Nat. Hist. Res., Special Issue, No. 1: 13–69. March 1994.

Flora and Vegetation of the Northern Mariana Islands, Micronesia

Tatsuyuki Ohba

Natural History Museum and Institute, Chiba
955-2 Aoba-cho, Chuo-ku, Chiba 260, Japan

Abstract Some 39 plant communities are described from the northern Mariana islands following the Braun-Blanquet method of Phytosociology. Fifteen new associations have been described and integrated into the newly described Elaeocarpetea jogae, Colubrinetea asiaticae and Miscanthetea floriduli classes. All the distinguished plant communities are integrated into 9 phytosociological classes. The newly distinguished associations are: Aglaio-Elaeocarpetum jogae, Hibiscetum tiliacei, Pipturo-Colubrinatum asiaticae, Boehmerietum virgatae, Phyllantho-Hedyotietum foetidae var. mariannensis, Capparidetum cordifoliae, Miscanthetum floriduli, Melastomo-Lycopodietum cernuae, Crinetum asiaticae, Digitarietum gaudichaudii, Fimbristyletum cymosae, Zoysietum matrellae, Sesuvietum portulacoidis, Portulacetum australe and Portulacetum luteae. *Cyrtandra agrihanensis* are described as new species. *Lagenophora lanata*, *Didymoplexis fimbriata*, *Thelypteris ogasawarensis*, *Diplazium proliferum*, *Pteris excelsa*, *Trichomanes javanicum* var. *boryanum*, *Osmunda japonica*, and *Ophioglossum reticulatum* are newly recorded for the northern Mariana Islands.

Key words: Northern Marianas, flora, phytosociology/classification.

The Mariana Islands are situated between 18°–12°N and 13°50′–13°20′E, about 3000 km south of Tokyo, Japan. The Mariana Islands are part of an extended arc of seamounts stretching southwards from Tokyo, the Bonin Islands, Minami-iwo-jima (Volcano Islands) to the Marianas, and then westwards towards the Palau Islands and the Phillipines. The plate tectonics of this area indicate the presence of two continental plates, the predominant large Pacific Plate and the smaller Phillipine Plate, both plates moving steadily to the northwest and colliding both with the China Plate. The collision zone of the Phillipine and Pacific Plates created the volcanic arc from the Japanese Islands, Mariana Islands and the Phillipine Islands. A deep ocean trough extends along this arc east of the Mariana Islands but its exact stratigraphy is presently unknown. The deep ocean trough acts as the plate boundary of the Phillipine Plate with the Pacific Plate (Menard, 1972). This may indicate a zone of subduction. The volcanism caused by this tangential subduction caused the formation of seamounts (=islands) in which the oldest seamounts may have surfaced millions of years ago at much lower latitudes and have been transported northwestly by the movement of the Philippine Plate (Morgan, 1972). However, topographic features associated with plate boundaries may result in transform faults and magnetic anomalies caused by "Sea-Floor Spreading". Its origin links the Marianas floristically with the Phillipine Plate to New Guinea.

The Mariana Islands can be divided into two contrasting island groups. The southern Marianas constitute relatively young volcanic landforms with flat uplifted marine sediments, including Guam (534 sq km, 405 m elev.), Rota (85 sq km, 491 m elev.), Tinian (101.7 sq km, 178 m elev.), Saipan (120 sq km, 465 m elev.) and Farallon de Medinilla (0.9 sq km, 81 m elev.).

The northern Marianas are the focus of the present study. They constitute nine islands from south to north: Anatahan (ANT, 32 sq km, 788 m elev.), Sarigan (SRG, 5 sq km, 549 m elev.), Guguan (GGN, 4 sq km, 301 m elev.), Alamagan (ALM, 11.2 sq km, 744 m elev.), Pagan (PGN, 48 sq km, 570 m elev.), Agrihan (AGR, 44 sq km, 965 m elev.), Asuncion (ASN, 7 sq km, 891 m elev.), Maug (3 small islets MGN, MGE, MGW, 1 sq km, 227 m elev.) and Uracas (URC, 2 sq km, 334 m elev.). Anatahan lies 200

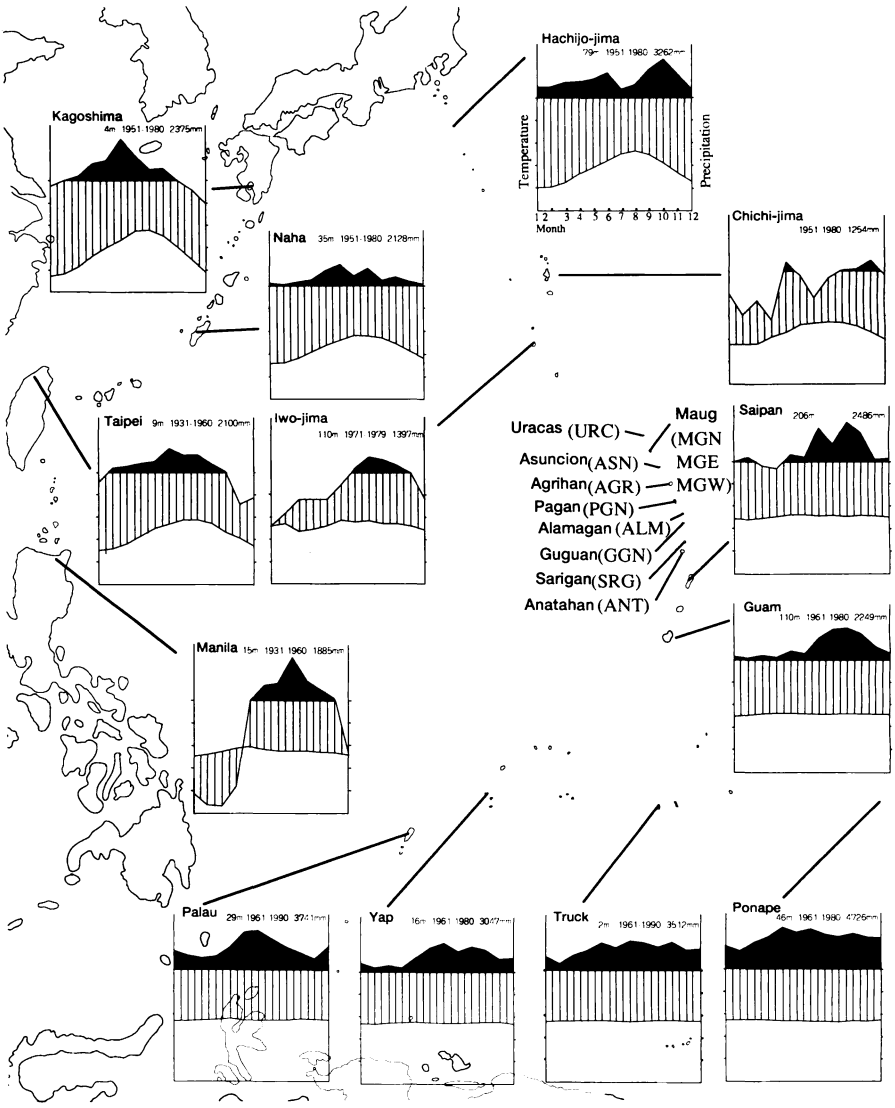


Fig. 1. Walter's climate diagram of the Southwest Pacific area.

km north of Saipan and Uracas lies 555 km south of Minami-iwo-jima (the Volcano Islands). See Fig. 2 for topography and travel routes for each individual island of the northern Marianas.

All the northern Marianas are of quaternary volcanic origin, composed of black basalts and are typical cone-shaped volcanoes with steep slopes. Active volcanoes with recent eruptions include Uracas, Pagan, Asuncion and Guguan with fresh volcanic ash and scoria deposits. The other islands have lost most of their volcanic ash and scoria due to erosion. The general coastline exhibits steep cliffs and some pebble beaches, signs of advanced erosion by wave action. Sandy shores are limited only to the northern part of Pagan and southern part of Alamagan. Coral reef development is limited to small areas around Pagan and Maug. The steep volcanic slopes have eroded into steep and deep ravines, often widening by erosion as in the western parts of Alamagan. The erosion channels carry no year-round surface water. Only two small lakes exist on Pagan.

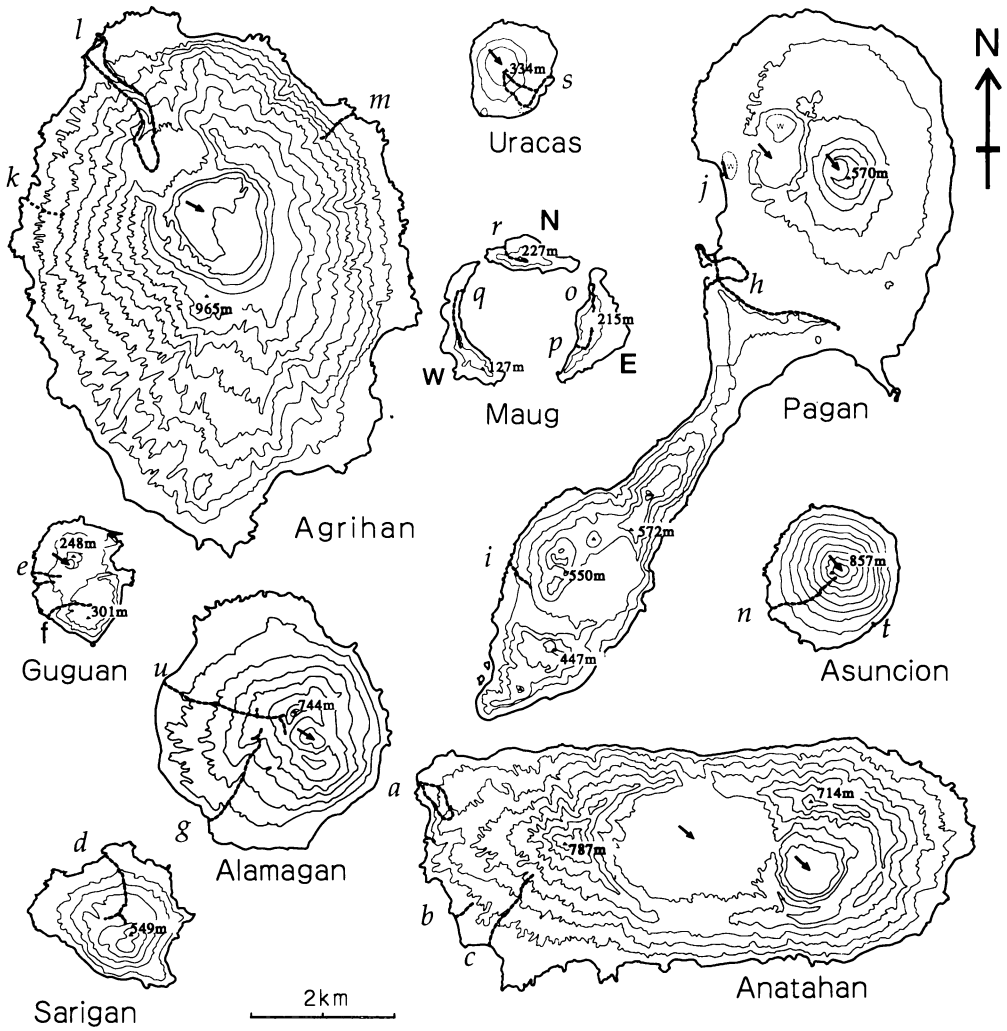


Fig. 2. Topography of the northern Mariana Islands, letters (italics) indicate survey route.

The northern Marianas have been characterized by their present natural vegetation conditions into the following three categories:

1. Small islands of low to medium elevation, free from impacts of domestic animals, heavy impacts of nesting seabird colonies, and poor floristic diversity: URC, MGN-MGE-MGW, GGN.

2. Small islands of medium to high elevation, free from impacts of domestic animals, uniformly vegetated: ASC.

3. Medium to large islands of medium to high elevation, heavy impacts of domestic animals, complex seral vegetation patterns due to repeated disturbance: AGR, PGN, ALM, SRG, ANT.

The high mountain areas of categories 2 and 3 have summits of different plant communities devoid of forest trees in contrast to their low elevation tropical forest zone. The flora and vegetation of the lower elevations is distinctly correlated with the southern Marianas while the summit zones have influences of the southeastern Asian temperate and subtropical vegetation, and with very different influences from the Phillipines and New Guinea as well.

Climatic observations for the northern Marianas are limited in that there are no year-round meteorological weather stations inoperation. Therefore, the climatic conditions of these is-

lands have been extrapolated from neighboring islands. Comparisons with surrounding regional meteorological weather stations like Saipan, Guam and Iwo-Jima indicate that these islands belong to the Tropical Rainforest (Af) Climate by Koeppen. The predominant rainfall occurs between August and October with a relative drought period in about April. See Fig 1. for climate diagrams of the west Pacific Islands.

