to scent coconut oil, and the likewise fragrant flowers to make leis.

Tree 5 m or more in height, with glabrous stems. **Leaves** simple, alternate; blade lanceolate to elliptic, 5–15 cm long, rounded to subcordate at the base, broadly acuminate at the tip; surfaces glabrous; margins entire; petiole 1–3 mm long. **Inflorescence** of solitary, cauliflorous flowers. **Calyx** of 3 ovate sepals 1–1.2 cm long, greenish tinged with rose on the outside, rose colored within; pedicel ca. 6–8 mm long. **Corolla** 6 ovate petals in 2 whorls, slightly smaller than the sepals, rose colored. **Ovaries** ca. 8, on a stipe 4–6 mm long; usually with 1 or 2 fertile ovules. **Stamens** many, free, included. **Fruit** composed of several indehiscent carpels, globose (if 1-seeded) or oblong (if 2-seeded), 1–2.8 cm long, green at maturity. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its tree habit; alternate, mostly lanceolate leaves on a short petiole; solitary, yellowish to purplish flowers; many stamens; and each flower producing about 8 free carpels that form green fruits at maturity.

Polyalthia amicorum (Tongatapu)

TONGATAPU:

Parks 15362—Cultivated in a garden at Ha‘amonga.
Yuncker 16228—Near Pikula.
Hotta 4080—Nakolo Village.
Sykes 882—Cultivated at Mu‘a, Lapaha.
Buelow 1695—Cultivated at the edge of Veitongo cemetery on the northeast side of the village.
Buelow 1881—Cultivated at the edge of Veitongo cemetery on the northeast side of the village.
Whistler 6542—Cultivated at Veitongo cemetery.

‘EUA:

Whistler 5996—Abandoned village or plantation in at the southwest tip of the island.

APOCYNACEAE

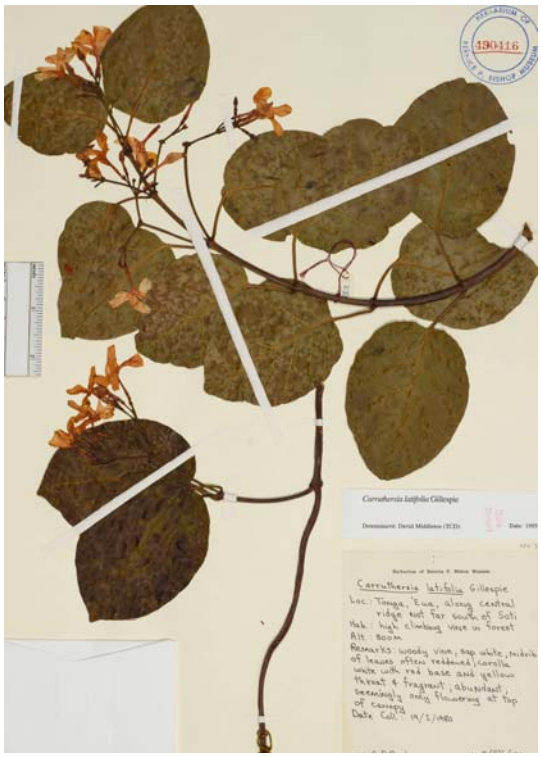
3. Carruthersia latifolia Gillespie

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island

Status: rare indigenous
Suggestion Action: Nothing much can be done specifically for this species, which in Tonga occurs only on ‘Eua, but the protection of native forests in the national park and other forest areas on ‘Eua is the most useful measure that can be taken to preserve this species in Tonga.

Indigenous to Tonga, also found in Fiji. This species is a new record for Tonga, where is has now been collected five times on ‘Eua, all since 1980. It was previously considered to be endemic to Fiji (Smith 4: 80; 1988). It is occasional in native forest, probably from near sea level to the highest elevation on the island (310 m), but in Fiji it occurs up to 900 m elevation. No local names or uses are reported, probably because of its rarity and because lianas do not have use as timber. The vine was seen once during a study of rare ‘Eua species in November of 2010.

Liana, high-climbing, with glabrous twining stems and a copious white latex. **Leaves** simple, opposite; blade ovate, 6–18 cm long, subcordate to truncate at the base, rounded to broadly acuminate at the tip; surfaces glabrous, midvein sometimes red; margins entire; petiole 1.5–4 cm long, usually bent or curved. **Inflorescence** a widely branching, axillary or terminal, many-flowered cyme up to 15 cm long. **Calyx** campanulate, 1.5–3 mm long, deeply divided into 5 ovate lobes, on a pedicel 1–7 mm long. **Corolla** sympetalous, salverform; limb deeply divided into 5 obovate lobes 1.5–2 cm long, white with red at the base, contorted in the bud; tube narrow, 1–2 cm long, white or yellowish. **Ovary** superior, comprising two carpels appressed to each other, their styles joining to form the 2-lobed stigma. **Stamens** 5, epipetalous, included. **Fruit** of 2 linear follicles up to 20 cm long, widely spreading from each other and filled with comose seeds. **Flowering** and fruiting probably occur throughout the year. (This description based on Fijian specimens.)



Carruthersia latifolia (Bishop Museum)

Distinguishable by its liana habit; milky latex; opposite leaves; many-flowered axillary cymes; white flowers with red in the center; and two spreading follicles up to 20 cm long filled with “parachute” seeds. When sterile, it is similar to *Gynochtodes epiphytica*, but differs in having milky sap and in lacking interpetiolar stipules.

‘EUA:
Buelow 1848—East side of eastern ridge cliff about 1.6 km from Soti at 200 m elevation.
Buelow 2331—Along central ridge not far south of Soti at 300 m elevation.
Buelow 2332?—Specimen not located. (Mistake for the above number?)
Whistler 7292—Ridge forest just north of the Pama forestry plantation at 200 m elevation.

4. Ochrosia vitiensis (Markgraf) Pichon

Excavatia vitiensis Markgraf
Ochrosia elliptica sensu Burkill; non Labill.

Tongan Name: ***toto hina***?
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: The distribution of this species, which in Tonga is known only from Vava‘u, should be determined, and areas where it is found should be preserved.

Indigenous to Tonga, also occurring in Fiji, including the Lau Islands. It is uncommon in Tonga, where it is restricted to littoral and coastal limestone forest on Vava‘u, reported from near sea level to 160 m elevation (up to 500 m in Fiji). This species may be known as ***toto hina***, but the tree is generally unknown, and no uses are reported for it.

Medium-sized tree up to 7 m (12 in Fiji) in height, with white latex, gray trunk, and glabrous stems. **Leaves** simple, in whorls of 3–5; blade coriaceous, oblanceolate to narrowly elliptic, 6–16 cm long, attenuate at the base, broadly acute to shortly acuminate at the tip; surfaces glabrous, upper side darker, with fine secondary veins perpendicular to the midrib; margins narrowly revolute; petiole 2–12 mm long. **Inflorescence** of 1–3 terminal cymes on a peduncle 1–6 cm long. **Calyx** narrowly cupulate, 2.5–3.5 mm long, with 5 shallow, rounded lobes, on a pedicel 1–2 mm long. **Corolla** sympetalous, salverform, contorted in the bud, white; tube 8–11 mm long; limb divided into 5 spreading, lanceolate lobes 6–9 mm long. **Ovary** superior, with an included, filamentous style bearing a short-cylindrical stigma. **Stamens** 5, epipetalous, included, with yellow anthers. **Flowering** reported from November to May, but possibly longer, fruiting reported in Fiji in most months.

Ochrosia vitiensis (Vava‘u)

Distinguishable by its medium-sized tree habit; narrow, whorled leaves; white latex; small white, trumpet-shaped flowers; and paired, flattened-ovate drupes.

VAVA‘U:
Crosby s.n.?—Without further locality.
Yuncker 16107—Upper rim of sea cliff above Ha‘alaufuli on the northeastern side of the island at ca. 120 m elevation.

Buelow 1447—Top of Mt. Talau in open forest at 120 m elevation.
Buelow & Sykes 48—Holonga at ca. 30 m elevation.
Cameron 4985—Coastal forest just west of causeway joining Pangaimotu and ‘Utungake.
Whistler 11674A—Forest on Mt. Talau.

ARALIACEAE

5. Polyscias samoensis (A. Gray) Harms

Nothopanax samoense (A. Gray) Seem.
Panax samoense A. Gray

Tongan Name: ***tanetane***, ***tanetane vao***
English Name: none
Reason for Listing: restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Its frequency on Niuafo‘ou should be determined, and an effort should be made to protect the native forests in which it occurs.

Indigenous to Tonga, also found in Samoa, where it is not uncommon. This tree is found in Tonga only on Niuafo‘ou, where it occurs in lowland forest, probably at all elevations away from the immediate coast. Another related, more common species, *Polyscias multiflora*, occurs on most of the rest of the Tongan islands. No uses are reported for this tree. The name ***tanetane*** is applied to the genus, especially introduced ornamentals used for hedges, etc.

Small tree up to 7 m in height (but usually much less), with glabrous stems marked by distinct lenticels. **Leaves** odd-pinnately compound, alternate, rachis up to ca. 100 cm long, sheathing at the base and swollen at the nodes, 11–17, opposite; leaflet blades oblong or elliptic to ovate, 9–22 cm long, truncate to subcordate at the base, acuminate at the tip; surfaces glabrous, veins prominent on lower side, aqueous; margins entire to undulate; petiolules of the lateral leaflets 5–40 mm long. **Inflorescence** an upper-axillary or terminal panicle up to 50 cm long, with the branches in whorls perpendicular to the axis and the flowers ultimately arranged in simple or compound umbels of 8–15 on a jointed peduncle up to 4 cm long. **Calyx** campanulate, 2.5–3.5 mm long, undulate to

Polyscias samoensis (Tutuila, Samoa)

shallowly 5-lobed on the rim, on a thin pedicel 6–24 mm long, with tiny bracteoles at the base. **Corolla** of 5 oblong to elliptic, green petals 3–3.5 mm long, marked with red, recurved at maturity. **Ovary** inferior, flattened, sometimes dark purple, with 2 curved, sessile stigma lobes. **Stamens** 5, free, exserted, anthers pale yellow. **Fruit** a dark purple, laterally compressed, suborbicular, 2-seeded berry 6–9 mm long, conspicuously striate when dry, with the stigma lobes persistent. **Flowering** and fruiting occur anytime during the year.

Distinguishable by its small tree habit; pinnately compound leaves; sheathing petiole bases; panicles of tiny greenish flowers borne on long thin pedicels, ultimately in umbels; and flattened, round, ribbed (when dry) fruits with a persistent 2-lobed stigma.

NIUAFO‘OU:

Buelow 2168—Near Makamaka‘uli on the west slope of the island.
Whistler 6326—Secondary forest on the west side of the crater.

ASCLEPIADACEAE

6. Tylophora samoensis A. Gray

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the national park and other areas on ‘Eua is the most useful measure that can be taken.

Tylophora samoensis (‘Upolu, Samoa)

Indigenous to Tonga, also found in Samoa and Fiji. It is restricted in Tonga to ‘Eua, where it occurs in native forest, probably from near sea level to the highest elevation on the island (310 m). In Samoa, where the species is more common, it has been reported from 75 to 1120 m elevation. No local names or uses are reported for this inconspicuous vine of native forest.

Herbaceous vine with subglabrous stems, ascending by means of twining stem tips; sap milky. **Leaves** simple, opposite; blade broadly ovate, 5–13 cm long, subcordate to cordate at the base, acuminate at the apex; surfaces glabrous, with a cluster of tiny glands at the base of the upper surface, not succulent; margins entire; petiole 1.8–5 cm long. **Inflorescence** an axillary umbel or umbelliform corymb on a slender peduncle up to 7

cm long, with 10–20 flowers per umbel, which leave a scar as the umbel elongates. **Calyx** campanulate, 1.5–2 mm long, deeply divided into five ovate lobes, on a pedicel 5–13 mm long (–17 mm in fruit). **Corolla** sympetalous, cream colored, rotate, 5–10 mm in diameter, deeply divided into 5 narrowly triangular lobes, the tube 0.5–1.5 mm long. **Ovary** superior, with a thick, 5-angled style head. **Stamens** 5, fused to the style head, with the pollen in the anthers fusing together to form pollinia. **Fruit** a linear follicle up to 25 cm long, containing comose seeds. **Flowering** and fruiting occur throughout the year.

Distinguishable by its herbaceous vine habit; white latex; opposite, non-succulent leaves with a heart-shaped base; simple or compound, many-flowered axillary umbels; cream colored, 5-lobed flowers; and a follicle up to 25 cm long containing parachute seeds.

ʻEUA:

Yuncker 15451—Open forest along trail above Fuai plantation at ca. 250 m elevation.
Yuncker 15664—Along trail in thicket above Fuai plantation at ca. 70 m elevation.
Buelow 1848b—Eastside of eastern ridge cliff about 1.6 km south of Soti at 200 m elevation.
Buelow 2508—Exposed limestone cliff on south slope of central ridge.
Whistler 7185—Forest at the southeast end of the island.

ASTERACEAE

7. Adenostemma lavenia (L.) Kuntze

Adenostemma lanceolatum sensu auct. non Miq.?
Adenostemma viscosum Forst.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of modern collection
Status: rare Polynesian adventive?
Suggestion Action: Little can be done to protect this species other than preserving the forest on Kao and Tofua, and preventing additional weedy species from reaching these islands.

Indigenous or perhaps an ancient introduction to Tonga, ranging from Sri Lanka (east Africa?) to Hawaiʻi (if this species name is used). It is most likely an ancient introduction to Hawaiʻi, at least, but could be native to western Polynesia. In Tonga it has been reported from Tongatapu, Vavaʻu, Kao, and Tofua, but probably has disappeared from the first two. It was probably a common weed in Tonga prior to the arrival of Europeans, but could not compete with the more recently introduced weeds, leading to its disappearance from Tongatapu and Vavaʻu. No habitat information was recorded on the specimens, but it probably is found on Kao and Tofua in forest clearings, at least up to 600 m elevation. Nowadays in Samoa it is found only in montane forest. Smith (1991: 294) noted that *Adenostemma lavenia* is a species apparently nearly restricted to Ceylon, and listed *Adenostemma viscosum* and *Adenostemma lanceolatum* as occurring in Polynesia—the former "into the Pacific to the Tuamotu Islands and Hawaii," the latter in "the Society Islands and Samoa." Wagner et al. (1990), however, used *Adenostemma viscosum* to include all of these Polynesian populations, noting that recognizing the three species "does not appear to result in meaningful taxa" in Hawaiʻi. More work needs to be done on this

complex. It is likely that only one species occurs in Polynesia, and that this should be called *Adenostemma lavenia*. The plant is used medicinally in the Society Islands, but is, now at least, unrecognized and unused in Tonga.

Herb, erect to ascending, up to 60 cm or more in height, with subglabrous to glandular-pubescence stems. **Leaves** simple, opposite; blade ovate to narrowly ovate, 4–14 cm long, long-attenuate at the base, blunt to occasionally acute at the tip; surfaces glabrous, 3-nerved from the base; margins coarsely dentate to subentire; petiole 0.5–3.5 cm long. **Inflorescence** of discoid heads 5–6 mm long, surrounded by several series of subequal, sparely glandular-pilose involucral bracts, on peduncles 0.5–2 cm long and arranged in spreading panicles up to 10 cm long. **Ray florets** none. **Disc florets** sympetalous, white, 1–2 mm long, campanulate to funnelform with a short tube, 5-lobed at the tip. **Ovary** superior, with a filamentous, 2-lobed style. **Stamens** 5, epipetalous in the corolla throat. **Fruit** a turbinate achene 2.5–3 mm long, with 3 short thick processes at the tip. **Flowering** and fruiting occur continuously.

Adenostemma lavenia (Samoa)

Distinguishable by its herbaceous habit; opposite leaves with toothed margins; foliage usually pubescent; and loose panicles of small discoid heads with white disc florets and no ray florets.

TONGATAPU:

Moseley s.n.—Without further locality.

KAO:

Buelow 3062—Near summit at 600 m elevation.
Buelow 3120—Apikakai.

VAVA‘U:

Crosby s.n.?—Without further locality.

8. Blumea milnei Seem.

Tongan Name: none
English Name: none
Reason for Listing: restricted in Tonga to a pair of islands, and its disappearance from elsewhere in Polynesia (Samoa)
Status: rare indigenous
Suggestion Action: The vegetation and flora of Kao and Tofua, the only places it now occurs, should be preserved. This adventive but native species is apparently unable to compete with more recently introduced weeds in most disturbed habitats.

Indigenous to Tonga, ranging westward from there and Samoa to New Guinea. The only records of this adventive but native species from Tonga are from Kao and Tofua. It is rare in Fiji, but has been seen in recent times (Whistler, pers. record), but was last collected in Samoa over a hundred years ago. It is reported in Tonga from somewhat open native forest, ranging from ca. 360 to 800 m elevation. It may have originally been a weed of all elevations, but was subsequently extirpated from the lowlands by competition with more aggressive weeds introduced to Tonga in modern times (since ca. 1772). See Randeria (1960) in *Blumea* 10: 231 for further information. No local names or uses have been reported.

Coarse erect herb up to 3 m in height, with pubescent stems. **Leaves** simple, alternate; blade elliptic, 4–27 cm long, attenuate at the base, acute to acuminate at the tip; surfaces appressed pubescent; margins toothed; petiole 0.5–3 cm long. **Inflorescence** of discoid heads in clusters borne in axillary and terminal panicles 10–30 cm long; heads 5–8 mm long, with linear to oblong phyllaries 5–8 mm long, the receptacle naked. **Disc florets** numerous, yellow, tubular, shallowly 5-lobed, ca. 6–8 mm long. **Ray florets** absent. **Ovary** inferior, 2-celled, with a long, 2-lobed style. **Stamens** 5, epipetalous, included. **Fruit** an oblong, 5–10-ribbed achene ca. 0.5 mm long, with a pappus comprising numerous fine white setae 4–5 mm long, in a single series borne on a basal ring. **Flowering** and fruiting have been reported throughout the year.

Blumea milnei (Tofua)

Distinguishable by its tall herbaceous habit; alternate leaves; panicles of heads bearing white disc florets; and tiny achenes bearing numerous terminal bristles in a basal ring.

KAO:

Buelow 2822—Treeline above Topu‘efio at 450 m elevation.

Buelow 2941—Moist rock outcropping at 360 m elevation.

Buelow 3044—Second crater from the top on the northeast side of the island at 700 m elevation.

Buelow 3043—Next to ravine coming from the second extinct crater on the northeast side down from the top of the crater.

Buelow 3045—Scrub forest on the plateau around the highest crater on the northeast side of the island at 800 m elevation.

TOFUA:

Buelow 2720—About 50 m down from the summit on the outer slope of the main caldera on the side opposite from Lofia Crater.

Buelow 2753—Near the summit on outer slope of the main crater above Ha‘amatu‘a at over 400 m elevation.

Whistler 10642—Forest on the east rim of the crater at 480 m elevation.

9. Centipeda minima (L.) A. Braun & Ascherson

Myriogyne minuta Less.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restriction to a threatened habitat
Status: rare indigenous, or possibly a Polynesian adventive
Suggestion Action: This is a wetland species, so its rarity in Tonga reinforces the ecological need to preserve wetlands in Tonga.

Indigenous to Tonga, also found in Samoa, Fiji, and westward, and apparently a modern introduction to the Society and Cook Islands. It is known in Tonga only from ‘Eua and Tongatapu (based on three collections), where it occurs in grassy areas, probably mostly areas with wet soil, reported from near sea level to 220 m elevation. No local names or uses have been reported for this tiny, inconspicuous herb.

Centipeda minima (Savai‘i, Samoa)

Prostate herb with glabrous, much-branched stems up to 20 cm long. **Leaves** simple, alternate; blade oblanceolate, 0.5–2 cm long, cuneate at the base, acute to subround at the tip; surfaces glabrescent, arachnoid-pilose on both sides when young; margins mostly 3–5 pinnately lobed; subsessile. **Inflorescence** a sessile, axillary, subglobose head 2–5 mm in diameter, surrounded by 1 or 2 series of tiny, subequal phyllaries. **Calyx** of 4 short lobes. **Corolla** dimorphic, sympetalous, shortly tubular, 4-merous; those of the ray florets 0.2–0.7 mm long, white or green; those of the disc florets yellow or violet tinged, 05–0.7 mm long. **Ovary** inferior, 2-celled; style 2-branched. **Stamens** 4, epipetalous, included. **Fruit** a 4-angled (3–5), narrowly ovoid achene ca. 1 mm long, the ribs appressed pubescent, the surfaces between them darker, with a minute, pale, spongy pappus on top. **Flowering** and fruiting probably occur continuously.

Distinguishable by its prostrate herb habit; small, alternate, 3–5 pinnately lobed leaves; small, sessile, axillary heads bearing tiny white to yellow or violet flowers; and tiny, ribbed achene ca. 1 mm long, with a spongy mass on top.

TONGATAPU:
Buelow 25—Swampy area in Pea near to Wesleyan Middle School at 1 m elevation.

‘EUA:
Hotta 5491—Grassland near Mt. Kolo‘aki-lupe-Tonga.
Buelow 1869—Small swamp-like lake along eastern ridge east of Kolomaile at 220 m elevation.

10. Dichrocephala integrifolia (L. f.) Kuntze

Dichrocephala bicolor (Roth) Schlecht.
Dichrocephala latifolia (Desf.) DC.
Cotula bicolor Parkinson

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection, especially modern collection
Status: rare Polynesian adventive, probably extirpated from Tonga
Suggestion Action: Nothing can be done for this species since it has not been collected in Tonga since 1773. It probably could not compete with more recently introduced weeds, and disappeared, as it has apparently also done in Fiji and Samoa (if it ever was in Samoa). In the Pacific, however, this species should be recognized as endangered in the few places it still occurs (Cook Islands, Society Islands).


Dichrocephala integrifolia (internet)

Distributed from tropical Africa to Eastern Polynesia, but probably native only to Asia and/or Africa. In Polynesia, it has been collected in the Society Islands, Cooks, Australs, Tonga, Fiji, and Samoa, but in the latter three archipelagos it is known from only a single collection each (and the Samoan record is questionable). Seemann (1865) noted it to be “common all over Viti [Fiji].” It was also reported from Hawai‘i based on a Nelson specimen, but this appears to be a mistaken identification (Wagner et al. 1990). *Dichrocephala* is probably an intentional Polynesian introduction that became naturalized, or it may have arrived as an accidental Polynesian introduction, transported by means of its sticky seeds. Today in Polynesia it is rarely found outside of the Society and Cook Islands, and even there it is mostly cultivated. It has been reported to be medicinal in Tahiti, the Austral Islands, and on Atiu.

Herb, low-growing to erect, up to 50 cm in height, spreading by rooting at the nodes of prostrate stems, young stems finely pubescent. **Leaves** simple, alternate; blade broadly ovate, 2–10 cm long, attenuate at the base, acute at the tip; surfaces appressed-pubescent to pilose; margins coarsely toothed, sometimes making the base appear lobed, the teeth apiculate; petiole 1–5 cm long. **Inflorescence** a terminal panicle up to 10 cm long, with several discoid to globose

heads 3–5 mm in diameter. **Ray florets** absent. **Disc florets** tiny, less than l mm long, tubular, white. **Ovary** inferior, 2-celled, style bifid. **Fruit** a tiny, sticky subglobose achene 1–1.5 mm long, irregularly ridged and sticky when mature. **Flowering** and fruiting probably occur continuously.

Distinguishable by its herbaceous habit; alternate, deeply lobed leaves; terminal panicles of several discoid heads of tiny white discoid florets; and sticky subglobose achene less than 2 mm long.

SINE LOC:
Cook s.n.—Without further locality in 1773.

11. Lagenophora pumila (Forst. f.) Cheeseman

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection, and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, since it is found only on isolated Kao Island. There is probably no danger to its existence other than its rarity and possible cataclysmic eruption of the volcano.

Lagenophora pumila (Bishop Museum)

Indigenous, also found in New Zealand and its outlying islands, as well as the Kermadec Islands. This species is a new record based for Tonga based on a single collection from Tonga (on Kao Island), where it was found in an unknown habitat (the one specimen of this known from Tonga was not located). The genus is discussed by A.L. Cabrera in See Blumea 14: 289–90 (1966), but of course there is no mention of its occurrence in Tonga. No local names or uses are reported for this rare and inconspicuous species.

Small herb up to 16 cm in height with pubescent stems. **Leaves** simple, alternate, forming a basal rosette; blade suborbicular to ovate, 5–20 mm long, attenuate to cuneate at the base, broadly acute to rounded at the tip; surfaces sparsely pubescent; margins entire, sometimes with small lobes at the base of the blade; petiole 8–30 mm long. **Inflorescence** a solitary composite head up to 8 mm in diameter, on a long thin, pilose peduncle; involucre hemispheric, 2.5–3 mm high, comprising linear lanceolate phyllaries (bracts). **Ray florets** many, with a white to pink ligulate corolla 3–4 mm long, pistillate. **Disc florets** with a tubular, white to pink corolla 5-lobed at the tip. **Ovary** inferior, style bifid. **Stamens** 5, epipetalous, included. **Fruit** an

obliquely obovate achene 1.5–2.5 mm long, with a glandular beak ca. 0.5 mm long at the top. **Flowering** and fruiting reported from October to January, possibly of longer duration. (The description based on New Zealand specimens.)

Distinguishable by its small herb habit; basal leaves in a rosette; relative long petioles; toothed leaf margins; and solitary, long-stalked composite heads of white flowers.

KAO:
Buelow 684—(Specimen not located.)

BRASSICACEAE

12. Rorippa sarmentosa (DC.) Macbride

Cardamine sarmentosa Sol. ex Forst. f.
Nasturtium sarmentosum (Sol.) O.E. Schulz

Tongan Name: *akataha*
English Name: Polynesian cress
Reason for Listing: infrequency of modern collection
Status: rare Polynesian adventive
Suggestion Action: The plant is medicinal, and should be located and propagated in gardens to make sure that it does not disappear from Tonga.

Rorippa sarmentosa (Samoa?)

A Polynesian introduction (or possibly indigenous) to Tonga, ranging from New Caledonia to Hawai‘i, but probably an ancient introduction over most of the eastern part of his range. It is found in Tonga on most of the islands, where it is a weed of cultivated places, particularly around houses in villages, reported from near sea level to 990 m elevation. It is known from, but has not been collected on Niuatoputapu and Tafahi. The plant is used medicinally in Tonga, as it is over most of its Polynesian range.

Herb up to 60 cm in height and with glabrous stems arising from a long, thick tap root. **Leaves** pinnately compound, alternate in a basal rosette, rachis mostly 2–9 (–18) cm long, leaflets 3–7, broadly and irregularly ovate to reniform, with the terminal one 0.6–4 cm long being the largest; surfaces glabrous; margins unevenly crenate; petiolule 1–12 mm long. **Inflorescence** of erect, several-flowered racemes up to 23 cm long arising from the rosette. **Calyx** of 5 ovate lobes ca. 1.5 mm long, on a pedicel up to 8 mm long in fruit. **Corolla** of 4 free round petals 1–2 mm long, white or tinged purple. **Ovary** superior,

with a short capitate style. **Stamens** 6, free, included. **Fruit** a cylindrical pod 1.4–3 cm long, with many tiny reddish brown seeds in 2 rows separated by a partition. **Flowering** and fruiting occurring throughout the year.

Distinguishable by its herbaceous habit; pinnately compound, alternate leaves in basal rosettes; racemes of flowers having 4 tiny white petals and 6 stamens; and cylindrical pods.

TONGATAPU:
USEE s.n.—"Growing around dwellings, rare," without further locality.
Graeffe 454—Specimen not located and it is unclear where this reference came from.
Parks 15492—(Specimen not located.)
Hurlimann 297—(Specimen stored at Vainī but not examined.)
Yuncker 16251—Crevices on seaside limestone cliff at Fangaveha.
Hotta 4029—Weed in Pea Village.
Sykes 1022—Common in Pea Village near Wesleyan Middle School around an open marshy area.

EUA:
Parks 16172—(Specimen not located.)
Yuncker 15422—Weed near plantation house.
Hotta 5320—East of Kolo'aki-lupe-Tonga.
Sykes 450—Kahana north of Houma.
Sykes 557—Coastal area behind Lokupo Beach at ca. 3 m elevation.
Sykes 773—Near Vaingana Stream at Vaifefe.

HAAPAI:
Hotta 4865—Lotofoa Village on Foa.
Hotta 4882—Lotofoa Village on Foa (not listed in Hotta, but in seen in his collections).

KAO:
Yuncker 15909—Thin soil near summit at ca. 990 m elevation.

VAVAU:
Barclay s.n.—Without further locality.
Soakai 682—(Specimen not located.)

NIUAFO'OU:
Whistler 6373—Weed at Mu'a.

SINE LOC:
Cartwright s.n.—Without further locality.

CAPPARACEAE

13. Capparis cordifolia Lam.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Its distribution on Tongatapu and 'Eua should be charted and its places of occurrence recommended for some kind of preservation.

Indigenous to Tonga, ranging from Palau to southeastern Polynesia. In Tonga it is found only on coastal limestone cliffs and makatea of Tongatapu and ʻEua, reported only near sea level. No local names or uses are reported. This species is also listed as "rare" in independent Samoa Whistler 2010). The species was collected on Tongatapu during the current project (2010), and according to Martin Runquist (pers. comm. 2010), he has seen moths in Vavaʻu that feed exclusively on this plant, so it is likely this species (or perhaps the related *Capparis quiniflora*) occurs in that island group as well. No local names or uses are reported, and few if any Tongans would recognize this rare plant.

Capparis cordifolia flower (Samoa?)

Capparis cordifolia fruit (Savaiʻi, Samoa)

Prostrate or low woody shrub up to 1 m in height, with glabrous stems. **Leaves** simple, alternate; blade somewhat fleshy, elliptic to ovate, 2–7 cm long, mostly rounded at both ends; surfaces glabrous; margins entire; petiole 1–4 cm long. **Inflorescence** of solitary, axillary flowers. **Calyx** of 4 unequal, sepals 1.4–3 cm long, the outer pair strongly concave (bent into a U-shape) and enclosing the bud, on a pedicel up to 8 cm or more in length. **Corolla** of 4 unequal, asymmetrical showy white petals 2.5–5 cm long. **Ovary** superior, 1-celled, with a small sessile stigma; borne on a long stalk (gynophore). **Stamens** numerous, free, anthers often pink. **Fruit** a clavate capsule 3–6 cm long borne on a gynophore up to 8 cm or more in length; seeds numerous, round 3–4 mm in diameter. **Flowering** and fruiting probably occur continuously.

Distinguishable by its prostrate woody habit; alternate, elliptic to ovate, somewhat fleshy leaves; large, showy, solitary white flowers bearing numerous stamens; and club-shaped fruit borne on a long stalk.

TONGATAPU:

Parks 15629—Lower littoral terrace on exposed rocks near a small cave at Hufangalupe.
Yuncker 16250—Sea cliff at Fangaveha on the south coast of the island.
Whistler 12178—Sea cliff edge ca. 200 m south of Hufangalupe.

