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Introduction to the Flora and Vegetation of the Marquesas Islands

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ABSTRACT

The Marquesas Islands are one of the most isolated groups of oceanic islands, situated in the SE Pacific Ocean about 4850 km from the W coast of Mexico, the nearest continental region. This archipelago of 12 islands has a total surface area of 1300 sq. km. The islands range in size from 61.3 to 330 sq. km, in elevation from 360 to 1276 m, and in age from 1.3 My for Fatu Hiva to 6.3 My for Eiao. The indigenous vascular flora comprises ca. 320 species, with 42% being endemic. Floristic affinities are with the Society Islands, other Polynesian islands, the paleotropics, and to a lesser degree, the Hawaiian Archipelago and the neotropics. Human colonization, feral animals, and alien plants have severely impacted the low- to mid-elevation vegetation of the Marquesas. Nuku Hiva is herein used as an example for Marquesan vegetation types. Leeward areas below 300 m have relict patches of *Sapindus-Xylosma* dry forest and some remnants of *Leptochloa* grassland and *Pisonia* dry forest in the coastal regions. In leeward areas from 300 to 1000 m anthropogenic grasslands of *Miscanthus, Paspalum,* and *Rhynchelytrum* have been induced by fires and overgrazing. These latter associations have largely replaced native xerophytic shrublands of Malvaceae and Sterculiaceae. Low- to mid-elevation windward montane sites (300–800 m) harbor moist and wet forest associations of *Hibiscus, Angiopteris,* and *Pandanus.* Mid- to upper elevation (800–1000 m) sites usually support moist forest and wet forest formations with *Metrosideros, Weinmannia, Hernandia,* and *Cyathea.* The highest slopes and summits at and above ca. 1000 m have cloud forest and summit wet shrubland communities.

INTRODUCTION

The Marquesas Islands (Iles Marquises) are volcanic, oceanic islands without any continental connections. Their ecosystems consequently are derived from long-distance colonizations and subsequent evolution via differentiation and adaptive radiation over geological time. Subsequent to human colonization, the Marquesan vegetation has undergone drastic alteration due to impacts from humans and feral animals and invasion by alien plant species. This paper, which has evolved from a treatment by the first author published in the *Atlas de la Polynésie française* (Florence, 1993) and a talk presented by the second author at the XVII Pacific Science Congress (Lorence et al., 1991), presents an overview of the flora and vegetation of the Marquesas Archipelago using the largest island, Nuku Hiva, as an example.

The Marquesas Archipelago is situated in the SE Pacific Ocean between 8° and 11° S latitude and 139° and 141° W longitude. Politically the archipelago belongs to French Polynesia (Polynésie française), a French overseas *territoire.* The Marquesas comprise the most isolated archipelago in the Pacific and are situated 4850 km from western Mexico, the nearest continental area. However, the Marquesas

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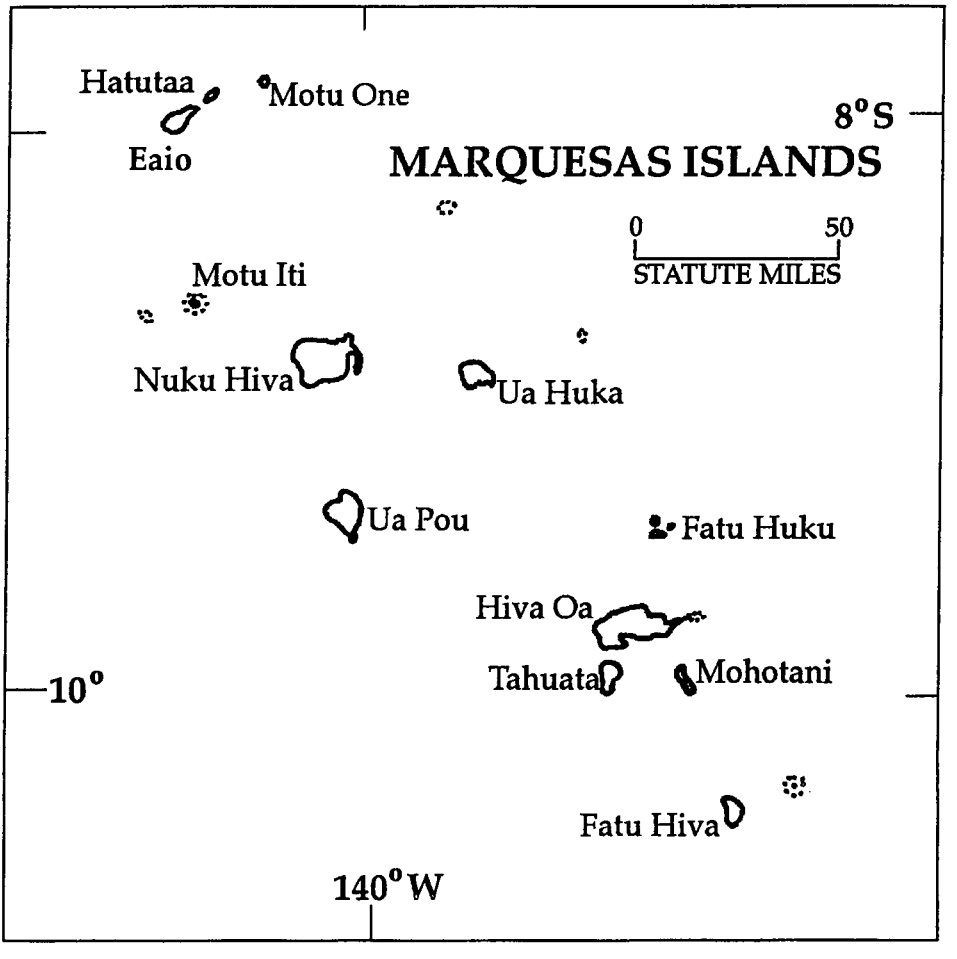