Overview of the Physiography and Vegetation of Each Island

1. ANATAHAN (ANT)

Anatahan is the most southerly island of the northern Marianas. The island is oval-shaped, 5 km west to east, 2 km south to north. The center of the island contains the oval-shaped large crater with its crater bottom at 30 m elevation above sea level and with its highest points of the crater edge at 788 m elevation. In its northwestern corner, the island has a flat site where once a village existed. Its coastline is formed by a steep slope of about 100 m average height. The middle part of the mountain slopes is rather gentle and worne out by many deep ravines. Beyond the 500 m elevation up to the crater rim slopes are very steep.

On the gentle slopes of the coastal flat, *Cocos nucifera* has been planted. Human occupancy with goat grazing has degenerated the native vegetation to *Miscanthus floridulus* or *Chrysopogon aciculatus* grasslands. The upland areas and most of the crest slopes are covered by secondary grasslands due to heavy grazing by goats. Its potential coastal vegetation might have been forests with *Terminalia catappa*, *Barringtonia asiatica* and *Callophyllum*.

Most ravines are covered by the almost impenetrable *Hibiscus tiliaceus*-association. At the cliffs, *Elaeocarpus joga* forests occur with *Cyathea aramaganensis* where fog conditions persist.

2. SARIGAN (SRG)

Sarigan is a small volcanic island with a central cone of 549 m elevation. The northern and eastern sides of the cone are heavily eroded creating a steep crumbling slope from its top to the coast. On its northwestern slope, a distinct stony ridge of lava flow is left from sea level to 400 m elevation. Native *Pisonia grandis* forest grows on this ridge. A large *Cocos nucifera* plantation is left on its west coast. At about 400 m elevation, the volcanic plateau is covered with *Chrysopogon aciculatus* grassland. Here, remnants of cultivated fields are now covered by the *Aglaia mariannensis* low forest. The central cone in the eastern corner of the plateau is covered by the *Miscanthus floridulus* association. The entire island has been heavily impacted by the grazing of goats.

3. GUGUAN (GGN)

Guguan is formed by old and recent volcanic deposits. The old volcano is of 301 m elevation and covered by fresh volcanic ash and scoria. These fresh volcanic ash fields covered by the *Ipomoea pes-caprae* var. *brasiliensis*, *Fimbristylis cymosa* and other strand plant communities. Within these plant communities are scrub patches of *Pipturus argenteus* and *Colubrina asiatica*. Dense seabird colonies are nesting in open areas or fields with scattered plant growth. The old volcano slopes have created some ravines by weathering. The ravines are covered by dense forests of *Terminalia catappa* on the dry ridge slopes and *Pisonia grandis* in wet to moist ravines. The island is not impacted by goats or other domestic animals.

4. ALAMAGAN (ALM)

Alamagan is a single 744 m high volcanic cone. On its westside, a deep canyon reaches up to the 550 m elevation. Its volcanic plateau is at 500–600 m elevation. The coastal slopes are extensively planted with *Cocos nucifera*. Behind the *Cocos nucifera* plantations, *Artocarpus altilis* have been planted too. Between 300–600 m elevation, the *Elaeocarpus joga* forest exists in ravines with *Cyathea aramagensis*. The crest of the slope is densely covered by *Miscanthus floridulus*. The upper part of the volcanic cone where fog prevails is also covered with *Miscanthus floridulus*. In the hollow crater, *Cyathea aramaganensis* persists with other shrubs, especially with *Eurya japonica* along the crest slope. The vegetation of the upper cone was reported to be covered by *Eurya japonica* by Kanehira (1934a) and Hosokawa (1934b). The degradation of the *Eurya* vegetation resulted from heavy grazing pressures of goats and cattle. The summit has a deep crater with its bottom

vegetated by *Miscanthus floridulus* and *Pandanus tectorius*. At the crater's edge, a wind-exposed cliff allows special plant communities to develop with *Schoenus philippinensis* and *Boehmeria densiflora*. Kanehira (1934a) reported that the crater rim developed into a "meadow" rich in species. Here, he found the endemic species *Styphelia mariannensis*. The author could not find such a "meadow" nor *Styphelia* anymore but only the introduced *Chrysopogon aciculatus* and other aliens.

5. PAGAN (PGN)

Pagan is the largest island in the northern Marianas with an area of 48 sq km. Its northern part contains Mt. Pagan, a very active volcano which last erupted in 1980 creating a large lava field with volcanic ash devoid of almost any vegetation. The most predominant vegetation is *Casuarina equisetifolia* forest in the northern part of Pagan. The large flat area at the southern foot of Mt. Pagan was used as an airport during the Pacific War. Now, about half of this flat is under the 1980 lava flow. The rest of this flat is covered by *Zoysia matrella* and other short grasses.

The southern part of the island contains three old volcanoes. The southern most volcanos has still its typical cone on top of the plateau. The central two volcanoes (Togariyama and Maru-yama) are relatively old and by weathering have been united into a mountain range with steep slopes with a gentle broad ridge.

The mountain slopes are covered by the *Pandanus tectorius*-association at lower coastal slopes and above 150 m elevation the *Elaeocarpus joga*-association. In the *Elaeocarpus joga* zone, *Artocarpus altilis* has been planted, especially on gentle slopes with richer soil conditions. Most parts of the *Elaeocarpus joga*-association have been degraded by goat grazing from a forest structure to dense *Miscanthus floridulus* grasslands inclusive the broad ridge between Togari-yama and Maru-yama.

At the northern end of the southern volcano complex, a 20–100 m high cliff (Gake-yama) rises above the flat plateau. In this vicinity are old planted trees and remnants of the native forest. Kanehira (1934a) and Hosokawa (1934b) reported in this area the most species-rich native forest locally. They found here *Guamia mariannae* in its native habitat. The present investigation determined that the species have become extinct due to grazing by cattles and goats.

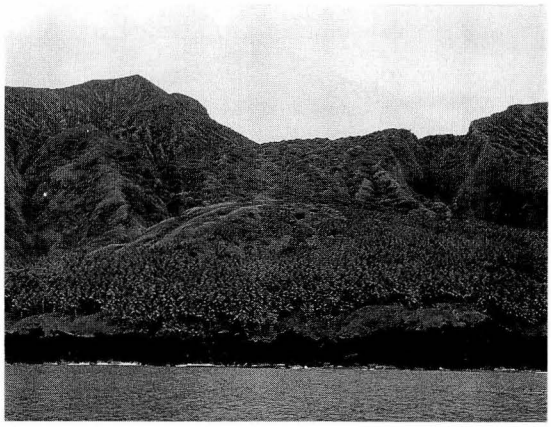


Fig. 3. Agrihan. Old lava flows generates its characteristic land form. *Cocos nucifera* plantations dominate in the lowlands, and *Elaeocarpus joga* forest covers the mountain slopes at higher elevation.

6. AGRIHAN (AGR)

Agrihan has the highest elevation among the northern Marianas and also of the whole Micronesia. Agrihan is almost a perfect round volcanic cone covering 44 sq km with very steep mountain slopes. A small village once subsisted here on the southwest side of the island on gentle slopes near the sea shore. Here, the only sandy shore is found. *Cocos nucifera* has been planted on alluvial fans or fan-like slopes near the coast. The remainder of the coastal area of the mountain slopes are covered by the *Pandanus tectorius*-association at crest slopes and ridges and by the *Hibiscus tiliaceus*-association in the ravines.

From 150 up to 600 m elevation, the *Elaeocarpus joga* forest association persists. Above 600 m elevation, the slopes are very steep and covered by shrubs till the pointed peaks of the crater rim. The author has not been able to reach these higher elevation areas during this exploration. The northwest part of the crater wall is evidently lower. Here, an old lava flow broke out of the crater to the sea. On this old lava flow, a deep and very wet ravine has been

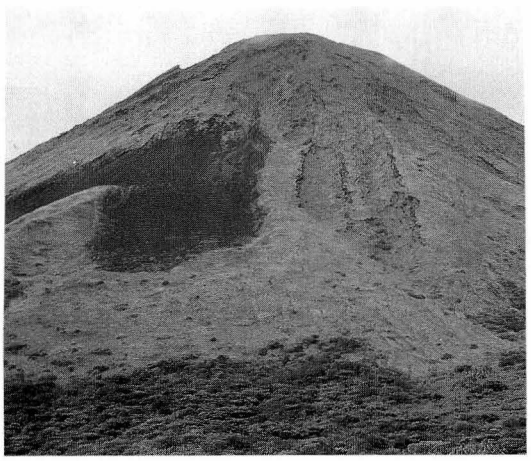


Fig. 4. Asuncion. Fern-rich communities covers the upper half of the volcano.

formed. Around this ravine, a well-developed *Elaeocarpus joga* forest developed with *Cyathea aramaganensis*, *Angiopteris erecta* and also *Cyrtandra agrihanensis*. The southwestern mountain slopes are covered by the dense *Miscanthus floridulus* association. These *Miscanthus* areas may be the result of human impact and the use of fire. About half of the island has been impacted by the goats but the other half is still goat-free. In the goat-free areas, dense stands of *Piper guahamense* develop within the *Elaeocarpus joga* forest. It is concluded that the *Piper guahamense* disappeared on account of goat grazing.

7. ASUNCION (ASN)

Asuncion is a small (7 sq km) island with very high (891 m) volcanic cone. The volcano is very active, its last reported eruption is reported in 1975. Still today, one can observe fresh and almost vegetation-free scoria fields at the higher parts of the volcano. Its volcanic cone is still very smooth. Only a very shallow gully could be detected. In coastal areas, *Cocos nucifera* has been planted locally. The lower half of the volcano slopes are covered by the dense *Pandanus tectorius*- and *Terminalia catappa*-association. A dense fern association of *Nephrolepis hirsutula* and *Davallia solida* exists on the upper forest limit at about 240 m elevation. The upper half of the volcano is very cloudy and covered by clouds almost daily. In this cloud belt on wind-exposed ridges the *Lycopodium cernuum*-association persists with *Styphelia mariannensis*, *Melastoma marabathricum* var. *mariannum*, *Lindsaea ensifolium*, *Cheilanthes tenuifolia* and other interesting plant species. *Osmunda japonica* is found here on wet rock faces. In the lava cracks in this cloud forest, *Cyathea aramaganensis* grows as a pioneer of the humid forest.

8. MAUG (MGN, MGE, MGW)

Maug is a sunken volcano with only three islets of its crater wall above the ocean. Its total area is 1 sq km and its highest point is at 227 m elevation. Each islet is formed by narrow rocky ridges. The north side of the North islet (MGN) has partly gentle slopes where *Cocos nucifera* has been planted. Most of the other parts of these islets is covered by medium to tall grass communities and low shrub communities. The forest communities of *Pisonia grandis* and *Terminalia catappa* cover some of the gullies, especially on the leeward side. There are no goats, cattle or pigs on these islets. Many kinds of seabirds have here formed large breeding colonies.

9. URACAS (URC)

Uracas is an active volcano with an area of 2 sq km and its highest point at 334 m elevation. About 70% of this island is without any vegetation. On gentle slopes of the lava flows and scoria, the patchy and open *Fimbristylis cymosa*-association exists. Some dense vegetation of *Ipomoea pes-caprae* ssp. *brasiliensis* and *Wollastonia biflora* var. *canescens* grows only on two fragments of an old lava flow. There are no humans nor domestic animals on this island. Large seabird nest colonies are found within the vegetated areas.

Vegetation Summary

The flora and vegetation of the southern Mariana Islands have been well studied by many authors as Merill (1914, 1919), Stone (1971), Falanruw, Cole and Ambacher (1989) and others. The most detailed publications are those of Kanehira (1934a), Hosokawa (1934b), and Fosberg (1960). In contrast, the northern Mariana Islands have been floristically far less explored and its vegetation had received only limited attention in the past.