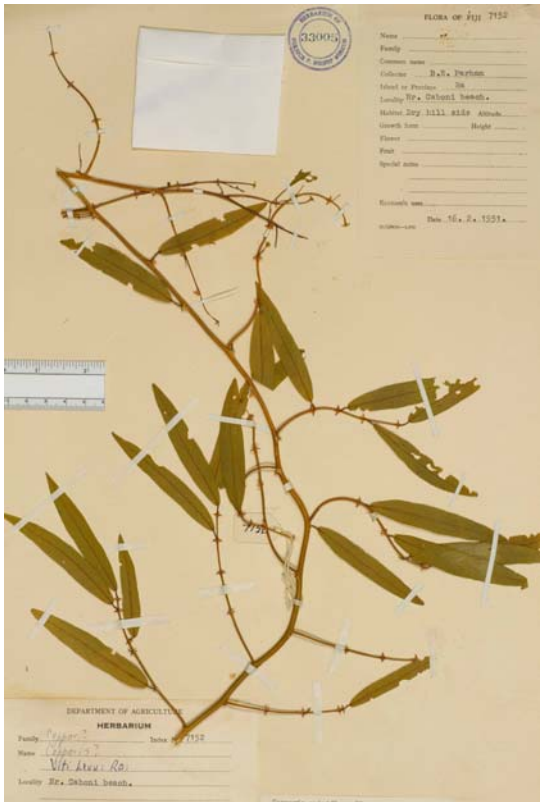
‘EUA:

Buelow 1856—Halfway between Vaingara and the cliff descending to Lokupo on jagged uplifted limestone in a somewhat sheltered crevice at 60 m elevation.

14. Capparis quiniflora DC.

Capparis richii A. Gray
Capparis sandwichiana sensu Yuncker; non DC.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous (a new record)
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the National Park and other areas on ‘Eua is the most useful measure that can be taken.



Capparis quiniflora (Bishop Museum)

Indigenous to Tonga, ranging from the Celebes and Australia eastward to Tonga. It is known in Tonga from only two modern collections, one from Tongatapu and one from ‘Eua, and these specimens represent a new record for the species in Tonga. It is reported on ‘Eua from limestone cliffs at 60 m elevation, and on Vava‘u in limestone forest at 95 m elevation. It is also infrequent in Fiji, where it is known from only a few collections. No local names or uses are reported, because of its rarity and its not having useful timber.

Liana or scandent shrub with glabrous stems with stout sharp, recurved stipular thorns 1–3 mm long on sterile branches. **Leaves** simple, alternate; blade narrowly lanceolate (on sterile branches) to ovate (on fertile branches), 7–10 cm long, rounded at the base, acute to acuminate at the tip; surfaces glabrous; margins entire; petiole 5–20 mm long. **Inflorescence** of 2–10-flowered terminal racemes up to 5 cm or more long, bearing caducous bracts. **Calyx** of 4 free, ovate sepals 3–5 mm long, in 2 pairs, imbricate, the outer ones strongly concave and enclosing the bud, on a pedicel 6–20 mm long. **Corolla** of 4 free, ovate to elliptic, white petals 5–7 mm long, subequal, the lower 2 free, the upper 2 fused at the base. **Ovary** superior, 1-celled, borne

on a long gynophore; stigma sessile, small. **Stamens** 7–12, free, 2–2.7 cm long, exserted, white. **Fruit** a subglobose to ellipsoid, many-seeded capsule 2–4 cm long, on a thickened pedicel up to 5 cm long. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its liana or scandent shrub habit; stipular thorns on sterile branches; alternate ovate to lanceolate leaves; several-flowered terminal racemes; 4-merous, white flowers; ovary borne on a long gynophore; 7–12 long-exserted stamens; and capsule fruit.

ʻEUA:

Buelow 1860—Near ocean cliff halfway between Vaingara and the cliff descending to Lokupo at 60 m elevation.

VAVAʻU:

Buelow 1442—South slope of Mt. Talau growing over a *Maniltoa* tree at ca. 95 m elevation.

15. Crateva religiosa Forst. f.

Crateva speciosa Volk.

Tongan Name: *pualiki*
English Name: none
Reason for Listing: restricted in Tonga to one island (with one old collection on another)
Status: rare indigenous or perhaps a Polynesian cultigen in Tonga
Suggestion Action: The tree is currently only known from low elevations on Tafahi, and the forests on that island are under threat from uncontrolled farming of kava. Everything possible should be done to preserve the island's forests, since it is home to several plant species found nowhere else in Tonga.

Indigenous to Tonga, ranging from northern India eastward to eastern Polynesia and Micronesia, but rare in most of the Pacific Islands, except in some parts of Micronesia (e.g., Yap, where it is cultivated for its edible fruits). In addition to a half-century-old record from Tongatapu, the tree is restricted to lowland forest on Tafahi, reported from near sea level to at least 50 m elevation. No uses have been reported for this tree that has foul bad-smelling flowers.

Medium-sized tree up to 15 m or more (up to 40 m in New Guinea) in height, with glabrous stems marked by conspicuous lenticels. **Leaves** trifoliate, alternate, rachis 4–13 cm long (larger in juvenile leaves); leaflet blades obovate to elliptic, 6–18 (–27) cm long, acute to oblique at the base, acuminate and apiculate at the tip; surfaces glabrous, upper side darker; margins entire to undulate; petiolules 2–10 mm long. **Inflorescence** a terminal, several-flowered (up to 18 or more) raceme 3–14 cm long, with tiny caducous bracts at the bases of the pedicels, flowers malodorous. **Calyx** of 4 elliptic to oblong, subequal sepals 4–7 mm long (or sometimes larger and petaloid) borne on a broad receptacle, atop a pedicel up to 9 cm long. **Corolla** of 2 pairs of free, ovate to elliptic petals 1.5–4 cm long, clawed at the base, white aging to pale yellow. **Ovary** superior, 1-celled, borne on an often reddish gynophore (ovary stalk) 4–9 cm long at anthesis, the ovary swollen at the tip and topped by a discoid stigma. **Stamens** many (10–30), free, exserted, with long filaments purplish towards their tips, protandrous. **Fruit** a somewhat garlicky smelling, mottled yellowish gray or pale green, ellipsoid berry 6–15 cm long. **Flowering** reported in April and May (January and February in cultivation in Hawaiʻi, but throughout the year in New Guinea (at least), fruiting from April to June.

Distinguishable by its medium-sized tree habit; alternate, trifoliate leaves; large white, bad-smelling flowers; ovary borne on a long stalk; stamens long and numerous; and a large, mottled gray or pale green, somewhat garlicky smelling, sausage-shaped fruit.

Crateva religiosa flowers (Foster Garden)

Crateva religiosa fruits (Ofu, American Samoa)

TONGATAPU:

Yuncker 16282—Thicket at Muʻa Bay by Pelehake. (Specimen not located at Bishop Museum.)

TAFAHI:

Hurlimann 514—Primary forest on steep volcanic slope covered with rock fragments between Tafahi township and Tafe at 50 m elevation.

Hurlimann 600—Primary forest on steep volcanic slope covered with rocks on the northeast coast towards the northern point at 30 m elevation.

Buelow 1293—Scrub area of plantation next to main path from town in bush about 1 km from the village.

Buelow 1310—Edge of plantation and on steep slope in the forest above Fakafafa-mo-e-Tauloto.

Buelow 1312—Near base of steep slope near Fakafafa-mo-e-Tauloto in understory.

Whistler 6450—Without further locality (collected by another person).

CELASTRACEAE

16. Salacia pachycarpa A. C. Sm.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done specifically for this species, which in Tonga occurs only on ‘Eua, but the protection of native forests in the national park and other areas on ‘Eua are the most useful measures that can be taken to preserve this species in Tonga.

Indigenous to Tonga, also found in Fiji. It is restricted in Tonga to ‘Eua, where it is uncommon in native forest, reported from near sea level up to the highest elevations of the island (ca. 300 m). No native names or uses are recorded for this inconspicuous liana. This species is a new record for Tonga, where it was first collected in ca. 1980.

Liana, high-climbing, with glabrous stems. **Leaves** simple, opposite; blade elliptic to ovate, 4–19 cm long, acute at the base, attenuate at the tip; surfaces glabrous; margins entire; petiole 8–16 mm longer. **Inflorescence** of several-flowered axillary fascicles. **Calyx** deeply divided into 5 triangular lobes, ca. 1 mm long, on a pedicel up to 7 mm long. **Corolla** of 5 free, narrowly imbricate, ovate green petals ca. 1.7–2.5 mm long. **Ovary** superior, 3-celled with a tiny obscure style. **Stamens** 3, free, included. **Fruit** a subglobose to ellipsoid, red (?) drupe up to 5 cm in diameter, obscurely 3-ridged distally. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its liana habit; opposite simple leaves; tiny greenish flowers in axillary clusters; and large drupe up to 5 cm in diameter.

Salacia polycarpa (‘Eua)

‘EUA:
Sykes 210—Kahana area on the edge of a makatea terrace north of Houma at 60 m elevation.
Buelow 2344—Lakataha Ravine near ‘Ohonua at ca. 15 m elevation.
Whistler 7172—Scrubby vegetation at the end of the cliff on the south end of the island.
Whistler 7255—Forest on terrace at the north end of the island near Houmatai.
Whistler 7300—Littoral forest between Folaha and Ha‘aluma on the southwest side of the island.
Whistler 7322—Primary forest on the southeast terrace of the island.

CHRYSOBALANACEAE

17. Atuna racemosa Raf.

Cyclandrophora laurina (A. Gray) Kosterman
Parinari glaberrimum sensu auct. non Hassk.
Parinari laurinum A. Gray

Tongan Name: *pipi fai lolo*
English Name: none
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen
Suggestion Action: The tree is still fairly well known because of its use as a fragrance plant, and its cultivation should be encouraged. It should also be planted in a gardens to ensure its presence in Tonga.

A Polynesian introduction to Tonga, ranging from tropical Asia to Fiji, and introduced to western Polynesia. In Tonga, where it grows on most of the larger islands, it is known only in cultivation. The grated pulp of the large seed was used for scenting coconut oil.

Medium-sized tree up to 20 m in height, but usually much less, with glabrous stems and linear caducous stipules up to 2.4 cm long. **Leaves** simple, alternate; blade chartaceous, lanceolate to elliptic, 12–30 cm long, acute to rounded at the base, subacute or acuminate or attenuate at the tip; surfaces glabrous; margins entire; petiole thick, 3–8 mm long. **Inflorescence** a many-flowered axillary raceme or panicle of 2 or 3 racemes 3–18 cm long, with tomentose branches and axis. **Calyx** hypanthium obconic, tube 8–11 mm long, tomentose on the outside, limb divided to the base into 5 ovate to elliptic lobes 5–8 mm long, on a pedicel 0–2 mm long, subtended by a tomentose bract up to 1 cm or more long. **Corolla** of 5 elliptic petals 8–10 mm long, white or tinged with purple, spreading or reflexed at anthesis. **Ovary** superior, adnate to the hypanthium, style filamentous, red, as long as the stamen filaments, with a small terminal stigma. **Stamens** many (ca. 20), free, exserted, filaments red, up to 1.5 cm long. **Fruit** a dry, subglobose to laterally-compressed ovoid drupe up to 8 cm long, with a thick (ca. 8 mm), hard, brown wall enclosing the single large seed. **Flowering** reported from July to March, possibly year round, fruiting throughout much of the year.

Atuna racemosa (Savai‘i, Samoa)

Distinguishable by its medium-sized tree habit; large, papery leaves; racemes or panicles of white flowers bearing many long red stamens; and large, brown, woody drupe.

TONGATAPU:
USEE s.n.?—Without further locality.

Hurlimann 679—Nukunonu Village.
Yuncker 15261—Below Fatai Village. (Specimen not located at Bishop Museum.)
Soakai 690—(Specimen not located).

ʻEUA:

Parks 16339—Thick wet bush near Tamua on lower terrace in liku [limestone] forest at 50 m elevation.
Hotta 5322—Above central valley.
Sykes 176—North of Hango, Haʻaniumea, relictual cultivation near an ancient dwelling site.
Sykes 435—Mahogany grove in plantation area near Hango College.

VAVAʻU:

Crosby 227—Without further locality.
Yuncker 16119—Along road west of Houma Village. (Specimen not located at Bishop Museum.)
Hotta 4990—Leimatua Village.
Whistler 6029—Plantation near Tuanuku.

NIUATOPUTAPU:

Kirch 331—Secondary growth on raised terrace behind Hihifo Village at 25 m elevation.
Buelow 1354—Small wooded area in bush east of Vaipoa at 40 m elevation.

TAFAHI:

Hurlimann 568—Grassy area in the village.

18. Parinari insularum A. Gray

Tongan Name: ***hea***
English Name: none
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen
Suggestion Action: The tree is still known to many older people because of its use as a fragrance plant, and its cultivation should be encouraged. It should also be planted in gardens to ensure its presence in Tonga.

A Polynesian introduction to Tonga (and elsewhere in western Polynesia), probably originally endemic to Fiji. It is restricted in Tonga to cultivation, and is currently known from only a few of places on Vavaʻu and on Niuatoputapu, but is probably no longer actively cultivated. Its large odoriferous fruit was formerly used for making fragrant fruit leis and when grated, for making scented coconut oil.

Medium-sized tree up to at least 12 m in height (30 m in Fiji), with densely brown-pubescent young stems and caducous linear stipules up to 1.6 cm long. **Leaves** simple, alternate; blade ovate, mostly 4–15 cm long, rounded to subcordate or truncate at the base, acute at the tip; upper surface glabrous or glabrescent, the lower side with arachnoid pubescence between the finely reticulate tertiary veins; margins entire; petiole 1–7 cm long, brown-pubescent or glabrous.

Parinari insularum flowers (Vava‘u)

Parinari insularum fruit (Vava u)

Inflorescence an axillary or terminal, several- to many-flowered panicle up to 12 cm long, with a tomentose axis and branches. **Calyx** hypanthium campanulate, 2–3 mm long, limb deeply divided into 5 ovate lobes brown-pubescent on the outside, on a pedicel up to 2 mm long. **Corolla** zygomorphic, with 5 white, spathulate petals ca. 2 mm long. **Ovary** superior, adnate to the hypanthium; style shorter than the calyx lobes, with a small capitate stigma. **Stamens** 7 or 8, free, shorter than the calyx lobes, with several staminodes. **Fruit** a brown to orange, ellipsoid drupe 3–4 cm long, covered with conspicuous lenticels. **Flowering** reported in Fiji from February to October, and fruits there persisting most of the year, so both probably occur throughout the year.

Distinguishable by its medium-sized tree habit; simple, alternate leaves; spiderweb-like pubescence on the lower leaf surfaces; panicles of small white flowers; and relatively large, fragrant, orange to brown, ellipsoid drupe.

TONGATAPU:

Soakai 756—Hofoa without further information.
Buelow—Next to Vaha‘akolo Road at a house near the Police Academy at Longolongo.

VAVA‘U:

Crosby 226—Without further locality.
Yuncker 16205—Near Mataika Village north of Neiafu.
Buelow 1025—In bush between Tefisi and liku cliff at ca. 110 m elevation.
Buelow—1479—Cemetery not far from the hospital away from Neiafu.

Whistler 6007—Cultivated in a village south of the airport.
Whistler 9280—Village on the north side of the island.
Whistler 11689—Side of a dirt road leading to the coast.
Whistler 11784—Plantation just north of Holonga Village along dirt road leading to the coast.

NIUAFO‘OU:

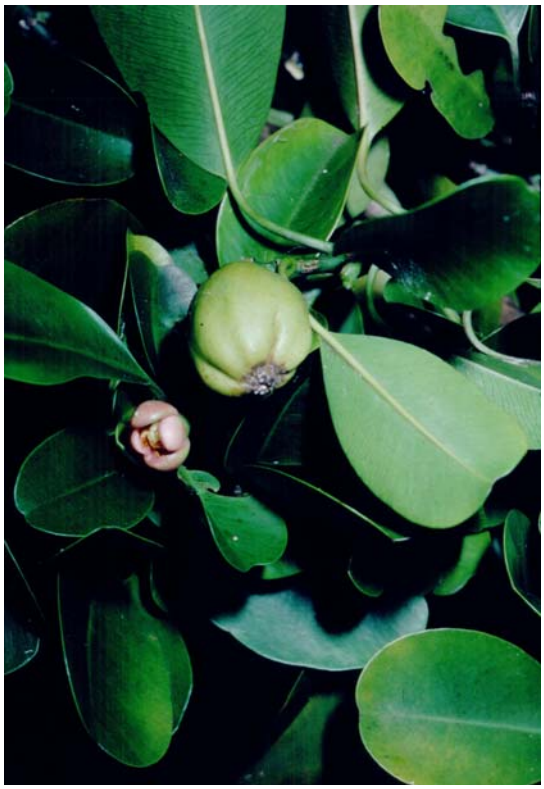
Buelow—Cultivated in village of Kolofo‘ou.
Whistler 6319—Secondary forest near the rim on the west side of the island.

CLUSIACEAE

19. Garcinia pseudoguttifera Seem.

Garcinia pedicellata Seem.

Tongan Name: *mo‘onia*
English Name: none
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen
Suggestion Action: The tree is still known to many older people because of its use as a fragrance plant, and its cultivation should be encouraged. It should also be planted in gardens to ensure its presence in Tonga.



Garcinia pseudoguttifera (‘Eua)

Probably an ancient introduction to Tonga, indigenous to Fiji and Vanuatu. Its name was recorded in the first Tongan dictionary (Rabone 1845), indicating it is probably of ancient rather than modern introduction to Tonga. In its native range it occurs in lowland to montane forest, where is it is fairly common, but in Tonga it is restricted to cultivation. The fragrant fruits and flowers are sometimes used to scent coconut oil in Tonga, and are occasionally fashioned into leis. It is a Tongan practice to plant fragrant trees around gravesites, and this is where the tree, now infrequently encountered in Tonga, is usually found. It was found in a cemetery at Mataliku during the 2010 rare plant work on Tongatapu. In Fiji, the same use as a perfume has been recorded, and the wood is sometimes used for timber.

Large tree up to 25 m in height (in native forest, but usually shorter in cultivation), with glabrous foliage and a copious yellow sap. **Leaves** simple, opposite; blade ovate to slightly obovate, mostly 6–17 cm long, obtuse to attenuate and decurrent at the base, cuspidate to

rounded or retuse at the tip; surfaces glabrous; margins entire; petiole 1–3.5 cm long. **Inflorescence** a terminal or axillary cyme 5–40-flowered in female trees, 1–7-flowered in male trees, up to 6 cm long, broader than long; flowers unisexual, trees dioecious. **Calyx** of 4 free, broadly ovate to suborbicular, fleshy, decussate sepals 3–5 mm long, on a pedicel 1–5 mm long. **Corolla** of 4 free, round to broadly orbicular, fleshy, imbricate petals 6–10 mm long, white but turning red at senescence. **Ovary** of female flowers superior, with a peltate to rounded stigma; ovary vestigial in male flowers. **Stamens** of male flowers many, in four clusters opposite the petals, reduced to staminodes in female flowers. **Fruit** a red, ovoid to obovoid 5- or 6-seeded berry up to 5 cm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its tree habit; yellow sap; opposite leaves; few-flowered (male) to many-flowered (female) cymes of unisexual flowers on separate male and female trees; 4 white petals aging to red; and a red berry up to 5 cm long.

TONGATAPU:

Hurlimann 286—Cultivated at Nukunuku.
Sykes 995—Along Taivakano Road south of Nukunuku Village.
Buelow 1770—Cultivated near dwellings with coconut trees at Mataliku.
Whistler 6779—Cultivated in Mataliku Village (and seen again here in 2010).

‘EUA:

Hurlimann 252—Plain northeast of Ha‘aluma on the eastern ridge at ca. 70 m elevation.
Whistler 6106—Cultivated in Houma Village.
Whistler 6516—Plantation southwest of the main villages on the island.

VAVA‘U:

Wilder 424—Cultivated at Afeiono Village near sea level. (Specimen not located at Bishop Museum).
Yuncker 16204—Near Mataika Village north of Neiafu.

20. Mammea odorata (Merr.) Kostermans

Lolanara odorata Raf.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species since it is known in Tonga only from a single population in littoral forest at the south end of the island. Its presence in this forest should be made known to the local population so they will not cut the small population down, and a study of adjacent forest should be made to see if it occurs in other places on the island.

Indigenous to Tonga, where it has recently been recorded for the first time in littoral forest on ‘Eua, also found westward to Java and the Philippines. In Tonga, it has only been collected twice, in littoral forest on the south end of the island near sea level. No uses or local names are reported for this rare tree. It is closely related to *Mammea glauca*, which endemic to Samoa, and which should perhaps be combined with *Mammea odorata*. A grove of at least four trees was

Mammea odorata leaves (‘Eua)

Mammea odorata flowers (‘Eua)

seen during a survey of ‘Eua rare species in November of 2010, the same place it was found originally in 2002.

Medium-sized tree up to 12 m in height, with glabrous stems, a cream-colored latex, and tan bark covered with dark brown lenticels. **Leaves** simple, opposite, distichous; blade coriaceous, oblanceolate to elliptic, 14–25 cm long, acute at the base, rounded to broadly acuminate at the tip; surfaces glabrous, upper side darker, the lower side with a prominent yellow midvein and finely reticulate tertiary veins; margins entire; petiole 1.5–3 cm long. **Inflorescence** in axillary fascicles of 1–3 flowers borne along the older (and often leafless) part of the stem, each subtended by tiny imbricate bracts; flowers male or bisexual, trees monoecious. **Calyx** of 2 free, ovate, concave sepals 7–9 mm long, on a pedicel 8–17 mm long. **Corolla** of 6 white, obovate petals 8–10 mm long, recurved at anthesis. **Ovary** of bisexual flowers superior, 4-celled, with a sessile peltate stigma; ovary absent in male flowers. **Stamens** of male and bisexual flowers many (ca. 200), yellow, free or fused only at the base, 5–7 mm long. **Fruit** not known in Tonga, but probably a greenish, curved-ovoid berry up to 10 cm long with the persistent stigma. **Flowering** reported in November and December, fruiting not recorded, but from February to August in Fiji.

Distinguishable by its medium-sized tree habit; opposite, finely veined leaves; cream-colored latex; 6 showy white petals; numerous yellow stamens; and curved ovoid fruit with a persistent sessile peltate stigma.

‘EUA:

Whistler 11706—Littoral forest at the end of a dirt road at the west end of Haʻaluma beach, near sea level.
Whistler 12175—Littoral forest at the end of a dirt road at the west end of Haʻaluma beach, near sea level; four trees seen.

CONVOLVULACEAE

21. Operculina turpethum (L.) A. Silva Manso

Ipomoea turpethum (L.) R. Br.
Operculina brownii sensu Staples non Ooststr.?

Tongan Name: none
English Name: none
Reason for Listing: infrequency of modern collection
Status: rare indigenous
Suggestion Action: Nothing much can be done to protect this species, since it seems to have almost entirely disappeared from Tonga. A study of its distribution on Niuatoputapu should be made and its distribution charted.


Operculina turpethum (ʻUpolu, Samoa)

Indigenous to Tonga, ranging from East Africa to the Society Islands. It was probably common as a weed of disturbed lowland places prior to the European era, but it seems to have disappeared from most of Tonga, based on the fact that only one of its collection records is younger than a hundred years. It seems to have become uncommon in most of the Polynesian islands, possibly because of competition with the recently introduced *Operculina ventricosa*, which may have spread naturally in the Pacific by seawater dispersal after an original introduction in the last century. It apparently hybridizes with this species, in Samoa at least. The two species can usually be differentiated on the basis of size and tip of the leaf blade, length of flowers, length of bracts, and size of seeds. However, Staples (2007) identified Crosby 126 as *Operculina brownii* (and Crosby 129 as *Operculina polynesica*, a new species he named). There is still much confusion in the species of this genus in the Pacific, probably because at least two of the species, one native and one of more recent introduction, apparently hybridize.

Prostrate to low-climbing vine with glabrate to pubescent, twining, winged stems, the wings ca. 1 mm wide, sometimes peeling off; axillary buds densely pubescent; sap clear. **Leaves**

simple, alternate; blade cordate to deltoid, 6–12 cm long, cordate with a shallow sinus at the base, acute with a tiny mucro at the tip; surfaces pubescent; petiole 1.5–10 cm long, pubescent. **Inflorescence** a compact, few-flowered axillary cyme, on a peduncle 2–8 (–12) cm long, pubescent to glabrate, bearing several oblong to elliptic bracts 1.5–2.2 cm long, round to acute and mucronate at the tip. **Calyx** of 5 free, oval to ovate, pink, pubescent sepals 1.8–2.5 cm long, acute and mucronate at the tip, on a pubescent pedicel 1.5–3 cm long. **Corolla** sympetalous, campanulate, 2.5–4.5 cm long, shallowly 5-lobed, white. **Ovary** superior, 2-celled, with a filiform style bearing the 2-lobed stigma. **Stamens** 5, epipetalous, included, anthers coiled. **Fruit** a subglobose, translucent, membranous, capsule 1.5–2 cm in diameter, enclosed within the persistent sepals, and containing mostly 4 black, glabrous, subglobose, somewhat irregularly angled seeds 4–7 mm in diameter. **Flowering** has been reported in Fiji from May to October, and in Samoa from May to December; fruiting in Fiji is reported from June to November. This is an unusual weed because of this limited flowering time.

Distinguishable by its low-climbing viney habit; winged stems; clear sap; few-flowered axillary cymes; white bell-shaped corolla 2.5–4.5 cm long; coiled anthers; and translucent, 4-seeded capsule.

TONGATAPU:

USEE s.n.—Frequent along seashore, without further locality.
Forster s.n.—Without further locality.
Nelson s.n.—Without further locality.
Lister s.n.—Without further locality.

VAVA‘U:

Crosby 126—Without further locality.

NIUATOPUTAPU:

Buelow 1105—Grassy area with scattered bushes in plantation on top of Fo‘imoa Ridge.

SINE LOC:

Matthews s.n.—Without further locality.

CUCURBITACEAE

22. Benincasa hispida (Thunb.) Cogn.

Benincasa cerifera Savi
Cucurbita hispida Thunb.
Cucurbita pruriens Sol.
Lagenaria siceraria sensu auct. non (Molina) Standley
Lagenaria vulgaris sensu Pickering; non. L.

Tongan Name: *fangu*
English Name: wax gourd
Status: rare Polynesian cultigen
Reason for Listing: reduction in cultivation and infrequency of collection
Suggested Action: The last known locations of collection of this plant should be visited to see if it is still present there, since it appears to last for long periods of time as seeds in the soil or

in the gourd-like fruits. If found, seeds should be planted in gardens to preserve this once useful species.

A Polynesian introduction to Tonga, probably native to Southeast Asia or Malaya, but an ancient introduction eastward all the way to the Marquesas. The Pacific island form, sometimes called var. *pruriens*, was cultivated for its gourd-like fruit used as a container for scented coconut oil, but since the introduction of the more useful bottles and cans, this use abruptly ceased and the plant is nowadays all but forgotten in Tonga and the rest of Polynesia. Interestingly enough, the current Tongan name for bottle is the same as the name for this plant. The vine persists as a rare occasional weed of disturbed places and plantations in the lowlands, climbing into. It appears to die back during part of the year and the only signs of its existence are numerous round, waxy white fruits on the ground.

Herbaceous vine, annual, with longitudinally ribbed, strigose stems with banded hairs, climbing by means of axillary bifid tendrils. **Leaves** simple, alternate; blade reniform to broadly ovate, mostly 7–15 cm long and as wide, cordate at the base, acute at the tip; surfaces pubescent; margins with 5–11 lobes or angles acute at the tips; petiole 3–12 cm long, strigose. **Inflorescence** of solitary axillary, unisexual flowers; plants monoecious. **Calyx** broadly campanulate, ca. 1–1.5 cm long, deeply divided into 5 recurved, narrowly lanceolate lobes, on a pedicel 1–4 cm long. **Corolla** sympetalous, rotate, yellow, divided to near the base into 5 obovate lobes ca. 2–3 cm long. **Ovary** of female flowers inferior, with a thick style bearing 3 stigmas; ovary rudimentary in male flowers. **Stamens** of male flowers 3, free, reduced to staminodes in female flowers. **Fruit** a globose, many-seeded, hard-shelled berry up to ca. 10 cm in diameter and length, covered with a white, powdery wax. **Flowering** and fruiting probably occur throughout the year, although the plant may die during the dry season.

Benincasa hispida (‘Upolu, Samoa)

Distinguishable by its viney habit; axillary, 2-parted tendrils; hairy stems; solitary, axillary, unisexual flowers; recurved calyx lobes; yellow, 5-lobed corolla; and round, waxy white, gourd-like fruit about the size of a tennis ball.

TONGATAPU:

USEE s.n.—Cultivated, without further locality.

‘EUA:

Buelow 1835—Open scrub area in forest at east corner of Ve‘ehala’s estate about 1.6 km south of Vaingana.

Whistler 7170—Forest on a fernland on the southeast end of the island.

VAVA‘U:
Crosby 71—“Saai,” without further information.
Whistler 6048—Near Longomapu Village.

23. Cucumis melo L.

Cucumis acidus Jacq.
Cucumis pubescens Willd.
Cucumis; bis?, compare (No. 1 Metia to) Taheiti [sic]. Pickering (p. 318)

Tongan Name: *katiu*
English Name: Polynesian melon
Status: rare Polynesian cultigen
Reason for Listing: reduction in cultivation and infrequency of collection
Suggested Action: Since there are no collections of this species in independent Samoa in over a century, it is possible that it has been extirpated from the country, and there are no likely places to search for it. Consequently, no action is recommended at this time other than to keep a lookout for this cultural species. The author has seeds for this species (from Samoa), which should perhaps be obtained and planted in a botanical garden in Tonga to reintroduce this cultural species.


Cucumis melo (Ta‘ū, American Samoa)

A Polynesian introduction to Tonga, native from tropical eastern Africa to India, but an ancient introduction eastward across the Pacific all the way to the Marquesas. This plant is probably the original variety (“wild type”) from which the larger, edible cantaloupe and honeydew melon were derived. Although it was probably once cultivated or naturalized in disturbed places in Tonga as a minor fruit (probably eaten by children) or as a fragrant decoration in leis, it fell into disuse and is now virtually unknown throughout its Polynesian range after other plant species with better edible fruits were introduced in modern times. It has probably now been extirpated from Tonga, and is probably unknown there nowadays. The Polynesian subspecies is *agrestris* (Naudin) Panalo.

Herbaceous vine, prostrate and weakly climbing by means of simple axillary tendrils, stems hispid. **Leaves** simple, alternate; blade ovate to subround, 4–11 cm long, cordate at the

base, blunt and apiculate at the tip; surfaces hispid; margins palmately 3–7-lobed or angular, finely toothed between the lobes; petiole mostly 2–7 cm long, densely hispid. **Inflorescence** solitary, axillary, with unisexual flowers; plants monoecious. **Calyx** sympetalous, campanulate, 4–6 mm long, with 5 shorter filiform lobes, densely pubescent, on a pedicel 5–20 mm long at anthesis. **Corolla** sympetalous, rotate, yellow, 8–12 mm long, divided about halfway into 5 rounded lobes. **Ovary** of female flowers inferior, with 3–5 stigmas on a short style; ovary rudimentary in male flowers. **Stamens** of male flowers 3, free, reduced to 3 staminodes in female flowers. **Fruit** a fragrant, pale yellow to brown, subglobose, many-seeded berry 3–5 cm long. **Flowering** and fruiting occur continuously.

Distinguishable by its herbaceous vine habit; bristly stems and foliage; alternate leaves with lobed and finely toothed margins; simple axillary tendrils; yellow, separate male and female flowers on the same plant; and a small, fragrant, cantaloupe-like fruit.

TONGATAPU:
USEE s.n.—"Growing around dwellings," without further locality.

24. Luffa cylindrica (L.) Roehmer, var. ***insularum*** Cogniaux

Cucumis? (No. 2) of Pickering (p. 319)

Tongan Name: ***mafa'i***
English Name: none
Reason for Listing: infrequency of modern collection
Status: rare indigenous?
Suggestion Action: The seeds of this vine should be collected and grown in gardens. Also, wetlands in Tonga should be protected, which should also occur because of the threatened status of this habitat.