FIGURE 1. Map of the Marquesas Islands.

lie much closer to other Pacific archipelagoes such as Tuamotu Atoll ca. 500 km to the SW and the Society Islands ca. 1300 km to the SW.

GEOMORPHOLOGY AND AGE

The Marquesas comprise a chain of 12 islands extending about 355 km in length, with a total land area of about 1050 sq. km (FIGURE 1). Their alignment and sequence of geological formation runs from NW to SE, as is the case for many other islands in the E Pacific (Duncan & McDougall, 1974). The Marquesas are high islands, with Hiva Oa reaching 1276 m elevation, Nuku Hiva 1227 m, Ua Pou 1203 m, Fatu Hiva 1125 m, and Tahuata 1050 m (Florence, 1993, pers. comm. 1996).

Geomorphologically, the Marquesas have little or no coral reef development.

Only sparse reefs fringe a few of the bays and coastal plains. In general, the islands' relief is extremely rugged, with sheer sea cliffs, steep and highly dissected slopes and valleys, and few beaches (Chubb, 1930).

Ages of the islands range from about 1.3 My for Fatu Hiva in the SE to 6 My for Eiao in the NW, with Nuku Hiva dating to 3.1–4.8 My (Liotard et al., 1986; Brousse et al., 1990). The Marquesas are comparatively young relative to the Hawaiian Islands, a chain of over 100 volcanoes which extends for 6000 km in length and whose origin dates back to perhaps 70 My (Wagner et al., 1990).

Most of the larger islands (i.e., Eiao, Ua Huka, Ua Pou, Tahuata, and Fatu Hiva) have precipitous central mountain ridges and peaks, although Nuku Hiva and Hiva Oa both have central plateaus which moderate the topography somewhat. An excellent description of the physical environment of the Marquesas Islands can be found in the work of Adamson (1936).

CLIMATE

Although relatively few climatic data exist for the archipelago (Leighly, 1933), precipitation varies greatly both between islands and from year to year. For example, rainfall for Atuona on Hiva Oa averages 1200 mm per year, but over the years a range from 560 to 4000 mm annually has been recorded (Adamson, 1936). During most of the year the Marquesas are subject to the trade winds which moderate the temperature and supply rain. Precipitation is greatest on the islands' windward (northeastern and southeastern) sides and decreases toward their leeward (western) sides, and often tends to be greatest during the year-end season (Leighly, 1933). Temperatures vary from hot and humid in the wet lowlands to cool and humid in the wet uplands and hot and dry on the leeward lowland slopes. Mean monthly temperatures for lower elevation sites generally range from about 25°C to 29°C.

The islands' rugged topography, together with climatic factors, provides a variety of microhabitats. This ecological diversity has resulted in a variety of vegetation types ranging from low altitude xeric shrubland and dry forest to rainforest and cloud forest on the upper windward slopes and summits.