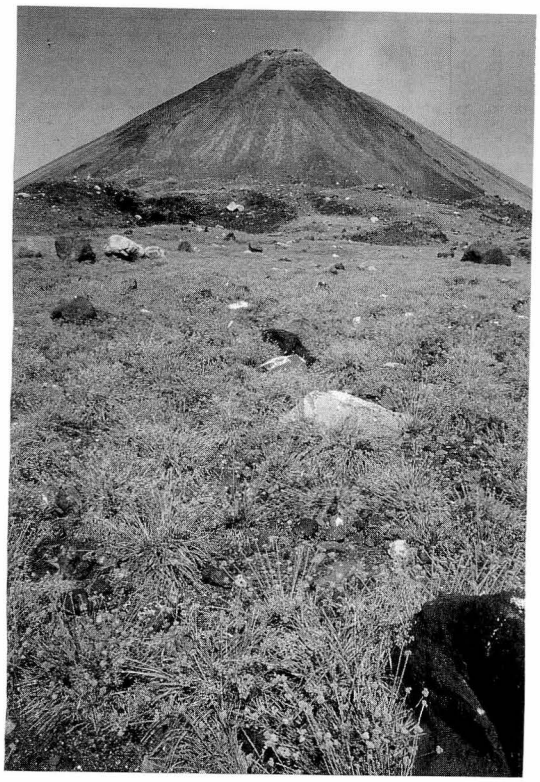


Fig. 5. Uracas. *Fimbristylis cymosa*-community cover the fresh lava and scoria fields.

Methods of Vegetation Survey and Classification

The present survey of the vegetation of the northern Marianas was carried out on all the terrestial plant communities except epiphytic plant communities using the standard methods of the Braun-Blanquet School of Phytosociology. Each stand was selected from the point of view of physiognomic homogeneity. All the plant species within the stand were included in the complete listing of plant taxa and stratified by height into three layers like tree, shrub and herb layers. Care was exercised to sample an sufficiently large minimum area to capture the characteristic floristic assamblage of the plant community. For the synthesis and the classification of plant communities, character species were selected for the description and distinction of plant communities. The standard hierarchical ordering of plant communities of the Braun-Blanquet method were applied.

Vegetation Description and Classification

1. Forest

1.1. Mesic forest

1.1.1. Upland mesic climax forest

1.1.1.1. Aglaio-Elaeocarpetum jogae ass. nov. (Table 1)

Evergreen mesic forest: The Aglaio-Elaeocarpetum jogae is the most important indigenous forest community in the northern Mariana Islands. Its exists on the mesic mountain slopes and ravine walls. Generally, its distribution ranges from 100 to 500 m elevation. But in deep wet ravines, this association can be found at 80 m elevation on Agrihan and Pagan. The highest habitat of the Aglaio-Elaeocarpetum jogae is 545 m on Agrihan.

The height of tree layers is 4 to 15 m. Well-developed stands have three vegetation hight layers. Through goat influences, many stands lost the shrub layer. *Elaeocarpus joga* dominates still in the tree layer in stands of over 8 m height at tree layer. The largest specimen of *Elaeocarpus joga* can reach the 15 m height and 80 cm in DBH. *Ficus tinctoria* var. *neo-ebudarum*, *Erythrina variegata* var. *orientalis*, *Pouteria obovata* and *Trema orientalis* var. *argentea* also reach the tree layer. Where the vegetation height is under 8 m, *Aglaia mariannensis*, *Psychotoria mariana*, *Morinda citrifolia* and *Pandanus tectorius* form tree layer with the former tree species. In the wet ravine habitat, often the endemic tree fern *Cyathea aramaganensis* is found in this association. *Cyathea aramaganensis* seems to constitute an independent plant community in the wet ravine. Also grazing by most stands of this associations lack seedlings or juveniles of *Elaeocarpus joga* upon goats. Nonetheless, old *Elaeocarpus joga* trees have many flowers and mature fruits. *Pteris boninensis* is a frequent species of the herb layer in most of the stands inspite of grazing.

The Aglaio-Elaeocarpetum jogae is divided into three subassociations. The first subassociation of *Pouteria obovata* is found in stony and rather dry places on Alamagan and Pagan. The second or typical subassociation is widespread on Pagan, Alamagan, Anatahan and Agrihan. But it is not "typical" but only the degenerated phase of the next subassociation

Table 1. Aglaio-Elaeocarpetum jogae ass. nov.

		sideroxyletosum glomeratae								*typicum*											*tremetosum orientalis var. argenteae*										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	23	24	25	26	27	28
Stand No.:	–	163	171	200	209	210	225	196	204	172	181	203	223	226	228	231	63	56	57	450	288	296	252	267	251	249	283	289	285	59	173
Month:	–	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	6	5	5	5	5	5	5	5	5	5	5	5
Day:	–	19	19	24	24	24	25	24	24	19	19	24	25	25	25	25	13	5	13	9	30	30	28	28	28	28	30	30	30	13	19
Locality:	–	ALM	ALM	PGN	PGN	PGN	PGN	PGN	PGN	ALM	ALM	PGN	PGN	PGN	PGN	PGN	ANT	ANT	ANT	ALM	AGR	AGR	AGR	AGR	AGR	AGR	AGR	AGR	AGR	ANT	ALM
Altitude(m):	–	85	325	20	15	15	185	15	30	390	430	20	115	205	240	290	170	50	240	330	325	545	140	205	125	90	115	145	175	370	450
Exposure:	–	E	E	.	N	N	N	N	N	N	S	NE	N	N	N	N	N	E	SE	W	E	E	S	.	.	W	NE	W	E	.
Steepness(°):	–	35	45	.	80	30	40	20	25	45	40	80	25	25	.	30	20	35	25	20	20	5	40	.	.	5	10	30	35	.
Area(m2):	–	200	200	200	225	225	225	20	100	100	400	225	225	225	2500	200	400	200	200	100	200	200	200	200	200	600	300	900	200	225	200
Height of vegetation(m):	–	6	8	7	5	6	5	6	6	5	6	3.5	10	4	7	6	5	4	8	10	12	7	12	15	8	15	4	10	8	8	6
Coverage of tree layer(%):	–	85	80	85	80	85	70	95	90	60	60	80	85	80	85	95	85	80	75	80	90	85	80	95	95	80	85	90	85	75	60
Coverage of shrub layer(%):	–	.	30	.	5	5	.	10	5	.	.	.	40	.	.	.	.	.	15	20	3	70	85	8	.	20	.	.	80	20	.
Coverage of herb layer(%):	–	15	40	15	5	5	85	10	15	15	80	5	1	35	15	70	15	60	60	60	40	40	70	1	40	40	1	10	70	40	60
Number of species:	–	7	13	9	8	8	9	7	10	11	8	5	10	9	7	7	5	6	9	8	11	12	14	12	18	17	9	10	11	11	11
Character species of ass. & higher units:																															
Aglaia mariannensis	T	4.4	.	2.2	2.1	2.2	2.2	.	.	2.3	.	1.1	.	4.4	4.4	3.4	4.4	1.1	.	4.4	.	.	.	.	.	.	.	.	.	.	.
–	S	.	1.1	.	.	.	.	.	1.1	.	.	.	3.3	.	.	.	.	.	.	.	.	.	2.1	2.2	.	.	.	1.2	1.1	.	.
–	K	.	.	2.2	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Elaeocarpus joga	T	.	3.2	.	.	.	2.1	.	.	2.1	.	.	1.1	2.1	3.2	3.2	.	.	4.4	3.2	5.5	3.1	4.1	4.3	2.1	4.4	.	.	4.1	2.1	2.1
Freycinetia reinneckei	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
–	S	2.3	2.2	.	.	.	.	.	.	3.3	3.4	.	1.2	.	.	.	.	.	.	.	1.2	.	.	1.3	.	1.3	.	.	.	2.2	3.4
–	K	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	2.3	.	1.3	.	.	.	.	.	.
Psychotria mariana	T	.	.	1.1	.	.	.	.	.	.	.	.	.	1.1	.	.	.	1.1	.	.	.	.	.	.	.	.	5.5	3.3	.	.	.
–	S	.	.	.	.	2.2	.	1.1	1.2	1.1	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.	1.1	.	.	3.3	.	.
Cyathea aramaganensis	T	.	.	.	.	.	1.1	.	.	3.4	4.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	1.1	2.2	2.1	1.1	3.3	2.2	.	.	.	2.2	.
Microlepia speluncae	H	.	.	.	.	.	.	.	.	1.2	.	.	.	+	+.2	.	.	.	1.2	.	.	.	1.2	+.2	+	+.2	.	.	.	2.2	.
Zeuxine fritzii	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Nervilla aragoana	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Differential species of subass.																															
Sideroxylon glomeratum	T	2.2	2.2	1.1	5.1	3.4	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Terminalia catappa	T	.	.	2.1	.	.	.	2.1	3.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Neiosperma oppositifolia	T	.	.	.	.	2.2	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential species of subass.																															
Trema orientalis var. *argentea*	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	2.2	2.1	2.2	2.1	2.1	.	2.1	1.1
Hibiscus tiliaceus	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.5	2.2	2.3	.	1.2	1.1	1.2	.	.
Angiopteris evecta	S	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	1.1	1.1	.	.	.	.	.	.	.
–	K	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	+	.	.	.	.	1.1
Piper guahamonse	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.3	2.3	4.4	4.4	3.4	3.4	.	.	.	.	.
Melanolepis multiglandulosa var. *glabratum*	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	1.1	1.1	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	2.2	.	.	2.1	.	.
Other species:																															
Pieris boninensis	H	2.3	3.4	2.3	1.3	1.3	5.5	2.2	2.3	1.2	.	1.2	1.3	3.3	1.2	4.4	2.3	4.4	3.4	.	3.4	+.2	+.2	+.2	+.2	1.2	1.2	2.3	4.4	3.3	.
Morinda citrifolia	T	.	.	3.3	.	2.2	3.2	.	3.4	.	.	1.1	.	1.1	1.1	2.1	.	.	.	.	.	.	.	.	1.1	.	1.1	2.2	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	1.1	.	1.1	.	.	1.1	.	.	1.1	1.1	.
–	K	.	.	.	.	.	.	1.1	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Ficus tinctoria	T	2.2	.	2.1	.	.	.	4.4	.	1.2	.	5.5	.	.	.	.	2.2	3.3	.	.	.	.	1.1	.	2.1	.	2.2	2.1	2.2	2.2	.
–	S	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	1.1	.	.	.	.	.	.	.	.	.	.
–	K	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pandanus tectorius	T	.	.	1.1	1.2	.	2.3	.	.	.	.	.	2.2	1.1	2.1	.	.	.	.	.	.	2.2	.	1.2	.	.	1.1	.	.	.	1.2
–	S	.	.	.	.	.	.	.	1.2	.	2.3	.	.	.	.	.	.	.	1.2	.	1.1	.	.	.	.	.	.	2.3	.	.
Nephrolepis hirsutula	H	.	1.3	.	.	.	1.2	.	.	1.2	2.2	+	.	2.3	2.3	.	.	.	.	4.4	.	.	.	.	.	.	.	.	.	.	2.3
Premna obtusifolia	T	.	.	1.1	.	.	.	.	.	.	2.2	.	.	.	.	1.1	2.2	2.2	.	.	.	.	.	.	.	.	.	.	.	2.1	.
–	S	.	1.2	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erythrina variegata var. *orientalis*	T	2.1	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	2.1	.	.	3.1	.	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boehmeria virgata	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3
–	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.3	.	1.1	.	.	.	.	.	.	.
–	K	.	.	.	.	.	.	.	.	1.2	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oplismenus compositus	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	1.2	1.3	1.2	.	.	.	.	.	+.2	.	.	.	.	.
Polypodium scoropendria	H	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+
Scleria lithosperma	H	.	.	.	+.2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium nidus	H	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
Eugenia palumbis	S	.	.	.	1.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrosia marianensis	T	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Piper betle	T	.	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thelypteris opulenta	H	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2
Cocos nucifera	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	K	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Macaranga thompsonii	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	3.1	.
Lunathyrium bonincola	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	2.2	1.2	.	.	.	.	.	.	.	.
Mucuna platyphylla	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	1.2	.	.	.	.
Musa sapientum	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	1.2	.	.
Ficus prolixa var. *carolinens*	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.1	.	.	.	2.1	.	.
–	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.
Elephantopus mollis	H	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium unilaterale	H	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bolbitis quoyana	H	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eupatorium odoratum	H	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vertonia cinerea	H	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Colubrina asiatica	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.
–	S	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Colocasia esculenta	H	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polyscias grandiflora	S	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Geniostoma micranthum var. *hoeferi*	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.
Cyperus kyllingia	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.
Microstegium glabratum	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.
Ophiogrossum reticulatum	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.
Stictocardia tiliaefolia	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Canavalia megalantha var. *falanrumae*	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.
Eurya japonica	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.4

Fig. 6. Aglaio-Elaeocarpetum jogae with wood fern (*Cyathea aramaganensis*), 240 m elevation, Agrihan.