Indigenous or a Polynesian introduction to Tonga, ranging from tropical Asia to the Society Islands. It is uncommon on all the major islands (except perhaps 'Eua) climbing in trees and on low vegetation in coastal and lowland areas, most typically in marshes, reported from near sea level to 150 m elevation. The cultivated variety, technically var. *cylindrica*, has a much larger fruit (called vegetable sponge, or ***pulu kaukau***). It is grown for this fruit, which is used as a bathing sponge. Smith (1981) does not recognize this small-fruited variety (var. *insularum*), but it is clearly distinct from the currently cultivated one, which has much larger fruits, and is apparently restricted to cultivation. This plant is somewhat of a mystery because of its uncertain provenance in Tonga. Its fibrous inner fruit may have been used as a sponge, but there is no evidence of this and the Tongan name is not found in Churchward's dictionary (1959).

Herbaceous vine with sparsely pubescent, 5-angled stems and axillary, 3–6-branched, vigorously twining tendrils. **Leaves** simple, alternate; blade broadly ovate, 7–17 cm long, cordate with a broad sinus at the base, shortly acuminate and apiculate at the tip; surfaces scabrous; margins irregularly lobed with apiculate vein endings; petiole 4–10 cm long. **Inflorescence** of unisexual flowers; the male flowers in axillary, pedunculate, many-flowered racemes up to 35 cm long; the females flowers solitary, axillary; plants monoecious. **Calyx** campanulate, up to 1.5 cm long in male flowers (female flowers not seen), deeply divided into 5 ovate, acute-tipped lobes, on a pedicel up to 1.5 cm long (longer in fruiting female flowers).

Corolla of 5 free, obovate, yellow petals up to 3 cm or more in length. **Ovary** of female flowers inferior with 3 bilobed stigmas; ovary rudimentary in male flowers. **Stamens** 5, free, reduced to thick staminodes in female flowers. **Fruit** a green, oblong to ellipsoid berry up to 8 cm long (longer in the cultivated variety), smooth or 5-ribbed (the ribs marked by darker green lines), splitting open by means of an apical operculum to expose the seeds embedded in a fibrous mesh. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its herbaceous viney habit; 3–6-branched axillary tendrils; male flowers in racemes and female flowers solitary and axillary; yellow corolla; and green fruit filled with seeds embedded in a fibrous mesh.

TONGATAPU:
USEE s.n.—Cultivated in "the heathen village," without further locality.
Moseley s.n.—Without further locality.
Buelow 797—Bushes next to road at Sia'atoutai College.

HA'APAI:
Soakai 670—Pangai, without further information.

VAVA'U:
Barclay 3405—Without further locality.
Yuncker 16165—Disturbed area on cliff on the northwest side of the island at ca. 150 m elevation.

NIUATOPUTAPU:
Buelow 1077—Plantation south of Hihifo.
Whistler 6161—Disturbed roadside at the northeast end of the island.

NIUAFO'OU:
Whistler 6335—Weedy area in plantation on the west side of the island.


Luffa cylindrica ('Upolu, Samoa)

NOTE: Whistler 6073 from Ha'apai represents the large-fruited, more recently introduced, cultivated variety. Although Smith (1981) does not recognize the variety as separated from the cultivated form, var. *insularum* is possibly native, and the larger fruited variety is probably a modern introduction.

EUPHORBIACEAE

25. Acalypha grandis Benth.

Tongan Name: ***kalakala'a pusi***?
English Name: none
Reason for Listing: restricted in Tonga to one island (with one old collection from another)
Status: rare indigenous or perhaps a Polynesian introduction

Suggestion Action: Nothing much can be done for tree, since it occurs only on one isolated island, but it would be useful to know its frequency there.

Possibly native to Tonga, ranging from the Philippines eastward to western Polynesia. It is currently known in Tonga only from Niuafo‘ou, where it occurs in lowland forest, often near the coast. There are a couple of old records from different islands (Tongatapu and one unspecified island), but the tree now may no longer occur anyplace but Niuafo‘ou. It is not clear if the tree is a native or introduced species. Its Tongan name translates as cat’s tail, but cats are a modern introduction to Tonga. Or perhaps the tree is native and without a name (since it has no uses), but since it looks like the introduced ornamental *Acalypha hispida*, it has inherited the name of this newer, more conspicuous introduction.

Shrub up to 2 (–5) m in height, with sericeous stems. **Leaves** simple, alternate; blade ovate, 10–21 cm long, subcordate at the base, acuminate at the tip; upper surface sparsely pubescent, lower surface glabrescent, 5-veined from the base; margins serrate; petiole 5–9 cm long, sericeous. **Inflorescence** of axillary spikes (female) or narrow axillary panicles (male) up to 21 cm long; flowers unisexual in separate inflorescences, trees monoecious; male flowers subsessile in dense, pubescent clusters, female flowers surrounded by a sheathing green bract up to 8 mm long with deeply toothed margins; rachis densely pubescent. **Calyx** of 4 small ovate sepals ca. 1 mm long, bearing stiff bristles; sessile. **Corolla** absent. **Ovary** of female flower superior, 3-celled, each cell with a single ovule; style divided into reddish filiform segments. **Stamens** of male flower 4–8, free. **Fruit** a tiny, green, 3-seeded, pubescent schizocarp 2–3 mm long. **Flowering** and fruiting probably occur throughout the year.

Acalypha grandis (Niuafo‘ou)

Distinguishable by its shrub habit; pubescent stems; large ovate leaves subcordate and 5-veined at the base; narrow axillary panicles (male) or spikes (female) flowers on the same plant; female flowers enclosed within a sessile, sheathing bract with toothed margins; and tiny green 3-celled schizocarp.

TONGATAPU:

Home—Without further locality (specimen not seen).

NIUAFO‘OU:

Buelow 1930—On west slope of Mokotu.
Buelow 2019—About 1.6 km west of ‘Esia next to the main road to Futu.
Whistler 6320—Roadside in disturbed forest on the west side of the island.
Whistler 6422—Roadside forest just to the west of Esia.

SINE LOC:
Hombron s.n.—Without further locality (specimen not seen, probably at Paris).

26. Acalypha repanda Muell. Arg.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the National Park and other areas on ‘Eua is the most useful measure that can be taken.

Acalypha repanda buds (‘Eua)

Acalypha repanda leaf (‘Eua)

Indigenous to Tonga, also occurring in Fiji, and apparently incorrectly attributed to Samoa. In Tonga it is restricted to ‘Eua, where it occurs in native lowland forest, reported from 60 to 270 m elevation, but in Fiji it goes up to 1150 m elevation. No local names or uses are reported. The tree was found on in primary forest on the ‘Eua liku during the present survey of rare species in November of 2010.

Shrub up to 5 m in height, with puberulous young stems. **Leaves** simple, alternate; blade ovate to elliptic, mostly 12–23 cm long, rounded to subcordate at the base, acuminate at the tip; surfaces glabrous, lower side lighter in color with aqueous veins and sometimes pubescent along the midrib and secondary veins; margins crenulate; petiole 4–13 cm long. **Inflorescence** of

axillary spikes (female) or narrow axillary panicles (male) up to 15 cm long; flowers unisexual in separate inflorescences, trees monoecious; male flowers subsessile in dense, pubescent clusters; female flowers surrounded by a sheathing green cup-like bract up to 5 mm long with shallowly toothed margins, pilose on the outside; rachis subglabrous. **Calyx** of 4 small ovate sepals ca. 1 mm long, glabrous or puberulent on the outside. **Corolla** absent. **Ovary** of female flower superior, 3-celled, each cell with a single ovule; style divided into reddish filiform segments. **Stamens** of male flower 4–8, free. **Fruit** a tiny, green, 3-seeded, pubescent schizocarp 2–3 mm long surrounded by the cup-like bract. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its shrub habit; large ovate to elliptic leaves rounded to subcordate but not 5-veined at the base; narrow axillary panicles (male) or spikes (female) flowers on the same plant; female flowers enclosed within a sessile, sheathing bract with toothed margins; and tiny green 3-celled schizocarp. The Fijian population differs from the ‘Eua population in having mostly smaller leaves, and pubescent lower-leaf surfaces.

‘EUA:

Parks 16294—Johansson plantation.
Yuncker 15560—Deep forest near the summit of the eastern ridge at ca. 270 m elevation.
Sykes 144—Fotoa.
Sykes 158—Fotoa.
Buelow 1857—Near the edge of a sea cliff halfway between Vaingara and the cliff descending to Lokupo at 60 m elevation.
Buelow 1858—Near the edge of a sea cliff halfway between Vaingara and the cliff descending to Lokupo at 60 m elevation.
Whistler 12167—primary forest near the cliff edge north of Lokupo lookout at ca. 260 m elevation.

27. Croton microtiglium Burk.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing special can be done for this species that occurs in intact native forest, other than simply preserving the forest. It would be useful to know just how common it is in these forests, because it may be more common than currently indicated since it is a rather inconspicuous shrub.

Indigenous to Tonga, also found in Fiji. It is found in Tonga only on Vava‘u and ‘Eua, where it occurs in lowland and limestone forest, probably at near sea level to 310 m elevation (up to 1030 m in Fiji). No names or uses are reported for this inconspicuous shrub.

Shrub up to 8 m in height, with glabrous stems. **Leaves** simple, alternate; blade elliptic to lanceolate or ovate, 2–13 cm long, acute to rounded at the base, broadly acute to subacuminate at the tip; surfaces glabrous, with a pair of glands at the base of the blade; margins entire; petiole mostly 5–25 mm long. **Inflorescence** an axillary, many-flowered spike up to 12 cm long in

fruit; flowers unisexual, plants monoecious, with the male flowers distil and the female flowers proximal on the rachis. **Calyx** of male flowers 5 free, ovate sepals ca. 1.5–2.5 mm long, with scattered stellate pubescence; calyx of female flowers similar in size, 5–7 lobed; pedicel 3–6 mm long. **Corolla** of 5 free white petals similar in size and shape to the sepals (but with a blunter tip), pilose, absent in female flowers. **Ovary** superior, 2- or 3-celled, with 2 or 3 bifid stigmas; outer surface stellate pubescent; ovary absent in male flowers. **Stamens** many, free, exserted, absent in female flowers. **Fruit** a subglobose, yellow to pale orange schizocarp ca. 6–8 mm in diameter, containing 1 seed per cell. **Flowering** and fruiting occur throughout the year.

Distinguishable by its shrubby habit; alternate leaves with a pair of glands at the base on the upper surface; tiny unisexual, white flowers in racemes, with the female flowers at the base and male flowers at the tip; male flowers with many stamens; and female flowers with a subglobose schizocarp.

ʻEUA:

Hurlimann 259—(Specimen not located.)
Whistler 7133—Makatea forest on the east-facing slope in the center of the island.

VAVAʻU:

Crosby 150—"Liku," without further locality.
Buelow 1629—(Specimen stored at Vainī but not examined.)
Whistler 6052—Forest on the slope between the Longomapu Village and the lake.

Croton microtiglium (Vavaʻu)

28. Phyllanthus amicorum Webster

Glochidion concolor sensu Yuncker pro parte; non Muell.-Arg.
Phyllanthus sp. of Hotta

Tongan Name: none
English Name: none
Reason for Listing: endemic to one Tongan island
Status: rare endemic
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the National Park and other areas on ʻEua is the most useful measure that can be taken. Since it is endemic to only one island, the protection of its habitat on ʻEua is especially important.

Endemic to Tonga, where is it is found only on ‘Eua. It occurs in native lowland and limestone forest, reported from near sea level to over 300 m elevation. No local names and uses are reported. The tree was seen in primary forest near the liku during a survey of ‘Eua rare plant species in November of 2010.

Phyllanthus amicorum (‘Eua)

Shrub or small tree up to 3 m or more in height, with glabrous, striate, somewhat zigzag stems. **Leaves** simple, alternate; blade ovate or elliptic to suborbicular, mostly 2–5 cm long, rounded to subtruncate at the base, subacute to emarginate at the tip; surfaces glabrous; margins entire; petiole 2–6 mm long. **Inflorescence** of several- to many-flowered axillary fascicles; flowers unisexual, trees dioecious. **Calyx** of 4–6 elliptic (outer) to ovate (inner) greenish white to yellow sepals 1–3 mm long, on a pedicel of similar length. **Corolla** absent. **Ovary** of female flowers superior, 3-celled, with the style spit at the base into 3 recurved lobes; ovary absent in male flowers. **Stamens** free, included, mostly 2–5, absent in female flowers. **Fruit** a greenish, compressed-globose capsule 3.5–5 mm in diameter, with three 2-seeded cells, borne one to several at each axil on a pedicel mostly 1–1.5 cm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its shrubby habit; small alternate leaves rounded to notched at the tip; inconspicuous unisexual flowers in axillary fascicles; and small 3-celled capsule.

‘EUA:

Parks 16152—Brushy places on Liku cliffs at 300 m elevation.
Parks 16154—Margin of dense forest on Liku plateau at 300 m elevation.
Parks 16287—Plateau forests.
Hurlimann 264—Primary forest on limestone ridge on the southern part of the eastern ridge at ca. 290 m elevation.
Hotta 5416—Eastern limestone cliff at Houma Village.
Hotta 5573—East side of Kolo‘aki-lupe-Tonga.
Wood 6893—Kahana Spring, northeast sea cliffs, and windswept cliff vegetation terracing down to the strand vegetation, at 3 to 130 m elevation.
Sykes 232—Kahana north of Houma.
Sykes 233—Kahana north of Houma.
Whistler 7111—Makatea forest in the central part of the east slope of the island.
Whistler 7174—Scrub forest on liku cliff at the southeast end of the island.
Whistler 7233—Forest along the trail down to Tangatave Beach at the northeast tip of the island.
Whistler 7396—Scrub forest on cliffs above Lokupo.

Whistler 7438—Forest along trail down to Musie-a-Monomono on the east-central part of the island.
Whistler 7484—On limestone cliffs east of Lake Vei Pueki.
Whistler 11695—Scrub forest on cliffs on top of the island near Lokupo lookout.

FABACEAE

29. Caesalpinia bonduc (L.) Roxb.

Caesalpinia bonducella Fleming
Guilandina bonduc L.
Guilandina bonducella L.

Tongan Name: *talatala ʻamoa*
English Name: gray nickers, wait-a-bit
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: The specific locations where this plant is found should be mapped and an effort made to preserve these sites. The plant is sometimes difficult to distinguish from the very similar and more common *Caesalpinia major*.

Caesalpinia bonduc (Savaiʻi, Samoa)

Indigenous to Tonga, widespread in the Pacific. It is known in Tonga only from Tongatapu, Haʻapai (Lotofoa), and Niuatoputapu, where it is a sprawling shrub in sunny littoral habitats, rarely scandent in littoral forest, reported only near sea level. The hard seeds are used as marbles and for making seed leis, and the thorny stems and leaves were formerly attached to long sticks used to ensnare fruit bats.

Scandent shrub, often sprawling, or a high-climbing liana, with prickly stems and leaves, tomentose young stems, and leafy, pinnately divided stipules. **Leaves** bipinnately compound, alternate, rachis up to 70 cm long, thorny, somewhat swollen at the base; pinnae in 3–11 pairs, 10–18 cm long, thorny; leaflets in 5–13 pairs; leaflet blades ovate to elliptic, mostly 1.5–3.5 (–6.5) cm long, rounded to subcordate at the base, acute to nearly rounded and mucronulate at the tip; upper surface glabrous, lower finely pubescent; margins entire; petiolules ca. 1–2 mm long. **Inflorescence** a many-flowered axillary raceme up to 20 cm long, rachis pubescent; flowers functionally unisexual, plants monoecious. **Calyx** of 5 oblong sepals 6–8 mm long, brown-pubescent on the outside, reflexed at anthesis; pedicel 2–6 mm long, subtended by a linear bract 8–11 mm long. **Corolla** of 5 free, yellow, petals, 4 of them oblong, 6–9 mm long, the other ca. 5 mm long and marked with red spots. **Ovary** of female flowers superior, with a simple style; ovary vestigial in male flowers. **Stamens**

of male flowers 10, free, sterile in female flowers. **Fruit** a prickly oblong pod 5–9 cm long, containing 1 or 2 glossy gray, ovoid to subglobose seeds 1.5–2 cm in diameter. **Flowering** reported from March to May (but probably of longer duration), fruiting for much of the year.

Distinguishable by its scrambling shrub habit; leafy stipules; thorny stems; thorny, bipinnately compound leaves; small yellow flowers in racemes; pedicels 3–5 mm long; one petal shorter than the others and marked with red; and gray, marble-like seeds in a spiny pod. This shrub can most easily be distinguished from the similar *Caesalpinia major* by its pinnate, leaf-like rather than subulate stipules.

Dalbergia candenatensis (Guam)

TONGATAPU:

Parks 15566—Inshore brush on the beach at Haʻavakatoto.

Soakai 308—(Specimen not located.)

HAʻAPAI:

Hotta 4194—Lotofoa Village on Foa.

NIUATOPUTAPU:

Buelow 1110—(Specimen stored at Vainī but not examined.)

Whistler 6301—Along trail behind Vaipoa Village.

30. Dalbergia candenatensis (Dennstaedt) Prain

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Its distribution on Vavaʻu should be mapped, but the best way to preserve it is to preserve the mangrove forests. It should also be searched for in the mangroves of Tongatapu and Nomuka.

Indigenous to Tonga, ranging westward to India. It occurs in Tonga on Tongatapu, Haʻapai, and Vavaʻu, but the only modern records (since 1953) are from the latter group. It roots along the margins of mangrove swamps and climbs over littoral and mangrove trees. No local names or uses are reported.

Liana or sprawling shrub with glabrous leaves. **Leaves** alternate, odd-pinnately compound, rachis 3–6 cm long, leaflets alternate, 3–7; leaflet blades obovate, 1–4 cm long, acute to subround at the base, rounded to subretuse at the tip; surfaces glabrous; margins entire; petiolule 1–3 mm long. **Inflorescence** a several-flowered axillary raceme or narrow panicle 1–4 cm long. **Calyx**

campanulate, 2.5–3.5 mm long, shallows divided into 5 unequal lobes; pedicel 1–3 mm long. **Corolla** papilionaceous, white, 5–8 mm long. **Ovary** superior, 2-celled, with a simple style. **Stamens** 10, diadelphous, with 9 fused together and one free, included. **Fruit** a curved, oblong legume 2.5–3.5 cm long, mostly 1-seeded. **Flowering** reported (in Fiji) in November and February; fruiting in February in Fiji and "June to August" in Tonga, but both are probably of longer duration (perhaps throughout the year).

Distinguishable by its liana habit; odd-pinnately compound leaves with 3–7 leaflets often slightly notched at the tip; short axillary racemes or narrow panicles; small white papilionaceous flowers; and an oblong, mostly 1-seeded pod.

TONGATAPU:

Parks 15326—Climbing over trees on edge of mangrove swamp in Nuku'alofa.

HA'APAI:

Yuncker 15839—Thicket between the road circling the Nomuka between the inland lake and the sea.

VAVA'U:

Crosby 39—Without further locality.
Buelow 949—Next to the road just before the causeway to Pangaimotu coming from Neiafu.
Buelow 1638—Lagoon between Ha'akio and Houma.

31. Mucuna glabra (Rein.) Dear-Wilmot

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species other than to protect its habitat in Tonga. In Tonga, this species is known only from 'Eua and Tafahi, and the preservation of native forest on 'Eua, especially in the National Park, is very important.

Indigenous to Tonga, also found in Samoa. It was named from Samoa, without mention of any Tongan specimens (which were probably not known to the researcher). It is known in Tonga only from 'Eua and Tafahi, where is it occurs in lowland forest, reported from 100 to ca. 300 m elevation. This vine is mostly an inland species, with the other species, *Mucuna gigantea*, being the predominant littoral species. No local names or uses are reported, but the seeds have probably been used in seed leis.

High-climbing liana with stems that are sparsely pubescent when young, woody, thick and knobby when mature. **Leaves** trifoliate, alternate, rachis 12–35 cm long, flat on the upper side, swollen at the base; leaflet blades elliptic to ovate, terminal one 6–17 cm long, lateral ones nearly as long but unequally sided, rounded or subtruncate to acute at the base (oblique on lateral leaflets), attenuate to sometimes rounded at the tip; surfaces glabrous, upper side dark green, lower side lighter, palmately 3- or 5-veined from the base; margins entire; petiolules thickened, 5–14 mm long, with a pair of tiny linear stipels. **Inflorescence** an axillary cluster of several racemes (often only one or two of them developing) up to 18 cm or more in length, borne on leafless woody stems. **Calyx** cup-shaped (broadly so in fruit), 1.3–1.8 cm long, with 5 inconspicuous lobes 2–5 mm long; pedicel up to 3 cm long. **Corolla** papilionaceous, pale green;

Mucuna glabra flowers (‘Upolu, Samoa)

Mucuna glabra fruit (‘Upolu, Samoa)

banner ovate, notched at the tip, ca. 3.2–4 cm long; wings falcate, 4.5–6 cm long; keel curved, 5.5–6.5 cm long. **Ovary** superior; style linear with a subglobose stigma. **Stamens** 10, diadelphous, 9 fused together, 1 free. **Fruit** an ovate to narrowly oblong legume 9–22 cm long, longitudinally 2-winged on the two margins, with the sides irregularly and transversely ridged with ridges up to 8 mm wide, appressed red-brown pubescent, containing 1–several dark, discoid seeds 2–2.5 cm in diameter. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its high-climbing woody vine habit; trifoliate leaves; terminal leaflet 6–17 cm long with a broadly cuneate base; petiole of leaflet sometimes pubescent; showy greenish, papilionaceous flowers in hanging racemes; and a pod with transverse ridges. It can most easily be distinguished from the related *Mucuna gigantea* by the presence of transverse ridges on the fruit.

‘EUA:

Sykes 186—North of Houma, no elevation given.
Whistler 7338—Forest near the top of the island near Liku.

TAFAHI:

Buelow 1308—Next to main path above Fakafafa-mo-e-Tauloto area at 140 m elevation.
Buelow 1329—Next to main path to bushy about a half mile outside of town at 100 m elevation.

32. Senna sophera (L.) Roxb.

Tongan Name: *matui*
English Name: none
Reason for Listing: apparently disappearing
Status: rare Polynesian adventive
Suggestion Action: The species is probably disappearing in competition with other weeds, so the seeds should be collected and the plant grown in a botanical garden to preserve its presence in Tonga.

A Polynesian introduction to Tonga, native to and widespread in the Old World Tropics. It is known in Tonga from Tongatapu, ‘Eua, Niuatoputapu, and Tafahi, but is seems to be disappearing, because only four of the nine collections have occurred in the last 57 years. The plant is probably unable to successfully compete with more aggressive, recently introduced weeds. The leaves of ***matui*** were once used to treat ringworm. It is probably effective at this because members of this genus are known to contain prussic acid, which adversely affects ringworm. The plant was not found in a previous collection site during a survey of rare plants on ‘Eua in November 2010.

Senna sophera (‘Eua)

Erect subshrub up to 2 m in height, with reddish, glabrate stems. **Leaves** even-pinnately compound, alternate, rachis 7–18 cm long, with a pair of clavate to cylindrical glands at the base, leaflets 6–12 pairs; leaflet blades lanceolate to ovate, mostly 1.5–3.6 cm long, unequally acute at the base, acuminate at the tip; surfaces glabrous; margins entire; petiolules 1–2 mm long. **Inflorescence** an axillary, 4–10-flowered raceme 3–5 cm long, bearing subacute to obtuse bracts. **Calyx** of 5 free, ovate sepals ca. 3.5–5 cm long, pedicel ca. 5–7 mm long (longer in fruit). **Corolla** of 5 free, yellow, obovate petals ca. 8–12 (?) mm long. **Ovary** superior, 1-celled, with a simple style. **Stamens** 10, free, some reduced to staminodes. **Fruit** a linear pod 6–9.5 cm long, bearing seeds in two rows. **Flowering** and fruiting occur continuously.

Distinguishable by its subshrub habit; alternate, pinnately compound leaves, often with a pair of club-shaped glands at the base of the rachis; 6 to 12 pairs of ovate leaflets; yellow, 5-parted flowers; and a narrow, flattened pod 6–9.5 cm long, with seeds in two rows.

TONGATAPU:
Forster s.n.—Without further locality.
Home s.n.—Without further locality.
Whistler 6683—Weed of lawn area at the cemetery at Pea Village.

‘EUA:
Yuncker 15620—Waste area near ‘Ohonua.
Soakai 370—Stony place “near the rocks” at ‘Ohonua at 6 m elevation.
Sykes 586—Waste place in ‘Ohonua.
Whistler 5013—Next to the bridge just north of the wharf at ‘Ohonua.

NIUATOPUTAPU:
Whistler 6197—Weed of disturbed areas in Falahau Village.

TAFAHI:
Hurlimann 576—On a stone wall in Tafahi township at 50 m elevation.
Buelow 1167—Above and around the village at 60 m elevation.
Whistler 6230—Weed common in the village.

33. Serianthes melanesica Fosb.

Serianthes myriadenia sensu auct. non Planch. ex Benth.

Tongan Name: *mohemohe*
English Name: none
Reason for Listing: restricted in Tonga to one island (with one other island record)
Status: rare indigenous
Suggestion Action: Its distribution in Tonga should be mapped, since most of the recent collections are from the same small site. The plant should also be grown in gardens and seedlings passed out to interested gardeners and farmers to assure its continued presence in Tonga.


Serianthes melanesica (Vava‘u)

Indigenous, ranging from Vanuatu to Tonga. It is known in Tonga only from Vava‘u and Late, where it occurs in coastal and lowland forest, reported from near sea level to 130 m elevation. The good quality timber is used for making boats, handicrafts, and wooden artifacts. The variety in Tonga is var. *yunckeri* Fosb.

Large tree with a spreading crown, up to 25 m in height with glabrescent young stems. **Leaves** bipinnately compound, alternate; rachis red-brown tomentose, 6.5–22 cm long with a large nectary gland near the base and smaller ones below the pinnae pairs, pinnae in 4–12 opposite or alternate pairs, leaflets in 7–16 (rarely up to 22), opposite or alternate pairs; leaflet blades oblong, 6–20 mm long, unevenly rounded to truncate at the base, rounded to emarginate at the tip; surfaces finely red-brown tomentose to nearly glabrous; sessile. **Inflorescence** of axillary, many-flowered heads arranged on panicles up to 10 cm long on a red-

brown tomentose peduncle. **Calyx** campanulate, 8–10 mm long, divided about ¼ of its length into 5 triangular lobes, densely pubescent on the outside; subsessile. **Corolla** sympetalous, funnelform, cream-white, 2.2–3.3 cm long, divided about a third of its length into 5 narrowly elliptic lobes densely pubescent on the outside. **Ovary** superior, 1-celled; style filiform. **Stamens** numerous (hundreds), free, protruding, with the filaments up to 4.5 cm long, white at the base, pink towards the tip. **Fruit** a straight, flat, several-seeded, narrowly oblong pod 8–11 cm long, velvety brown, with slightly thickened margins. **Flowering** reported in December to February and June, but probably occurring throughout the year, fruiting probably occurring throughout the year and fruits persisting on the tree.

Distinguishable by its large tree habit; bipinnately compound leaves; leaflet blades 6–20 mm long; panicles of flowers bearing many showy pink and white stamens; and velvety-brown, strap-shaped pod.

TONGATAPU:

USEE s.n.—Planted in the village of Nuku'alofa.

VAVA'U:

Crosby 57—Without further locality.
Yuncker 16141—At summit of Mt. Talau at 130 m elevation.
Buelow 873—East side of Mt. Talau.
Whistler 6023—Coastal forest on a steep slope at Utungake at the south end of Pangaimotu Island at ca. 3 m elevation.
Whistler 6552—Coastal forest on a steep slope at Utugake at the south end of Pangaimotu Island at ca. 3 m elevation.
Whistler 11334—Coastal forest on a steep slope at Utungake at the south end of Pangaimotu Island at ca. 3 m elevation.
Whistler 11686—Coastal forest on a steep slope at Utungake at the south end of Pangaimotu Island at ca. 3 m elevation.

LATE:

Grubbe 3—(Specimen not located.)

SINE LOC:

Matthews 66—Without further locality.

34. Sesbania coccinea (L. f.) Poir.

Aeschynomene coccinea L. f.

Tongan Name: *'ohai*
English Name: none
Reason for Listing: restricted in Tonga to one island group and infrequency of collection
Status: rare indigenous
Suggestion Action: The small islands of Vava'u should be surveyed to see if the species is found at additional sites, and its populations on the islands on which it is know to occur should be sampled to estimate population size.

Indigenous, also found on the Isle of Pines and nearby islands, Loyalty Islands, and Fiji (Lau Islands only). It is restricted in Tonga to a few islands south of the main Vava'u island

(Maninita, Mounu, and Taunga), where it occurs on sandy beaches. No local names or uses are reported, probably because of its rarity and occurrence mostly on small uninhabited islands.

Sesbania coccinea (Vava‘u)

Shrub or tree up to 2 m or more in height, with pubescent young stems and caducous, lanceolate stipules up to 8 mm long. **Leaves** odd-pinnately compound, alternate, rachis up to 22 cm long, leaflets mostly in 16–19 pairs; leaflet blades elliptic to oblong, 1.2–4.5 cm long (longest in the middle of the rachis), rounded at the base, rounded at the tip; surfaces pale green, upper side darker, glabrous, lower side pubescent; margins entire; petiolules 1–2 mm long. **Inflorescence** a short, several-flowered, axillary raceme with a rachis up to 4 cm long. **Calyx** 1–1.2 cm long, shallowly 5-toothed, pubescent, on a pedicel up to 2 cm long and swollen at the apex. **Corolla** papilionaceous, pale reddish yellow; banner suborbicular, 3.2–3.6 cm long, clawed, notched at the tip; wings unequally narrowly elliptic, 3.2–3.6 cm long, clawed; keel as long as the wings, enclosing the androecium. **Ovary** superior, style long and filamentous, unlobed. **Stamens** diadelphous, 9 united with one free. **Fruit** a linear pod 24–36 cm long. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its shrub habit; odd-pinnately compound leaves with 16–19 pairs of elliptic to oblong leaflets; large, showy pale reddish yellow, papilionaceous corolla; and linear pod.

VAVA‘U:

Crosby 46—Without further locality.
Cameron 4975—Taunga Islet at 1 m elevation.
Drake 362—Low sandy isthmus separating the north and south ends of Taunga Islet.
Whistler 11692—Uncommon on the east side of Maninita Islet, also seen on Mounu Islet, near sea level.
Suzuki 255—Taunga Islet.

35. Uraria lagopodioides (L.) Desv.

Uraria lagopoides DC.

Tongan Name: none

English Name: none
Reason for Listing: infrequency of modern collection
Status: rare Polynesian adventive
Suggestion Action: Little can be done for this plant, other than to collect it and grow it in gardens. However, it is lawn weed that very amenable to growing in gardens.


Uraria lagopodoides (Niuatoputapu)

A Polynesian introduction to Tonga, native to southern Asia. It occurs in Tonga in lawns and other disturbed places on all the main islands, reported only from the lowlands. This plant was probably accidentally introduced in ancient times and a common weed, but it has now nearly disappeared since it cannot compete with the aggressive, more recently introduced weeds. It is virtually unknown to Tongans, and no uses or local names have been reported.

Prostrate or suberect subshrub with pubescent stems up to 60 cm long, and deltoid, acuminate-tipped stipules ca. 5 mm long. **Leaves** trifoliate, alternate, rachis 1–2.5 cm long, pubescent, with a swollen base; leaflet blades suborbicular to ovate or elliptic, 1–5.5 cm long, rounded at the base, obtuse to notched at the tip; upper surface glabrous, veins of lower surface pubescent; margins entire; petiolules 1–2 mm long, with a linear stipel ca. 1 mm long. **Inflorescence** a dense, many-flowered, cylindrical, terminal raceme 2.5–5.5 cm long, the flowers subtended by an ovate, densely hirsute bracteole 5–7 mm long. **Calyx** divided to near the base into 5 unequal, densely hirsute linear lobes, the longest ones 5–7 mm long, on a short pedicel. **Corolla** papilionaceous, lavender and white; banner orbicular, ca. 3 mm long; wings falcate-oblong, adhering to the keel, ca. 3 mm long; keel enclosing the stamens. **Ovary** superior, 1-celled, style filiform with a capitate stigma. **Stamens** 10, diadelphous, with 9 fused together, enclosed within the keel. **Fruit** a black, indehiscent, ovoid legume 2.5–3.5 mm long. **Flowering** and fruiting occur continuously.