DISTURBANCES

Subsequent to colonization by the Polynesians some 1000–2000 years ago (Buck, 1953), the human population of the Marquesas reached an estimated 80,000 inhabitants at its peak. Consequently most of the original vegetation accessible to humans in the valleys and slopes from sea level to mid-elevation was disturbed or destroyed for cultivation of foodcrops. Feral pigs were introduced by the Polynesians and wild populations became established. Contact with Europeans occurred in 1595, when Spanish sailors led by Avaro de Medaña visited the islands and named them "Las Islas de Marquesa de Mendoza", after the Viceroy of Peru. Captain James Cook visited the Marquesas in 1774 during his second circumnavigation of the globe, on H. M. S. *Resolution*. Contact with Westerners brought numerous diseases that rapidly decimated the Marquesans, reduc-

TABLE 1. SUMMARY OF THE MARQUESAN VASCULAR FLORA. Generic endemism is limited to two genera of dicots and one genus of monocots.

Group	Families	Genera	Species	% Sp. Endemism
Pteridophytes	27	53	108	16
Dicots	53	101	176	5
Monocots	6	23	36	53
Angiosperms	59	124	212	55
Total	85	177	320	42

ing their population to a low of 3800 in 1938. However, by 1988 the population had reached an estimated 7358 (Florence, 1993).

The goats, cattle, and horses introduced during this last period also have had a severe impact on the native vegetation as feral populations became established. Numerous alien plant species introduced by humans have become naturalized and now nearly equal the native species in number. Together these factors have probably resulted in the extirpation of unknown numbers of endemic plant species at low- to mid-elevations. Consequently, the present state of the vegetation of the Marquesas is a result of all these factors (Decker, 1970, 1992).

GENERAL CHARACTERISTICS OF THE FLORA

The principal elements governing biological diversity and vegetation types in the Marquesas are distance from other land masses and size, elevation, and age of the islands. The indigenous vascular flora (angiosperms plus pteridophytes) of the Marquesas comprises 85 families, 177 genera, and 320 species, 42% of which are endemic (Wagner 1991; TABLE 1). However, if infraspecific categories are included, this rises to 351 taxa, of which 50% are endemic. Although the percentage of endemism for the Marquesas is relatively high for oceanic islands of this size, this diversity is considerably less than that of the Hawaiian Islands, whose flora includes 114 families, 267 genera, and 1138 species of vascular plants, 86% of which are endemic (Wagner, 1991). In the Hawaiian Archipelago species endemism is 69% for pteridophytes, 89% for angiosperms, 92% for dicots, and 86% for monocots, whereas for the Marquesas it is 16% for pteridophytes, 55% for angiosperm, 55% for dicots, and 53% for monocots (Wagner, 1991). Only two angiosperm genera, *Lebronnecia* Fosberg (Malvaceae) and *Plakothira* Florence (Loasaceae), but no fern genera, are endemic to the Marquesas, as compared with 32 angiosperm genera and two fern genera endemic to Hawai'i (Wagner et al., 1990). The Marquesas have a disproportionately low number of monocots and a comparatively species-rich pteridophyte flora. Pteridophyte spores are easily dispersed over long distances by air currents, a feature that also results in a much lower rate of endemism for this group.

In general, species diversity and endemism are strongly correlated with island size (TABLE 2). However, the smaller islands like Eiao and Mohotani (Motane) are exceptionally depauperate not only because of their small ecosystem size, but

TABLE 2. VASCULAR PLANT SPECIES DISTRIBUTION FOR NINE LARGEST MARQUESAS ISLANDS.

Island	Area (sq. km)	Indigenous Species	Island Endemics	Alien Species
Nuku Hiva	340	251	46	220
Hiva Oa	315	205	24	178
Ua Pou	105	90	2	71
Fatu Hiva	85	175	21	136
Ua Huka	83	97	2	87
Tahuata	61	85	5	51
Eiao	40	46	3	57
Motane	9	35	0	31
Hatutaa	7	28	0	22

also because habitat destruction by humans and feral animals and subsequent invasion by alien plants have had a proportionately greater impact here.

Finally, botanical exploration and collecting have not been uniform for all the islands. For example, the atypically low diversity figure for Ua Pou (TABLE 2), third highest and third largest island, is likely an artifact of undercollecting because its highest peaks, which exceed 1200 m, are exceptionally steep, spire-like, and virtually inaccessible except by helicopter. The central mountain chain of Ua Pou, although only 750–800 m in elevation and relatively accessible to collectors, does not harbor the more species-diverse montane and summit vegetation types.