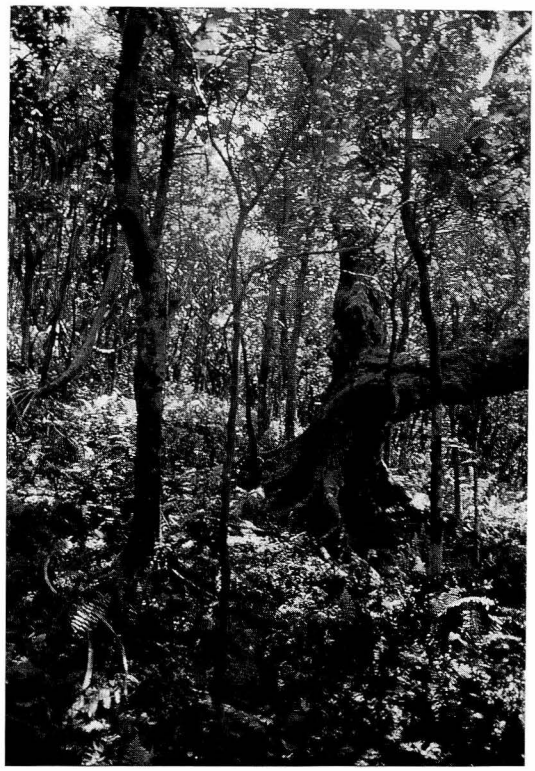


Fig. 7. Agalaio-Elaeocarpetum jogae on the southern part of Pagan. Shrub and herb layer have a very poor coverage due to goat grazing.

by goats. The third subassociation of *Piper guahamense* is found only on Agrihan. This subassociation is characterized by the rich herb layer of *Piper guahamense*. Thick growth of *Piper guahamense* is found only the goat-free areas of Agrihan. It appears that the *Piper guahamense*-subassociation is the most natural and best developed aspect of the Aglaio-Elaeocarpetum jogae association.

The Aglaio-Elaeocarpetum jogae is only distributed on the large and stable islands in the northern Mariana Islands such as Anatahan, Agrihan, Alamagan and Pagan. In Sarigan, fragmental stand can be found at high elevation. In the southern Mariana Islands also grow *Elaeocarpus joga* grows with *Agalia mariannensis*, *Guamia mariannae* and other character species of the association. These communities seem to belong to Aglaio-Elaeocarpetum jogae.

1.1.1.2. Pisonia grandis-community (Table 2)

Evergreen pionier forest: *Pisonia grandis* is a well-known tree, which has the prominent ability of dispersal (Carlquist, 1967). Its adhesive fruits can be carried long distances to oceanic islands by birds. *Pisonia grandis* is the most important forest tree on young and small islands in the northern Mariana Islands such as Sarigan and Maug. *Pisonia grandis* has a fresh greened thin leaf likes *Helianthus annuus*. It is distinctly recognized by its light green foliage color among the other dark-green tree crowns. In Sarigan, *Pisonia grandis* creates a mixed forest with *Aglaia mariannensis*, *Ochrosia mariannensis*, *Ficus tinctoria* var. *neo-ebudarum* and *Ficus prolixa* var. *calorinensis* on old lava flows, where the lava is heaped up into 1 to 3 m diameter basalt blocks. These stands can be distinguished as subassociation of Aglaio-Elaeocarpetum jogae. The tree layer of this subassociation is relatively open and 3 to 15 m high. In this subassociation, trunks of *Pisonia grandis* divide at lower parts of the stem and

Table 2. Pisonia grandois-community.

		typical subcommunity							subcommunity of *Aglaia mariannensis*									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Stand No.:	-	359	360	364	407	408	409	447	83	92	97	108	93	88	90	91	141	89
Month:	-	409	447	6	6	6	6	6	5	5	5	5	5	5	5	5	5	5
Day:	-	4	4	4	5	5	5	7	14	14	15	15	14	14	14	14	17	14
Locality:	-	MGE	MGE	MGE	MGN	MGN	MGW	ASN	SRG	SRG	SRG	SRG	SRG	SRG	SRG	SRG	GGN	SRG
Altitude(m):	-	50	60	140	200	195	180	20	25	150	280	325	170	90	125	130	55	95
Exposure:	-	.	.	E	N	N	.	W	S	W	.	.	N	S	.	N	.	.
Steepness(°):	-	.	.	20	45	35	.	38	15	40	.	.	20	25	.	20	.	.
Area(m2):	-	200	.	400	400	.	.	.	100	100	900	400	100	600	400	800	.	.
Height of vegetation(m):	-	4	12	7	4	12	1.8	2	3	10	10	12	8	7	6	8	15	8
Cov. of tree layer(%):	-	95	95	100	95	95	90	95	85	85	80	85	70	80	70	75	90	75
Cov. of shrub layer(%):	-	.	.	.	.	2	15	.	.	.	4	3	.	1	2	2	15	.
Cov. of herb layer(%):	-	.	1	1	5	3	3	.	1	10	1	40	5	1	5	5	20	1
Number of species:	-	3	3	1	5	5	2	2	4	5	4	6	6	7	7	7	6	3
Differential species of community																		
Pisonia grandis	T	5.5	5.5	5.5	5.5	5.5	5.5	5.5	2.1	3.1	5.5	3.1	2.1	3.2	3.1	2.1	5.5	4.4
-	S	.	.	.	.	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.
-	H	.	1.2	+	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.
Character species of subcommunity																		
Aglaia mariannensis	T	.	.	.	.	.	.	.	.	.	.	3.3	2.2	2.2	3.3	3.3	.	2.2
-	S	.	.	.	.	.	.	.	.	.	3.3	.	.	.	.	.	2.2	.
-	H	.	.	.	.	.	.	.	.	+	+	.	+	.	+.2	.	+	.
Ochrosia marianensis	T	.	.	.	.	.	.	.	5.5	.	.	.	2.2	2.2	.	.	.	.
-	S	.	.	.	.	.	.	.	.	.	.	1.2	.	.	2.2	1.1	.	.
-	H	.	.	.	.	.	.	.	+	1.1	.	.	1.1	.	+	1.2	.	.
Other species																		
Pteris boninensis	H	.	1.2	.	+.2	.	.	+	+.2	+.2	1.2	3.4	+.2	1.2	1.2	1.2	.	.
Ficus tinctoria var. *neo-ebudarum*	T	.	.	.	.	.	.	.	.	.	.	2.1	.	1.1	2.1	.	.	.
-	S	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	1.1	.
-	H	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Morinda citrifolia	T	1.1	.	.	1.1	.	.	.	.	.	.	.	.	.	1.1	.	.	.
-	S	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.
-	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Carica papaya	T	1.2	.	.	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium nidus	H	.	.	.	1.2	1.1	.	.	.	.	.	.	.	.	.	.	1.2	.
-	S	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.
Hibiscus tiliaceus	T	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
-	H	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.
Cynometra ramiflora	T	.	.	.	.	.	.	.	.	4.5	.	.	.	.	.	2.1	.	.
Ficus prolixa var. *carolinensis*	T	.	.	.	.	.	.	.	.	.	.	.	3.2	2.1	.	.	.	.
Neiosperma oppositifolia	T	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.
Nephrolepis hirsutula	H	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.
Clerodendron inerme	S	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.
Erythrina variegata var. *orientalis*	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.1	.	.
Pandanus tectorius	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.
Blechum brownei f. *puberulum*	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.
Terminalia catappa	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.1

create wide crowns. In Maug, *Pisonia grandis* dominates mostly in large and deep gullies. Such habitats are well-protected against wind, and *Pisonia grandis* grows straight and forms a dense canopy in such sheleterd habitats. In these stands, very many sea birds are nesting. One can find very little ground cover due to because of the many bird droppings and too high nutrient content. Branches of *Pisonia grandis* grows narrow-angled and bends easily. For these branch characterics, red-footed booby birds cannot use *Pisonia* branches for nesting because of their heavy weight. On the other hand contrary, *Terminalia catappa* has wide-angled and stronger branches, and often red-footed booby birds prefer to nest in *Terminalia* trees. The presence of *Carica papaya* in pure stands of *Pisonia grandis* is also chracteristic. The *Pisonia grandis*-community is found 25 to 325 m elevation but not close to the sea.

1.2. Gully mesic-humid forest

1.2.1. Hibiscetum tiliacei ass. nov. (Table 3)

Tropical Monsoon forest: *Hibiscus tiliaceus* creates a very dense rather low sprawling vegetation in the gullies. By its pale green foliage color and flat canopy form, one can distinguish the Hibiscetum tiliacei at great distances. In Saipan, *Hibiscus tiliaceus* forms the mangrove like a tall forest at the sea coast. But in the northern Mariana Island, we do not observe

Fig. 8. *Pisonia grandis* community on old lava flow, 250 m elevation, Sarigan.

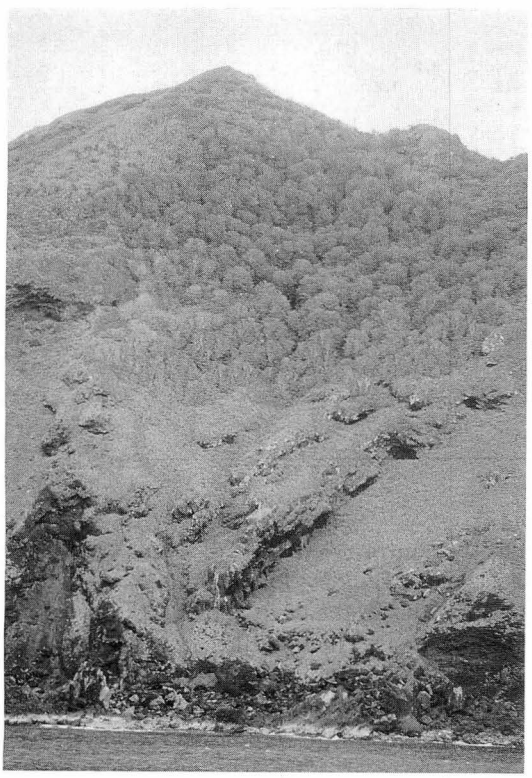


Fig. 9. *Pisonia grandis* community.

such tall *Hibiscus tiliaceus* forests. In every case, *Hibiscus tiliaceus* exists in the wettest sites of the lowland area in the northern Mariana Islands. Hibiscetum tiliacei exists from near sea level to 240 m elevation. It is one of the typical lowland associations. Its vegetation height is 2.5 to 7 m. The truncks of *Hibiscus tiliaceus* are conspicuously sprawling and divide into numerous branches. Because of its very intertwined dense branch system, it is difficult to go through these thickets. The number of species of each stand is 1 to 8. At the canopy level, *Hibiscus tiliaceus* dominates exclusively. But *Mucuna platyphylla* can climb up in some stands. *Pteris boninensis* is the most common plants in the herb layer. In very wet gullies, one can find many fern species such as *Thelypteris torresiana*, *Microlepia speluncae*, *Bolbitis quoyana* and *Asplenium unilaterale*.

The Hibiscetum tiliacei occurs at other Pacific Islands often as the pioniеer vegetation (Imanishi (ed.), 1944). However, in the northern Mariana Islands, the assciation forms a stable and continuous vegetation in most stands on the basis of its hardy tolerance against grazing goats. The most abundant plant community growing in contact with the Hibiscetum tiliacei is the Pandanetum tectorii and the *Terminalia catappa*-community.

1.2.2. Lowland mesic forest

1.2.2.1. Barringtonietum asiaticae Niiro *et al.* 1974 (Table 4)

Tropical coastal forest: *Barringtonia asiatica* is known as a member of the coastal forests. Only at Agrihan and Anatahan the well-developed forest of *Barringtonia asiatica* was observed, where *Barringtonia asiatica* becomes the dominant plant community near the sea shore. Commonly, *Barringtonia asiatica* will invade the native stands of *Barringtonia asiatica* and *Cocos nucifera*-plantations are therefore, intricately overlapping. Native stands of *Barringtonia asiatica* were probably destroied by the *Cocos nucifera* plantations by native people. Barringtonietum asiaticae reach 8 to 15 m ancl to a height of with a 80–90 per cent tree cover. The most common herb cover is *Pteris boninensis*. The large fruits of *Barringtonia asiatica* can distribute only by ocean currents. But in Anatahan we found at an inland canyon wall a well-developed *Barringtonia asiatica*-community. It seems to have been planted origin by native people.