Distinguishable by its low-growing subshrub habit; pubescent stems; trifoliate leaves; lavender flowers borne in dense hairy raceme; and a one-seeded pod.

TONGATAPU:
Home—Without further locality.
Soakai 191—(Specimen not located.)
Soakai 454—(Specimen not located.)

EUA:
Lister s.n.—Without further locality.
Parks 16024—Open meadows at “the Liku” at “350 m” elevation [which is higher than the island].

Whistler 7413—Fernland on a ridge north of Lokupu.

HAAPAI:

Yuncker 15805—Sandy soil along road encircling the island, near sea level.
Soakai 526—(Specimen not located.)

VAVAU:

Crosby s.n.?—Without further locality.

NIUATOPUTAPU:

Hurlimann 367—On path on mountain rage east of Vaipoa.
Whistler 6123—Roadside weed on the south end of the island.

TAFAHI:

Hurlimann 544—Roadside between the township of Tafahi and the landing place at Faihavanui.

FLACOURTIACEAE

36. Casearia buelowii Whistler

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and endemic to one island
Status: rare endemic
Suggestion Action: This tree must be considered rare and endangered, since it is known only from three records all possibly from a single small locality. This area should be protected, and a botanical survey done on it and in surrounding areas to see what the population size is for this species.

Casearia buelowii (Vava‘u)

Endemic to Tonga, where it is restricted to Vava‘u. In fact, it is known from only a single locality there, Mt. Talau, and has only been collected three times, two of them fertile (1892 and 1978). It was mostly recently found in forest on this hill in 2004 (Whistler, pers. research). It is perhaps most closely related to *Casearia richii* of Fiji, but A.C. Smith (on an annotated specimen) did not even believe the Tongan specimen was in the genus *Casearia*. No local names or uses are reported, probably because of its rarity.

Small tree or shrub up to 2 m or more in height, with glabrous, longitudinally striate, somewhat zigzag stems marked with conspicuous, small, light-colored lenticels. **Leaves** simple, alternate, distichous; blade coriaceous, elliptic, 6–14 cm long, rounded to acute at the base, acute to

broadly acuminate at the tip; surfaces glabrous, upper surface darker, sometimes with brown peltate scales; margins entire; petiole 4–10 mm long. **Inflorescence** of axillary, many-flowered clusters. **Calyx** cup-shaded to rotate, comprising 4 green, elliptic to suborbicular sepals ca. 5–7 mm long, subtended by 2 hemispherical sepal-like bracts 1.5–2 mm long. **Corolla** absent. **Ovary** superior, with a short style and discoid stigma. **Stamens** 5–7, free. **Fruit** a capsule (but not seen), probably with many seeds surrounded by a red aril. (The description may be revised if additional fertile specimens are found.) **Flowering** reported in September and February, fruiting not recorded, but both probably occurring throughout the year.

Distinguishable by its small tree habit; simple alternate leaves on a zigzag stem; axillary, many-flowered clusters; absence of corolla; 5 to 7 free exserted stamens; and capsule fruit.

VAVA‘U:

Crosby 294—“Tree from Talam [Talau?] Top, Feb. 92.”
Buelow 1445—Top of Mt. Talau, Vava‘u, 120 m elevation.
Whistler 11780—Below the south side of top of Mt. Talau at 120 m elevation.

GOODENIACEAE

37. Scaevola gracilis Hook. f.

Scaevola porrecta A.C. Sm. in Yuncker

Tongan Name: *ngahu uta?*
English Name: none
Reason for Listing: restricted in Tonga to a two islands, limited elsewhere to Kermadecs
Status: restricted indigenous
Suggestion Action: Nothing much can be done for this species, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes.

Scaevola gracilis (Tofua)

Indigenous to Tonga, also found in the Kermadec Islands. The species was originally recognized as an endemic species, *Scaevola porrecta* by A.C. Smith, but was subsequently combined with *Scaevola gracilis* of the Kermadecs. It is restricted in Tonga to Kao and Tofua, where it grows in open areas near the coast and inland up to 1020 m elevation. No local names (other than the somewhat dubious ***ngahu uta***) or uses are reported, mostly because it is a small plant restricted to remote islands.

Shrub with weak branches trailing along the ground; stems pilose. **Leaves** simple, alternate; blade subsucculent, narrowly oblanceolate, 4–8 cm long, long attenuate and decurrent

at the base, acute at the tip; surfaces appressed-pubescent; margins remotely and shallowly toothed; petiole 1–2 cm long. **Inflorescence** of solitary, axillary flowers at the ends of the branches. **Calyx** campanulate, 3.5–5 mm long, divided about halfway into 5 lanceolate lobes, densely pilose on the outside; sessile. **Corolla** sympetalous, bilabiate and slit down one side to the base so that the lobes are arranged on one side, white, 1.5–2 cm long, divided about halfway into 5 oblanceolate lobes, densely pilose on the outside. **Ovary** inferior, with a somewhat spathulate style. **Stamens** 5, free, included. **Fruit** a white, subglobose drupe 6–8 mm long. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its trailing shrub habit; oblanceolate leaves with hairy surfaces; solitary flowers in the upper leaf axils; white corolla split down one side so as to appear to have half missing; and white drupe.

KAO:

Yuncker 15928—Sprawling over rocks near the summit at ca. 900 m elevation.
Buelow 682—Top of Kao summit at ca. 1020 m elevation.
Buelow 2874—Coast east of Topu‘efio.

TOFUA:

Hotta 4386 (n.s.)—Near top of “soma.”
Scarth-Johnson 64—(Specimen not located.)
Buelow 583—Along crater rim between Manaka and Hokula in rocky area at 470 m elevation.
Buelow 2550—On outer flank near the rim at Makatu‘utaha at 400 m elevation.
Whistler 10549—North side of rim and down into the crater, at 130 to 460 m elevation.

GYROCARPACEAE

38. Gyrocarpus americanus Jacq.

Tongan Name: ***puko vili***
English Name: none
Reason for Listing: reduction in cultivation
Status: Rare Polynesian cultigen?
Suggestion Action: It is likely that the tree is no longer being planted or tended, and is in danger of disappearing from Tonga once the old trees die. The seeds should be planted in gardens, and seedlings distributed to any one who is interested.

Probably a Polynesian introduction to Tonga, ranging throughout the tropics and in the Pacific as far east as the Society Islands. It is known in Tonga only in cultivation in villages on most of the islands. Children play with the winged fruits, which spin when thrown into the air. An extract of the scraped bark is used to treat stomachache, and the timber is sometimes used to make canoes. The tree was seen near the airport during a survey of ‘Eua rare plant species in November of 2010.

Medium-sized tree up to 18 m in height, but usually much less, with subglabrous stems, and when old, with a thick gnarled trunk; bark tan, smooth except for scattered horizontal ridges, vertical shallow grooves, and vertical rows of conspicuous, corky lenticels. **Leaves** simple, alternate, often crowded at the branch tips and nearly deciduous during flowering; blade ovate to subround and often 3-lobed, 10–26 cm long, rounded to subcordate at the base, narrowly acute to

Gyrocarpus americanus flowers (Savai‘i, Samoa)

Gyrocarpus americanus fruits (Savai‘i, Samoa)

attenuate at the tip; upper surface glabrous, lower side pubescent; margins entire to lobed; petiole 7–25 cm long. **Inflorescence** of upper-axillary, many-flowered cymes up to 15 cm long in fruit (much shorter at anthesis); flowers unisexual, plants monoecious; male flowers many and borne towards the upper portion of the cyme; female or bisexual flowers fewer and borne towards the base. **Calyx** usually of 7 elliptic, white sepals ca. 1 mm long, puberulent on the outside, 2 of which enlarge after anthesis to form wings, on a pedicel 2–12 mm long. **Corolla** absent. **Ovary** of female flowers superior, with a subsessile capitate stigma; ovary vestigial in male flowers. **Stamens** of male flowers 3–5, free, with or without staminodes, stamens present or absent in female flowers. **Fruit** a brown, pendulous, ovoid to ellipsoid drupe 1.2–1.6 cm long, with 2 prominent oblanceolate wings up to 9 cm long, surfaces puberulent. **Flowering** seasonal, reported from April to September, fruiting from July to January.

Distinguishable by its medium-sized tree habit; often thick trunk; alternate, long-stalked, often palmately lobed leaves; small white flowers in axillary cymes; and ovoid, dry fruit bearing two long, prominent wings.

TONGATAPU:

Parks 15297—Margin of cemetery in Nuku‘alofa.
Sykes 945—Near Ha‘amonga, Afa.
Sykes 946—Near Ha‘amonga, Afa.

ʻEUA:

Yuncker 15633—Cultivated in ʻOhonua Village.

HAʻAPAI:

Yuncker 15793—Cultivated in Pangai Village near a dwelling. (Incorrectly listed by Yuncker as ʻEua.)

Hotta 4183—Hihifo Village on Lifuka

Whistler 6607—One tree at the west end of Haʻano.

VAVAʻU

Whistler 6022—Cultivated in Mataika Village.

NIUATOPUTAPU:

Whistler 6299—At least two trees cultivated in Vaipoa Village.

NIUAFOʻOU:

Whistler 6379—Cultivated in Fataʻulua Village.

LAMIACEAE

39. Plectranthus forsteri Benth.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this rare herb than grows in sunny, rocky places (and hence agriculture is not a threat to it), other than to protect its habitat in Tonga. This species is known in Tonga only from ʻEua, and the preservation of native forest on this island, especially in the National Park, is very important.

Indigenous to Tonga, ranging from New Caledonia to Fiji and Tonga. It has been erroneously attributed to Samoa (Smith 1991, 5:224), based upon an incorrect identification of another species. In Tonga it is known only from limestone cliffs on ʻEua, but may also be found on ʻAta, which is sorely in need of a botanical visit. No local names or uses are reported, mostly because it is so rare and inconspicuous. This plant appears to be indistinguishable from *Plectranthus parviflorus* Willd., which Wagner et al. (1990) noted occurs from Australia and Hawaiʻi. Specimens annotated as this at Bishop are from the Austral Islands, and a new record of this has tentatively been identified on Rarotonga (de Lange, pers. comm. 2010). No local names or uses are reported for this rare, inconspicuous plant. The species are discussed in Blake (1971).

Perennial herb or subshrub up to 1 m in height, with 4-angled, pubescent stems. **Leaves** simple, opposite; blade ovate, 1–3 cm long, broadly acute to truncate at the base, rounded to broadly acute at the tip; surfaces finely pubescent; margins crenate; petiole 0.5–3 cm long. **Inflorescence** of terminal racemes up to 25 cm long, with numerous verticils of 10–16 flowers and small bracts. **Calyx** bilabiate, 2–2.5 mm long (larger in fruit), unequally 5-lobe d or 2-lipped, inflated and papery with age, on a slender pedicel 2–5 mm long. **Corolla** bilabiate, white to pale blue, 2.5–4 mm long, the lobes ca. 1 mm long. **Ovary** superior, divided to the base into

four carpels united at the base by their common style. **Stamens** 4, epipetalous, exserted. **Fruit** comprising 4 1-seeded nutlets 0.7–1 mm in diameter. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its herbaceous habit; mature stems 4-angled in cross sections; small, opposite, pubescent leaves with scalloped margins; thin white flowers in whorls on long racemes; white to pale blue, 2-lipped flowers; and fruit of 4 tiny nutlets.

ʻEUA:

Hotta 5524—Mt. Koloʻaki-lupe-Tonga limestone cliff.

Buelow 1851—About 2/3 of the way from Vaingara to the cliff descending to Lokupo at the top of the cliff, growing on vertical coral cliff facing the ocean at 60 m elevation.

Plectranthus forsteri (Fiji)

MALVACEAE

40. Sida samoensis Rechinger

Sida microphylla sensu Hemsley, Burkill; non Cav.
Sida parvifolia sensu auct. non DC.
Sida retusa sensu auct. non L.

Tongan Name: none
English Name: none
Reason for Listing: apparently disappearing in Tonga
Status: rare indigenous?
Suggestion Action: The plant should be located, perhaps most easily on ʻEua, where the only known modern collections have been made, and the seeds gathered to be planted in gardens. However, it is not typical to grow "weeds" in botanical gardens, even one that may be native.

Possibly an unintentional Polynesian introduction to Tonga, native to Fiji and western Polynesia. It is known in Tonga from the three main islands, but only two of its seven known collections are recent (e.g., since 1953). It would seem to be native since it has a restricted regional distribution, but collections indicate that it does not occur in native habits, at least in Samoa where it is a minor weed in coastal villages and sunny disturbed places, reported only near the coast. It was probably much more common prior the European era, but has declined in

frequency probably because of the competition with more aggressive weeds introduced during the last two centuries. No local uses are names are known.

Sida samoensis (Niuatoputapu)

Prostrate subshrub, much-branched, with finely stellate-pubescent stems up to 35 cm long, and equal, filiform, stipules 1–3 mm long. **Leaves** simple, alternate; blade orbicular to broadly ovate, 0.5–2.5 cm long, cuneate to rounded at the base, acute to obtuse at the tip; lower surface densely stellate-pubescent; margins serrate; petiole 3–5 mm long. **Inflorescence** of solitary, axillary and subterminal flowers. **Calyx** cup-shaped, 3.5–5 mm long, deeply divided into 5 broadly ovate, apiculate, strongly ribbed lobes**,** on thin pedicel 1–2 cm long. **Corolla** rotate, with 5 free, pale orange, obovate, unequally bilobed petals ca. 7–9 mm long. **Ovary** superior, usually 1-celled; stigma 5-lobed. **Stamens** many, monadelphous. **Fruit** a flattened-globose schizocarp 3–4.5 mm in diameter, breaking up at maturity into 5 mericarps, each with a pair of terminal awns ca. 1.5 mm long. **Flowering** and fruiting occur continuously.

Distinguishable by its prostrate, somewhat woody herb habit; small, alternate leaves with toothed margins; pale orange, 5-parted, monadelphous flowers lacking bracts below the calyx; and a rotate schizocarp that splits into 5 segments (mericarps), each bearing a pair of awns. (N.B. The mericarps of Matthews s.n. are awned unlike the rest of the plants in Tonga and elsewhere, according to an unknown source.)

TONGATAPU:

Forster s.n.—Without further locality.

Moseley s.n.—Without further locality.

‘EUA:

Sykes 789—Matalangi-a-Maui.

Palmer 143—(Specimen not located.)

HA‘APAI:

Buelow 341—Yard near Free Church of Tonga on Ha‘afeva.

VAVA‘U:

Crosby 2—Without further locality.

Yuncker 16071—Grassy area near the upper rim of the limestone coastal cliff on the northern side of the island above Leimatua at ca. 150 m elevation.

NIUATOPUTAPU:

Buelow 1113—Coconut plantation northeast of Hihifo.

SINE LOC:

Matthews 107—Without further locality (June 1830).

MELIACEAE

41. Aglaia heterotricha A.C. Sm.

Tongan Name: *langakali vao*
English Name: none
Reason for Listing: endemic to one island
Status: rare endemic
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the national park and other areas on ‘Eua is the most useful measure that can be taken. Since it is endemic to only one island, the protection of its habitat on ‘Eua is especially important.

Endemic to ‘Eua, where it is occasional in primary forest in the higher, undisturbed parts of the island, probably occurring from middle elevations to the highest of the island. This tree is probably called ***langakali*** or ***langakali vao***, because of its being the genus *Aglaia*, but unlike the related *Aglaia saltatorum*, it has no reported uses. The tree was seen several times in primary forest during a survey of ‘Eua rare plant species in November of 2010.

Small tree up to 10 m or more in height, with lepidote scales on the young stems. **Leaves** odd-pinnately compound, with the rachis up to 55 cm long, conspicuously swollen at the base; leaflets mostly 7, opposite; leaflet blades elliptic to almost obovate, 15–25 cm long, obtuse or acute at the base, obtuse to obtusely cuspidate at the tip; surfaces punctate, lower surface subglabrous; margins entire; petiolules 7–17 mm long. **Inflorescence** a spreading, many-flowered, axillary panicle up to 10 cm long when flowering, bearing stellate pubescence. **Calyx** rotate, ca. 1.5 mm across, deeply divided into 5 ovate lobes, stellate pubescent on the outside; pedicel less than 1 mm long. **Corolla** of 5 yellow, oblong petals 1.5–1.8 mm long. **Ovary** superior, with a subsessile, capitate stigma; ovary vestigial in male flowers. **Stamens** 5, their filaments united to form an urceolate staminal tube, stellate-pubescent, sterile in female flowers. **Fruit** a tan-colored, 2-seeded berry (but not known). **Flowering** and fruiting occur throughout the year.

Aglaia heterotricha (Bishop Museum)

Distinguishable by its small tree habit; stellate pubescence on the young stems and leaf rachis; odd pinnately compound leaves with about 7 leaflets; large panicles of tiny yellow flowers; and a tan, 2-seeded berry. The species is close to *Aglaia saltatorum*, but differs in having the basal leaflets reduced in size and a glabrous staminal column.

‘EUA:
Parks 16305—Central plateau.
Hurlimann 265?—(Specimen stored at Vainī but not examined.)
Buelow 485—(Specimen not located.)
Whistler 7192—Forest on a terrace at Makalea on the southeast side of the island.

42. Dysoxylum tongense A.C. Sm.

Tongan Name: ***mo‘ota***; ***mo‘ota mea***; ***mo‘ota kula***
English Name: none
Reason for Listing: endemic to one Tongan island
Status: restricted endemic
Suggestion Action: Nothing much can be done specifically for this species, but the protection of native forests in the National Park and other areas on ‘Eua is the most useful action that can be taken. Since it is endemic to only one island, the protection of its habitat on ‘Eua is especially important.

Endemic to Tonga, where it has been collected only on ‘Eua. However, the tree may also occur on Ata Island (Manu Pomelile, pers. comm.). It is occasional to common in lowland forest, probably up to 310 m elevation. The timber is used for houses, furniture, canoes, and bowls. The tree is very similar to *Dysoxylum huntii* of Samoa, and may be the same species. However, the Samoan species is found mostly in montane forest, mostly above 600 m elevation (and is the dominant tree in montane and cloud forest).

Large tree up to 15 m or more in height, with glabrate young stems. **Leaves** even-pinnately compound (sometimes odd-pinnate), alternate, rachis 17–28 cm long, swollen at the base, leaflets in (2–) 3–6 opposite pairs; leaflet blades coriaceous, unequally sided, subfalcate to ovate, 7–12 (–15) cm long (reduced in size towards the base of the rachis and the terminal one often atrophied), broadly obtuse and decurrent at the base, obtusely cuspidate or short-acuminate at the tip; surfaces glabrous and lacking pubescent domatia; margins entire; petiolule 6–12 mm long. **Inflorescence** a many-flowered raceme or branching panicle 8–13 cm long, bearing small, caducous, oblong, obtuse-tipped bracts 2–3 mm long. **Calyx** broadly cup-shaped, deeply split into 4 or 5 hemispherical lobes 2.5–3 mm long, minutely puberulent on the outside, sessile. **Corolla** of 5 oblong to petals 7–7.5 mm long, free or weakly adhering at the base, copiously sericeous on the outside. **Ovary** superior, mostly 4-celled, style filamentous, with

Dysoxylum tongense (‘Eua)

a discoid stigma. **Stamens** 10, fused by the filaments into an urceolate staminal tube 5–6 mm long. **Fruit** a capsule containing 3 red seeds. **Flowering** reported in June or July. (Fruiting specimens have not been described.)

Distinguishable by its large tree habit; pinnately compound leaves with 4–13 leaflets; inflorescences mostly 8–13 cm long; and green globose capsule that splits open to expose the bright red seeds.

‘EUA:

Parks 16036—(Specimen not located.)
Parks 16072—Johannsen plantation.
Parks 16133—High central plateau.
Parks 16282—Plateau forests.
Parks 16389—(Specimen not located.)
Yuncker 15316—Forest above Fua plantation.
Yuncker 15336—Edge of forest near the center of the island.
Yuncker 15366—Forest above Riechelmann’s Fuai plantation near the center of the island at ca. 240 m elevation.
Yuncker 15662—Forest above Riechelmann’s Fuai plantation near the center of the island at ca. 240 m elevation.
Hotta 5340—Forest on Mt. Ma‘atakitau.
Sykes 374—Near top of ridge at Makalea in limestone forest.
Sykes 485—Rainforest near summit ridge at Forest Farm near Makalea.
Sykes 520—Secondary forest remnant near Hango College on the second terrace.
Sykes 533—Rainforest near summit ridge at Forest Farm near Makalea.
Sykes 1155—Upper terrace at the Lokupo Beach track.
Whistler 6492—Lowland forest in the center of the island.
Whistler 7384—Lowland forest near the top of the slope west of Lokupo.

MYOPORACEAE

43. Myoporum sandwicense A. Gray

Tongan Name: none
English Name: false sandalwood
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Other than surveying the cliffs of ‘Eua to determine if it is more common than the only known collection would indicate, nothing much can be done for this shrub other than to protect its habitat in Tonga. It is known in Tonga only from ‘Eua, and the preservation of native forest on this island, especially in the National Park, is very important.

Indigenous to Tonga, where it is known from only a single population scrub forest on the cliffs of ‘Eua. It differs from other regional species or populations in having the leaf tips mostly rounded rather than acute. No local names or uses are reported for this plant, probably because of its rarity and occurrence far from any village.

Indigenous to Tonga, where it is known from only a single population scrub forest on the cliffs of ‘Eua. It differs from other regional species or populations in having the leaf tips mostly rounded rather than acute. No local names or uses are reported for this plant, probably because of its rarity and occurrence far from any village.

Myoporum sandwicense (‘Eua)

Shrub up to 1 m in height, with glabrous stems marked by conspicuous leaf scars. **Leaves** simple, alternate, crowded at the ends of the stems; blade somewhat fleshy, oblanceolate, 6–9 cm long, attenuate and decurrent at the base, broadly acute to subround at the tip; surfaces glabrous, more or less concolorous, lower side glandular-pubescent; margins entire; sessile. **Inflorescence** an axillary cluster of up to 4 flowers. **Calyx** broadly obconic, 3.5–4.5 mm long, divided about halfway into 5 triangular lobes, on a pedicel 2–7 mm long. **Corolla** sympetalous, campanulate, 6–8 mm long, divided about halfway into 5 broadly oblong to ovate lobes, white with pale purple nectar guides, hairy inside. **Ovary** superior, with a simple, exserted style. **Stamens** 5, epipetalous, exserted with purple anthers. **Fruit** a white to purplish (?) ovoid drupe 4–5 mm long, with a persistent withered style. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its shrubby habit, alternate, oblanceolate leaves clustered at the ends of the branches, clusters of small white, bell-shaped flowers marked with purple dots, and small fruit with a persistent style.

‘EUA:

Whistler 11701—One patch seen just over the cliff south of Lokupo lookout at 260 m elevation.

MYRSINACEAE

44. Discocalyx listeri (Stapf) Mez and Stapf

Ardisia listeri Stapf

Tongan Name: none
English Name: none
Reason for Listing: endemic to one Tongan island
Status: rare endemic
Suggestion Action: Nothing much can be done for this forest tree, which is endemic to the island of ‘Eua, except to preserve the native forests on that island, especially in the National Park.

Discocalyx listeri flowers (‘Eua)

Discocalyx listeri fruits (‘Eua)

Endemic to Tonga, where it is found only on ‘Eua. It occurs in native lowland and limestone forest probably from near sea level to the highest elevation on the island (310 m). No local names or uses known.

Small tree or shrub up to 5 m in height, narrow, branches perpendicular to the trunk, stems glabrous. **Leaves** simple, alternate, clustered at the ends of the stems; blade coriaceous, oblanceolate, 13–25 cm long, attenuate at the base, broadly acute at the tip; surfaces glabrous, upper side darker, lower side glandular-punctate; margins entire; petiole 5–30 mm long, flat on the axial surface. **Inflorescence** an axillary, several-flowered cyme up to 6 cm long. **Calyx** rotate, divided to the base into 5 ovate, punctate sepals 1.5–2 mm long. **Corolla** of 5 red ovate sepals 2.5–4 mm long, punctuate. **Ovary** superior, with a subsessile, discoid stigma. **Stamens** 5, their filaments fused into at tube adnate to the corolla, included. **Fruit** a red, subglobose drupe 1.1–1.4 cm long, containing 1 large seed pointed at one end. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its small tree habit with spreading branches; alternate, oblong to oblanceolate leaves; short terminal panicles of small red flowers; and a subglobose red.

‘EUA:

Lister s.n.—On limestone cliff at summit of island.
Parks 16125—Upper plateau.
Parks 16320—Liku terraces.
Parks 16367—Liku terraces.
Parks 16397—Upper plateau.

Hurlimann 257—Primary forest in limestone area on the eastern ridge above Vaingara at ca. 270 m elevation.
Ives s.n.—Eastern edge.
Sykes 386—Rainforest near ridge at Forest Farm in the central part of the island near Makalea.
Buelow 1731—Edge of the ridge cliff at Makalea, windward side of the slope at 280 m elevation.
Buelow 1732—Edge of the ridge cliff at Makalea, windward side of the slope at 280 m elevation.
Buelow 1819—Understory in limestone forest just below the ridge on the east side of the island near Makalea.
Buelow 1852—One quarter of the way from Makalea to the cliff descending to Lokupo near the ocean in understory about 10 m back from the ocean cliff at 60 m elevation.
Buelow 1961—Understory in shaded forest between the sea cliff and the eastern ridge east of Kolomaile at 140 m elevation.
Whistler 7110—Makatea forest on the central part of the island on the east slope.
Whistler 7156—Forest at Makalea at ca. 170 m elevation.
Whistler 7329—Forest above Liku in the central part of the island.
Whistler 11699—Forest on top of the island near Lokupo lookout at ca. 260 m elevation.

MYRTACEAE

45. Metrosideros collina A. Gray

Tongan Name: ***vunga***
English Name: metrosideros
Reason for Listing: infrequency of collection and probably extirpated from Tonga
Status: rare Polynesian cultigen
Suggestion Action: Probably nothing can be done for this cultigen, since it has apparently disappeared from Tonga due to neglect of its cultivation. It could be reintroduced from Fiji to become reestablished in Tonga.


Metrosideros collina (Savai'i, Samoa)

Probably a Polynesian introduction to Tonga from Fiji, native from Vanuatu to the Marquesas, but particularly common in eastern Polynesia. The tree would be expected to occur on Kao, but apparently does not. In Tonga the tree, called ***vunga***, was apparently grown as an ornamental, and the name is still known by older people. It apparently was neglected and when the last trees died out, it disappeared from the country. The author searched for the tree in

the 1990s, and found a family that dug up part of a root they said belonged to the tree, which used to grow by their front door. Where it is common, its flowers are a major source of food for nectar-feeding flowers, but its only use in Tonga was apparently as an ornamental.

Medium-sized tree up to 20 m in height (but usually much shorter), with a thick trunk, glabrescent, often 4-angled or winged, red young stems, and gray bark. **Leaves** simple, opposite; blade coriaceous, quite variable in shape, suborbicular to elliptic, 1.5–9 cm long, acute to round or subcordate at the base, rounded to acuminate at the tip; surfaces glabrous, upper side darker, lower side glandular-punctate; margins entire, thickened, usually narrowly revolute, with a distinct intramarginal collecting vein originating from one of the basal veins; petiole 0–12 mm long (longest in the orange-flowered form), red. **Inflorescence** a short, several-flowered, axillary panicle with a rachis up to 3 cm long, ultimate branches with 1–3 flowers. **Calyx** cup-shaped, 3–6 mm long, divided about 1/3 of its length into 5 ovate lobes, subglabrous to tomentose on the outside, on a pedicel 1–2 mm long. **Corolla** of 5 obovate, concave, caducous, red, orange, or yellow petals 1.5–4 mm long. **Ovary** inferior; style filamentous, slightly longer than the stamens, concolorous with the stamen filaments, unlobed. **Stamens** many (20–24), free, colored like the corolla, up to 2 cm long. **Fruit** a small subglobose, 3-celled capsule 4–6 mm in diameter, with persistent calyx lobes, and filled with tiny, splinter-like seeds. **Flowering** and fruiting occur throughout the year.

Distinguishable by its medium-sized tree habit; opposite, glandular-punctate leaves; flowers with many showy red, yellow, or orange stamens and corolla; small, 3-celled capsule enclosed within the calyx; and numerous, tiny, splinter-like seeds.

TONGATAPU:
Beechey s.n.—Without further locality.

VAVA‘U:
Harvey s.n.—Without further locality.

46. Syzygium neurocalyx (A. Gray) Christoph.

Eugenia neurocalyx A. Gray
“*Eugenia* sp. aff. *E. neurocalyci*, A. Gray” of Burkill p. 37

Tongan Name: *koli*
English Name: none
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen
Suggestion Action: Fruits should be collected and grown in gardens, and seedlings given out to those interested in growing this interesting fragrance plant.

Probably a Polynesian introduction to Tonga, also found in Samoa, Futuna, and Fiji. In Tonga, it is restricted to cultivation, but it is found also found in lowland forest Samoa. The tree has been cultivated primarily for its large fruit, which was used in leis and to scent coconut oil. Seemann (1865–1873) noted in Fiji “The natives wear the whole fruit, or part of it, around their neck, suspended on a string, for the sake of the delicious odour, and also scent with it the cocoa-nut oil used for greasing their naked bodies.”

Syzygium neurocalyx flowers (Vava‘u)

Syzygium neurocalyx fruit (Savai‘i, Samoa)

Small tree up to 4 m (9 m in Fiji) in height, with terete, glabrous stems. **Leaves** simple, opposite; blade lanceolate to long-elliptic, 12–30 cm long, rounded to subcordate at the base, rounded to acute at the tip; surfaces glabrous, glossy above, lighter, dull, and glandular-punctate below; margins entire; petiole 1–7 mm long. **Inflorescence** a terminal, short, several-flowered capitate panicle. **Calyx** campanulate to rotate, 1.5–2 cm long, strongly 10–14-ribbed, notched into round or oblong, red- or green-tinged with red calyx lobes up to 1 cm long; sessile. **Corolla** of 4 white, suborbicular petals 8–15 mm long. **Ovary** inferior, with a simple style 3–5 cm long. **Stamens** many (several hundred), free, yellow, the filaments up to 2.5 cm long. **Fruit** a fragrant, subglobose, shallowly angled, red to purple berry up to 7.5 cm long. **Flowering** reported from January to August, fruits from May to December (in Fiji).

Distinguishable by its small tree habit; large, opposite, short-stalked leaves; large flowers in short, terminal clusters; numerous spreading yellow stamens; and large red to purple, shallowly angled berry.

TONGATAPU:
Yuncker 15247—Open forest below Nualei.

EUA:
Whistler 6476—Along roadside in south-central part of the island.

VAVAU:
Whistler 6020—Uncommon in cultivation at Holonga Village.

NIUATOPUTAPU:
Hurlimann 648—(Specimen stored at Vainī but not examined.)

47. Syzygium quadrangulatum (A. Gray) Merr. & Perry

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this tree other than to protect its habitat in Tonga, where it is known only from ʻEua. The preservation of native forest on this island, especially in the National Park, is very important.