A relatively large number of Marquesan endemic species (65, or 18% of the total) belong to comparatively few species-rich genera (8, or 4.5% of the total). These include *Asplenium* L. (12 spp.), *Psychotria* L. (11 spp.), *Bidens* L. (9 spp.), *Cyrtandra* J. R. & G. Forst. (8 spp.), *Peperomia* Ruiz & Pav. (7 spp.), *Myrsine* L., *Cyperus* L. [including *Mariscus* Ehrh.], and *Melicope* J. R. & G. Forst. (each with 6 spp.). Most of these lineages likely evolved from single colonizations (Wagner, 1991).

The Marquesas are relatively young group, ranging in age from 1.3 to 6 My, and are composed of 12 islands. In comparison, the Hawaiian Archipelago comprises approximately 100 islands and is perhaps 70 My old (Wagner et al., 1990). Furthermore, the Marquesas Islands are relatively low in elevation. Only three have peaks slightly exceeding 1200 m, compared with elevations of 3000–4200 m for the two largest Hawaiian Islands. The comparatively small size of the Marquesas, with a total surface area of 1050 sq. km, only 6% that of the Hawaiian Archipelago with 16,885 sq. km, correspondingly reduces habitat availability and the potential for subsequent adaptive radiation. This has meant less time and space available for species to evolve, and consequently levels of species diversity and endemism are lower in the Marquesas.

ORIGIN AND DERIVATION OF THE FLORA

Compared to continental areas, the vascular floras of oceanic islands are impoverished because their colonization has been via long-distance dispersal. The nearest source areas for the Marquesan flora are neighboring archipelagoes, i.e.

the Tuamotu Islands, 500 km distant, and the Society Islands, 1300 km distant. The Tuamotu are atolls mostly under 10 m in elevation (although Makatea Atoll reaches 110 m), but they are much older than the Societies, ranging in age from 37 to 57 MY. Consequently the Tuamotu already had been transformed into species-poor atolls by the time the Marquesas were being formed. The flora of the Tuamotu is relatively depauperate, consisting of only ten indigenous pteridophyte and 65 indigenous angiosperm species (Florence, 1987). For these reasons it is unlikely that the Tuamotu were a major floristic source area for the Marquesas.

Although the Society Islands are more distant, they are more likely to have served as a primary source area for the Marquesan flora because they are much younger (Tahiti is ca. 1 My, Moorea is ca. 1.5–2 My, and the leeward islands are ca. 2–4.5 My), sufficiently high in elevation (Tahiti reaches 2241 m), and much richer floristically than the Tuamotu (Florence, 1987). The flora of the Societies comprises 416 angiosperm species, of which 81 are shared with the Marquesas (Florence, 1987). Other Marquesan floristic affinities are with the Austral Islands (32 angiosperm species shared with the Marquesas), Rapa (27 species shared with the Marquesas), the Gambier Islands (32 species shared with the Marquesas), and to a lesser degree with the Hawaiian Islands (e.g. *Cheirodendron* Nutt. ex Seem., Araliaceae), tropical America (Loasaceae), Melanesia and southwestern Polynesia (*Metrosideros* Banks ex Gaertn., Myrtaceae), Fiji (*Trimenia* Seem., Trimeniaceae), and the Malesian region (*Ascarina* J. R. & G. Forst., Chloranthaceae) (Florence, 1987).

PRIOR VEGETATION STUDIES

Other than the introduction to Brown's *Flora of Southeastern Polynesia* (Brown, 1931), there have been few studies dealing with the vegetation of the Marquesas. These include Decker's thesis and a related publication on secondary plant cover on upland slopes between 0 and 750 m elevation (Decker, 1970, 1992), Schäfer's unpublished report on a trip to the Marquesas in 1975 (Schäfer, 1975), Hallé's synopsis of Marquesan plant communities (Hallé, 1978), and Jourdan's thesis on the "Terre Deserte" vegetation of Nuku Hiva (Jourdan, 1988). The material presented herein utilizes all these sources but focuses on Nuku Hiva, the largest island. The present work is based primarily on the field observations, data, and text assembled by the first author for the *Flore de la Polynésie français* project, resulting in production of a modern vegetation map for Nuku Hiva (Florence, 1993). In addition, observations, data, and photos compiled by the second author and Warren L. Wagner during the 1988 Fatu Hiva Expedition provided a foundation for the present work.