1.2.2.2. Blechum brownei f. puberulum-Ter-

Table 3. Hibiscetum tiliaceae ass. nov.

		typicum												*freycinetietodum reineckeii*			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stand No.:	-	87	96	357	440	193	197	253	280	194	52	281	305	36	39	38	37
Month:	-	5	5	6	6	5	5	5	5	5	5	5	6	5	5	5	5
Day:	-	15	15	4	7	24	24	28	30	24	12	30	1	11	11	11	11
Locality:	-	SRG	SRG	MGE	ASN	PGN	PGN	AGR	AGR	PGN	ANT	AGR	ASN	ANT	ANT	ANT	ANT
Altitude(m):	-	90	240	30	10	20	25	135	70	15	85	75	85	200	165	170	190
Exposure:	-	.	.	.	.	.	.	W	W	.	.	.	.	.	.	.	.
Steepness(°):	-	.	.	.	.	.	.	15	50	.	.	.	.	.	.	.	.
Area(m2):	-	400	160	30	100	80	900	400	100	100	85	.	.	400	.	.	400
Height of vegetation(m):	-	5	3	3	2.5	5	6	7	4	5	4	5	4	4	5	4	4
Coverage of herb layer(%):	-	.	.	.	3	1	1	10	1	20	.	1	1	5	6	60	40
Coverage of shrub layer(%):	-	.	.	100	100	.	.	.	.	.	.	.	.	.	.	.	.
Coverage of tree layer(%):	-	100	100	.	.	100	100	100	100	95	95	95	100	90	100	100	100
Number of species:	-	1	1	1	2	4	3	6	2	7	5	6	5	7	7	8	6
Character species of ass.																	
Hibiscus tiliaceus	T	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4.5	5.5	5.5	5.5	5.5	5.5
-	H	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Differential species of subass.																	
Mucuna platyphylla	T	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2.2	1.2
-	H	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Freycinetia reineckei	H	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	+	2.2
Elephantopus mollis	H	.	.	.	.	.	.	.	.	.	.	.	.	+.2	+	.	.
Oplismenus compositus	H	.	.	.	.	.	.	.	.	.	.	.	.	+.2	+.2	.	.
Bolbitis quoyana	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	+
Other species																	
Pteris boninensis	H	.	.	.	.	.	+.2	2.2	1.2	3.3	4.4	1.2	+	1.2	1.2	3.3	3.3
Cyperus javanicus	H	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Polypodium scolopendria	H	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Morinda citrifolia	H	.	.	.	.	.	.	.	.	.	.	1.1	.	.	+	.	.
Nephrolepis hirsutula	H	.	.	.	.	.	.	.	.	1.2	.	.	.	+	.	.	.
Microlepia speluncae	H	.	.	.	.	.	.	+.2	.	.	1.2	.	.	.	.	1.1	.
Thelypteris torresiana	H	.	.	.	.	.	.	+	.	.	.	.	.	+.2	.	1.2	.
Aglaia mariannensis	T	.	.	.	.	.	.	.	.	1.1	.	1.1	.	.	.	.	.
-	H	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Vertonia cinerea	H	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Hymenocallis littoralis	H	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Piper guahamuense	H	.	.	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.
Canavalia megalantha var. *falanruwae*	T	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
Ficus tinctoria var. *neo-ebudarum*	H	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.	.
Scleria lithosperma	H	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.
Thelypteris opulenta	H	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.
Benincasa hispida	H	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.
Hernandia sonora	T	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
Psychotria mariana	T	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.
Pandanus tectorius	T	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Neiosperma oppositifolia	H	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Diplazium proliferum	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.
Asplenium unilaterale	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2

minalia catappa-community (Table 5)

Tropical coastal to lowland forest: The most common forest community at low elevations on the goat-free islands of Guguan, Maug and Asuncion. *Terminalia catappa*-forests occurs on different sites on each island. In Maug, *Terminalia catappa* positioned at stony steep slopes and rocky ridges. Where *Terminalia* has been heavily damaged by nesting of the red-footed booby birds it forms only a sparse canopy. In Asuncion, *Terminalia catappa* persists in the Hibiscetum tiliacei and Pandanetum tectorii association sites with rather stable volcanic ash slopes.

In the southeastern part of Guguan, one can observe the well-developed *Terminalia catappa*-communities in the deep and wet gullies of old volcanic areas. These gullies are well-protected against the strong winds. *Terminalia catappa* vegetation can reach 15 m. These stands are distinguished from *Aglaia mariannensis*-subtype by the occurrence of *Aglaia mariannensis*, *Pisonia grandis*, *Erythrina variegata* var. *orientalis* and *Asplenium nidus*. The number of species varies from 5 to 12 per relivee. In Guguan, this community seems to be the most-developed climax vegetation. This community has almost exactly the characteristics of the Terminalio

Table 4. Barringtonietum asiaticae Niiro *et al.* 1974.

		1	2	3	4	5	6	7	8
Stand No.:	-	43	46	48	53	261	264	273	278
Month:	-	5	5	5	5	5	5	5	5
Day:	-	11	12	12	12	29	29	29	30
Locality:	-	ANT	ANT	ANT	ANT	AGR	AGR	AGR	AGR
Altitude(m):	-	3	5	8	25	5	30	10	45
Exposure:	-	.	.	S	.	.	W	W	.
Steepness(°):	-	.	.	40	.	.	10	10	.
Area(m2):	-	.	500	.	.	200	.	.	.
Height of vegetation(m):	-	8	8	10	10	12	15	10	8
Coverage of tree layer(%):	-	85	80	90	90	85	90	85	80
Coverage of shrub layer(%):	-	40	5	5	.	.	1	.	5
Coverage of herb layer(%):	-	.	.	40	80	1	5	1	1
Number of species:	-	6	4	10	6	4	8	4	4
Character species of ass.									
Barringtonia asiatica	T	3.3	5.4	5.5	5.5	5.4	5.5	5.5	5.4
-	S	.	.	.	.	.	1.2	.	.
-	H	.	.	.	+	1.2	.	.	.
Ohter species									
Pteris boninensis	H	3.4	1.3	3.4	1.3	.	1.3	+.2	1.2
Cocos nucifera	T	3.2	.	.	.	2.2	2.1	1.1	2.1
-	S	.	.	.	.	.	.	.	1.2
-	H	2.2	1.1	.	.	1.2	.	+	+
Pandanus tectorius	T	.	.	.	1.2	.	.	.	.
-	S	.	.	1.1	.	.	.	.	.
-	H	.	1.2	.	.	.	.	.	.
Hibiscus tiliaceus	T	.	.	.	.	.	.	.	2.1
-	S	.	.	.	.	.	.	.	1.2
-	H	.	.	.	1.2	+.2	.	.	.
Ficus tinctoria var. *neo-ebudarum*	S	.	.	1.2	.	.	1.1	.	.
Microlepia speluncae	H	.	.	+	.	.	+	.	.
Freycinetia reineckei	H	.	.	+.2	1.2	.	.	.	.
Oplismenus compositus	H	.	.	+.2	+.2	.	.	.	.
Melanolepis multiglandulosa var. *glabrata*	T	.	.	1.1	.	.	.	.	.
-	S	.	.	.	.	.	1.1	.	.
Morinda citrifolia	H	1.1	.	.	.	.	.	.	.
Nephrolepis hirsutula	H	+	.	.	.	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	H	1.2	.	.	.	.	.	.	.
Mucuna platyphylla	S	.	.	1.3	.	.	.	.	.
Psychotria mariana	S	.	.	1.1	.	.	.	.	.
Hernandia sonora	H	.	.	.	.	1.1	.	.	.
Piper guahamense	S	.	.	.	.	.	+	.	.
-	H	.	.	.	.	.	1.2	.	.
Artocarpus altilis	S	.	.	.	.	.	1.1	.	.
Polypodium scoropendoria	H	.	.	.	.	.	.	+.2	.

catappae-Hernadietum sonorae association (Ohba and Sugawara, 1977), but in the northern Marianas *Hernandia sonora* is rather sparsely distributed and will not grow together with *Terminalia catappa.*

1.2.2.3. Hernandietum sonorae Niiro *et al.* 1974 (Table 6)

Tropical coastal or lowland forest: *Hernandia sonora* grows often with *Terminalia catappa* and *Erythrlna variegata* var. *orientalis* in the Pacific islands. *Terminalia* and *Hernandia* have well-floating and drifting fruits or seeds and make up commonly the strand forests. In the northern Marianas Islands, *Hernandia sonora* occurs rarely. The author has observed only one fragmentary *Hernandia* forest (See Table 5).

1.3. Dry forest

1.3.1. Pandanetum tectorii Miyawaki *et* K. Suzuki 1976 (Table 7)

Tropical low land forest: *Pandanus* forests are a very characteristic vegetation in the Pacific islands. In the northern Mariana Islands the author found the Pandanetum tectorii on most of the islands except Uracas. The Pandanetum tectorii develops on young volcanic soils extremely well such as on Asuncion. *Pandanus tectorius* prefers stony soils with numerous cavities. *Pandanus* can grow on very steep slopes, even on cliffs. Predominantly, the *Pandanus tectorius* vegetation occurs at 10 to 200 m elevation, but small stands or individuals of *Pandanus tectorius* can occur above 500 m elevation on Alamagan. Also *Pandanus tectorius* exists in the *Terminalia catappa* and other forests.It often can be found in the forest borders.

Table 5. Blechum brownei f. puberulum-Terminalia catappa-community.

		sub-community of *Pisonia grandis*					typical sub-community												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Stand No.:	-	145	146	137	138	140	365	148	159	142	135	136	139	433	303	304	310	339	383
Month:	-	5	5	5	5	5	6	5	5	5	5	5	5	6	6	6	6	6	6
Day:	-	17	17	17	17	17	4	17	18	17	17	17	17	7	1	1	1	2	5
Locality:	-	GGN	GGN	GGN	GGN	GGN	MGE	GGN	ALM	GGN	GGN	GGN	GGN	ASN	ASN	ASN	ASN	MGE	MGW
Altitude(m):	-	150	175	25	30	45	140	210	10	65	25	30	30	5	40	90	185	30	115
Exposure:	-	W	W	.	.	.	E	-	S	.	.	.	.	.	.	.	.	.	.
Steepness(°):	-	40	45	.	.	.	20	-	30	.	.	.	.	.	.	.	.	.	.
Area(m2):	-	400	.	.	600	.	100	.	.	.	100	100	200	50	900	.	400	100	100
Height of vegetation(m):	-	8	8	7	12	15	3	7	6	15	6	4	10	3	8	4	5	7	2
Coverage of tree layer(%):	-	80	100	80	80	80	80	85	70	80	85	100	80	.	100	85	95	.	100
Coverage of shrub layer(%):	-	5	10	2	70	20	.	20	.	30	.	.	60	.	3	.	2	.	.
Coverage of herb layer(%):	-	70	80	30	5	3	50	20	30	40	10	1	15	1	60	80	85	3	3
Number of species:	-	10	10	8	12	7	9	6	7	9	10	6	7	5	6	8	11	5	7
Differential species of community																			
Terminalia catappa	T	4.1	4.3	4.2	5.5	4.2	3.3	3.1	4.4	5.5	4.2	2.2	5.5	5.5	5.5	2.1	4.4	5.4	4.2
-	S	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Differential species of sub-community																			
Pisonia grandis	T	3.3	3.3	3.1	2.1	3.3	.	.	.	.	.	.	.	.	.	.	.	.	.
-	S	.	.	+	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.
-	H	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Other species																			
Ficus tinctoria var. *neo-ebudarum*	T	.	.	.	2.1	.	.	.	.	.	.	3.4	.	.	.	.	.	.	.
-	S	1.2	1.2	.	.	.	.	.	.	3.2	.	.	2.2	.	.	.	.	.	.
-	H	.	.	.	.	.	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.
Erythrina variegata var. *orientalis*	T	.	.	.	2.1	.	.	.	.	.	1.1	.	.	.	.	.	2.1	.	.
-	S	.	.	1.1	.	1.1	.	.	.	1.1	.	.	1.1	.	.	.	.	.	.
-	H	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blechum brownei f. *puberulum*	H	4.4	1.3	1.3	+.2	1.3	.	.	.	.	3.4	+.2	2.3	.	.	.	.	.	.
Pteris boninensis	H	+.2	2.3	.	.	.	.	.	1.3	1.2	1.2	.	.	+.2	.	+.2	1.2	+.2	.
Asplenium nidus	H	1.2	2.2	.	1.2	1.2	1.1	2.2	.	2.2	2.2	.	1.2	.	2.3	.	.	.	.
Pandanus tectorius	T	.	.	.	.	.	.	.	1.2	.	.	.	.	.	3.4	2.1	4.4	.	.
-	S	.	.	1.3	4.4	.	.	.	.	1.2	.	.	4.4	.	.	.	.	.	.
-	H	.	2.2	.	.	.	+	.	.	.	.	.	.	.	.	1.1	1.1	.	.
Morinda citrifolia	T	.	.	1.1	.	.	2.2	.	1.1	.	.	.	.	.	.	.	.	1.1	2.2
-	S	.	.	2.1	1.1	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.
-	H	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Aglaia mariannensis	S	.	2.2	.	.	2.2	.	2.2	.	2.2	.	.	1.2	.	.	.	.	.	.
-	H	.	2.2	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.
Polypodium scolopendria	T	+.2	.	2.3	1.3	.	.	2.2	.	.	+.2	.	.	.	2.3	3.3	3.3	.	.
Pipturus argenteus	T	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	2.1
-	S	1.2	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	1.1	1.1	.
-	H	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus javanicus	H	.	.	.	.	.	.	.	2.3	.	.	.	.	+.2	.	.	.	1.3	1.3
Trema orientalis var. *argentea*	T	1.1	.	.	2.1	.	.	.	.	.	.	.	.	.	.	3.4	.	.	.
Stictocardia tiliaefolia	S	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
-	H	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Colubrina asiatica	S	.	.	1.1	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3
Ficus prolixa var. *carolinensis*	T	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	3.1	.	.
-	S	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.
Carica papaya	T	.	.	.	.	.	2.2	.	.	.	2.1	.	.	.	.	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	H	.	.	.	.	.	.	.	1.2	.	.	.	.	+	.	.	.	.	.
Hibiscus tiliaceus	T	.	.	.	.	2.2	.	.	.	.	.	.	.	.	1.1	.	.	.	.
Neiosperma oppositifolia	T	.	.	.	.	.	2.3	.	.	.	.	.	.	.	2.1	1.1	.	.	.
Nephrolepis hirsutula	H	.	.	.	.	.	.	.	.	3.4	.	.	.	.	.	.	2.3	.	.
Canavalia megalantha	S	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	1.2	.	.
Davallia solida	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.4	2.3	.	.
Clerodendron inerme	S	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Miscanthus floridulus	H	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.
Premna obtusifolia	T	.	.	.	.	.	.	.	.	.	3.1	.	.	.	.	.	.	.	.
Eugenia palumbis	S	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.
Sideroxylon glomeratum	S	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.
Polypodium scolopendria	H	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Vertonia cinerea	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Digitaria ciliaris	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2