Syzygium quadrangulatum (Fiji)

Indigenous, also found in Fiji. In Tonga it occurs only on ʻEua, where it is reported in lowland forest, probably from near sea level to the highest elevation of the island (310 m). No local names or uses are known.

Medium-sized tree up to 20 m in height, with glabrous, 4-angled stems. **Leaves** simple, opposite; blade elliptic to obovate, 14–32 cm long, broadly acute to subcordate at the base, acuminate at the tip; surfaces glabrous, the looping primary veins not forming a distinct intramarginal vein; margins entire; petiole thick, 2–5 mm long, red. **Inflorescence** a several-flowered, terminal panicle up to 5 cm long. **Calyx** turbinate, 2–2.7 cm long, divided at the top into 4 triangular lobes, subsessile. **Corolla** of 4 free, white, caducous, ovate petals 1–1.4 cm long. **Ovary** inferior, with a filamentous, unlobed stigma. **Stamens** many (hundreds), white to yellowish, free, exserted, up to 3 cm long. **Fruit** a red obovoid drupe (not seen). **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its tree habit; 4-angled stems; opposite leaves on short, thick, red petioles; showy white flowers with hundreds of stamens; and a red drupe.

ʻEUA:
Parks 16211—Plateau rocky ridges.
Whistler 7497—Along Lakataha Stream northeast of Ohonua.
Whistler 11705—Forest at the top of the island south of Lokupo lookout at ca. 260 m elevation.

NYCTAGINACEAE

48. Pisonia umbellifera (Forst. f.) Seem.

Calpidia gracilescens Heimerl?

Ceodes brunoniana sensu F. Brown; non (Endl.) Skottsb.
Ceodes excelsa (Bl.) Skottsb.
Ceodes siphanocarpa Heimerl
Ceodes umbellifera Forst.
Pisonia brunoniana sensu auct., non Endl.
Pisonia excelsa Bl.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this tree other than to protect its habitat in Tonga. It is known in Tonga only from ʻEua, and the preservation of native forest on this island, especially in the National Park, is very important.


Pisonia umbellifera (Tutuila, American Samoa)

Indigenous to Tonga, ranging from Madagascar to Hawaiʻi, which is a large range for an inland tree species. In Tonga it is an understory tree in lowland forest on ʻEua, probably at all elevations up to 310 m. Its eastern Polynesian range includes the Cook Islands, the Austral Islands, Pitcairn, the Marquesas, and Hawaiʻi. The population in the Society Islands has recently been separated as *Pisonia tahitensis*, a view that may need further consideration. In western Polynesia it is also found in Samoa. No local names or uses are known.

Small tree up to 10 m in height (usually much shorter in Polynesia, but reported to 15 m in Fiji and 28 m elsewhere), with glabrous stems. **Leaves** simple, opposite, often in pseudo-whorls at the ends of the branches; blade brittle, ovate to elliptic, 7–25 cm long, acute to rounded at the base, acute to acuminate at the tip; surfaces glabrous, secondary veins indistinct, midrib prominent on both sides; margins entire to subundulate; petiole mostly 1–3.5 cm long. **Inflorescence** a terminal, many-flowered cyme up to 9 (–18) cm long, ultimately in several-flowered umbels; flowers unisexual (and trees dioecious) or bisexual. **Calyx** campanulate, (–2.5) 5–7 mm long, divided about ¼ of its length into 5 (4) ovate lobes, white to greenish yellow or pink, on pedicel 2–8 mm long. **Corolla** absent. **Ovary** inferior; style as long or longer than the calyx, with a capitate and often papillose stigma; ovary vestigial in male flowers. **Stamens** mostly 8–14, free, slightly exserted in male and bisexual flowers, sterile and included in female flowers. **Fruit** a narrowly fusiform anthocarp 3–6 (–8) cm long surrounded by the enlarged

calyx, tinged with purple, with 5 viscid ribs, on an elongated stalk. **Flowering** and fruiting reported during most months, both probably occurring periodically throughout the year.

Distinguishable by its small tree habit; leaves opposite and typically in pseudo-whorls; small white to greenish yellow or pink flowers with petal-like sepals and no corolla; 8–14 stamens; and narrowly spindle-shaped fruit with sticky ribs.

ʻEUA:

Buelow 1882—Forest between the sea cliff and the eastern ridge east of Kolomaile.
Buelow 2335—Understory of dense forest about halfway from the top of the ridge down towards Vaifefe.
Buelow 2385—Forest at Lokupo and Vaifefe on the east slope of the central ridge.
Sykes 1120—Second terrace above Vaifefe.
Sykes 1121—Second terrace above Vaifefe.
Whistler 7195—Native forest at Makalea at the southeast end of the island.

PASSIFLORACEAE

49. Passiflora aurantia Forst. f.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands (and an old record from a third)
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes.

Passiflora aurantia (Savaiʻi, Samoa)

Indigenous to Tonga, ranging from eastern Australia to Niue. It is known in Tonga only from Kao and Tofua, where it is probably found in sunny forest clearings and disturbed areas, reported from 130 to 300 m elevation (but probably much lower and higher). No local names or uses are known. The fruit is too small to be edible by humans, and the plant is virtually unknown to Tongans, mostly because of its occurrence on the isolated Kao and Tofua islands. The report that Captain Cook collected it indicates it may have had a large range prior to the European Era, since Cook's botanists did not collect on Kao or Tofua.

Climbing herbaceous vine up to 6 m or more in height, with mostly glabrous stems. **Leaves** simple, alternate; blade broadly ovate to suborbicular, mostly 3–9 (–15) cm long, subacute to cordate at the base, acute at the tip; surfaces glabrous, 3-nerved from the base, with several glands on the lower surface; margins 3- or 5-lobed; petioles 1.5–3.5 cm long, often with a pair of glands along its length. **Inflorescence** of solitary, axillary flowers, borne on an articulated pedicel 1–4 cm long. **Calyx** deeply 5-lobed, lobes oblong, 3–5 cm long, keeled on the back, often petaloid on the inside, white or tinged with red or orange, turning darker with age. **Corolla** of 5 cream-colored to orange or red petals similar to the sepals, but usually absent; outer corona composed of purplish threads mostly 8–12 mm long, inner corona tubular, 7–15 mm long. **Ovary** superior, 1-celled; style with 3 capitate stigmas. **Stamens** 5, united at the base into an androgynophore, with versatile anthers. **Fruit** a subglobose capsule 2.5–5 cm long, containing many seeds borne on parietal placenta. **Flowering** reported from May to September, fruiting in February, but both probably occur throughout the year.

Distinguishable by its climbing herbaceous vine habit; axillary tendrils; alternate, trilobed, glabrous leaves; white and reddish flowers with a purple corona; and an ovoid, many-seeded berry having parietal placentation.

KAO:

Yuncker 15942—Open area of lower slope at 130 m elevation.

Buelow 3108—Northeast corner of the island at top of sea cliff at 100 m elevation.

TOFUA:

Scarth-Johnson 19—(Specimen not located.)

Buelow 2630—Small gully on slope above Manaka about halfway to the summit at 250 m elevation.

Buelow 2675—Agriculture clearing up a small ravine at Hotaʻane.

Whistler 10631—Sunny places in the forest on the inner rim of the south side of the island at 300 m elevation.

SINE LOC:

Cook s.n. (n.s.)—Without further locality.

PIPERACEAE

50. Peperomia pallida (Forst. f.) Dietr.

Tongan Name: none
English Name: none
Status: rare indigenous
Reason for Listing: infrequency of collection
Suggested Action: Nothing much can be done for this species, which occurs in a wide range of elevations, other than to protect the native forests in which it occurs. This is particularly important on Tafahi, where most of its collections have been made, and where the forest has been under pressure from kava growers.

Indigenous to Tonga, ranging from Fiji (the Lau Islands at least) to the Marquesas, and occurring on most of the makatea and high islands in between. It is known in Tonga from Vavaʻu, Niuatoputapu, and Tafahi, where it is reported in coastal to cloud forest, reported

from near sea level to nearly 600 m elevation. It is sometimes epiphytic, but more commonly grows on rocks and cliff faces. No Tongan names or uses have been reported. This species and its genus in the Pacific need further study.

Peperomia pallida (Savai‘i, Samoa)

Erect to ascending herb up to 40 cm or more in height, rooting at the lower nodes, with mostly glabrous, somewhat succulent stems. **Leaves** simple, opposite, sometimes appearing alternate (or even whorled) at some nodes; blade variable in shape, but mostly obovate or suborbicular to elliptic, 1–6 cm long, rounded to cuneate at the base, rounded to broadly acute at the tip; surfaces mostly glabrous, palmately 3-5–veined from the base; margins entire; petiole 2–6 mm long. **Inflorescence** of terminal or subterminal spikes in the upper 1–2 axils, 1–2 (–4) per axil, 2–6 (–8) cm long. **Calyx** absent. **Corolla** absent. **Ovary** superior, one-celled, with a simple stigma. **Stamens** 2, free. **Fruit** a tiny green drupe less than 1 mm long. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its small herb habit; stems rooting at the nodes; mostly opposite, glabrous leaves; upper axillary and terminal spikes mostly 2–6 cm long; tiny green flowers lacking a calyx and corolla; 2 stamens; and a tiny green drupe.

VAVA‘U:

Buelow 1658—(Specimen not located.)

NIUATOPUTAPU:

Whistler 6137—On rocks in coastal forest just to the east of the airport.

TAFAHI:

Hurlimann 430—Epiphyte on rotten log in montane forest at 450 m elevation.
Buelow 1233?—(Specimen not located.)
Whistler 6249—Epiphyte in cloud forest at the top of the island.

51. Piper macropiper Pennant

Piper graeffei Warb.
Piper graeffei var. *cordatum* Warb.
Piper longepedunculata C. DC.
Piper magnispicum C. DC.
Piper pubipetiolatum C. DC.
Piper tutuilae C. DC.
Piper vaupelii Lauterb.

Tongan Name: ***fue fai lolo***
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, other than to protect the native forests in which it occurs on Tafahi. This is particularly important because the native forest on Tafahi has been under pressure from kava growers.

Piper macropiper (Savai'i, Samoa)

Indigenous to Tonga, ranging from Taiwan and Australia eastward to western Polynesia (Tonga, Samoa, Futuna), but absent from Fiji. The literature on this genus is confusing, with many species named. It occurs in montane forest and probably lowland forest on Tafahi, reported from ca. 600 m elevation (but 920 m in Samoa). The fragrant stems are used on Tafahi to scent coconut oil.

Creeping vine or trunk climber that ascends tree trunks by means of adventitious roots. **Leaves** simple, alternate; blade ovate to subcordate, 9–18 cm long, rounded to subcordate at the base with a small basal auricle on the abaxial side, acute to acuminate at the tip; surfaces mostly glabrous, subpalmately veined; petiole 0.6–2 cm long, pubescent. **Inflorescence** a solitary spike mostly 13–23 cm long (in fruit), arising at right angles opposite to a leaf; flowers unisexual, plants dioecious. **Calyx** absent. **Corolla** absent. **Ovary** of female flowers superior, partially covered by minute, peltate scales; stigma 3 (–5), ellipsoid to ovoid, together ca. 0.5–0.8 mm in diameter. **Stamens** of male flowers usually 3. **Fruit** a small ellipsoid drupe 1–2 mm in diameter, densely arranged but free from the other drupes and the rachis, sessile, red at maturity. **Flowering** and fruiting occur throughout the year. (Description based on Samoan specimens.)

Distinguishable by its trunk climber or creeping habit; alternate, ovate to subcordate leaves somewhat 3-veined from the base; solitary axillary spikes; tiny green flowers lacking petals or sepals; and small red drupes densely arranged on the rachis.

TAFAHI:
Buelow 1291—(Specimen stored at Vainī but not examined.)
Buelow 1299—(Specimen stored at Vainī but not examined.)
Buelow 1322—(Specimen not located.)
Whistler 6247—Cloud forest at the summit of the island.

PITTOSPORACEAE

52. Pittosporum brackenridgei A. Gray

Tongan Name: ***masi kona***
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this forest tree, which in Tonga is known only from Vava‘u, other than preserving the small remaining amounts of forest on the island.

Pittosporum arborescens (Vava‘u)

Indigenous to Tonga, also found in Fiji, Tonga, and Niue. It is known in Tonga only from Vava‘u, where only two collections are known. It is rare in coastal to limestone, reported from near sea level probably to the highest elevation of the island (200 m). The tree is much more common in Fiji and Niue. No local names or uses are reported for this species, but the fruits were probably used like those of the more common *Pittosporum arborescens* to prepare a fish poison.

Tree up to 20 m or more in height, but usually much less, with glabrous stems. **Leaves** simple, alternate, bunched in clusters on the stem; blade obovate to elliptic, 6–15 cm long, acute to subattenuate and decurrent at the base, rounded to broadly acute at the tip; surfaces glabrous; margins subentire; petiole 1–2.6 cm long. **Inflorescence** of axillary or subterminal, 3-9–flowered cymes up to 4 cm in width. **Calyx** spathaceous, 7–11 mm long, the sepals fused but splitting down one side and frequently caducous. **Corolla** of 5 narrowly oblong, white petals 9–13 mm long, somewhat recurved near the tip. **Ovary** superior with a 2-celled ovary; stigma capitate. **Stamens** 5, free, included. **Fruit** a subglobose to ellipsoid capsule 1.7–3.2 cm long, splitting open by means of two valves to expose the numerous seeds embedded with a viscid orange pulp. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its tree habit; alternate obovate to elliptic leaves borne in clusters on the stems; corolla of 5 narrow petals recurved at the tip; and capsule fruit that opens by means of 2 valves to expose the seeds embedded in the orange pulp.

VAVA‘U:

Crosby 200 p.p.—Without further locality.
Whistler 11687—Small patch of limestone forest below the road just to the west of the causeway on the island west of Pangai.

53. Pittosporum yunckeri A.C. Sm.

Tongan Name: none
English Name: none
Reason for Listing: endemic to one Tongan island (with an old collection from another)
Status: rare endemic
Suggestion Action: Nothing much can be done for this tree which in Tonga is known only from ‘Eua and a single record from Tongatapu. The preservation of native forest on this island, especially in the National Park, is very important. A survey of the littoral areas of Tongatapu should also to be done to determine how rare the plant is on that island.

Pittosporum yunckeri flowers (‘Eua)

Pittosporum yunckeri fruit (‘Eua)

Endemic to Tonga, where it is reported from ‘Eua and Tongatapu (but only a single specimen is known from the latter), where it occurs from coastal scrub to limestone forest, and is easiest to find on the liku cliffs of the east side of ‘Eua. No local names or uses are reported, but Tongans might call it ***masi kona***, the name for the much more common *Pittosporum brackenridgei*. The tree was seen several times on the liku cliffs during a survey of ‘Eua rare plant species in November of 2010.

Shrub or small tree up to 6 m in height with puberulous young stems. **Leaves** simple, alternate; blade obovate to narrowly so, 4–11 cm long, attenuate and long-decurrent at the base, rounded at the tip; surfaces glabrate, densely brown tomentose when young, upper side dark

green, lower side lighter, with aqueous veins; margins entire, revolute; petiole (–5) 8–15 mm long. **Inflorescence** of axillary (sometimes terminal), 1–10-flowered corymbs 3–4 cm long, conspicuously tomentose. **Calyx** cup-shaped, of 5 ovate sepals 4–6 mm long, densely tomentose on the outside, on a pedicel 6–11 mm long. **Corolla** salverform, of 5 connate, white, oblanceolate petals 1.5–2 cm long. **Ovary** superior, 2-celled, with a capitate stigma. **Stamens** 5, free, included. **Fruit** an ovoid to oblong capsule 2.5–3 cm long, opening to expose the numerous seeds embedded in a bright orange pulp. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its shrub or small tree habit; obovate leaves conspicuously concave (revolute); white trumpet-shaped flowers with the 5 petals fused on their margins; and ovoid to oblong capsule splitting open to expose the seeds embedded in a bright orange pulp.

TONGATAPU:

Yuncker 16248—Fangaheve on the south coast of the island at ca. 280 m elevation.

ʻEUA:

Parks 16099—Western slopes of plateau region.
Parks 16209—Plateau forests.
Hurlimann 215—Limestone rocks on the edge of the cliff of the central part of the eastern ridge at ca. 200 m elevation.
Yuncker 15668—Near summit of eastern ridge, Matanga, Lokupo district.
Hotta 5513—Mt. Kolo-ʻaki-lupe-Tonga (but not recorded in Haas's monograph on *Pittosporum*).
Hotta 5528—Near eastern limestone cliff at Mt. Kolo-ʻaki-lupe-Tonga at ca. 300 m elevation. (Not in Hotta, but cited by Haas.)
Sykes 550—Coast behind Lokupo at ca. 3 m elevation.
Sykes 808—Near Kahana north of Houma at ca. 150 m elevation.
Whistler 7163—Cliffs not far above sea level at Lokupo.
Whistler 7234—Forest on the steep slope down to Tangatave Beach at the northeast end of the island.
Whistler 11696—Cliffs at the top of the island near Lokupo lookout at 260 m elevation.
Whistler 12168—Cliffs north of Lokupo lookout at ca. 260 m elevation.

PLUMBAGINACEAE

54. Plumbago zeylanica L.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restriction in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species other than to visit the island and do a survey to determine its frequency.

Indigenous to Tonga, widespread in the Old World tropics. It is known in Tonga only from Tafahi, where it apparently grows in sunny places near the coast. No local names or uses are known.

Subshrub with weak sprawling, longitudinally striate, glabrous stems up to 2.5 m long. **Leaves** simple, alternate; blade ovate, 3–10 cm long, rounded to broadly cuneate at the base, acute to acuminate at the apex; surfaces glabrous; margins entire; petiole 0.3–1.5 cm long, clasping at the base. **Inflorescence** a many-flowered raceme 6–30 cm long, densely covered with stalked, sticky glands and lanceolate, attenuate-tipped bracts 5–8 mm long. **Calyx** synsepalous, tubular, 5-lobed, 7–11 mm long, covered with stalked sticky glands. **Corolla** white, salverform, tube narrow, 1.8–2.3 cm long, the 5 obovate lobes 6–7 mm long. **Ovary** superior, with a short deeply 5-lobed style. **Stamens** 5, free, included. **Fruit** an oblong, circumscissile capsule 4–5 mm long containing a dark purplish brown seed. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its sprawling subshrub habit; alternate, ovate leaves; panicles of white, salverform flowers; and oblong, sticky calyx enclosing the 1-seeded capsule.

Plumbago zeylanica (Olosega, American Samoa)

VAVA‘U:

Graeffe 87—Possibly a mistaken locality, and not from Tonga.

TAFAHI:

Buelow 1240—(Specimen not located.)

PORTULACACEAE

55. Portulaca lutea Sol. ex Forst. f.

Tongan Name: tamole
English Name: sea purslane
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species other than to visit the Tafahi to see if it still occurs in littoral habits there.

Indigenous to Tonga, ranging from New Caledonia to Pitcairn Island. It is rare on the coast of Tafahi, and apparently was collected on Tongatapu in 1840 by the USEE. It is probably called ***tamole*** in Tonga, but this term is generic, and may not have specifically applied to this plant since it is so uncommon. The plant has edible leaves, but may not have been eaten if it was so rare.

Succulent herb, perennial, prostrate to ascending, with glabrous stems arising from a swollen tuberous root. **Leaves** simple, mostly alternate; blade obovate to subround, mostly 5–30 mm long, attenuate at the base, rounded at the tip; surfaces glabrous: margins entire; subsessile. **Inflorescence** of 1–3 flowers in terminal, congested cymes. **Calyx** of 2 overlapping sepals 7–9 mm long, sessile. **Corolla** of 5 yellow obovate petals 9–12 mm long. **Ovary** superior, 1-celled. **Stamens** 18–50, free, yellow. **Fruit** an ovoid, circumscissile capsule 6–8 mm long, opening by means of a dehiscent cap to release the many tiny, shiny black seeds. **Flowering** and fruiting occurring continuously.

Distinguishable by its succulent herb habit; fleshy, obovate to nearly round leaves; flowers 1–3 congested in the axils; yellow corolla 9–12 mm long; many yellow stamens; and an ovoid fruit opening by a cap that splits off to release the many tiny black seeds.

Portulaca lutea (Ta‘ū, American Samoa)

TONGATAPU:

USEE s.n.—“Near the seashore, rare,” without further locality.

TAFAHI:

Hurlimann 602—(Specimen stored at Vainī but not examined.)

RHAMNACEAE

56. Ventilago vitiensis A. Gray

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, since it is uncommon in native forests on two islands. It would be a good idea to determine just how common it is in these forests, since vine frequency is not something that is typically done.

Indigenous, also found in Fiji, and recently recorded from Mangaia in the Cook Islands. It occurs in Tonga in native lowland and limestone forest of Vava‘u and ‘Eua, elevation not reported, but in Fiji is reported from near sea level to 850 m elevation. No local names or uses are reported, since the species is an uncommon or rare vine of native forests. This species was first reported from Tonga by Smith (1985, 3: 700) based on the Sykes’ specimen.

Liana climbing into the forest canopy, with finely pubescent young stems. **Leaves** simple, alternate, distichous; blades ovate to elliptic, 3–10 cm long, rounded at the base, attenuate at the tip; surfaces glabrous, conspicuously pinnately veined with fine tertiary veins parallel to each between the looping secondary veins and perpendicular to the midrib; margins entire; petiole 3–9 mm long. **Inflorescence** a spreading, many-flowered cyme up to 30 cm long, the lower branches in leaf-bearing axils, the upper portion lacking the leaves. **Calyx** broadly cup-shaped, ca. 1.2 mm long, deeply divided into 5 ovate lobes, on an appressed-pubescent pedicel 1–3 mm long. **Corolla** of 5 clawed, yellow-green petals ca. 1 mm long, fragrant. **Ovary** superior, 2-celled, with a short style bearing to inconspicuous stigmas. **Stamens** 5, free, exserted. **Fruit** a green indehiscent drupe with a narrowly oblong wing up to 5 cm long. **Flowering** and fruiting reported from May to September, but both probably occur throughout the year.

Ventilago vitiensis (Bishop Museum)

Distinguishable by its liana habit; alternate, mostly ovate leaves; cymes borne in the upper axils and stem tip; tiny greenish flowers; and a fruit bearing a long, narrowly oblong wing.

ʻEUA:

Sykes 274—Bottom of Lakataha Gully near Hango College.
Whistler 7498—Forest along the edges of Lakataha stream northeast of Ohonua.

VAVAʻU:

Buelow & Sykes 39—(Specimen not located.)

ROSACEAE

57. Osteomeles anthyllidifolia (J.E. Smith) Lindley

Pyrus anthyllidifolia J.E. Smith

Tongan Name: none
English Name: none
Reason for Listing: restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this shrub, which in Tonga is known only from ʻEua. Its habitat is probably not threatened, since it typically grows on limestone cliffs, which are not threatened by agriculture.

Indigenous to Tonga, also found in Hawai‘i, Rarotonga, Rapa, and Pitcairn Island. In Tonga, it is known only from ‘Eua, where is occurs mostly in sunny exposed places on the cliffs on the east (especially the northeast) side of the island. No local names or uses are known. The plant was found to be locally common on the cliffs on the north end of the island during the present rare plant survey in November 2010.

Osteomeles anthyllidifolia (‘Eua)

Shrub, prostrate or ascending, with appressed-pubescent stems. **Leaves** odd-pinnately compound, alternate; rachis 1.5–3 cm long, grooved on the axial side, leaflets mostly 9–13; leaflet blades coriaceous, oblanceolate to obovate, 4–12 mm long, acute at the base, rounded to notched at the tip; upper surface glabrous, lower surface moderately appressed-pubescent; margins entire; leaflets sessile. **Inflorescence** of several-flowered cymes subtended by 1 or 2 subulate bracteoles 2–3 mm long, the cymes clustered together into terminal clusters. **Calyx** cup-shaped, densely tomentose on the outside, 3.5–5 mm long, divided at the top into 5 triangular-dentate lobes. **Corolla** of 5 free, broadly obovate, convex shortly clawed, white petals 5–6 mm long. **Ovary** inferior, Styles 5, distinct, with thickened truncate stigmas. **Stamens** ca. 15–20, free, shortly exserted. **Fruit** a white to purple, subglobose pome 6–10 mm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its low shrub habit; odd-pinnately compound leaves with 15–25 leaflets; cymes of white flowers; densely pubescent calyx; many stamens; and a subglobose, white to black fruit. This species is has much shorter leaves, fewer and smaller leaflets, and smaller flowers than the Hawaiian population, and should be studied to see if it is a different species endemic to Tonga.

‘EUA:

Parks 16225—Plateau ridges.
Hurlimann 206—Border of eastern ridge in central part of the island.
Yuncker 15652—Dry open grazing area on the western slope of the eastern ridge.
Yuncker 15679—Sea-facing limestone cliff of eastern ridge.
Hotta 5412—Eastern limestone cliff of northern part of the island.
Sykes 206—Near Kahana north of Houma at ca. 60 m elevation.
Buelow 1827—(Specimen not located.)
Whistler 7429—Liku cliff southeast of the Houma “palace.” (add to whole flora).
Whistler 7478—Liku cliffs east of Vei Pueki.
Whistler 12170—On the top of cliffs at the north end of the island.

RUBIACEAE

58. Antirhea inconspicua (Seem.) Christoph.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this tree other than to protect its habitat in Tonga. It is known in Tonga only from ʻEua, and the preservation of native forest on this island, especially in the National Park, is very important.

Antirhea inconspicua flowers (Savaiʻi, Samoa)

Antirhea inconspicua fruit (ʻEua)

Indigenous to Tonga, also found in Fiji, Samoa, and the Horne Islands. It is occasional in Tonga in native limestone forest of ʻEua, reported from near sea level probably up to the highest elevations on the island (310 m elevation). The tree is too small and too uncommon to be of much use for its wood, and no other uses, or even local names, have been reported from Polynesia. Several trees were encountered in primary forest on ʻEua during the present rare plant survey in November 2010.

Small tree up to 10 m in height, with densely pubescent young stems and awl-shaped, attenuate-tipped, pubescent interpetiolar stipules up to 1 cm long. **Leaves** simple, opposite;

blade variable in shape but mostly elliptic to obovate, 6–15 cm long, acute to subround at the base, attenuate at the tip; surfaces pubescent, especially on the veins of the lower side; margins entire to undulate; petiole 8–25 mm long, pubescent. **Inflorescence** a drooping, several-flowered (6–13) axillary cyme 1.5–9 cm long, with a pubescent rachis; flowers unisexual, subtended by linear bracts, trees dioecious. **Calyx** broadly campanulate, ca. 1 mm long in male flowers and ca. 2–3 mm in females, shallowly 4-lobed, on a pedicel 0–4 mm long. **Corolla** salverform, appressed-pubescent on the outside, tube of female flowers 4–6 mm long, that of the males 7–9 mm, dark red, limb divided about halfway into 4 (3–5) yellow, rounded lobes 1.5–2 mm long. **Ovary** of female flowers inferior; style short, with a 3-branched stigma; ovary vestigial in male flowers. **Stamens** of male flowers as many as the corolla lobes, epipetalous, included, sterile in female flowers. **Fruit** a red to orange, obovoid, 2-seeded drupe 8–10 mm long, topped by the persistent crown-like calyx rim. **Flowering** reported from August to April, fruiting from March to August and in December, but both probably throughout the year.

Distinguishable by its small tree habit; opposite leaves with interpetiolar stipules; cymes of small, unisexual flowers yellow with red at the base; and small red to orange drupe with a persistent, crown-like calyx on top.

ʻEUA:

Buelow 1830—Forest about 400 m south of Vaingana near Kape plantation.
Whistler 6465—Forest on the south central part of the island.
Whistler 7140—Forest on slope west of the summit on the central part of the island.

59. Atractocarpus crosbyi (Burkill) Puttock

Porterandia crosbyi (Burkill) A.C. Sm. & S. Darwin
Randia crosbyi Burkill

Tongan Name: none
English Name: none
Reason for Listing: endemic to one Tongan island
Status: rare endemic
Suggestion Action: Nothing much can be done for this species, other than to protect its habitat in Tonga. In Tonga, it is known only from Vavaʻu, and the preservation of the remaining native forest on this island is very important.

Endemic to Vavaʻu, where it is uncommon in lowland and limestone forest, reported from 40 to 160 m or more elevation. No common names or uses are reported for this shrub, probably because of its small size and infrequency of occurrence. Its closest relatives are in Fiji and Tahiti.

Shrub or small tree up to 2.5 m in height, stems glabrous, interpetiolar stipules ovate, up to 5 mm long. **Leaves** simple, opposite; blade elliptic to lanceolate, 7–13 cm long, acute and shortly decurrent or oblique at the base, acute to bluntly acute at the tip; surface glabrous, upper side darker; margins entire; petiole 4–10 mm long. **Inflorescence** of solitarily or paired, axillary flowers on a peduncle 1–2.5 cm long. **Calyx** obconic, 9–12 mm long, with 5 short, apiculate lobes. **Corolla** sympetalous, salverform, showy white, tube 1.4–1.8 cm long, swollen in the upper half, limb divided to the base into 5 linear-lanceolate lobes 1.8–2.2 cm long. **Ovary**

inferior, style as long as the tube, bearing a clavate stigma. **Stamens** 5, epipetalous, included at the top of the throat, with yellow anthers. **Fruit** a globose, yellowish berry 2–2.8 cm long, with the persistent, crown-like calyx up to 4 mm high on top. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its shrubby habit; leaves opposite with interpetiolar stipules; solitary or paired axillary flowers; showy white corolla with long narrow lobes; and globose, yellowish berry.

Atractocarpus crosbyi (Vava‘u)

VAVA‘U:

Barclay s.n.—Without further locality.
Crosby 76—Without further locality.
Yuncker 16172—Thicket along upper rim of seaside cliff on the northwest side of the island at 150 m elevation.
Buelow 285—(Specimen not located.)
Buelow 882—(Specimen stored at Vainī but not examined.)
Buelow 902—(Specimen not located.)
Buelow 1601—(Specimen stored at Vainī but not examined.)
Whistler 6012—Open forest along the trial down to Liku‘one.
Whistler 6573—Sea cliff on the west of side of the island near Longomapu.
Whistler 11678—Understory of limestone forest on Mt. Talau at 160 m elevation.
Whistler 11690—Along the trail from the road north of Holonga to the coast at ca. 40 m elevation.

60. Psychotria leiophylla Merr. & Perry

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this rare forest small tree, other than to protect its habitat in Tonga. It is known in Tonga only from ‘Eua, and the preservation of native forest on this island, especially in the National Park, is very important.

Indigenous to Tonga, also found in Fiji. It is restricted in Tonga to limestone forest on ‘Eua, with no elevation given. No local names or uses are reported for this uncommon, small tree. A.C. Smith (1988, 4: 309) noted that this also occurs in Samoa, but the Samoan population, which is best referred to *Psychotria forsteriana* A. Gray, has red fruit, while the Tongan *Psychotria leiophylla* has purple fruit (an unusual color of fruit for this genus).

Small tree up to 2 m in height, with glabrous stems and broadly ovate, apiculate, interpetiolar stipules. **Leaves** simple, opposite; blade elliptic to oblanceolate, 7–17 cm long, attenuate at the base, shortly acuminate at the tip; surfaces glabrous; margins entire; petiole 1–4 cm long. **Inflorescence** at terminal 3–7 cm across. **Calyx** cup-shaped, ca. 1 mm long, shallowly 5-lobed, on a pedicel 1–3 mm long. **Corolla** sympetalous, salverform, 2–3 mm long, white, limb divided into 5 spreading ovate lobes. **Ovary** inferior, 2-celled; style bifid at the tip. **Stamens** 5, epipetalous, included**. Fruit** a subglobose, purple berry 1.1–1.5 cm long, bilobed. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its small tree habit; interpetiolar stipules; elliptic, opposite leaves; tiny white flowers ca. 2 or 3 mm long; and a subglobose purple berry bilobed with dried.