VEGETATION OF NUKU HIVA

The present day plant communities occurring in the Marquesas are a function of two principal ecological gradients: precipitation and temperature. Rainfall is usually highest on the windward (N and E) sides of the islands where the trade winds impinge and are driven upward, causing most of their moisture to precip-

itate out as rainfall. Temperature is a function of elevation and exposure to the cooling trade winds. In addition, edaphic factors including soil types and salt spray influence development of vegetation types. Finally, on most of the larger islands the indigenous lowland vegetation has been destroyed or greatly disturbed and invaded by alien weeds, and only fragments remain. Although high elevation communities on the larger islands have remained mostly intact, these are threatened by development for agriculture and forestry, particularly on Nuku Hiva.

1. Indigenous Coastal Vegetation

Although many coastal areas in the Marquesas are characterized by steep, precipitous cliffs, small areas of beach occur in some bays. In suitable areas the native strand flora consists of an association of the vines *Ipomoea pes-caprae* (L.) R. Br. ssp. *brasiliensis* (L.) Ooststr., *I. macrantha* Roem. & Schult., and occasionally *Canavalia rosea* (Sw.) DC. as dominant taxa. This type of community is characteristic of sandy beaches in many parts of the Indo-Pacific region.

Coastal cliffs and rocky outcrops support herbaceous communities dominated by clumps of *Leptochloa xerophila* (F. Br.) P. M. Peterson & Judz. [syn. *Eragrostis xerophila* F. Br.] and *Pennisetum articulare* Trin. ex Spreng. *Portulaca lutea* Sol. ex G. Forst. and *Phymatosorus scolopendria* (Burm. f.) Pic. Serm. often grow between these grasses. Rare individuals or small populations of the stem succulents *Nicotiana fatuhivensis* F. Br. and *Heliotropium marchionicum* Decne. are restricted to sheer cliff faces.

2. Indigenous Para-littoral and Lowland Forest

Relicts of a transitional forest type occur in certain certain areas from just above sea level to about 200 or 300 m elevation where the annual precipitation is less than 2000 mm. Here *Pisonia grandis* R. Br. is the dominant tree species, reaching 15 m tall with large, radiating surface roots. Other canopy trees attaining an impressive size include *Thespesia populnea* (L.) Sol. ex Corrêa, *Calophyllum inophyllum* L., and *Terminalia glabrata* J. R. & G. Forst. The understory consists of the shrubs *Eugenia reinwardtiana* (Blume) DC., *Psydrax odorata* (G. Forst.) A. C. Sm. & S. P. Darwin, and *Maytenus crenatus* (G. Forst.) Lobr.-Callen as well as herbaceous species.

3. Indigenous and Secondary, Dry to Semi-dry, Low- to Mid-elevation Associations

These communities occur at elevations from ca. 100 to 1000 m in areas with an annual precipitation less than 2000 mm. Most of these areas have been highly disturbed or converted to secondary vegetation, but some relatively intact indigenous remnants still exist.

The most common type of indigenous dry forest consists of *Sapindus saponaria* L. and *Xylosma suaveolens* (J. R. & G. Forst.) G. Forst. as dominants with a shrub understory. Drier areas in northern Nuku Hiva often include *Cordia lutea*

Lam. and those in the northwest include *Erythrina variegata* L. as principal dry forest components. *Ficus prolixa* G. Forst. and *Hibiscus tiliaceus* L. are characteristic species of more humid sectors. Naturalized species, primarily *Coffea arabica* L., *Mangifera indica* L., and *Tamarindus indica* L., occur in valleys and on slopes as escapes from cultivation.

Following human disturbance and grazing, secondary shrubland dominated by species of Malvaceae and Sterculiaceae and, eventually, secondary forest replaces the indigenous dry and semi-dry forest communities. *Sidastrum paniculatum* (L.) Fryxell, the dominant secondary species here, occurs with two other introduced Malvaceae, *Abutilon grandifolium* (Willd.) Sweet and *Gossypium barbadense* L., and two indigenous Sterculiaceae, *Waltheria indica* L. and *W. tomentosa* (J. R. & G. Forst.) H. St. John. Other associates include *Melochia pyramidata* L., *Indigofera suffruticosa* Mill., *Ocimum gratissimum* L., *Rhynchosia minima* (L.) DC., and *Passiflora foetida* L.