Such scattered *Pandanus tectorius* distribution in and near the forests are caused by seed dispersal of fruits bat (*Pteropus murinus*). The *Pandanus tectorius*-community has 2 or 3 hight layers. The coverage of tree layer is 85 to 100 per cent and dominated by *Pandanus tectorius*. The shrub layer is very weakly developed. The ground is covered by the coarse fallen leaves of

Table 6. Hernandietum sonorae Niiro *et al.* 1974.

		1
Stand No.:	-	80
Month:	-	5
Day:	-	14
Locality:	-	ANT
Altitude(m):	-	15
Exposure:	-	N
Steepness(°):	-	30
Area(m2):	-	300
Height of gegetation(m):	-	6
Coverage of tree layer(%):	-	90
Coverage of herb layer(%):	-	15
Number of species:	-	9
Character species of ass.		
Hernandia sonora	T	5.5
-	H	1.2
Other species		
Pteris boninensis	H	2.3
Ipomoea pes-caprae var. *brasiliensis*	H	+
Polypodium scolopendria	H	+
Hedyotis corymbosa	H	+
Ageratum conyzoides	H	+
Blechum brownei f. *puberulum*	H	+
Asplenium nidus	H	+
Psilotum nudum	H	+

Pandanus tectorius. Few plant species grow here. In some of stands, with a mixture of *Terminalia catappa* in the tree layer, one can find some ferns as *Polypodium scolopendria* and *Pteris fauriei* persist. In Asuncion, the Pandanetum tectorii association develops from sea level to 240 m elevation on fresh volcanic cinder soils.

1.3.2. Casuarina equisetifolia-community (Table 8)

Casuarina equisetifolia generate *Pinus*-like dry forests. In Pagan, *Casuarina equisetifolia* develops in various situations such as on sand dunes, on steep slopes near the coast, fresh volcanic ash and scoria fields. *Casuarina equisetifolia* grows 5 to 15 m high with 70 to 85 per cent cover at the tree layer coexist. Very few

Table 7. Pandanetum tectorii Miyawaki et K. Suzuki 1976.

		1	2	3	4	5	6	7	8	9	10	11
Stand No.:	-	130	47	79	306	439	71	303	308	381	304	310
Month:	-	5	5	5	6	6	5	6	6	6	6	6
Day:	-	16	12	14	1	7	14	1	1	5	1	1
Locality:	-	GGN	ANT	ANT	ASN	ASN	ANT	ASN	ASN	MGW	ASN	ASN
Altitude(m):	-	30	5	10	90	20	5	40	95	110	90	185
Exposure:	-	.	NW	N	.	.	E	.	.	.	.	.
Steepness(°):	-	.	50	.	.	.	20	.	.	.	.	.
Area(m2):	-	250	25	100	400	400	40	900	.	100	.	400
Height of vegetation(m):	-	5	4	4	3.5	6	7	8	5	2.5	4	5
Coverage of tree layer(%):	-	100	100	100	100	100	85	85	95	100	85	95
Coverage of shrub layer(%):	-	.	.	.	.	.	.	3	3	.	.	2
Coverage of herb layer(%):	-	.	.	1	1	1	20	60	5	.	80	85
Number of species:	-	2	2	3	4	4	4	6	6	6	8	11
Character species of ass.												
Pandanus tectorius	T	5.5	4.5	5.5	5.5	5.5	5.5	3.4	4.4	5.5	2.3	2.2
Other species												
Polypodium scolopendria	H	.	.	.	+	.	.	2.3	2.3	.	3.3	3.3
Ipomoea pes-caprae ssp. *brasiliensis*	H	+	.	1.1	.	+	2.3	.	.	.	.	.
Pteris fauriei	H	.	.	+.2	.	.	+.2	.	.	.	+.2	1.2
Terminalia catappa	T	.	.	.	2.1	.	.	5.5	.	.	2.1	4.4
Neiosperma oppositifolia	S	.	.	.	2.1	.	.	2.1	2.1	.	1.1	.
Hibiscus tiliaceus	T	.	2.3	.	.	.	.	1.1	2.2	.	.	.
Canavalia megalantha var. *falanruwae*	S	.	.	.	.	.	.	2.2	.	.	.	1.2
Asplenium nidus	H	.	.	.	.	.	.	2.3	1.1	.	.	.
Morinda citrifolia	T	.	.	.	.	.	.	.	.	.	1.1	1.1
Davallia solida	H	.	.	.	.	.	.	.	.	.	3.4	2.3
Thelypteris torresiana	H	.	.	.	+	.	.	.	.	.	.	.
Cyperus javanicus	H	.	.	.	.	+.2	.	.	.	.	.	.
Ficus tinctoria var. *neo-ebudarum*	H	.	.	.	.	+	.	.	.	.	.	.
Cocos nucifera	T	.	.	.	.	.	1.1	.	.	.	.	.
Premna obtusifolia	T	.	.	.	.	.	.	.	2.2	.	.	.
Scleria lithosperma	H	.	.	.	.	.	.	.	3.4	.	.	.
Colubrina asiatica	T	.	.	.	.	.	.	.	.	1.2	.	.
Carica papaya	T	.	.	.	.	.	.	.	.	1.1	.	.
Morinda citrifolia	T	.	.	.	.	.	.	.	.	1.1	.	.
Wollastonia biflora var. *canescens*	H	.	.	.	.	.	.	.	.	1.2	.	.
Pipturus argenteus	T	.	.	.	.	.	.	.	.	1.1	.	.
-	S	.	.	.	.	.	.	.	.	.	.	1.1
Trema orientalis var. *argentea*	T	.	.	.	.	.	.	.	.	.	3.4	.
Ficus prolixa var. *carolinensis*	T	.	.	.	.	.	.	.	.	.	.	3.1
Erythrina variegata var. *orientalis*	T	.	.	.	.	.	.	.	.	.	.	2.1
Nephrolepis hirsutula	H	.	.	.	.	.	.	.	.	.	.	2.3

plants coexist on the forest floor covered by dense falling twigs. *Casuarina equisetifolia*-community is also found on the other islands but limited to small areas near sea level. On the fresh volcanic materials on Uracas and Guguan, *Casuarina equisetifolia* is not found. The general aspect of *Casuarina equisetifolia*-community suggests *Casuarina eqiuisetifolia* is an introduced plant species on this Islands by natives.

1.4. Plantation-origined forest

1.4.1. Cocos nucifera-community (Table 9)

Cocos nucifera has been planted after 1900 on all the islands of the northern Marianas. German and Japanese pioneers planted *Cocos nucifera* intensively on almost all the gentle slopes of the sea shore and lowlands. Most *Cocos nucifera*-plantations have received no care today but continue to grow very well. *Cocos nucifera* reach 15 m or more in height and makes a completely dominant pure forest. The ground is covered with coarse fallen leaves and varying-aged nuts. At the herb layer grow juvenile of *Cocos nucifera* plants and *Pteris fauriei* are constantly represented otherwise, few plants grow only under *Cocos nucifera*.

1.4.2. Artocarpus altilis-community (Table 10)

Artocarpus altilis is planted on inland sites, where the todays-potential natural vegetation is Aglaio-Elaeocarpetum jogae. Well-developed

Table 8. Casuarina equisetifolia-community.

		1	2	3	4	5	6
Stand No.:	-	239	236	220	221	219	262
Month:	-	5	5	5	5	5	5
Day:	-	27	27	24	24	24	28
Locality:	-	PGN	PGN	PGN	PGN	PGN	AGR
Altitude(m):	-	3	3	10	15	10	15
Exposure:	-	SW	-	-	W	-	-
Steepness(°):	-	50	-	-	60	-	-
Area(m2):	-	400	200	200	100	100	200
Height of vgegetation(m):	-	8	7	15	15	8	5
Coverage of tree layer(%):	-	80	70	80	85	70	80
Coverage of herb layer(%):	-	.	1	5	1	30	1
Number of species:	-	1	2	3	2	6	3
Differential species of community							
Casuarina equisetifolia	T	5.5	4.5	5.5	5.5	4.4	5.5
-	H	.	+	.	.	.	.
Other species							
Cocos nucifera	T	.	.	.	.	1.2	.
-	H	.	.	.	.	1.1	.
Pteris fauriei	H	.	.	1.2	.	.	+
Chloris inflatus	H	.	.	1.2	+	.	.
Hymenocallis littoralis	H	.	.	.	.	3.3	.
Cyperus javanicus	H	.	.	.	.	1.2	.
Ipomoea pes-caprae ssp. *brasiliensis*	H	.	.	.	.	1.2	+

Table 9. Cocos nucifera-community.

		1	2	3	4	5	6	7	8	9	10	11
Stand No.:	-	85	201	263	111	160	437	72	54	154	42	302
Month:	-	5	5	5	5	5	6	5	5	5	5	6
Day:	-	14	24	29	15	18	7	14	12	18	11	1
Locality:	-	SRG	PGN	AGR	SRG	ALM	ASN	ANT	ANT	ALM	ANT	ASN
Altitude(m):	-	1	10	10	150	20	20	3	5	5	70	8
Exposure:	-	-	-	-	-	S	-	-	-	-	-	-
Steepness(°):	-	-	-	-	-	20	-	-	-	-	-	-
Area(m2):	-	120	2500	900	200	.	300	.	.	100	.	400
Height of vegetation(m):	-	12	15	12	15	10	8	10	9	8	7	10
Coverage of tree layer(%):	-	70	85	85	75	80	100	10	60	60	95	100
Coverage of shrub layer(%):	-	-	-	-	20	.	-	70	60	-	95	50
Coverage of herb layer(%):	-	1	5	5	15	10	5	15	1	15	25	20
Number of species:	-	3	4	6	3	4	4	3	2	2	5	4
Differentia species of community												
Cocos nucifera	T	4.4	5.5	5.5	5.5	5.5	5.5	4.4	4.4	4.4	5.5	5.5
-	S	.	.	1.2	2.2	.	.	.	.	.	.	3.4
-	H	.	1.2	1.2	1.2	2.1	+	.	1.2	2.3	1.1	1.2
Other species												
Pteris fauriei	H	+.2	1.2	+.2	1.2	1.3	.	+.2	+.2	+	1.2	+
Ochrosia mariannensis	S	1.1	.	.	.	1.1	.	.	.	.	.	1.1
Ipomoea pes-caprae ssp. *brasiliensis*	H	.	.	.	.	.	+	2.2	.	.	.	.
Polypodium scoropendoria	H	.	.	1.2	.	.	.	.	.	.	.	2.3
Hibiscus tiliaceus	H	.	.	.	.	.	+	.	.	.	.	.
Neiosperma oppositifolia	H	.	.	.	.	.	+	.	.	.	.	.
Vertonia cinerea	H	.	+	.	.	.	.	.	.	.	.	.
Aglaia mariannensis	H	.	+	.	.	.	.	.	.	.	.	.
Colocasia esculenta	H	.	.	.	1.2	.	.	.	.	.	.	.
Pandanus tectorius	H	.	.	.	.	1.1	.	.	.	.	.	.
Freycinetia reineckei	H	.	.	.	.	.	.	.	.	.	2.3	.
Ficus tinctoria var. *neo-ebudarum*	T	.	.	.	.	.	.	.	.	.	1.1	.
Elephantopus mollis	H	.	.	.	.	.	.	.	.	.	+.2	.
Morinda citrifolia	H	.	.	1.1	.	.	.	.	.	.	.	.
Barringtonia asiatica	S	.	.	1.1	.	.	.	.	.	.	.	.
Dioscorea alata	H	.	.	+	.	.	.	.	.	.	.	.

stands *Artocarpus altilis* reach a hight of 20 m and contain many indigenous species of Aglaio-Elaeocarpetum jogae. Such stands of the Aglaio-Elaeocarpetum jogae can be identified by their species composition. Large plantations of *Artocarpus altilis* are limited to the large islands of Pagan, Alamagan, Agrihan and Anatahan. In the southern Marianas Island, the indigeneous *Artocarpus marianensis* grows in the *Elaeocarpus joga*-forest as Rota and Guam. Fosberg *et al.* (1975) reported *Artocarpus marianensis* in Alamagan. The author could not found *Artocarpus marianensis* in this trip.