Psychotria leiophylla (‘Eua)

‘EUA:

Buelow 1737—Without further locality (data missing from Bishop Museum specimen).
Whistler 6538—Coastal forest at the south end of the island.
Whistler 7311—Forest west of Pangai.
Whistler 7330—Forest at Liku near the top of the ridge.
Whistler 7490—Ridge forest east of Vei Pueki.

SAPINDACEAE

61. Arytera bifoliata Whistler

Guioa lentiscifolia sensu Hotta, non Cavanilles

Tongan Name: none
English Name: none
Reason for Listing: endemic to one Tongan island
Status: rare endemic
Suggestion Action: Nothing much can be done for this forest tree, which is endemic to the island of ‘Eua, except to preserve the native forests on that island, especially in the National Park.

Endemic to ‘Eua, where it is reported only from the liku cliffs on the eastern side of the island. It grows in the windswept vegetation, reported from ca. 250 m elevation, but probably

goes much lower on the inaccessible cliffs. With its leaflets reduced to a single pair, it apparently differs from all other *Arytera*. No local names or uses have been reported.

Arytera bifoliata (‘Eua)

Small shrub perhaps dwarfed by strong winds, with glabrous stems. **Leaves** even-pinnately compound, alternate, rachis 9–25 mm long, leaflets 2, terminal; leaflet blades obovate, 2–5 cm long, rounded at the apex, acute or oblique and shortly decurrent at the base; margins somewhat revolute, entire; upper surface glabrous, lower covered with microscopic peltate scales, with no domatia present; petiole 0–4 mm long. **Inflorescence** an axillary panicle 2–9 cm long, its branches bearing short racemes; flowers mostly unisexual, plants monoecious; pedicel ca. 1 mm long. **Calyx** synsepalous, ca. 1 mm long, divided about halfway into 5 ovate lobes. **Corolla** absent, or if present, consisting of 5 tiny petals. **Ovary** superior, pubescent; style 1–2 mm long, bilobed at the apex; ovary absent in male flowers. **Stamens** 6–8, free, anther ca. 0.7 mm long, on a pilose filament up to 2 mm long, subsessile and perhaps rudimentary in female flowers. **Fruit** a 2-lobed, laterally compressed, obovoid capsule (not seen mature), as wide or wider than long, splitting open along 2 seams; seeds 2, enclosed within a sheath-like aril. **Flowering** reported in June, July, and September, fruiting in June and September, but both probably occurring throughout the year.

Distinguishable by its small tree habit; alternate, pinnately compound leaves with only two leaflets; short panicles of inconspicuous greenish white flowers; and an obovoid capsule bearing arillate seeds.

‘EUA:

Parks 16317—Liku terraces.

Yuncker 15678—Limestone outcropping near the seaward side of the eastern ridge at Matanga, Lokupo District, at ca. 240 m elevation.

Hotta 5411—Limestone cliff of eastern side.

Sykes 804—In scrubby forest on cliff margins north of Houma near Kahana at ca. 160 m elevation.

Whistler 7394—On top of the liku cliff south of Lokupo trail on the eastern side of the island.

Whistler 7481—Scrub forest on cliff east of Vei Pueki.

62. Sapindus saponaria L.

Sapindus vitiensis A. Gray

Elattostachys falcata sensu Yuncker pro parte; non Radlk.

Tongan Name: ***ngatata hina***?
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this forest tree, which in Tonga, except for a single record, is found only on ‘Eua. The thing most helpful to this plant would be to preserve the native forests on ‘Eua, especially in the National Park. The one Tongatapu site of collection should be visited to see if the tree still occurs there.

Indigenous to Tonga, widely ranging from tropical America and Hawai‘i sporadically eastward to New Caledonia, as well as to Africa. There appear to be no significant differences to separate it from *Sapindus vitiensis*, which is reportedly endemic to Fiji, although Smith (1985) noted that the latter species has fewer leaflets and an unwinged rachis. It is known in Tonga only from Tongatapu (a single record) and ‘Eua, where it occurs in coastal and lowland forest, probably from near sea level up to the highest elevations of the islands (310 m elevation on ‘Eua). No local names or uses are known.

Sapindus saponaria (‘Eua)

Medium-sized tree up to 15 m in height (up to 30 m in Fiji), with subterete glabrous stems. **Leaves** even-pinnately compound, alternate, rachis 20–35 cm long, yellowish green, distinctly (in saplings) to obscurely winged, leaflets in 2–4 alternate pairs; leaflet blades ovate to lanceolate or elliptic, 6–20 cm long, rounded to acute at the base, acute to shortly acuminate at the tip; surfaces glabrous, conspicuously reticulate-veined with a yellowish midvein; margins entire; petiolules 2–5 mm long, conspicuously swollen at the base. **Inflorescence** a large, spreading, terminal, many-flowered panicle up to 30 cm long, copiously tomentose; flowers unisexual, trees monoecious. **Calyx** of 5 unequal, suborbicular sepals 1.5–3 mm long, on a pedicel ca. 1 mm long. **Corolla** of 5 white, suborbicular petals as long as the sepals, with a bifid scale on the inside base. **Ovary** of female flowers superior, surrounded by an annular disk, with a short unlobed style; ovary vestigial in male flowers. **Stamens** of male flowers 8, free, exserted on pilose filaments, white, sterile in female flowers. **Fruit** a dark red, fleshy, drupe-like, indehiscent schizocarp with 1 or 2 subglobose to obovoid mericarps developing, each up to 1.8 cm long, often with the aborted mericarps at the base. **Flowering** reported from April to July, fruiting from June to December, but both probably occur throughout the year.

Distinguishable by its medium-sized tree habit; pinnately compound leaves with 2–4 pairs of alternate leaflets on a more or less winged rachis; many-flowered panicles; and dark red, 1-or 2-lobed, drupe-like fruit with aborted carpels at the base.

TONGATAPU:

Yuncker 15277—Near Ha‘akame on the southwest side of the island.

‘EUA:

Whistler 5590—Native forest on the south end of the island.
Whistler 6536—Coastal forest at the south end of the island.
Whistler 7213—Scrub forest on makatea cliff just above the beach at Haunui Beach at the northwest end of the island.

63. Manilkara dissecta (L. f.) Dubard

Mimusops kauki sensu Hemsley
Gen. Sapot. (No. 2); *Aegiceras*-like of Pickering (p. 316)

Tongan Name: *ngesi*
English Name: none
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen

Suggestion Action: The tree is still known to many older people because of its use as a dye plant, and its cultivation should be encouraged. It should also be planted in gardens to ensure its presence in Tonga.

Probably a Polynesian introduction to Tonga, native from Samoa westward to New Caledonia. It appears to be restricted in Tonga to cultivation in villages. The durable timber is favored for making slit gongs and bowls, and McKern (n.d.) noted it to be one of the best house timbers, but the wood is infrequently utilized now for this purpose because of its rarity. Perhaps it is cultivated today for its bark, from which a brown dye for tapa cloth is extracted.

Small tree up to 15 m in height (but usually much smaller), with a gnarled trunk, and glabrous stems thickened apically; bark dark, inner bark tan, exuding a copious white latex. **Leaves** simple, alternate, crowded at the branch tips; blade coriaceous, obovate, 3–9 cm long, acute to cuneate at the base, rounded to retuse at the tip; surfaces concolorous, finely parallel veined from the midrib, mostly glabrous or lower side glabrescent, midrib of lower side prominent; margins entire, narrowly revolute to entire; petiole 8–20 mm long. **Inflorescence** of axillary clusters of 1–5 flowers congested towards the stem tips. **Calyx** 4–7 mm long, deeply divided into 6 ovate to lanceolate lobes in 2 whorls of 3, the inner series white, conspicuously sericeous on the outer surface, inner surface less so, on a down-curved pedicel up to 3.5 cm long. **Corolla** white, deeply divided into 6 narrowly elliptic lobes 5–7 mm long, concave and appearing linear at anthesis, each with a shorter pair of dorsal, recurved appendages, falling as a ring with the stamens attached. **Ovary** superior, 6-angled and 6-celled, with a glabrous, unlobed style 6–8 mm long. **Stamens** 6, epipetalous, with an equal number of staminodes. **Fruit** a red to orange, ovoid to subglobose, 1-seeded berry 6–10 mm long. **Flowering** reported in February and

Manilkara dissecta flower (Tutuila, American Samoa)

Manilkara dissecta fruit (Tutuila, American Samoa)

from July to December, and fruiting in February, April, and July, but both probably periodically occurring throughout the year.

Distinguishable by its small tree habit; white latex; small, mostly obovate leaves notched at the tip; axillary clusters of 1–5 flowers; calyx of 6 lobes in 2 whorls; small white, 6-lobed corolla; and small globose, red to orange berry.

TONGATAPU:

Forster s.n.—Without further locality.

USEE s.n.—"Near the margin of the lagoon-like inlet," without further locality.

Yuncker 16281—Sandy soil near Navutoka Village on the northeast side of the island.

HA'APAI:

Whistler 6079—Cultivated in Lifuka Village.

VAVA'U:

Buelow 1480—Town between yards and being strangled by a banyan tree, at 10 to 15 m elevation.

Buelow & Sykes 286—Cultivated in Neiafu.

Whistler 6035—Cultivated in Tefisi Village.

NIUATOPUTAPU:

Buelow 1402—Next to a house in Vaipoa at 1 to 5 m elevation.

Whistler 6300—Next to a house in the village of Vaipoa.

SCROPHULIARIACEAE

64. Limnophila fragrans (Forst.) Seem.

Ambulia serrata (Gaud.) Wett.
Ruellia fragrans Forst. f.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: The preservation of wetlands in Tonga is the thing most likely to protect this species. Also advisable is a survey of the wetlands to see if this species has a wider distribution. The species is also very rare in Samoa and American Samoa.

Indigenous to Tonga, ranging from Australia and Melanesia to the Society Islands (it was originally named from Tahiti). It is known in Tonga only from Tongatapu and ‘Eua, based on four collections, and is restricted to sunny places in wetlands. No local names or uses are known.

Limnophila fragrans (‘Upolu, Samoa)

Herb with weak, greenish, glabrous stems up to 15 cm or more in height, often prostrate but sometimes held upright by surrounding vegetation. **Leaves** simple, opposite, decussate; blade elliptic to obovate, 1–2.5 cm long, broadly acute and winged at the base, broadly acute at the tip; surfaces glabrous, gland-dotted, fragrant; margins finely serrate; sessile. **Inflorescence** of solitary, axillary flowers, one per leaf pair, subtended by several subulate bracts 1.5–2.5 mm long. **Calyx** 3.5–5.0 mm long, cut halfway to the base into 5 lobes. **Corolla** bilabiate, white, 7–9 mm long, the limb shallowly divided into 5 rounded lobes, with dark longitudinal lines in the throat and faintly showing on the outside. **Ovary** superior, with a 2-lobed style. **Stamens** 4, epipetalous, included. **Fruit** an obovoid capsule about as long as the calyx, 4-valved, many-seeded. **Flowering** and fruiting probably occur continuously.

Distinguishable by its weak-stemmed herbaceous habit; small, fragrant, opposite, sessile leaves with finely toothed margins; and small, solitary, white, 5-lobed flowers borne one to an axil.

‘EUA:

Hurlimann 194—(Specimen not located.)

Sykes 405—Dry mud on the margin of a small lake at the Forest Farm on the upper terrace in the center of the island.

Buelow 1867—Small swamp-like lake along the eastern ridge east of Kolomaile at 220 m elevation.

VAVA‘U:

Buelow 1042—Wet mud next to the edge of Ngofe swamp.

SOLANACEAE

65. Lycium sandwicense A. Gray

Lycium carolinense Walt. var. *sandwicense* A. Gray

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: A survey of its known locations on Tongatapu should be made, as well as other suitable locations, in order to determine its range on the island. The area around where it was recorded once on ‘Eua should also be checked to see if the species is still there or if it has a wider range on the island.

Lycium sandwicense (Maui)

Indigenous to Tonga, ranging from there eastward to Hawai‘i and Easter Island. In French Polynesia it occurs on Rapa, Rurutu, and Mangareva, as well as on Pitcairn, and Henderson Island. It is reported in Tonga only from ‘Eua (one record) and Tongatapu, where it occurs on coastal makatea, reported from near sea level to 10 m elevation. No local names or uses are known since the plant is small, inconspicuous, and rare. The shrub was seen once during a survey of Tongatapu rare plant species in November of 2010.

Low, glabrous shrub up to 1 m in height with glabrous stems. **Leaves** simple, in alternate fascicles; blade spathulate, 5–30 mm long, attenuate at the base, rounded at the tip; surfaces glabrous; margins entire; subsessile. **Inflorescence** axillary, solitary or several-flowered axillary fascicles. **Calyx** campanulate, 2–4 mm long, divided about 1/3 of its length into 4 triangular lobes, on a pedicel 5–15 mm long.

Corolla sympetalous, campanulate, 5–7 mm long, deeply divided into 4 rounded, pink to white lobes. **Ovary** superior; style 2-lobed. **Stamens** 4, epipetalous, slightly exserted. **Fruit** a red, subglobose berry 6–10 mm in diameter. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its low shrub habit; alternate, simple or fascicled leaves; spathulate blade; flowers solitary or in axillary fascicles; white to pink, 4-lobed flowers; 4 stamens; and red subglobose berry.

TONGATAPU:

Parks 15604—Hollows in spray-swept makatea rocks at Houma.
Parks 15617—Hollows among mud and spray-swept rocks, blowholes, at Houma.
Hotta 5637—Haʻatua [Haʻatafu?] Village.
Buelow 65—Makatea coast at ʻUtulau.
Buelow 1785—Makatea coast at Tokomololo.
Whistler 4982—Makatea coast at Houma Beach (and seen there again in 2010).

ʻEUA:

Buelow 750—Ocean terrace next to the ocean below and north of the "Soldier's Grave" at 5 to 10 m elevation.

66. Nicotiana fragrans Hooker

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: A survey of its known locations on Tongatapu should be made, as well as other suitable locations, in order to determine its range on the island. There is not much danger to its habitat since it occurs on rugged limestone cliffs that are not under pressure from human activities.

Nicotiana fragrans (Tongatapu)

Indigenous to Tonga, also found in New Caledonia (Isle of Pines) and Niue. It is reported in Tonga only from Tongatapu, where it grows on coastal limestone rocks and cliffs, reported only near sea level (and probably dispersed by seawater). While rare in Tonga, where it is known from five collections, it is more common in Niue. No Tongan names or local uses are reported for this plant, which is virtually unknown in Tonga. It was encountered in two places during work on Tongatapu in 2010.

Stemless perennial herb up to 50 cm in height, stemless, with a woody base and densely viscid stems. **Leaves** simple, alternate, in a basal rosette; blade fleshy, oblanceolate to spathulate, 3–22 cm long, rounded at the tip, attenuate at the base; surfaces densely viscous, upper side slightly darker than lower, veins of lower surface somewhat aqueous; margins entire; petiole tapering into the blade. **Inflorescence** a several-flowered (4–6 flowers, rarely as many as 9) terminal raceme with a viscous rachis up to 20 cm long. **Calyx** synsepalous, campanulate, 9–2.2 cm long, divided about halfway into 5 unequal, lanceolate lobes, viscous on the outside. **Corolla** sympetalous, salverform, white, tube 4–5.5 cm long, viscous on the outside, limb 1.8–2.5 across, divided into 5 rounded lobes 5–8 mm long slightly notched at the tip. **Ovary** superior, shallowly 4-lobed; style as long as the tube and bearing a green, capitate, 2-lobed stigma. **Stamens** 5, epipetalous, included, with the anthers reaching the top of the throat. **Fruit** an ovoid, papery capsule 1.1–1.3 cm long, enclosed within the calyx and containing many tiny black seeds. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its woody herb habit; alternate leaves covered with sticky hairs; narrow, several-flowered, axillary inflorescences; white salverform corolla up to 5.5 cm long, with 5 rounded, spreading lobes; and many-seeded, ovoid capsule up to 1 cm long.

TONGATAPU:

Graeffe 1360—Makatea rocks affected by sea spray on the south coast of the island.
Yuncker 16252—Sea cliff at Fangaveha on the south coast of the island.
Cottrell-Dormer 44-3—Coastal limestone rocks at Ha‘ateiho.
Buelow 70—Hufangalupe.
Whistler 6540—Sea cliff at Keleti Beach on the southwest side of the island (and seen there again in 2010, but not collected).
Whistler 12171—Base of limestone cliffs on beach south of Keleti Beach.

67. Solanum ferox L.

Solanum lasiocarpum Dunal
Solanum repandum Forst. f.
Solanum seedi Horne

Samoan Name: *touloku*?
English Name: Polynesian tomato
Status: rare Polynesian cultigen
Reason for Listing: infrequency of collection, and probably extirpated from Tonga
Suggested Action: This plant almost certainly has been extirpated from Tonga. However, a photo and description of the species should be put in local newspapers to see by chance anybody recognizes and/or has this species that was last collected in Samoa in 1905.

A Polynesian introduction to Tonga, native to somewhere in Melanesia, recorded from New Britain to the Marquesas. Originally the Polynesian and Melanesian form were thought to belong to a separate species, *Solanum repandum*, but they now appear to be a cultivars of an Asian species, *Solanum ferox*, and, according to Heiser (1996), are correctly called *Solanum ferox* var. *repandum* (Forst. f.) Bitter. Whalen et al. (1981) considered it to be nearly identical to an American species, *Solanum sessiliflorum* Dunal, found in the same kind of habitats, and

speculated on its mode of dispersal from there out into the Pacific, but Heiser discounted this relationship. It may have been derived from Melanesian and Indo-Malayan *Solanum lasiocarpum* by selection of spineless individuals. Its natural habitat comprises places associated with human activities, and it apparently never becomes naturalized in undisturbed habitats. It was apparently last collected in Tonga in 1926. Its Tongan name ***touloku*** is found in an early Tongan dictionary (Rabone 1845), Churchill (1959) spelled it *toulohu*, but the plant may have been extirpated by the time he did is linguistic work, and he may have received incorrect spellings about the nearly forgotten plant. It was called ***tauloku*** in Futuna and ʻUvea, ***lokumoka*** on Niue, and ***taulo'u*** in Samoa. The fruits were once eaten, and possibly used to make colorful fruit leis.

Solanum ferox (unknown provenance)

Shrub up to 1.5 m in height, unarmed, but stems covered with simple or stellate pubescence, at least when young. **Leaves** simple, alternate; blade broadly ovate, 13–35 cm long, obtuse to truncate and often unequally-sided at the base, rounded to acute at the tip; upper surface sparsely pubescent, lower side densely stellate-pubescent; margins with 3–5 lobes at the lateral vein terminations; petiole 3–11 cm long. **Inflorescence** a 5–12-flowered axillary cyme up to 1.5 cm long. **Calyx** synsepalous, campanulate, deeply divided into 5 ovate, acute-tipped lobes 5–9 mm long, pubescent on the outside, on a pedicel 5–15 mm long in flower (elongating in the fruit). **Corolla** white, sympetalous, star-shaped, deeply divided into 5 ovate to nearly lanceolate lobes 5–9 mm long. **Ovary** superior, 4–6-celled, with numerous ovules; style simple with a capitate stigma; ovary sterile in the upper flowers on the cyme. **Stamens** 5, epipetalous, yellow. **Fruit** a subglobose, many-seeded, red to yellow berry 4–5 cm long, pubescent, 1 (2–4) forming per inflorescence. **Flowering** and fruiting occur throughout the year.

Distinguishable by its shrubby habit; pubescence often of star-shaped hairs; large, alternate leaves; lobed leaf margins; white, 5-lobed flowers in short axillary cymes; and fuzzy, red to yellow, tomato-like berries usually borne singly or in pairs.

ʻEUA:

Parks 16340—In thick bush at Tamua.

STERCULIACEAE

68. Heritiera ornithocephala Kostermans

Heritiera littoralis sensu Yuncker pro parte; non Aiton

Tongan Name: ***mamea***?
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes.

Indigenous to Tonga, also found in Fiji, Samoa, and Niue. The tree is known in Tonga only from Kao and Tofua, where it occurs in lowland and secondary forest, reported from near sea level to 140 m elevation. The name is questionable since the species occurs on sparsely inhabited islands, and no uses are known.

Heritiera ornithocephala (‘Upolu, Samoa)

Large tree up to 25 m or more in height, forming a large spreading crown, young stems lepidote with the scales having fimbriate margins, the trunk typically forming massive buttresses; bark mealy or scaly brown on the outside, red inside, wood white. **Leaves** appearing simple (but actually palmately compound and reduced to 1 leaflet), alternate; blade very coriaceous, elliptic to ovate, mostly 6–30 (–40 in young leaves) cm long, obtuse or rounded at the base, broadly obtuse or shortly acuminate (or sometimes attenuate in saplings) at the tip; upper side green, glabrescent, lower side densely lepidote, silvery, with scattered red scales; margins subentire; petiole 4–12 (–16) cm long, slightly peltate, thick, expanded at both ends, lepidote. **Inflorescence** a many-flowered, axillary panicle up to 15 cm long, rachis lepidote; flowers unisexual, trees monoecious. **Calyx** campanulate, 3–7 mm long, divided over halfway into 4 or 5 lanceolate lobes purple on the inside with green margins, green and lepidote on the outside, on a pedicel 1–4 mm long. **Corolla** absent. **Ovary** of female flowers comprising 4 or 5 nearly separate carpels with a short 4- or 5-lobed style; ovary vestigial in male flowers. **Stamens** of male flowers 4 or 5, monadelphous on a stalk in a yellow capitate cluster, sterile in female flowers. **Fruit** of 1–5 irregularly ovoid, indehiscent nutlets 2.5–5 cm long including the apical beak. **Flowering** reported from August to December, but probably of longer duration, fruiting reported in October (March and May in Fiji), but probably also longer.

Distinguishable by its large tree habit; alternate, coriaceous leaves covered with silvery scales (especially evident on the lower surface); tiny greenish, bell-shaped flowers purple on the inside; and fruit comprising several separate ovoid nutlets beaked at the tip.

KAO:
Yuncker 15949—Rocky slope in open forest at ca. 140 m elevation.

TOFUA:

Hotta 4358—Outside of "somma" on the eastern part of the island.
Scarth-Johnson 55—Steep forested slope above the beach on the north side of the island.
Buelow 487—Shallow soil on terrace next to ocean just down from Hokula at about 2 m elevation.
Whistler 10570—Secondary forest on the west side of the island at Hokula at 40 m elevation.

69. Sterculia fanaiho Setchell

Tongan Name: ***fanakio***
English Name: none
Reason for Listing: restricted in Tonga to one island (with one record from another)
Status: rare indigenous
Suggestion Action: The tree is restricted to one isolated island, and is probably common in the forests there, so nothing needs to be done at the moment since the forests on Niuafo'ou are not under pressure, even though the inhabitants use the tree to make mats and clothing.

Indigenous to Tonga, and is also found in Samoa, Niue, Rotuma, and the Horne Islands. It is known in Tonga in its natural state only on Niuafo'ou, where it is probably common in native lowland and coastal forest, and there is a single record from Ha'apai of a tree in cultivation. Narrow strips of the inner bark are used to plait distinctive *fala fanakio* mats and garments (*ta'ovala* and *salusalu*), and similar plaiting uses are reported for this tree from Samoa, and Niue.

Sterculia fanaiho (Niue)

Medium-sized tree up to 12 m in height, with golden-brown stellate pubescence on the young stems, older stems distinctly and irregularly grooved; inner bark fibrous. **Leaves** simple, alternate, crowded at the ends of the stems; blade coriaceous, elliptic to ovate, 7–25 cm long (up to 40 cm in saplings), rounded or truncate to subcordate at the base, shortly acuminate at the tip; surfaces mostly glabrous, upper side darker, lower side with prominent veins; margins subentire; petioles 1.5–10 cm long, swollen at both ends, borne at an angle to the blade, sparsely stellate-pubescent. **Inflorescence** a narrow, many-flowered, axillary panicle 4–17 cm long, with the rachis and short, irregularly spreading branches stellate-pubescent; flowers unisexual or bisexual, trees monoecious. **Calyx** campanulate, greenish or pale purple on the outside, purple inside at the base, 6–10 mm long, divided over halfway into 4 (3–5) linear lobes, stellate-pubescent on the outside, on a pedicel 1–3

mm long. **Corolla** absent. **Ovary** of female flowers superior, of 5 free carpels, each with a short style bearing a small stigma; ovary vestigial in male flowers. **Stamens** of male flowers 5–15, with their filaments united basally to form a staminal column, vestigial in female flowers. **Fruit** of 1–5 irregularly fusiform, wrinkled, velvety, reddish brown follicles 4–9 cm long, containing 1–3 large, black seeds. **Flowering** and fruiting probably occur throughout the year (but Trail [n.d.] in American Samoa reported no fruiting in March to May).

Distinguishable by its medium-sized tree habit; alternate, elliptic leaves; petiole swollen at both ends; panicles of tiny greenish to pale purple flowers; and 1–5 large, reddish brown follicles each containing 1–3 large black seeds.

HA‘APAI:

Whistler (observed, not collected)—Cultivated on Lifuka.

NIUAFO‘OU:

Jaggar s.n.—Without further locality.

Yuncker 16013—Forest on inner slope of the main crater above the central lake at 30 to 60 m elevation.

Buelow 2053—Small ravine about 1.6 km west of ‘Esia on the main road at 80 m elevation.

Whistler 6344—Along the road on the southeast side of the island.

TILIACEAE

70. Corchorus torresianus Gaud.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: The places where this shrub has been collected on Tongatapu and in Ha‘apai, and adjacent areas, should be checked to see if the plant is still there, since it has not been collected in Tonga for nearly a half century, and to determine its population size in Tonga.

Corchorus torresianus (Atiu, the Cook Islands)

Indigenous to Tonga, ranging from New Caledonia and the Marianas eastward to the Tuamotus, mostly on atolls and coral islands; in Fiji it is found only in the Lau Islands. It is known in Tonga only from Tongatapu and Ha‘apai, where it occurs on rocky or sandy shores near sea level. No local names or uses are reported.

Shrub up to 1 m in height with stems densely covered with stellate pubescence. **Leaves** simple, alternate; blade obovate, 2–4

cm long, rounded at the base, truncate at the tip; surfaces velvety gray and densely stellate-pubescent, 3-veined from the base; margins toothed; petiole 2–13 mm long. **Inflorescence** of 2- or 3-flowered axillary cymes. **Calyx** deeply divided into 5 lanceolate lobes 6–9 mm long, on a pedicel 9–18 mm long in fruit. **Corolla** of 5 yellow, obovate petals 6–9 mm long, reflexed at anthesis. **Ovary** superior, with a short style bearing a lobed stigma. **Stamens** many, free, exserted, yellow. **Fruit** an ellipsoid capsule 1.2–2 cm long, covered with short, thick, stiff bristles, and splitting open in at the tip into 5 valves.

Distinguishable by its shrub habit; alternate obovate leaves covered with a velvety gray stellate pubescence; toothed leaf margins and blunt tip; few-flowered racemes of yellow flowers bearing numerous stamens; and bristly capsule splitting open at the tip along 5 seams.

TONGATAPU:

Parks 15574—Sandy area near Ha‘atafu on the west side of the island.
Hotta 5625—Shore at Ha‘akili Village.

HA‘APAI:

Yuncker 15985—Rocky shore just above high tide mark on the north end of Lifuka.
Hotta 4225—Lotofoa Village on Foa Islet.
Hotta 4232—Without further locality (specimen seen by the author in Japan, but the data on the specimen was recorded, and the specimen is not listed in Hotta).

URTICACEAE

71. Laportea interrupta (L.) Chew

Urtica interrupta L.

Tongan Name: *hongohongo*, *ngohongoho*
English Name: Polynesian nettle
Reason for Listing: apparently disappearing
Status: rare Polynesian adventive
Suggestion Action: Villagers throughout Tonga should be surveyed to see if they know where this plant still occurs (it is likely to be known by older healers). Seeds should be collected and grown in a gardens so that the species, which probably suffers from competition with more aggressive, more recently introduced weeds, does not become extirpated from Tonga.

Laportea interrupta (Mangaia, the Cook Islands)

A Polynesian introduction to Tonga and as far east as Tahiti, probably native to Southeast Asia. In Tonga it is rare in disturbed places, especially in plantations and around houses. It

was once reported from Hawai‘i, but is probably no longer found there or in Tahiti. The plant is used in traditional medicine in the Niuas.

Erect herb up to 80 cm in height, with irritant hairs on the foliage and inflorescence, and pubescent stems reddish at the base. **Leaves** simple, alternate; blade ovate, 3–17 cm long, rounded to subcordate at the base, acuminate at the tip; surfaces with imbedded cystoliths, upper surface appressed-pubescent, lower surface with scattered hairs; margins serrate; petiole 1–13 cm long. **Inflorescence** of narrow, axillary panicles
up to 25 cm long with flowers in fascicles; flowers unisexual, plants monoecious. **Calyx** of 4 or 5 greenish, ovate sepals 0.3–1.5 mm long, pubescent on the outside, on a pedicel less than 1 mm long. **Corolla** absent. **Ovary** of female flower superior, celled, stigma 3-lobed; absent in male flowers. **Stamens** of male flowers 4 or 5, free, absent in female flowers. **Fruit** a green, compressed-ovoid achene 1.5–2 mm long surrounded by a membranous wing that is dispersed with the achene. **Flowering** and fruiting occur continuously.

Distinguishable by its herbaceous habit; irritant hairs; alternate, ovate leaves with coarsely toothed margins; long, narrow panicles of inconspicuous green flowers in clusters at intervals along the axis; and small, ovoid, seed-like fruits.

TONGATAPU:

Cook s.n.—Without further locality.
Moseley s.n.—Without further locality.
Soakai 641—(Specimen not located.)
Palmer 95—Crevices in limestone rock next to path between Hufangalupe Beach and the road.

‘EUA:

Sykes 212—Kahana area north of Houma.
Buelow 1841—Next to small stream at Suli’s *api* south of the Royal Estate at Lokupo.

HA‘APAI:

Whistler 6086—Weed growing under a house verandah in Pangai Village.

TOFUA:

Hotta 4341—Outside of “somma.”
Scarth-Johnson 46—(Specimen not located.)

VAVA‘U:

Crosby 167—Without further locality.
Buelow and Sykes 4—Longomapu.

TAFAHI:

Hurlimann 561—Plantation above the road from Tafahi township towards Faihavanui at ca. 100 m elevation.
Buelow 1246—Plantation between lower slope and main path south east of the village.

NIUAFO‘OU:

Buelow 2026—Fata‘ulua Village.

SINE LOC:

McKern 8—Without locality (but probably ‘Eua).

MONOCOTYLEDONAE
ARACEAE

72. Amorphophallus paeoniifolius (Dennst.) Nicolson

Amorphophallus campanulatus (Roxb.) Bl.
Amorphophallus sp. of Burkill

Tongan Name: ***teve***
English Name: stink lily
Reason for Listing: reduction in cultivation
Status: rare Polynesian cultigen
Suggestion Action: This plant is no longer cultivated, and it is not clear if it can maintain itself in disturbed vegetation. It should be cultivated in botanical gardens to assure its presence in Tonga, and to show locals and visitors what this interesting traditional famine food plant looks like.

Amorphophallus paeoniifolius
(Tutuila, American Samoa)

A Polynesian introduction to Tonga, native to somewhere in the Old World tropics between Madagascar and Indo-Malaya, perhaps closer to the latter (since it doesn't set seed in the western part of its range), but was an ancient introduction eastward into the Pacific as far as the Marquesas. Although once cultivated and often common, it is now uncommon throughout Polynesia, but is sometimes found naturalized in open native and secondary forest and plantations (although it is often difficult to find, especially since it is leafless during part of the year). It is found in Tonga on all the major inhabited islands in secondary forest and old plantations. The corm is edible, but only after prolonged cooking, and its use is restricted mostly to times of famine. McKern (n.d.) noted that in such times the corm was prepared into a gruel.