Other dry secondary communities include shrublands dominated by *Leucaena leucocephala* (Lam.) de Wit, which has replaced native dry forest, especially on Nuku Hiva, and forests of *Casuarina equisetifolia* L. on steep, dry slopes and ridge crests.

Grasslands with native species of *Leptochloa* P. Beauv., *Pennisetum* Pers., and *Aristida* L. formerly occurred in certain dry areas. However, in the Terre Deserte region of Nuku Hiva these native grasslands and some secondary shrublands are being replaced by stands of invasive introduced forage grasses, primarily *Rhynchelytrum repens* (Willd.) Hubb., *Paspalum paniculatum* L., and *P. conjugatum* Berg. Heathland dominated by *Dicranopteris linearis* (Burm. f.) Underw. occurs on barren humid areas at ca. 600–800 m elevation where it has replaced mesic *Sapindus* forest. Savannas of the large, coarse grass *Miscanthus floridulus* (Labill.) Warb. occur in the north, often following the destruction of *Dicranopteris* heathland by wild cattle. Overgrazing of these shrublands and grasslands by feral or semi-feral ungulates, particularly horses and sheep, usually leads to bare soil and subsequent erosion which has transformed certain areas between 600 and 1000 m into denuded red hills termed "collines rouges" (Jourdan, 1987).

4. Indigenous and Secondary, Low- to Mid-elevation Moist and Wet Forest

Low- to mid-elevation moist and wet forest communities occur between ca. 300 and 800 m elevation in areas with an annual precipitation of 2000–3000 mm, usually on relatively wet windward slopes and crests where less disturbance has occurred. These forests may reach, but rarely exceed, 20 m in height.

Several different native associations occur in these zones. *Hibiscus tiliaceus* forest with an understory of *Angiopteris evecta* (G. Forst.) Hoffm. is perhaps the commonest, often in association with *Pandanus tectorius* Sol. ex Parkinson. Other areas support forests characterized by *Alphitonia marquesensis* F. Br., *Cerbera manghas* L., and *Weinmannia parviflora* G. Forst. var. *marquesana* (F. Br.) Fosberg, frequently with an understory of *Cyclophyllum barbatum* (G. Forst.) N. Hallé & Florence, *Glochidion marchionicum* F. Br., and *Angiopteris evecta.*

A mixed forest of *Hibiscus tiliaceus, Pandandus tectorius,* and *Weinmannia*

parviflora var. *marquesana* occurs in the upper parts of Taipivai valley. This association is transitional between the *Hibiscus–Angiopteris* forest and upper-elevation forests because, in addition to the former two taxa, it also includes *Weinmannia* and *Crossostylis biflora* J. R. & G. Forst., which are characteristic of the wet forest. The herbaceous understory includes numerous epiphytes and tree ferns.

After disturbance or clearing, these native communities are generally replaced by secondary forests dominated by *Mangifera indica, Syzygium cumini* (L.) Skeels, *S. malaccense* (L.) Merr. & Perry, *Cananga odorata* (Lam.) Hook. f. & Thomson, *Inga feuillei* DC., and *Cocos nucifera* L., often with an understory of *Coffea arabica.* The Tahitian chestnut, *Inocarpus fagifer* (Parkinson) Fosberg, frequently forms dense gallery forests along streams.

5. Native Mid- to Upper-elevation Moist Forest and Wet Forest

Moist and wet forest formations occur in areas where the annual precipitation exceeds 3000 mm, generally between about 800 and 1000 m elevation. Most of these areas have suffered relatively little biotic disturbance and are characterized by primarily indigenous species. On Nuku Hiva these formations correspond to the most humid sectors of the island, i.e. around Toovii in the central plateau region. Two subtypes may be distinguished: *Metrosideros–Weinmannia* forest on drier slopes and ridges, and *Hernandia–Cyathea* forest in more humid valleys and gulches.

Metrosideros collina (J. R. & G. Forst.) A. Gray and *Weinmannia parviflora* var. *marquesana* are the dominant trees on ridges and relatively drier slopes. This forest type is relatively open and low in stature, reaching only about 3 m tall, with an abundance of ferns and other pteridophytes in the understory. Other woody endemics include *Apetahia longistigmata* (F. Br.) Wimm., *Phyllanthus pacificus* Müll. Arg., and *Santalum marchionense* Skottsb. The herbaceous understory is rich in ferns and other pteridophytes.