Around old village sites, many tropical fruits trees remain such as *Mangifera indica*, *Citrus* spp. and *Persea americana*. Each tree grows well under the current conditions. Possibly, the weaker cultivated trees have become extinct in early times. Now one can observe only the remaining cultivated hardy species. Some of these trees such as *Mangifera indica* play an important role as landscape elements.

2. Scrub

2.1. Mesic scrub

2.1.1. Pipturo-Colubrinetum asiaticae ass. nov. (Table 11)

In the northen Marianas Islands, the mantle communities are not clearly distinct. Heavy grazing of goats is one of the main reasons of the lack of mantle communities. The author observed some of shrub communities on goats-free islands on the steep rocky slope sites and on the wind-swept ridges. Some of these communities play the role of forest mantle communities.

In Guguan, *Pipturus argenteus* exists in the most stable flats or depressions within the fresh volcanic ash fields. The vegetational zonation varies from young to weathered open ash fields. The vegetation is 1.8–3 m high, and its plant cover is 70–100 per cent. In Pagan and Guguan, *Pipturus argenteus*-community grows on the damp ravine walls. *Pipturus argenteus* is found also on steep slopes facing the sea on Maug-East. Every *Pipturus* stand has no other constant species. This *Pipturus*-community acts as a mantle community of fresh ledges and as a pioneer scrub community on steep slopes and volcanic ash fields.

Colubrina asiatica is the most constant shrub-community in the upland savanna and the coastal herb communities. *Colubrina asiatica* builds an interwined 0.7–1.5 m high scrub. Each stand occupies a very limited strip of only a few to 10 m width. In Pagan, the *Colubrina asiatica* exist on wind-exposed ridges as persistent vegetation, with *Melochia villosissima* and *Gossypium hirtum*. In Guguan, the *Colubrina asiatica*-patches grow on the fresh volcanic scoria fields, previously dominated by the *Ipomoea pes-caprae* ssp. *brasiliensis*-community, as the second stage of the succession. In such stands, some of the third stage successional species like *Ficus carlinensis* and

Table 10. Artocarpus altilis-community.

		1	2	3	4	5	6
Stand No.:	-	449	272	40	282	41	266
Month:	-	6	5	5	5	5	5
Day:	-	9	29	11	30	11	28
Locality:	-	ALM	AGR	ANT	AGR	ANT	AGR
Altitude(m):	-	180	200	170	80	165	125
Exposure:	-	W	.	.	.	.	S
Steepness(°):	-	10	.	.	.	.	8
Area(m2):	-	100	200	.	400	.	1000
Height of vgegetation(m):	-	10	12	10	18	8	12
Coverage of tree layer(%):	-	80	100	80	90	65	90
Coverage of shrub layer(%):	-	80	40	20	15	.	15
Coverage of herb layer(%):	-	5	70	30	10	65	30
Number of species:	-	17	14	10	8	12	13
Differential species of comm.							
Artocarpus altilis	T	2.1	3.2	4.1	5.5	3.3	2.1
-	S	.	.	.	2.2	.	.
Alliance of Aglaio-Elaeocarpion							
Elaeocarpus joga	T	2.1	4.3	.	.	3.1	3.1
Aglaia mariannensis	T	.	+	.	1.2	.	2.3
-	S	4.5	.	.	.	.	.
Freycinetia reineckei	T	.	1.2	2.3	1.3	.	1.3
-	S	.	.	.	.	.	+.3
Psychotria mariana	T	1.1	.	.	.	.	.
Cyathea aramaganensis	S	.	1.1	.	.	.	.
Angiopteris evecta	S	.	1.1	.	.	.	.
Oter species							
Pteris boninensis	H	1.2	1.2	2.3	2.3	2.2	2.3
Cocos nucifera	T	2.1	.	2.1	.	2.1	2.1
-	K	.	.	.	.	+	.
Morinda citrifolia	T	.	1.1	+	.	1.1	+
-	K	+	.	.	.	.	.
Oplismenus compositus	H	1.2	.	+.2	.	2.3	.
Erythrina variegata var. *orientalis*	T	3.2	2.1	.	.	.	2.1
Hibiscus tiliaceus	T	2.2	.	2.3	.	1.2	3.4
Ficus tinctoria var. *neo-ebudarum*	T	.	.	.	1.1	2.1	1.1
Terminalia catappa	H	.	.	.	.	1.1	.
Blechum brownei f. *puberulum*	H	+.2	.	+.2	.	.	.
Asplenium nidus	H	+.2	+.2	.	1.1	.	.
Melanolepis multiglandulosa var. *glabrata*	H	+	.	.	.	.	+.2
Trema orientalis var. *argentea*	T	.	2.1	.	.	.	.
Piper guahamonse	H	.	4.4	.	.	.	2.2
Microlepia speluncae	H	.	1.2	.	.	.	+
Elephantopus mollis	H	.	.	1.3	.	2.3	.
Pandanus tectorius	T	.	.	.	.	1.1	.
Musa sapientum	S	1.1	.	.	.	.	.
Polypodium scolopendria	H	+.2	.	.	.	.	.
Nephrolopis hirsutula	H	+.2	.	.	.	.	.
Premna obtusifolia	S	1.1	.	.	.	.	.
Boehmeria virgata	S	.	3.4	.	.	.	.
Eupatprium odoratum	H	.	.	+.2	.	.	.
Microstegium glabratum	H	.	.	.	.	3.4	.

Table 11. Pipturo-Colubrinetum asiaticae ass. nov.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sand No.:	-	335	334	128a	207	143	124	134	355	370	382	118	400	121	358	340	402	404	371	403	361	395	396	397	398
Month:	-	6	6	5	5	5	5	5	6	6	6	5	6	5	6	6	6	6	6	6	6	6	6	6	6
Day:	-	2	2	17	17	17	17	17	4	5	5	16	5	16	2	2	5	5	5	5	4	5	5	5	5
Locality:	-	MGE	MGE	GGN	PGN	GGN	GGN	GGN	MGE	MGW	MGW	GGN	MGN	GGN	MGE	MGE	MGN	MGN	MGW	MGN	MGE	MGN	MGN	MGN	MGN
Altitude(m):	-	5	3	20	15	100	70	5	20	30	110	25	155	80	10	30	193	227	35	227	135	108	120	125	150
Exposure:	-	.	.	.	N	.	.	.	W	-	W	.	N	W	.	.	.	.	.	-	W	N	N	N	N
Steepness(°):	-	.	.	.	70	.	.	.	40	-	20	.	30	15	.	.	.	.	.	-	30	40	20	40	35
Area(m2):	-	50	12	15	100	100	100	100	100	25	400	15	1	100	10	24	6	9	25	20	25	100	100	25	25
Height of vegetation(m):	-	0.8	0.8	0.8	1.5	4	1.8	3	1.5	1	0.8	1	1.2	0.8	0.8	1.2	0.7	0.8	0.8	1.2	2	2.5	3	5	4.5
Coverage of shrub layer(%):	-	.	.	.	.	100	.	95	.	.	.	.	.	.	.	.	.	.	.	.	80	75	70	95	85
Coverage of herb layer(%):	-	20	95	35	80	5	70	5	100	85	100	95	90	95	90	80	100	40	80	80	.	30	40	5	5
Number of species:	-	1	2	3	3	4	5	6	3	4	4	5	6	7	4	8	7	8	5	3	5	6	7	5	7
Character species of ass. & higher units																									
Pipturus argenteus	S	.	.	.	5.5	3.4	4.4	4.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
–	H	2.3	5.5	3.1	.	.	.	.	1.1	.	.	.	.	.	4.4	4.4	.	.	.	.	.	1.1	.	.	+.2
Colubrina asiatica	S	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	1.2
–	H	.	.	.	.	.	.	.	5.5	5.4	4.4	4.4	5.5	4.4	2.3	.	1.2	1.2	.	.	.	.	.	.	.
Melochia villosissima	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.4	3.3	5.5	.	.	.	.	.	.
Cordia subcordata	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	4.4	2.2	5.5	5.5
–	H	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	5.5	.	.	.	.	.
Stictocardia tiliaefolia	S	.	.	.	.	3.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2
Solanum guamense	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.
Other species																									
Cyperus javanicus	H	.	.	.	.	.	1.2	.	.	+.2	1.1	.	1.2	2.2	1.2	3.2	+.2	.	1.2	.	.	.	.	.	.
Pteris fauriei	H	.	.	.	+.2	.	.	.	.	.	.	.	+	.	.	+.2	+.2	.	.	.	.	3.3	+.2	+.2	+.2
Asplenium nidus	H	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	+	.	.	.	.	1.1	3.4	1.2	1.2
Morinda citrifolia	S	.	.	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	1.1	1.1	2.1	1.1	+
Vertonia cinerea	H	.	.	.	.	.	+	.	.	.	.	.	.	1.2	.	2.2	1.2	.	.	.	.	.	.	.	.
Emilia sonchifolia	H	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Mollastonia biflora var. *canescens*	H	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	1.2	1.2	.	.	.	.	.	.
Ficus tinctoria var. *neo-ebudarum*	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.4	.	.	.	.
–	H	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	1.2	.	.	.	1.2	.	.	.	.	.
Gossypium hirsuta	H	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	2.2	1.1	.	.	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	H	.	1.2	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blechum brownei f. *puberulum*	H	.	.	.	.	1.3	.	3.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hyptis pectinata	H	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+.3	.	.	.	.	.	.
Paspalum sp.	H	.	.	.	.	.	.	.	.	.	.	.	.	.	+.3	+.2	.	.	.	.	.	.	.	.	.
Boerhavia diffusa	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Nephrolepis hirsutula	H	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polypodium scolopendria	H	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	+.2	.	.
Clerodendron inerme	S	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carica papaya	S	.	.	.	.	3.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eugenia palumbis	S	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pandanus tectorius	S	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
heteropogon contortus	H	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.
Cassytha filiformis	H	.	.	.	.	.	.	.	.	.	.	3.3	.	.	.	.	.	.	.	.	.	.	.	.	.
Morinda citrifolia	H	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis corniculata	H	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Chrysopogon aciculatus	H	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.
Trema orientalis var. *argentea*	H	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.	.	.	.	.	.
Ficus prolixa var. *carolinensis*	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.4	.	.
–	H	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.
Portulaca oleracea var. *granulato-stellulata*	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.
Capparis cordifolia	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
Zoysia matrella	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
Pisonia grandis	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.
Cyperus javanicus	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Achyrantes canescens	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.
Hibiscus tiliaceus	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.
Neiosperma oppositifolia	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.

Trema orientalis var. *argentea* have been sampled in stand No. 143.

Cordia subcordata is a wide thin-leaved pioneer tree. It is not common in the northern Marianas Islands. It was observed only in Maug. *Cordia subcordata* exists on steep stony slopes and wind-exposed ridges. Its scrub height is 1.2 to 5 m and 70 to 95 per cent of coverage. Its scattered shrub canopy contain *Morinda citrifolia* or *Ficus tinctoria* var. *neo-ebudarum*. The herb layer mostly consists of *Pteris boninensis* and *Asplenium nidus*. Some places, the *Cordia subcordata*-community creates parallel stripe with the *Pisonia grandis*-community forms a parallel strip with the *Pisonia grandis*-community. The *Pisonia grandis*-community exists in deep wet gullies and the *Cordia*-community colonize the rocky ridges.