Large herb, stemless, arising from an acrid tuber up to 30 cm in diameter. **Leaves** compound, solitary and arising from the corm after flowering; blade palmately divided into three lobes that are further divided, 30–40 cm or more long, oblique at the lobe base, acute at the lobe tips; surfaces glabrous; margins of lobes entire; petiole smooth or rough, mottled in color, solid (rather than hollow), up to 65 cm or more in length. **Inflorescence** of unisexual flowers on a spadix surrounded by a spathe, borne on a stalk up to 10 cm long; spadix cylindrical, ca. 15–20 cm long, comprised of three parts—an upper expanded, purple "appendix," a medial part bearing the closely packed male flowers, and a basal part bearing the densely packed female flowers; spathe ca. 20 cm long, green on the outside, purple within, spreading and campanulate at anthesis and drooping with age. **Female flowers** sessile, lacking a perianth; ovary 1–4-celled with a single ovule, absent in male flowers; style purple, 3–4 times as long as the ovary, with a deeply lobed, yellow stigma. **Male flowers** sessile, lacking a perianth, with several united stamens having purple filaments

and yellow anthers; stamens absent in female flowers. **Fruit** a red, ovoid, 1-seeded berry ca. 8–12 mm long. **Flowering** and fruiting occur in the winter to early spring (i.e., perhaps June to November in the southern hemisphere).

Distinguishable by its stemless herb habit; large, palmately lobed leaves; mottled, solid leaf stalks; and large, seasonal, bad-smelling, purple spathe and spadix. The single large leaf, which is palmately 3-lobed from the base and further divided, is very similar to that of the Polynesian arrowroot, but the latter's stalk differs in having a warty, mottled surface rather than one that is green and longitudinally grooved. The plant dies back during the end of the rainy season. The huge inflorescence, something like a spreading, dark-colored calla lily and appearing once a year (usually in October and November) after the leaves begin to die off, is the color of rotting meat and emits an unpleasant odor that attracts the flies needed for pollination.

TONGATAPU:

Yuncker 15004—Calcareous soil in thicket near the shore at Sopu (misidentified as *Tacca leontopetaloides* in Yuncker)

Hotta 5643—In "bush" near Mataha'u Village.

Whistler 6752—Roadside area in Pili in Nuku'alofa.

'EUA:

Sykes 651—Uluvai (the Hango College water supply cave, no elevation recorded.

Suzuki 199—Lokuoi [Lokupu?] track in the National Park.

TOFUA:

Scarth-Johnson 122—(Specimen not located.)

VAVA'U:

Crosby 299—Without further locality.

NIUATOPUTAPU:

Kirch 191—Second year swidden.

TAFAHI:

Buelow 1292—(Specimen not located.)

SINE LOC:

McKern 72 (probably 'Eua)—Without further locality.

ARECACEAE

73. Pritchardia thurstonii F. Muell. & Drude

Tongan Name: ***piu***
English Name: Lauan fan palm
Reason for Listing: restricted distribution and infrequency of collection
Status: rare indigenous
Suggestion Action: Seeds should be collected from this tree and planted, just as those of the related Pacific fan palm *Pritchardia pacifica* are. Seedlings should be distributed to anyone who wants to grow them.

Indigenous to Tonga, also found in the Fijian Lau islands of Ogea Driki and Fulanga. It is restricted in Tonga to 'Eua, where it confined to the rocky limestone cliffs on the southeast coast, reported from near sea level to 200 m elevation. At the base of the cliff it occurs on large

limestone boulders. No uses are reported for this plant, but the similar and related *Pritchardia pacifica* is sometimes used as fans and the fruits are edible.

Medium-sized palm up to 8 m in height and 20 cm in diameter. **Leaves** simple, alternate; blade fan-shaped, up to 1 m long or more; surfaces waxy-glaucous, the lower side covered with lepidote scales conspicuously arranged in distinct, parallel lines; margins divided ¼ to 1/5th of its length into 50 to 70 stiff bifid segments; petiole not toothed. **Inflorescence** of a single, axillary, many-flowered panicle branched to 2 or 3 orders, the long peduncle equal to or longer than the leaves, drooping at maturity; the base covered with tubular peduncle bracts that closely sheath it, these becoming fibrous at the tip or not at all. **Calyx** of 3 connate sepals ca. 3 mm long, shallowly 3-lobed. **Corolla** of 3 petals ca. 5 mm long, forming a circumscissile cap over the soft connate base, deciduous at anthesis. **Ovary** superior, with recurved styles united at their base. **Stamens** 6, connate at the base, epipetalous. **Fruit** a 1-seeded, black globose berry 6–7 mm in diameter, often crowned with the persistent remains of abortive carpels and the style.

Pritchardia thurstonii (Hawai‘i via Fiji?)

Distinguishable by its palm habit; large fan-shaped leaves with the 50 to 70 stiff, bifid segments on the margin; solitary panicles with the peduncle nearly as the leaves; and black globose fruits.

EUA:
Parks 16374—South plateau cliffs.
Yuncker 15607—Ha ‘aluma (cultivated).
Sykes 786—Vaifefe.

COMMELINACEAE

74. Aneilema vitiense Seem.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this herb since it is found on two isolated islands. It is probably safe as long as the forest is safe, but the forest on Tafahi has been severely damaged by kava farmers, and thus forest protection there should be a high priority.

Indigenous to Tonga, also found in Samoa and Fiji. It is known in Tonga only from Tafahi and Niuafo‘ou, where it probably occurs in lowland forest at near sea level to perhaps the highest elevation of the islands (over 600 m). No local uses or names are known.

Aneilema vitiense (Savai‘i, Samoa)

Terrestrial herb, creeping to ascending, with glabrous stems up to 30 cm or more long beyond the highest rooting node. **Leaves** simple, alternate; blade lanceolate to ovate, 3–9 cm long, rounded to subcordate at the base, narrowly acute at the tip; surfaces glabrous; petiole 0–7 mm long, borne on an inflated sheath 1.3–2 cm long that surrounds the stem. **Inflorescence** a several-flowered cincinnus (a monochasial scorpioid cyme) mostly 7–14 cm long, with the slightly zygomorphic flowers aggregated into a thryse bearing tiny cup-shaped, sheathing bracts ca. 1 mm long at the nodes. **Calyx** of 3 free, imbricate, ovate sepals 2–4 mm long, on a pedicel up to 1.5 cm long. **Corolla** of 3 white to blue, subround, clawed petals 6–10 mm long. **Ovary** superior, 3-celled, with a tiny capitate stigma on a long style. **Stamens** (fertile) 3 (rarely 2), free. **Fruit** a few-seeded, ovoid capsule 5–8 mm long covered with fine, hooked hairs. **Flowering** and fruiting occur throughout the year.

Distinguishable by its herbaceous habit; lower stems rooting at the nodes; alternate lanceolate leaves borne on an inflated sheath; small flowers borne in a few-flowered terminal cyme; and corolla of 3 clawed, round, white petals.

TAFAHI:

Hurlimann 402—Roadside on volcanic soil near the lower end of the path to the summit of the island at ca. 120 m elevation.

Buelow 1194—Edge of plantations and beginning of the upper forest on the village side of the island at 300 m elevation.

Buelow 1220—Plantation near the path down from the top of the mountain growing on rocks at 300 m elevation.

NIUAFO‘OU:

Buelow 2000—Small ravine running parallel to the crater rim about 1.6 km southwest of ‘Esia at ca. 160 m elevation.

CYPERACEAE

75. Eleocharis geniculata (L.) Roemer & Schultes

Tongan Name: none

English Name: none
Reason for Listing: infrequency of collections, restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Little can be, or needs to be done for this plant, since although rare, it occurs on two isolated islands in a habitat there that does not appear to be threatened.

Probably indigenous to Tonga, found throughout the tropics. This small sedge is weedy in many places in the Pacific (e.g., in Hawai‘i, where it was first recorded in 1909), but appears to be native to Tonga, where it has been collected twice, both times in wet areas near the summit of on Kao, reported from 900 to 950 m elevation. No local names or uses are reported for this small, inconspicuous plant found only one isolated island.


Eleocharis geniculata (Swains Island)

Annual herb with densely tufted, glabrous stems up to 20 cm or more in height and 0.5–1.5 mm in diameter. **Leaves** absent, sheath 1–6 cm long, the lowest ones often brownish purple, margins tinged with purple. **Inflorescence** a solitary, many-flowered, terminal, ovoid to subglobose spikelet 3–4 mm long. **Glumes** brown, ovate, 1–1.5 mm long, with a board hyaline margin and green midrib; bristles 6 or 7, longer than the achene. **Ovary** superior, style base nearly as broad as the ovary, with 2 or 3 stigmas. **Stamens** 2 or 3, free. **Fruit** an obovoid, biconvex achene 0.5–0.7 mm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its small sedge habit; narrow, leafless, cylindrical, septate stems; and green flowers borne in a terminal ovoid spikelet. It can easily be distinguished from *E. dulcis* by its much smaller size.

KAO:
Yuncker 15974—Margin of an alpine lake near the summit of the island at about 950 m elevation.
Buelow 3058—Small ponds below the summit at 900 m elevation.

76. Kyllinga nemoralis (Forst.) Dandy ex Hutch. & Dalziel

Cyperus kyllingia Endl.
Kyllinga monocephala Rottb.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of modern collection

Status: rare Polynesian adventive
Suggestion Action: Little can be done for this plant, other than to collect it and grow it in gardens. However, it is lawn weed that very amenable to growing in gardens.

A Polynesian introduction to Tonga, where it was first recorded in 1840, probably native to somewhere in the Old World Tropics, but now pantropic in distribution. It is common as a weed of disturbed places such as lawns and pastures on all the main islands of Tonga, reported only from the lowlands. No uses are reported for this sedge, except for the general uses of stiff-stemmed sedges used to clean out the ears.

Perennial creeping sedge spreading by means of a long-creeping rhizome; culms tufted or spaced, erect, up to 55 cm in height, 3-angled. **Leaves** many, usually shorter than the culm, linear, 1.5–3 mm wide, up to 15 cm or more long; leaf sheath brown to purple-brown. **Inflorescence** a globose head 5–10 mm in diameter, sometimes with 2 or 3 smaller fused lateral ones, subtended by 3 or 4 unequal, spreading, leafy bracts up to 20 cm long. **Spikelets** ovate to lanceolate, white, 2.5–3 mm long, 1-flowered. **Glumes** usually 5, upper ones longest, boat-shaped, white variegated with brown, with a green keel. **Ovary** superior; stigmas 2. **Stamens** 3, free. **Fruit** an oblong to suborbicular, biconvex achene 1.2–1.5 mm long, brown.

Kyllinga nemoralis (Ta‘ū, American Samoa)

Distinguishable by its small sedge habit; triangular stems arising from a creeping rhizome; and small head of white bracts subtended by three leaf-like bracts. N.B. Hotta (1962) identified Hurlimann 4 from Tongatapu as this species, but Yuncker identified it as *Kyllinga brevifolia*.

TONGATAPU:
Moseley s.n.—Without further locality.
Yuncker 15080—Low area along margin of marsh at Navutoka Village.
Yuncker 15134—Common along trail below Niuatoua Village.
Soakai 197—(Specimen not located.)
Soakai 628—(Specimen not located.)
Krauss 1026—(Specimen not located.)

EUA:
Yuncker 15389—Open grassy area along the trail near the center of the island.
Hotta 5500—Near Mt. Kolo-‘aki-Lupe Tonga.
Martin 28?—(Specimen not located.)
Martin 29?—(Specimen not located.)

TOFUA:
Buelow 2635—Weed around dwellings at Manaka, not seen anywhere else.
VAVAU:
Kubury s.n.—(Specimen not located.)
Crosby 179—Without further locality.
Soakai 1059—(Specimen not located.)
TAFAHI:
Hurlimann 532—Roadside between the township of Tafahi and Faihavanui.
SINE LOC:
Jensen s.n.—(Specimen not located.)

77. Lepironia articulata (Retz.) Domin

Tongan Name: *kutu kofe*
English Name: none
Reason for Listing: restricted to a single locality in a threatened habitat
Status: rare indigenous
Suggestion Action: The marshes on Vava‘u should be located and surveyed to see in which of these places with the appropriate habitat the sedge occurs. Preserving wetlands, which is a priority for conservation around the world, also is a priority for this wetland species.


Lepironia mucronata (Vava‘u)

Indigenous to Tonga, widely ranging from Madagascar to Tonga and Fiji. It is apparently restricted in Tonga to one marsh on Vava‘u, where it grows in the waterlogged soil and sometimes dominates the site or parts of it. It is known from only a single island in Fiji (Taveuni). It is very similar to *Eleocharis dulcis* (water chestnut), which occurs in similar habitats, but the inflorescence of *Lepironia* is axillary rather than terminal. The stems are sometimes woven into sleeping mats in Fiji, but this has not been reported yet from Tonga.

Perennial sedge with creeping rhizomes; culms erect, up to 2.5 m in height and 2–8 mm in diameter, hollow, transversely septate and glaucous green, arranged in rows along the rhizome. **Leaves** reduced to 3 sheathes 3–30 cm long, split on one side, obliquely truncate at the top. **Inflorescence** a single, lateral or subterminal, ovate to oblong, many-flowered, brown to purple-brown spikelet 1–3.5 cm long, bearing tightly imbricated glumes, and subtended by an erect, single culm-like, non-septate bract. **Glumes** oval to obovate-orbicular, coriaceous with a

cartilaginous margin, 3–7 mm long in the middle of the spikelet. **Ovary** superior, 2-celled, with a matching number of stigmas. **Stamen** 1, exserted. **Fruit** a brown, oval to obovate achene 3–4 mm long, bearing the 2 persistent stigmas at the top. **Flowering** and fruiting probably occur continuously.

Distinguishable by its leafless sedge habit; hollow, narrowly cylindrical stems bearing transverse septa; and a brown, ovate to oblong, many-flowered spikelet borne on the side (rather than tip) of the culm.

VAVA‘U:
Crosby 178—Without further locality.
Yuncker 16026—Large patch in Ngofe marsh at the southwest end of the island.
Hotta 5067—Ngofe marsh in Tuanuku Village.
Whistler 6032—Center of Ngofe marsh in Tuanuku Village.

ORCHIDACEAE

78. Acanthephippium splendidum J.J. Smith

Acanthephippium papuanum Schltr.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao, Tofua, and Tafahi. There is probably no danger to its existence on Kao and Tofua other than possible cataclysmic eruption of volcanoes, but the forests on Tafahi are threatened by kava production.

Acanthephippium splendidum
(Ta‘ū, American Samoa)

Indigenous to Tonga, also found in Sulawesi, New Guinea, the Solomon Islands, Vanuatu, Fiji, Samoa (based on a recent new record), and New Caledonia. It occurs in Tonga only on the three highest islands, Kao, Tofua, and Tafahi, in lowland to foothill forest, reported at 150–400 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Terrestrial orchid up to 80 cm in height, with ovoid-conical to conical-cylindrical, 3-noded, green pseudobulbs 6–12 × 2.5–5 cm. **Leaves** simple, alternate, 2 or 3 per pseudobulb, suberect, plicate; blade elliptic, 25–45 × 10–15 cm, acute at the base, acute at the tip; surfaces glabrous, plicate; margins entire; petiole slender, up to 25 cm long. **Inflorescence** an erect, 1–7-

flowered raceme 10–15 cm long, bearing lanceolate bracts up to 2.5 cm long. **Flowers** urceolate; sepals white to creamy yellow, reddish or striped with pink; petals and lip pale yellow. **Dorsal sepal** oblong-lanceolate, 3.5–4 × 1–1.2 cm. **Lateral sepals** obliquely oblong-ovate, 3.5–4 × 1.2–1.5 cm; mentum sub-gibbose at apex, 0.7–1.4 cm long. **Petals** rhombic, obtuse, 3.1–3.9 × 1.6–2.2 cm. **Lip** 3-lobed, 1.5–1.8 × 1.2–1.6 cm; side lobes erect; midlobe oblong to oblong-spathulate; callus of 3–5 longitudinal keels. **Column** ca. 1.5 cm long; foot incurved, ca. 2.8 cm long. **Fruit** a capsule elliptic or oblanceolate in outline, 4.5–6 cm long, on a stalk of similar length. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its terrestrial orchid habit; pseudobulbs bearing 2 or 3 large leaves; 1- to several-flowered racemes; large showy flowers that are cream to yellow with red lines and a sac-like base; and large, conspicuous, yellow column in the center.

KAO:

Buelow 2956—In sparse ground cover in a *Calophyllum* forest on the south slope of the mountain at 150 m elevation.

TOFUA:

Buelow 2543—One clump found near the rim of a small crater in light forest.

Buelow 2655—Forest inside the main crater on the side at 400 m elevation.

TAFAHI:

Hurlimann 439—Cloud forest on steep volcanic slope on the rim of the crater at ca. 580 m elevation.

Buelow 1262—Steep slope with scattered ferns on the southwest side of the mountain just below the summit of Piu-‘o-Tafahi at ca. 525 m elevation.

79. Bulbophyllum longiscapum Rolfe

Bulbophyllum praealtum Kraenzl.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: This species is restricted to the forests on the isolated island of Tafahi, which are under pressure from kava growers. Everything possible should be done to preserve these forests, since they are home to many rare species in Tonga.

Bulbophyllum longiscapum (‘Upolu, Samoa)

Indigenous to Tonga, also found in the Solomon Islands, Vanuatu, Fiji, Samoa, ‘Uvea, and Niue. It is known in Tonga only from Tafahi, where it reported from 400 to 525 m elevation, but over its whole range it occurs from near sea level to 500 m or more in

elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Creeping epiphytic orchid with an elongated rhizome 3–4.5 mm in diameter, bearing widely spaced, narrowly conical-ovoid pseudobulbs 2–4.5 × 0.8–1.8 cm. **Leaves** simple, alternate; blade oblong-elliptic, 11–23 × 2–3.5 cm, attenuate at the base, broadly acute at the tip; surfaces glabrous; margins entire; petiole 3–5 cm long. **Inflorescence** a several-flowered raceme 25–79 cm long bearing several flowers in succession, and broadly ovate, acuminate-tipped bracts 8–12 mm long; flowers produced sequentially, white or greenish yellow marked with dull purple or red at base of segments. **Dorsal sepal** lanceolate, acuminate, 25–30 × 5–5.5 mm. **Lateral sepals** weakly spreading, obliquely lanceolate, attenuate, acute, 30–35 × 6.5–7.5 mm. **Petals** broadly ovate, acuminate, briefly setiform at apex, ca. 2 × 1.5 mm. **Lip** very fleshy, porrect, oblong-lanceolate, narrowly obtuse, 26–32 × 8–9 mm; side margins revolute, crenate-undulate distally; callus of two prominently raised keels that coalesce in front. **Column** ca. 5 mm long; foot 7–8 mm long. **Fruit** a narrowly oblanceolate capsule ca. 4–7 cm long.
Flowering and fruiting reported between July and November, but possibly of longer duration.

Distinguishable by its epiphytic herb habit; pseudobulbs 2–4.5 cm long; leaves 11–23 cm long; several flowered racemes with white to greenish yellow flowers marked with dull purple or red at the base and up to 3.5 cm long.

TAFAHI:

Hurlimann 416—Epiphyte in montane forest along the path to the top of the mountain at ca. 400 m elevation.
Buelow 1172—Fog forest near summit of Piu-‘o-Tafahi at ca. 525 m elevation.
Buelow 1184—Epiphyte in cloud forest near the summit of the island at 500 m elevation.
Whistler 6245—Cloud forest at the summit of the island.

80. Crepidium latisegmentum (C. Schweinf.) M.A. Clem. & D.L. Jones

Malaxis latisegmenta C. Schweinf.
Oberonia latisegmenta (C. Schweinf.) Parham

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this species, since it is found on the isolated Kao and Tofua islands, as well as ‘Eua (where it is not uncommon). There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, an unlikely event, but even then it would still be found on ‘Eua.

Indigenous to Tonga, also found in Fiji, Vanuatu, and the Solomon Islands. In Tonga, this orchid is found on Kao, Tofua, and ‘Eua, where it grows in open foothill forest, reported at 260–450 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga. Specimens at the Bishop Museum were out on loan during the site visit. The orchid was found to be common in primary forest on top of the island during a survey of ‘Eua rare plant species in November of 2010.

Small terrestrial orchid 12–30 cm in height with a creeping rhizome and erect stem 4–14 cm long. **Leaves** simple, alternate, 3–7; blade ovate to ovate-elliptic, 6–13 × 2.5–7 cm, obliquely rounded at the base, acute at the tip; surfaces glabrous, lower side prominently pinnately veined from the base; margins entire; petiole 2.5–7 cm long. **Inflorescence** a subdensely, many-flowered raceme 8–30 cm long, with the peduncle and rachis weakly costate; bracts lanceolate, acuminate, 5–11 mm long. **Flowers** yellow. **Dorsal sepal** broadly elliptic to elliptic-ovate, 5–6 × 3–5 mm. **Lateral sepals** obliquely suborbicular-obovate, ca. 5 × 3.1–3.8 mm. **Petals** spathulate to elliptic-obovate, 4–5 × 1.8–2.5 mm. **Lip** cordate, 2.5–3.5 × 2.3–3 mm, prominently auriculate at base. **Column** 0.7–0.8 mm long. **Fruit** a narrowly cylindrical capsule 8–10 mm long. **Flowering** and fruiting reported between January and June, but probably occurring throughout the year.

Crepidium latisegmentum (‘Eua)

Distinguishable by its small terrestrial orchid habit; many-flowered terminal raceme; pale yellow flowers; and a somewhat heart-shaped lip with entire margins (i.e., lacking teeth).

‘EUA:
Wood 6836—(Specimen not located.)
Whistler 5969—Forest floor in the central part of the island.
Whistler 12166—Forest floor in primary forest just north of Lokupo lookout at 260 m elevation.

KAO:
Yuncker 15887—Open forest.
Buelow 713—Shaded forest on south side of the island at 200–300 m elevation.

TOFUA:
Buelow 2719—Open forest between two large ravines 2/3 of the way up to the summit.

81. Crepidium taurinum (Rchb. f.) Szlach.

Malaxis taurina (Reichenb. f.) Kuntze
Microstylis taurina Reichenb. f.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous

Suggestion Action: This species is restricted to the high elevations of isolated Tafahi, and the forests on that island are under pressure from the production of kava. Everything possible should be done to preserve the forests on Tafahi, since so many species rare in Tonga are found on the island.

Indigenous to Tonga, also found in Vanuatu, New Caledonia, Samoa, and Fiji. It is restricted in Tonga to Tafahi, where it was collected at 500 m elevation (habitat data not found). No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Crepidium taurinum (Ta‘ū, American Samoa)

Small terrestrial orchid with short erect stems 3–6 (–15 cm) long. **Leaves** simple, alternate, 5–10; blade ovate, 6–9 × 1.8–3.5 cm, acute at the base, acute at the tip; surfaces glabrous; margins entire; petiole slender, up to 5 cm long, sheathing at the base. **Inflorescence** a subdensely many-flowered raceme up to 22 cm long, with the flowers in the upper half; bracts reflexed, linear, acuminate, 4–6 mm long. **Flowers** small, purple to pink or rarely dull yellowish. **Dorsal sepal** ovate, obtuse, ca. 3 × 2 mm. **Lateral sepals** oblong, obtuse, ca. 3 × 1.5 mm. **Petals** linear-oblong, obtuse, ca. 3 × 1 mm. **Lip** 3-lobed, ca. 4 × 3.5–4 mm; side lobes hatchet-shaped, acute in front; midlobe oblong-elliptic or tapering, emarginate. **Column** short. **Fruit** an ellipsoid capsule 7–11 mm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its small epiphytic orchid habit; mostly basal, lanceolate leaves; long several-flowered racemes; small purple to pink flowers with a irregularly heart-shaped lip with several tiny teeth on the edge.

TAFAHI:

Buelow 1256—Fog forest in a gully near the top of the north side of the mountain at 500 m elevation.

82. Dendrobium dactylodes Reichenb. f.

Dendrobium involutum sensu Kraenzl.; non Lindl.
Dendrobium vaupelianum Kraenzl.
Dendrobium whitmeei Kraenzl.

Tongan Name: none
English Name: none

Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: This species is restricted to isolated Tafahi, and the forests on that island are under pressure from the production of kava. Everything possible should be done to preserve the forests on Tafahi, since so many species rare in Tonga are found on the island.

Dendrobium dactylodes (‘Upolu, Samoa)

Indigenous to Tonga, also found in Vanuatu, Fiji, Samoa, and the Cook Islands (Rarotonga only). It is known in Tonga only from the top of Tafahi in montane or cloud forest, reported from 500 to 590 m elevation, but probably also at lower elevations (to near sea level in Samoa, where it is common). No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Medium-sized epiphytic orchid with clustered, many-noded slender stems 25–140 cm long. **Leaves** simple, alternate, distichous, many per stem; blade somewhat fleshy, lanceolate, 3.5–8 × 1–2.5 cm, attenuate at the base, obliquely obtuse or subacute at apex; surfaces glabrous; margins entire; petiole articulated to sheathing leaf bases, 5–10 mm long. **Inflorescence** lateral, 2-flowered, borne at nodes 3–6 mm long opposite a leaf; bracts small, scale-like. **Flowers** white to pale creamy white or tinged with pink, ephemeral. **Dorsal sepal** linear-lanceolate, acute, 15–24 × 3–3.5 mm. **Lateral sepals** falcate, lanceolate, attenuate, acute, 13–28 × 6–10 mm; mentum inflexed, conical, 5–7 mm long. **Petals** linear-lanceolate, acute, 13–24 × 1–2 mm. **Lip** 3-lobed, recurved, 7–14 × 5–8 mm; side lobes erect, obliquely ovate, subacute to obtuse; midlobe ovate, attenuate, acuminate, sparsely papillate at apex of callus, the margins irregularly crenate-dentate below; callus with a prominently raised keel, verruculose in basal part, crenate in apical part. **Column** 3–3.5 mm long; foot 4.5–6 mm long. **Fruit** an ellipsoid capsule 1.5–3 cm long. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its epiphytic orchid habit; long, many-noded, leafy stems; flowers borne in pairs at nodes opposite the leaves; flower parts white and sometimes tinged with pink, and up to 2.8 cm long.

TAFAHI:
Hurlimann 463—Cloud forest below the summit at ca. 590 m elevation.
Buelow 1186—Epiphyte in fog forest near the top of the mountain at 500 m elevation.
Buelow 1274—On hibiscus tree in fog forest along the path to the summit on the western side of the island at 500 m elevation.
Whistler 6243—Epiphyte in cloud forest at the summit of the island.

83. Erythrodes oxyglossa Schlechter

Erythrodes lilyana (H. Fleishm. & Rech.) Schltr.
Physurus lilyanus H. Fleischm. & Rech.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, an unlikely event.

Erythrodes oxyglossa (‘Upolu?, Samoa)

Indigenous to Tonga, also found in New Caledonia, Fiji, and Samoa. It is known in Tonga only from Kao and Tofua, where it occurs on ridges and in foothill to montane forest, reported from 100 to 600 m elevation (but up to 1000 m elsewhere). No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small terrestrial orchid 25–40 cm in height. **Leaves** simple, alternate, several; blade obliquely oblong-lanceolate to oblong-ovate, unequally sided, 5–10 × 1.5–2.5 cm, acute to oblique at the base, acuminate at the tip; surfaces glabrous; margins entire; petiole slender, 2.5–3.3 cm long, sheathing at the base. **Inflorescence** a 12–27 cm long, several-flowered raceme, the peduncle pubescent in upper part, the rachis pubescent; bracts lanceolate, 8–10 mm long, hairy. **Flowers** dull brownish white, pubescent on the outside of the sepals. **Sepals** lanceolate, 6–8 × 1.7–2.3 mm, densely hairy. **Petals** obliquely oblanceolate, acute, 5.5–7.5 × 1.5–1.7 mm. **Lip** 6–8.5 mm long, lanceolate to oblong-lanceolate, acute; spur bilobed at apex, 2.5–3.5 mm long, with 2 small glands within. **Column** 2.5–3.5 mm long. **Fruit** an ellipsoid capsule 1.1–1.5 mm long, sessile. **Flowering** and fruiting occur throughout the year.

Distinguishable by its small terrestrial herb habit; leaves 5–10 cm long; several-flowered raceme distinctly pubescent rachis and flowers; and dull brownish white, pubescent flowers bilobed at the base (the spur) and 6–8 mm long.

KAO:
Buelow 621—Forest on south side of the island at 100 to 200 m elevation.
Buelow 3004—Scrubby forest at treeline on south side of the island at 600 m elevation.
Buelow 3197—Moist ridge forest under somewhat open canopy at Motua above Manaka.

TOFUA:
Buelow 439—Forest inside the crater northeast of Hokula at 350 m elevation.
Whistler 10602—Forest floor on the east rim of the crater at 440 m elevation.

84. Erythrodes purpurascens Schltr.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, an unlikely event.

Erythrodes purpurascens
(Tutuila, American Samoa)

Indigenous to Tonga, also found in New Guinea, Fiji, and Samoa. It is uncommon in Tonga in foothill to scrubby montane forest on Kao and Tofua, reported at 360–600 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small terrestrial orchid up to 32 cm in height. **Leaves** simple, alternate; blade obliquely ovate, 3–5.5 × 1.5–2.2 cm, rounded to oblique at the base, acute to bluntly so at the tip; surfaces glabrous; margins entire; petiole 1–1.5 cm long before it joins the sheath. **Inflorescence** a several-flowered raceme up to 28 cm long; bracts lanceolate, acuminate, 5–8 mm long, with a pubescent rachis and peduncle. **Flowers** white within, brown on outside and with brown marks on lip, small, 4–6 mm long. **Sepals** elliptic-lanceolate, 2.5–4 × ca. 1 mm, glabrous or very sparsely pubescent on outer surface. **Petals** obliquely oblanceolate, acute, 2.5–3.5 × 0.7–0.8 mm. **Lip** subpandurate, 2.5–4.5 mm long, the apical lamina ovate, obtuse; spur 1.5–2.5 mm long, bilobed, usually with 2 small calli within. **Column** 2.5–3.5 mm long. **Fruit** an ellipsoid capsule 8–10 mm long, pubescent. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its small terrestrial herb habit; leaves less than 6 cm long; pubescent, several flowered racemes; and brown and white, sparsely pubescent flowers bilobed at the base (the spur) and 2.5–4 mm long.

KAO:
Buelow 2940—Rock outcrops and small gullies at 360 m elevation.
Buelow 3005—Scrubby forest at treeline on the south side of the island at 600 m elevation.

TOFUA:
Buelow 2541—Open forest inside main crater north of the ʻaʻa lava field at 450 m elevation.
Whistler 10603—Forest floor on the east rim of the crater at 440 m elevation.

85. Eulophia pulchra (Thou.) Lindl.

Eulophidium pulchrum (Thouars) Summerh.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid since it is found mostly in isolated islands.