Hernandia nukuhivensis F. Br. and the tree ferns *Cyathea affinis* (J. R. & G. Forst.) Sw. and *C. feanii* E. Br. are the dominant species in wet forests between ca. 800 and 1000 m on the windward slopes and on leeward slopes of the summit crest (but usually not on the ridge tops). This forest type is considerably taller than the former type, attaining 6–8 (–15) m, and is very rich floristically. Associated trees include *Weinmannia parviflora* var. *marquesana, Fagraea berteroana* A. Gray ex Benth. var. *marquesensis* Fosberg & Sachet, *Crossostylis biflora,* and *Oparanthus teikiteetinii* (Florence & Stuessy) R. K. Shannon & W. L. Wagner, an unusual arborescent Asteraceae reaching 12 m tall. Other woody components of lower and middle strata include *Freycinetia* spp., *Psychotria* spp., and *Cyrtandra* spp. Ferns and other pteridophytes are abundant both as epiphytes and in the understory.

6. High-Elevation Cloud Forest

The cloud forest community is restricted to the upper slopes—but not the summits—of the central mountains above ca. 1000 m, especially in the northern and

eastern sectors of Nuku Hiva, where the annual precipitation exceeds 3000 mm and the area is usually covered by clouds. The cloud forest forms a low, dense canopy 3–5 m tall with *Cheirodendron bastardianum* (Decne.) Frodin, *Ilex anomala* Hook. & Arnott, *Metrosideros collina,* and *Freycinetia* spp. as the dominant arborescent species. Mid-stratum and understory trees and shrubs include *Coprosma* spp., *Psychotria* spp., *Trimenia marquesensis* F. Br., *Reynoldsia marchionensis* F. Br., *Geniostoma* spp., and an abundance of pteridophytes growing as epiphytes and in the understory.

7. Summit Wet Shrubland

The summits of peaks reaching ca. 1200 m or more primarily in the western and southern sectors are windswept, relatively drier, and receive more sunlight than does the cloud forest community situated in the eastern sector. These areas usually support low, wet shrubland or heathland communities reaching about 1 m tall, with shrubs of *Metrosideros collina, Vaccinium cereum* (L. f.) G. Forst. var. *adenandrum* (Decne.) F. Br., *Styphelia tameiameiae* (Cham. & Schltdl.) F. Muell. var. *marquesensis* F. Br., indigenous grasses, and numerous pteridophytes. Certain rare endemic taxa are confined to these summit shrublands, notably *Apetahia seigelii* Florence and an apparently undescribed species of *Bidens* on Fatu Hiva.

CONCLUSIONS

A comprehensive, modern floristic treatment clearly is needed for the Marquesas, as the only existing treatment is the outdated *Flora of SE Polynesia* (Brown, 1931, 1935; Brown & Brown, 1931). Subsequently a relatively small number of species belonging to an assortment of genera have been described or discussed in publications by Fosberg and Sachet (Fosberg, 1937; Fosberg & Sachet 1966, 1975, 1981). The first and only fascicle of a new *Flora of the Marquesas,* comprising 12 small families, was published by the late Marie-Hélène Sachet (1975). The first author of this paper has described and published a number of new Marquesan species (Florence 1985, 1986, 1990; Florence & Stuessy, 1988) in conjunction with the *Flore de la Polynésie française* project, which will encompass the Marquesas Islands. Warren L. Wagner (Smithsonian Institution, Department of Botany) and the second author are collaborating on a *Vascular Flora of the Marquesas* project, which aims to produce an illustrated, synoptical flora of the archipelago.

In view of the paucity of studies dealing with the Marquesan flora and vegetation, it is imperative that further field surveys and detailed studies be carried out before further habitat degradation occurs. Development, land utilization for forestry and agriculture, degradation by feral animals, and invasion by alien plant species all pose serious threats to the native flora. Nevertheless, rare and endangered taxa can often be successfully cultivated in botanical gardens. For example, *Lebronnecia kokioides* Fosberg & Sachet, an extremely rare small tree known only from Tahuata and Mohotani where it is threatened by the ravages of feral

animals, is easily cultivated in botanical gardens such as the National Tropical Botanical Garden. Nevertheless, it is essential that conservation strategies for the Marquesas flora and vegetation be planned and carried out before further degradation and loss of habitat and the associated native flora and fauna occur.

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