Eulophia pulchra (Vavaʻu)

Indigenous to Tonga, widespread from tropical Africa and Madagascar eastward to Southeast Asia, the Malay Archipelago, and the Southwest Pacific islands eastward to Niue. It is uncommon in Tonga in lowland forest on Kao, Vavaʻu, and Late, reported from near sea level to 250 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Medium-sized terrestrial orchid up to 50 cm in height, with cylindrical pseudobulbs 6–10 cm long, 2–3-leafed-leaved at the apex. **Leaves** simple, alternate, suberect; blade broadly elliptic, 18–28 × 4.5–7 cm, acute at the base, acuminate at the tip; surfaces glabrous, plicate, petiole articulated in middle, 6–10 cm long. **Inflorescence** a several-flowered terminal raceme 40–75 cm long, with linear bracts 6–12 mm long subtending the flowers. **Flowers** green and yellow with red stripes on lip. **Sepals** ovate, 8–10 mm long. **Petals** narrower than sepals, 7–9 mm long. **Lip** 4-lobed with a small basal, bilobed callus; spur short, globular, ca. 3 mm long. **Fruit** a cylindrical to narrowly elliptic capsule 2–3 cm long, on a shorter stalk. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its medium-sized terrestrial orchid habit; tall, cylindrical pseudobulbs; large acuminate-tipped leaves; several-flowered racemes; and yellowish flowers marked with red striations.

KAO:
Buelow 2830—*Calophyllum* forest above Topuʻefio at 250 m elevation.

VAVAʻU:
Whistler 6572—Coastal forest above the sea cliff on the west side of the island north of Longomapu.

LATE:
Buelow & Sykes 71—Rainforest on west side of the island near the top.

86. Eulophia spectabilis (Dennst.) C. R. Suesh

Eulophia nuda Lindl. ex Wallich
Wolfia spectabilis Dennst.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, and unlikely event.

Eulophia spectabilis (internet, China?)

Indigenous to Tonga, ranging from Sri Lanka westward to Palau, Fiji, and Tonga. It is restricted in Tonga to Kao and Tofua, where it is found in clearings and probably lowland forest, reported from near sea level, but in Fiji it ranges up to more than 800 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Medium-sized terrestrial orchid up to 75 cm in height. **Leaves** simple, alternate, erect, 2 or more; blade elliptic-lanceolate, up to 44 × 3–3.5 cm, attenuate at the base, acuminate at the tip; surfaces glabrous, plicate; margins entire; petiole tapering into the blade. **Inflorescence** erect, 28–80 cm long, 2–10-flowered; peduncle and rachis stout, up to 5 mm diameter. **Flowers** showy, probably self-pollinating, white to greenish white; pedicels ca. 2.5 cm long. **Sepals** lanceolate, acute, 2.2–2.5 cm long. **Petals** ovate, acute, 1.8–2 cm long. **Lip** ovate to oblong, entire, 1.8–2 × ca. 1 cm; spur broad, flattened, 2–3 mm long, recurved. **Capsule** nodding, ribbed. **Column** stout, clavate, 9–11 mm long, winged near the base. Fruit a cylindrical capsule up to 4 cm long. **Flowering** recorded between December and March, but probably of longer duration.

Distinguishable by its medium-sized terrestrial orchid habit; large folded leaves; several-flowered raceme of white to greenish flowers with a small short curved spur 2–3 mm long

KAO:
Buelow 2829—Grassy clearing near coconut-drying shed not far from the landing at Topu‘efio.

TOFUA:
Buelow 469—(Specimen stored at Vainī but not examined, but this number is also listed for *Erythrodes purpurascens*, and the specimen needs to be checked.)

SINE LOC:
Lister s.n.?—Without further locality.

87. Hetaeria whitmeei Reichenb. f.

Adenostylis stricta Rolfe
Habenaria sp. of Yuncker
Hetaeria francisii Schltr
Hetaeria polyphylla Reichenb. f.
Zeuxine betchei Schltr
Zeuxine sphaerocheila H. Fleischm. & Rech.
Zeuxine triandra M. Hotta

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid except to preserve the forest on ʻEua, particularly in the national park.

Hetaeria whitmeei (Taʻū, American Samoa)

Indigenous to Tonga, also found in New Caledonia, Fiji, and Samoa. It is restricted in Tonga to ʻEua, where it occurs in limestone forest, reported from 150 to ca. 310 m elevation, but elsewhere in the region it occurs from near sea level to 900 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Medium-sized terrestrial orchid up to 60 cm in height, arising from a creeping rhizome-like stems rooting at the nodes. **Leaves** simple, alternate; blade narrowly elliptic to lanceolate, acuminate, 10–22 × 0.7–2.2 cm, attenuate at the base, attenuate and apiculate at the tip; surfaces pubescent; margins entire; petiole 2–3.5 cm long. **Inflorescence** glabrous, 20–40 cm long, laxly many-flowered. **Flowers** brownish white on the outside, creamy within. **Dorsal sepal** ovate, subacute, 4–5 mm long. **Lateral sepals** obliquely oblong-ovate, subacute, 4–5.5 × 2–2.5 mm. **Petals oblong**, rounded at apex, 4–4.5 × 0.7–1 mm. **Lip** 4.5–5.5 × 3–4 mm, saccate at the base with two lamellate, papillate calli within, and longitudinally divided by a shallow groove externally; apical part transversely oblong, 1–1.5 × 1.5–2 mm. **Column** ca. 1.5 mm long. **Fruit** an ellipsoid capsule 1–1.3 cm long, sessile. **Flowering** and fruiting reported June to October, but probably occurring throughout the year.

Distinguishable by its small orchid habit with the rhizome-like stems rooting at the nodes; narrowly elliptic to lanceolate leaves with an attenuate tip; pubescent racemes 20–40 cm long; and flowers brown on the outside and white within.

ʻEUA:
Yuncker 15404—Moist forest floor near center of the island.
Hotta 5332—Primary forest at Maʻatakitau at the south end of the island at 150 m elevation.

Hotta 5334—Primary forest at Ma‘atakitau at the south end of the island at 200 m elevation.
Buelow 2507—Top of central ridge near the south end.
Whistler 7421—Ridge forest north of Lokupo.
Whistler 11703—Floor of patches of forest no the top of the island near Lokupo lookout at 260 m elevation.

88. Liparis laydardii F. Muell.

Liparis mataanensis J.J. Sm
Liparis stricta Schltr.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao and Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, and unlikely event.

Liparis layardii (Savai‘i?, Samoa)

Indigenous to Tonga, also found in the Solomon Islands, Vanuatu, New Caledonia, Samoa, and Fiji. It is restricted in Tonga to Kao and Tofua, where it occurs in lowland to montane forest and native fernlands, reported from near 400 to 1040 m elevation, but extending to lower elevations elsewhere in the region. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small terrestrial orchid, erect, up to 45 cm in height, with clustered, 2–3-leafed, cylindrical pseudobulbs up to 20 × 1 cm. **Leaves** simple, alternate; blade ovate to ovate-elliptic, 6.5–10 × 5–7 cm, acute at the base, acute at the tip; surfaces glabrous; margins entire; petiole 2–3.5 cm long. **Inflorescence** laxly 8–15-flowered, 12–30 cm long; bracts 5–10 mm long. **Flowers** purple with a green column. **Dorsal sepal** erect, oblong-lanceolate, acute, 7–12 × 2–2.5 mm. **Lateral sepals** reflexed, oblong to oblong-ovate, obtuse, 6.5–10 × 2.5–3 mm. **Petals** linear-ligulate, subacute, 6–12 × 0.75–1.25 mm. **Lip** recurved, flabellate to obovate, 6.5–10 × 5.5–7.5 mm, the margins weakly crenulate; callus bilobed, basal. **Column** incurved at apex, 5–6 mm long. pedicel and ovary 1–1.2 cm long, 6-angled. **Fruit** an ellipsoid capsule 1–2.5 cm long. **Flowering** and fruiting occur throughout the year.

Distinguishable by its small terrestrial orchid habit; relatively broad, ovate leaves; raceme of purple flowers marked with green; and ellipsoid capsule up to 2.5 cm long.

KAO:

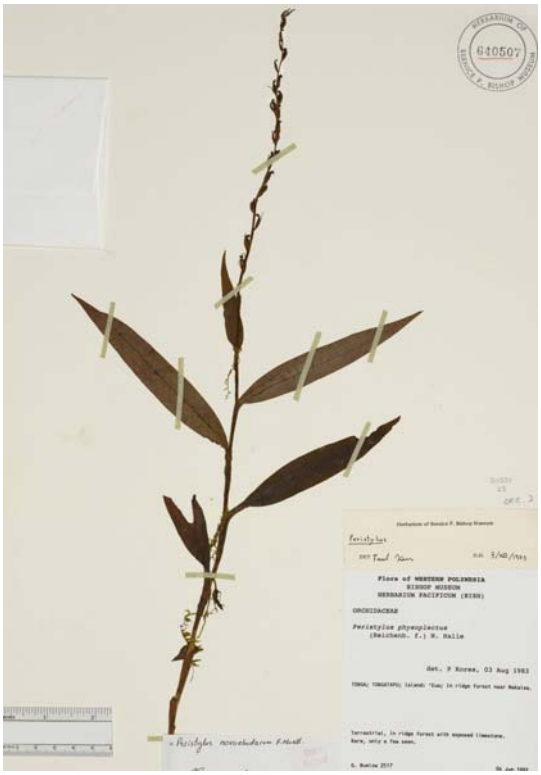
Buelow 713—Forest floor on the south side of the crater.
Whistler 10713—Dense herbaceous scrub at the summit of the island at 1040 m elevation.

TOFUA:

Buelow 2547—Light forest inside of and near the rim of a small crater at 400 m elevation.
Whistler 10600—Forest floor on the east rim of the crater at 440 m elevation.

89. Peristylus novoebudarum F. Muell.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Because of its rarity on three islands, nothing much can be done for this orchid other than to protect the forests on Kao, Niuafo‘ou, and ‘Eua, especially in the National Park on the latter island.



Peristylus novoebudarum (Bishop Museum)

Indigenous to Tonga, also found in New Caledonia and Vanuatu. It occurs in Tonga on ‘Eua, Kao, and Niuafo‘ou, where it is found in lowland forest, reported at 350 m elevation, but elsewhere in the region it can be found at up to 800 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Medium-sized terrestrial orchid up to 60 cm or more in height. **Leaves** simple, alternate, clustered in middle of stem; blade narrowly lanceolate to elliptic, 10–17 × 1.5–2.5 cm, attenuate at the base, acuminate and apiculate at the tip; surfaces glabrous; margins entire; petiole 1–2.5 cm long. **Inflorescence** a subdensely many-flowered raceme up to 30 cm long, with the slender rachis bearing lanceolate bracts 1–1.5 cm long equaling or longer than the flowers. **Flowers** pale greenish yellow to yellowish brown, small. **Dorsal sepal** ovate, obtuse, ca. 3 × 1.5 mm. **Lateral sepals** oblong-ovate, shortly mucronate, ca. 3 × 1–1.5 mm. **Petals** entire, obliquely ovate, obtuse, ca. 3.5 × 1 mm. **Lip** 3-lobed, with a horn-like callus at mouth of spur; side lobes spreading, linear-tapering, ca. 3 mm long; midlobe ligulate, obtuse, fleshy, ca. 2 mm long; spur globular, ca. 2 mm long. **Column** very short, ca. 1 mm long. **Fruit** an ellipsoid capsule ca. 6–8 mm long, on a short pedicel. **Flowering** and fruiting reported from April to June, but probably of longer duration.

Distinguishable by its medium-sized terrestrial orchid habit; narrowly lanceolate to elliptic leaves with an attenuate tip; long, many-flowered raceme with a slender rachis; and tiny green flowers.

‘EUA:

Buelow 2517—Ridge in limestone forest near Makalea.

KAO:

Buelow 618?—(Specimen not located.)

NIUAFO‘OU:

Buelow 2146—Wooded area with coconuts, about halfway from ‘Esia to Koko at Vailahi at over 350 m elevation.

90. Phaius amboinensis Bl.

Phaius graeffei Reichenb. f
Phaius terrestris (L.) Ormerod

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to a pair of islands
Status: rare indigenous
Suggestion Action: This species is restricted to isolated Kao and Tafahi, and the forests on the latter island are under pressure from the production of kava. Everything possible should be done to preserve the forests on Tafahi, since so many species rare in Tonga are found in the remaining montane forest on island. Its presence on Kao is probably not threatened other than possible cataclysmic eruption of volcanoes, an unlikely event.

Phaius amboinensis (‘Upolu, Samoa)

Indigenous to Tonga, widely distributed from Indonesia (Ambon) and New Guinea to the Cook Islands (Rarotonga), and a new record from Ra‘iatea in the Society Islands. It occurs in Tonga on Kao and Tafahi, where it occur in lowland to montane forest, reported from 300 to 400 m elevation (but at 50–800 m elevation elsewhere in the region). No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Large terrestrial orchid up to 1 m in height with leafy, elongate, non-pseudobulbous stems up to 30 cm long. **Leaves** simple, alternate; blade elliptic-lanceolate, 30–70 cm × 4–9 cm, long-attenuate at the base, long-acuminate at the tip; surfaces glabrous, strongly veined; margins entire; petiole indistinguishable from the blade. **Inflorescence** an erect, axillary, laxly 5–15-flowered raceme 30–70 cm long, bearing caducous obovate bracts 2.5–3.5 cm long. **Flowers** showy, white with a pale yellowish lip, turning blue when damaged, sometimes cleistogamous. **Sepals** oblong-obovate, subacute, 2.8–3.5 × 1–1.3 cm. **Petals** oblanceolate, slightly falcate, rounded at apex, 2.8–3.3 × 0.7–0.8 cm. **Lip** embracing column, flabellate when flattened, 3-lobed at apex, 2.5–3 cm long and wide, lacking a spur, mealy-tomentose on the disc. **Column**

clavate, 2–2.5 cm long. **Fruit** a pendulous ellipsoid capsule 2.5–3.5 cm long on a slightly shorter pedicel. **Flowering** and fruiting occur throughout the year.

Distinguishable by its large terrestrial herb habit; large, strongly veined leaves up to 70 cm or more in length; racemes of large, showy white flowers with a yellow lip; and large pendulous fruit.

KAO:

Buelow 722—Forest on the south side of the island over halfway up to the treeline at 300 to 400 m elevation.

TAFAHI:

Buelow 1161—Forest above Fakafafa-mo-e-Tauloto at 300 to 400 m elevation.

Buelow 1196—Edge of plantation and beginning of the upland forest on the village side of the island.

91. Phaius robertsii Muell.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found only on isolated Tofua. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, and unlikely event.

Phaius robertsii (Tofua)

Indigenous to Tonga, also found in Vanuatu, New Caledonia, and Fiji. It is only known in Tonga from Tofua, where it occurs in lowland forest, reported between 440 and 500 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Large terrestrial orchid up to 90 cm in height, with cylindrical pseudobulbs, 5–8-leafed along length in upper part. **Leaves** simple, alternate; blade elliptic, 11–26 × 4–8 cm, acute at the base, long-acuminate at the tip; surfaces glabrous; margins entire; petiole tapering into the blade. **Inflorescence** an erect, laxly several-flowered raceme 50–90 cm long, bearing persistent bracts 1.5–2.8 cm long. **Flowers** yellow, lip white with purple guidelines and yellowish in center. **Sepals** lanceolate, acuminate, 2.3–2.5 × 0.4–0.5 cm; lateral sepals falcate. **Petals** similar to sepals. **Lip** connate for ca. 4 mm with the column, rhombic-orbicular, somewhat 3-lobed in front, 2.3–2.5 × 2–2.5 cm, apical margins undulate-crispate; spur very shortly conical, 1–2 mm

long. **Column** hairy on ventral surface, ca. 1.5 cm long. **Fruit** a fusiform capsule ca. 3 cm long, on a shorter pedicel. **Flowering** and fruiting reported in June, but probably of longer duration.

Distinguishable by its large terrestrial orchid habit; strongly veined leaves; showy yellow flowers marked with purple and yellow; and a large pendulous fruit.

TOFUA:

Buelow 2619—Foothill forest above Fakaholongakao and between Haʻamatuʻa and Manaka along the crater rim at ca. 500 m elevation.

Whistler 10599—Forest floor on the east rim of the crater at 440 m elevation.

92. Phreatia matthewsii Reichenb. f.

Phreatia myosurus (Forst. f.) Ames
Eria myosurus (Forst. f.) Reichenb. f
Phreatia myosurus (Forst. f.) Ames
Phreatia neocaledonica Schltr
Phreatia reineckei Schltr
Phreatia upoluensis Schltr
Phreatia yunckeri L.O. Williams

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: This species is restricted to Tafahi, and the forests on that island are under pressure from the production of kava. Everything possible should be done to preserve the forests on Tafahi, since so many species rare in Tonga are found on the island.

Phreatia matthewsii (Savaiʻi, Samoa)

Indigenous to Tonga, also found in New Ireland, Bougainville, the Solomon Islands, Vanuatu, the Horne Islands, Fiji, Niue, Samoa, and the Society Islands. It is restricted in Tonga to Tafahi, where it is found in lowland to montane or cloud forest, reported from 500 to ca. 600 m elevation (but from near sea level to 800 m elsewhere in its range). No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small epiphytic orchid with a short stem 1–4 cm long covered by the residual leaf sheathes. **Leaves** simple, alternate, 6–10, in a fan-shaped arrangement (equitant); blade linear-ligulate, 4–10.5 cm × 2–5 mm, articulated to sheathing, imbricate leaf bases; long-attenuate at base, shortly and obliquely unequally bilobed at the tip; surfaces glabrous; margins entire; petiole indistinct from the tapering leaf base. **Inflorescence** a laxly many-flowered axillary raceme 3–11

cm long; peduncle about half as long as the rachis; bracts lanceolate, acuminate, 1.5–2 mm long. **Flowers** tiny, white. **Dorsal sepal** ovate, subacute, 0.8–1.2 × 0.6–0.8 mm. **Lateral sepals** obliquely ovate, acute, 1–1.5 × 0.9–1.2 mm; mentum subconical. **Petals** elliptic-ovate, acute, 0.8–1.2 × 0.6–0.8 mm. **Lip** clawed, with a transversely ovate, obtuse lamina 0.9–1.3 × 0.7–0.9 mm, obscurely saccate at base. **Column** short; foot ca. 0.3 mm long. **Fruit** a tiny ellipsoid capsule 2–3 mm long, subsessile. **Flowering** and fruiting occur throughout the year.

Distinguishable by its tiny epiphytic orchid habit; linear to strap-shaped leaves less than 6 mm wide and arranged in fan-like fashion; racemes of tiny white flowers; and tiny ellipsoid capsule less than 3 mm long.

TAFAHI:

Buelow 1190—Cloud forest at the summit of the island at over 500 m elevation.
Buelow 1191—On a hibiscus branch in fog forest on the top of the mountain at 500 m elevation.
Whistler 6244—Epiphyte on trees in the cloud forest at the summit of the island.

93. Vrydagzynea vitiensis Reichenb. f.

Vrydagzynea whitmeei Schltr.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection and restricted in Tonga to one island
Status: rare indigenous
Suggestion Action: This species is restricted to Tafahi, and the forests on that island are under pressure from the production of kava. Everything possible should be done to preserve the forests on the island, since so many species rare in Tonga are found on there.

Vrydagzynea vitiensis (‘Upolu, Samoa)

Indigenous to Tonga, also in Vanuatu, Fiji, and Samoa. It is restricted in Tonga to Tafahi, where it occurs in foothill to montane forest, reported from 450 to 500 m, but probably extending above and below these elevations. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small terrestrial orchid 8–25 cm in height with glabrous stems rooting at the lower notes. **Leaves** simple, alternate; blade unequally sided, lanceolate or narrowly ovate, 3.5–6 × 1.2–2 cm, obtuse at the base (one side acute, one side acuminate), acute at the tip; surfaces green with a central white stripe; margins entire; petiole 0.8–1.5 cm long. **Inflorescence** a densely many-flowered raceme 2–7 cm long, with a short, sparsely villose rachis. **Flowers** greenish white to white. **Dorsal sepal** oblong-ovate, subacute, 3–3.5 × 1–1.5 mm. **Lateral sepals** oblong, obtuse,

oblique at the base, 3–3.5 × 1.5–2 mm. **Petals** falcately linear-oblong, obtuse, 2–2.5 × 1–1.5 mm. **Lip** ovate, blunt with incurved sides, 2–2.5 × 1–1.7 mm; spur conical, obscurely bilobed at apex, 2.5–3 mm long. **Column** 1.5–2 mm long. **Fruit** an ellipsoid capsule 9–12 mm long. **Flowering** and fruiting reported from August to November, but probably of longer duration.

Distinguishable by its small terrestrial orchid habit; unequally sided ovate leaves less than 7 cm long; whitish midrib on upper surface; short dense raceme of tiny white flowers.

TAFAHI:

Hurlimann 442—(Specimen not located.)
Buelow 1255—Fog forest on the north side of the mountain at ca. 500 m elevation.
Buelow 1300—Next to path from village to Piu-ʻo-Tafahi near where it meets the ridge at 450–500 m elevation.

94. Zeuxine stenophylla (Reichenb. f.) Benth. & Hook. f. ex Drake

Adenostylis vitiensis Rolfe
Monochilus stenophyllus Reichenb. f.
Zeuxine vitiensis (Rolfe) L.O. Williams

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection
Status: rare indigenous
Suggestion Action: Nothing much can be done for this orchid, since it is found on isolated Kao and Tafahi. There is probably no danger to its existence in Tonga other than possible cataclysmic eruption of volcanoes, an unlikely event.

Zeuxine stenophylla (ʻUpolu, Samoa)

Indigenous to Tonga, also found in Vanuatu, Fiji, and Samoa. It is restricted in Tonga to Kao and Tafahi, where it is found as a terrestrial or epiphyte in forests, reported from ca. 300–400 m elevation. No local uses or names are reported for this orchid, as orchids have virtually no local names or uses (other than as the occasional ornamental) in Tonga.

Small terrestrial orchid (or sometimes epiphytic) 18–35 cm in height with glabrous stems rooting at the lower notes. **Leaves** simple, alternate; blade falcate-lanceolate, unequally sided, 1.8–5 × 0.6–1.3 cm, oblique at the base, acute and apiculate at the tip; surfaces glabrous; margins entire; petiole 2–3 cm long and joining the sheath. **Inflorescence** a laxly, many-flowered raceme up to 20 cm or more in length, peduncle and rachis sparsely hairy, bearing lanceolate, acuminate bracts up to 2 cm long. **Flowers** white, sparsely hairy, each subtended by an attenuate-tipped bract; the perianth somewhat angled to the

pubescent ovary. **Dorsal sepal** ovate, obtuse, 3–4 × 2–3 mm. **Lateral sepals** obliquely oblong-ovate, obtuse, 4–5 × 2–3 mm. **Petals** obliquely ovate, obtuse, 3–3.5 × 2–2.5 mm. **Lip** 3.5–4 × ca. 2 mm, recurved at apex; basal part bearing two recurved hook-like calli within; apical lamina transversely oblong, ca. 1 × 2–2.5 mm. **Column** 1.7–2 mm long. **Fruit** an ovoid to elliptic capsule 5–10 mm long, sparsely hairy. **Flowering** and fruiting reported from July to September, but probably occurring throughout the year.

Distinguishable by its small terrestrial orchid habit; lower stems rooting at the nodes; unequally sided, ovate leaf blades; many-flowered, pedunculate raceme; small white flowers with the perianth somewhat angled to the ovary.

KAO:

Buelow 2948—West of a ravine on the southwest slope near treeline at 300 m elevation.
Buelow 2949—On tree trunk in forest near treeline at 400 m elevation.
Buelow 3118—Forest floor above fernlands south of Apikakai.

TAFAHI:

Buelow 1266—Just below the summit on the southwest side of the mountain.

POACEAE

95. Cenchrus caliculatus Cav.

Cenchrus calyculatus Cav. (an incorrect spelling)

Tongan Name: ***hefa***
English Name: Polynesian burr-grass
Reason for Listing: apparently disappearing and modern collections restricted to one island
Status: rare indigenous
Suggestion Action: The ridges of ‘Eua should be surveyed to see where this grass currently occurs, since it seems to have disappeared from the rest of the Tonga.

Cenchrus caliculatus (‘Eua)

Indigenous to Tonga, ranging from New Caledonia and Australia to the Society Islands. It has been collected on several Tongan islands, but the only recent records are from ‘Eua, where it occurs mostly in openings on limestone cliffs and ridges, reported from near sea level to ca. 310 m elevation. It is probably dispersed by sea birds, but cannot compete with more aggressive, recently introduced weeds, and it is now rare over most of its native range in Tonga and elsewhere. No uses are reported.

Robust annual or perennial grass with culms trailing to erect, up to 2 m in length, rooting at the lower nodes. **Leaf sheath** glabrous, rounded on back; ligule 0.5–1 mm long, membranous with a fringe of hairs. **Leaf blade** coarse, 20–50 cm long, 0.8–2.5 cm wide; upper surface scabrous, lower smooth; margins scabrous. **Inflorescence** a dense cylindrical spike-like raceme 8–25 cm long bearing many spiny burrs on a somewhat zigzag rachis. **Spikelet** 5–8 mm long, 2-flowered, lower flower male or sterile, upper bisexual, both surrounded by hard spines fused into a burr 2–4 mm long with a short-hairy base; outer bristles stiffer, longer inner bristles scabrid or somewhat featherlike. **Flowering** and fruiting probably occur throughout the year.

Distinguishable by its tall grass habit; dense, cylindrical, unbranched, spike-like racemes up to 25 cm long; and burr-like spikelets with soft spines, borne on a zigzag rachis. It differs from sand bur *Cenchrus echinatus*, a common and troublesome weed, by its much longer inflorescence and soft rather than hard, sharp-tipped burrs.

TONGATAPU:

USEE s.n.—Without further locality.
Home s.n.—Without further locality.
Moseley s.n.—Without further locality.

ʻEUA:

Parks 16191—Wet places in open bush at Houma.
Yuncker 15489—Open shade along the trail above Houma Village on the northwest end of the island at ca. 100 m elevation.
Hotta 5592—Forest Near Lokupo east of Teʻemoa at ca. 300 m elevation.
Sykes 193—Near Kahana north of Houma at ca. 60 m elevation.
Buelow 1824—Next to the cliff at the edge of the pasture north of the stream at Vaingana.
Buelow 1825—33(Specimen not located.) (Mistake for the above number?)
Whistler 7178—Edge of the fernland on the southeast end of the island.
Whistler 7225—Just over the edge of the liku cliff on the northeast coast east of Houma.

HAʻAPAI:

Yuncker 15827—Clearing along the road encircling the island between the inland lake and the sea.
Soakai 694—Nomuka, without further information.
Buelow 311—Along road on the east side of Nomuka Island.

TOFUA:

Scarth-Johnson 114—Without further locality.

VAVAʻU:

Barclay s.n.—Without further locality.
Crosby 195—Without further locality.

96. Heteropogon contortus (L.) Beauv. ex Roemer & Schultes

Andropogon contortus L.

Tongan Name: none
English Name: none
Reason for Listing: infrequency of collection

Status: rare indigenous

Suggestion Action: Nothing much that can be done for this grass, which grows mostly in sunny disturbed places, other than to survey its known area of occurrence to be able to estimate its distribution and population size. Only two of the collections of this grass has been made in the last 50 years, on Vava u and ʻEua.

Possibly a Polynesian introduction to Tonga, or perhaps modern, pantropic in distribution and present in Hawaiʻi before the first botanical collections there. It is known in Tonga from a number of islands, but only one of the collections has been in the last 50 years. It occurs in open, often disturbed places, such as fernlands and burn-over areas, reported from near sea level to over 130 m elevation. No local names or uses are known.

Tufted perennial grass with erect, glabrous culms 30–100 cm long; leaf sheath compressed, keeled, glabrous or sparsely hispid in the throat; ligule a fringed membrane 0.5–1 mm long. **Leaves** simple, alternate; blade 10–25 x 0.3–0.7 cm; surfaces glabrous; margins finely scabrous. **Inflorescence** a solitary raceme 3–7 cm long. **Spikelets** narrowly lanceolate, 6–10 mm long, paired, one sessile and one stalked; the lower 2–6 pairs male, the upper 8–13 pairs with a sessile female or bisexual spikelet with a bearded sharp barb below it, and a stalked male or sterile one. **Glumes** lanceolate, as long as the spikelet, often with tubercle-based hairs, lower glume keeled, upper one rounded on back; fertile lemma of upper sessile flowers with a bent, flexuous awn 5–12 cm long intertwined with others. **Fruit** a caryopsis ca. 1 cm long enclosed within the glumes. **Flowering** and fruiting occur throughout the year.

Distinguishable by grass habit; long raceme of paired spikelets; and long (5–12 cm) awns borne on the lemmas, with their tips intertwined.

Heteropogon contortus (Vavaʻu)

ʻEUA:

Ives s.n.—Without further locality.

Whistler 7401—Fernland on a ridge north of Lokupo.

HAʻAPAI:

Soakai 653—Nomuka, without further information.

VAVAʻU:

Crosby 192—Without further locality.

Yuncker 16064—Grassy plain along the upper rim of the steep coastal cliff along the northern side of the island above Leimatua at ca. 150 m elevation.

Hotta 4725—Without further locality (and not listed in Hotta).

Whistler 6548—Burnt grassland at the old airport at the north side of the island.

NIUAFO‘OU:
Buelow 2143—On bench above Vailahi just north of Koko.
Buelow 2162—On top of ‘Ahea Ridge facing Vaisi‘i.

97. Schizostachyum glaucifolium (Rupr.) Munro

Bambusa glaucifolia Rupr.

Tongan Name: *kofe*, ***kofe vai***
English Name: Polynesian bamboo
Reason for Listing: reduction in cultivation and infrequency of collection
Status: rare Polynesian cultigen
Suggestion Action: Rhizomes should be harvested in the groves where it occurs on Tafahi and planted on different islands by those who are interested, and in a botanical garden.

Schizostachyum glaucifolium (Hawai‘i)

A Polynesian introduction to Tonga, apparently native to Fiji, and was probably carried by early Polynesian voyagers to nearly all the high island archipelagoes of Polynesia, since it does not readily reproduce by seed (flowering occurs once every decade or two). It forms large dense patches in the mountainous interior of Viti Levu in Fiji. Since it rarely flowers, most of the groves in Polynesia are probably relicts of former cultivation that perpetuate themselves by spreading rhizomes. The stems contain potable water that can be used when one is thirsty. The larger stems were probably used in ancient times to make water containers by cutting a length of stem, removing the woody partitions at each of the nodes except the bottom one, and using a stopper to plug the top end. The split stems were used for the sides of traditional houses. The broken stems served as knives, but this use is virtually forgotten.

Large grass (bamboo) up to 15 m in height, forming large groves by sprouting from spreading underground rhizomes; culms hollow, conspicuously jointed with the leaves forming a single ring-like scar, green, up to 7 cm in diameter, forming slender branches mostly above the 10th node; each node with a large deciduous culm sheath that is glabrous or covered with shedding itchy hairs. **Leaves** simple, alternate; blade linear-lanceolate, 8–25 cm long, rounded at the base, acuminate at the tip; surfaces parallel-veined with a prominent midvein on the lower surface; margins scabrous; ligule narrow, thin, less than 1 mm high, fimbriate or ciliate; sheaths glabrous, mostly striate; petiole mostly 3–13 mm long. **Inflorescence** of flowers in heads of spikelets borne along axillary branches up to 40

cm long arising in axillary clusters, the heads sometimes running together. **Spikelets** narrowly fusiform to cylindrical, ca. 1–1.5 cm long, 1-flowered, borne in clusters of 2 or 3. **Glumes** 3, ovate, membranous, 2–6 mm long, enclosing the somewhat longer lemma and palea. **Fruit** an ovoid caryopsis (but rarely seen). **Flowering** and fruiting occur only at long intervals.

Distinguishable by its bamboo habit; green stems up to 7 cm in diameter; nodes with single ring-like scars; and infrequently forming inflorescences of heads of spikelets forming on clusters of axillary branches. The common bamboo, *Bambusa vulgaris*, can be distinguished when sterile by its larger stems often yellow rather than green, and the ring-like nodal scars being double rather than single.

ʻEUA:

Parks 16092?—(Specimen not located.)

TAFAHI:

Whistler 6267—Thickets in disturbed areas behind the village.