In the northern Marianas Islands, each scrub species grows almost separately. But the above-mentioned shrub species grow on Guam all together at the forest edge. From observations in Guam these shrub communites can be integrated into the same association.

2.2. Humid gully scrub or suffruticose scrub

2.2.1. Boehmerietum virgatae ass. nov. (Table 12)

The tropical moist-ravine scrub: *Boehmeria virgata* is distributed in moist ravines on the large islands of Anatahan, Alamagan and Agrihan. *Boehmeria virgata* grows in the bottom and walls of the wet gullies and in ravines or canyons. At the dry open canyon-wall, Boehmerietum virgatae has a poor floristic composition of the typical subassociation or pioneer phase. At high elevations of Agrihan another subassociation is well developed. This community grows in narrow wet gullies on old lava flows associated with *Angiopteris evecta*, *Bolbitis quoyana* and *Cyrtandra agrihanensis*. On dry sites of the same gullies, a subassociation persists, characterized by *Boehmeria densiflora* and *Nephrolepis hirsutula*. These last two subassociations contain very rare plants as *Cyrtandra aramaganesis*, and are situated in goat-free areas of Agrihan.

The *Boehmeria virgata*-association is closely related to the community of *Blumea conspicua*, *Blumea lacera*, *Cyrtandra yaeyamae*, *Rhynchotechum discolor* of the Ryukyu Islands (Niiro, Miyagi, Shinjo and Simabukuro, 1974).

Character taxa: *Boehmeria virgata*, *Cyrtandra agrihanensis*.

2.3. Dry rock ledge suffruticose scrub

2.3.1. Phyllantho-Hedyotietum foetidae var. mariannensis ass. nova (Table 13)

Table 12. Boehmerietum virgatae ass. nov.

		subass. of *Blumea* sp.					typical subass.					subass. of *Angiopteris evecta*			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Stand No.:	-	295	293	292	269	291	255	244	33c	50	280	270	268	298	297
Month:	-	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Day:	-	31	31	31	29	31	28	28	10	12	19	29	29	31	31
Locality:	-	AGR	AGR	AGR	AGR	AGR	AGR	AGR	ANT	ANT	ALM	AGR	AGR	AGR	AGR
Altitude(m):	-	550	520	510	300	340	120	25	90	90	280	310	230	510	520
Exposure:	-	.	.	.	.	.	N	S	.	.	N	.	.	.	.
Steepness(°):	-	.	.	.	.	.	70	90	.	.	90	.	.	.	.
Area(m2):	-	100	100	75	25	25	15	25	25	25	3	200	200	50	100
Height of vegetation(m):	-	1.8	1.8	2	3	2.5	3.5	.	.	.	1.5	4	4	3	4
Coverage of shrub layer(%):	-	100	50	100	90	95	80	15	100	95	65	95	90	95	100
Coverage of herb layer(%):	-	.	.	.	20	60	.	.	.	.	.	20	10	30	5
Number of species:	-	10	7	9	5	9	5	3	6	7	4	6	9	9	9
Character species of ass.															
Boehmeria virgata	S	3.3	2.3	3.4	5.5	5.5	5.5	1.2	2.3	3.2	4.3	2.3	5.5	2.3	3.3
Differential species of subass.															
Blumea sp.	S	3.3	2.3	2.2	.	1.2	.	.	.	.	.	.	.	.	.
Nephrolepis hirsutula	H	.	3.4	2.3	2.2	+.2	.	.	.	.	.	.	.	.	.
Pipturus argenteus	S	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.
-	H	1.1	.	1.1	.	.	.	.	.	.	.	.	.	.	.
Boehmeria densiflora	S	2.2	1.1	2.2	.	.	.	.	.	.	.	.	.	.	.
Piper guahamense	S	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	.
Differential species of subass.															
Angiopteris evecta	S	.	.	.	.	.	.	.	.	.	.	4.4	3.3	3.3	2.1
Bolbitis quoyana	H	.	.	.	.	.	.	.	.	.	.	2.3	1.3	2.3	.
Pteris exilis	H	.	.	.	.	.	.	.	.	.	.	.	.	1.2	1.2
Cyrtandra agrihanensis	S	.	.	.	.	.	.	.	.	.	.	.	.	1.1	1.2
Other species															
Pteris boninensis	H	1.2	.	.	1.3	3.4	.	1.2	2.2	2.2	2.2	+	+.2	.	+.2
Lunathyrium boninicola	H	2.2	.	1.2	2.3	2.3	1.2	.	.	1.2	.	+.2	+.2	2.3	1.2
Microlepia speluncae	H	.	.	.	1.2	1.2	2.3	.	.	.	.	.	2.3	.	.
Freycinetia reineckei	S	.	.	.	.	.	.	.	3.4	3.3	1.3	.	.	.	.
-	H	.	.	.	.	.	.	.	.	.	.	.	+.2	.	+.2
Cyathea aramaganensis	S	1.1	.	.	.	.	1.1	.	.	.	.	.	2.1	.	3.3
Elaeocarpus joga	S	.	.	.	.	2.1	.	.	.	.	.	.	.	3.1	.
-	H	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.
Thelypteris torresiana	H	+	+	.	.	.	.	+.2	1.1	1.2	.	.	.	.	.
Asplenium unilaterale	H	.	.	.	.	.	2.3	.	.	.	.	1.3	1.3	.	.
Geniostoma micranthum var. *hoeferi*	S	.	2.2	.	.	.	.	.	.	.	.	.	.	.	1.1
Musa sapientum	S	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.
-	H	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Paspalum conjugatum	H	.	.	.	.	.	.	.	+.2	+.2	.	.	.	.	.
Pityrogramma calomelanos	H	.	.	.	.	.	.	.	+.2	1.2	.	.	.	.	.
Ischaemum longisetum var. *raulersoniae*	H	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.
Miscanthus floridulus	S	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.
Gramineae sp.	S	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.
Peperomia mariannensis	H	.	.	.	.	.	.	.	.	.	+.3	.	.	.	.
Ophioglossum reticulatum	H	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.

Tropical suffruticose community. This association exists at sunny or half-shaded cliffs. It occurs abundantly on sea-shore cliffs and also grow on inland cliffs on Pagan. Character species of the association are *Hedyotis foetida* var. *mariannensis* and *Phyllanthus marianus*. *Hedyotis foetida* var. *mariannensis* produces a draping or hanging phenotype about 30 cm high. *Phyllanthus marianus* remains an erect phenotype 15 to 25 cm height. The association cover is 5 to 30 per cent, rarely up 70 per cent. Each stand is very limited in extent. Its typical floristic composition is limited to a narrow strip of about 5 to 30 cm wide and 1 to 3 m wide on ledges of steep cliffs. No constant plant species of this association can be identified. It is a continuous pioneer-type vegetation occurring on very dry narrow ledges and an endemic association in the nothern Marianas Islands.
Character taxa: *Phyllanthus marianus*, *Hedyotis foetida* var. *mariannensis*.
Distribution: Anatahan, Pagan and Maug.

Table 13. Phyllantho-Hedyotietum foetidae var. mariannensis ass. nov.

	1	2	3	4	5	6	7	8
Stand No.:	199	213	216	218	219	224	81	394
Month:	5	5	5	5	5	5	5	6
Day:	24	24	24	24	24	24	14	5
Locality:	PGN	PGN	PGN	PGN	PGN	PGN	ANT	MGN
Altitude(m):	20	65	60	50	45	160	5	105
Exposure:	N	.	N	N	N	N	N	.
Steepness(°):	80	.	85	90	90	90	90	.
Area(m2):	9	5	25	25	25	30	25	15
Coverage(%):	20	25	5	5	20	30	15	70
Number of species:	4	3	4	5	4	5	5	4
Character species of ass.								
Hedyotis foetida var. *mariannensis*	2.2	2.2	+.2	1.2	2.2	2.2	1.2	4.4
Phyllanthus marianus	1.2	.	1.2	1.1	1.1	1.2	1.1	.
Other species								
Nephrolepis hirsutula	+.2	.	.	.	.	2.3	.	.
Pteris vittata	1.1	.	.	1.2	.	.	.	.
Fimbristylis cymosa	.	1.2	.	.	.	.	2.2	.
Lepturus repens	.	1.3	1.3	.	.	.	.	.
Pteris fauriei	.	.	.	.	+	1.2	.	.
Wollastonia biflora var. *canescens*	.	.	.	.	.	.	1.2	2.2
Emilia sonchifolia	.	.	+	.	.	.	.	.
Heteropogon contortus	.	.	.	1.3	.	.	.	.
Lysimachia mauritiana	.	.	.	+	.	.	.	.
Zoysia matrella	.	.	.	.	2.4	.	.	.
Miscanthus floridulus	.	.	.	.	.	1.2	.	.
Portulaca australis	.	.	.	.	.	.	1.2	.
Cyperus javanicus	.	.	.	.	.	.	.	1.3
Achyranthes canescens	.	.	.	.	.	.	.	+

2.4. Dry rocky shore suffruticose scrub

2.4.1. Capparidetum cordifoliae ass. nov. (Table 14)

Tropical herb or suffruticose community. The character and dominant species is *Capparis cordifolia*. Its graish-green foliage is very conspicuous. The Capparidetum cordifoliae developes on sea cliffs behind the *Ipomoea pescaprae* ssp. *brasiliensis*-community. The trailing stems of *Capparis cordifolia* hang down from the narrow cliff ledges, or spread out over flat stony terraces. Its plant cover averages 25–100 per cent and is 10 to 20 cm high. Its most commonly associated species are *Ipomoea pescaprae* ssp. *brasiliensis* and *Pteris fauriei* at half-shaded sites, and less frequently *Cyperus javanicus* at exposed sunny places. Its floristic composition is limited to 5 species its maximum.

The Capparidetum cordifoliae is distributed in the southern Mariana Islands, and endemic to the Marianas Islands.
Character taxon: *Capparis cordifolia*.
Distribution: Anatahan, Sarigan, Maug and Pagan.

2.4.2. Scaevola taccada-community (Table 15)

The tropical shrub or suffruticose community is very common and wide spread in the

Fig. 10. Phyllantho-Hedyotietum foetidae var. mariannensis, on the coastal cliff, Pagan.

Table 14. Capparidetum cordifoliae ass. nov.

	1	2	3	4	5	6	7	8	9	10	11	12
Stand No.:	84	112	333	82	352	30	69	377	348	240	66	76
Month:	5	5	6	5	6	5	5	6	6	5	5	5
Day:	14	15	2	14	3	10	14	5	2	27	14	14
Locality:	SRG	SRG	MGE	SRG	MGE	ANT	ANT	MGW	MGE	PGN	ANT	ANT
Altitude(m):	25	2	5	20	5	2	5	95	5	5	3	3
Exposure:	.	S	.	S	.	W	-	.	.	S	N	N
Steepness(°):	.	25	.	15	.	90	.	.	.	80	70	70
Area(m2):	100	200	40	200	25	12	40	2	25	45	25	20
Coverage(%):	25	60	80	75	90	.	40	95	100	80	65	60
Number of species:	2	2	2	2	3	3	3	3	4	4	5	5
Character specie of ass.												
Capparis cordifolia	2.3	4.4	5.4	4.5	5.5	2.2	3.4	5.5	5.5	4.4	3.4	3.4
Other species												
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	2.2	.	1.1	1.2	2.2	.	+.2	.	1.2	1.2
Pteris fauriei	1.3	1.3	.	1.2	.	.	1.3	.	.	.	1.2	.
Cyperus javanicus	.	.	.	.	1.2	.	.	.	1.2	1.2	.	.
Vertonia cinerea	.	.	.	.	.	.	.	+	.	+	.	.
Hedyotis foetida var. *mariannensis*	.	.	.	.	.	2.2	.	.	.	.	.	.
Phyllanthus marianus	.	.	.	.	.	.	.	+.2	.	.	.	.
Boerhavia diffusa	.	.	.	.	.	.	.	.	+.2	.	.	.
Digitaria cilialis	.	.	.	.	.	.	.	.	.	+	.	.
Portulaca oleracea var. *granulato-stellulata*	.	.	.	.	.	.	.	.	.	.	+.2	.
Chloris inflata	.	.	.	.	.	.	.	.	.	.	1.2	.
Wollastonia biflora var. *canescens*	.	.	.	.	.	.	.	.	.	.	.	2.3
Portulaca australis	.	.	.	.	.	.	.	.	.	.	.	+.2
Fimbristylis cymosa	.	.	.	.	.	.	.	.	.	.	.	+.2

tropical islands of the Pacific (Miyawaki and K. Suzuki, 1976, Miyawaki (ed.), 1989, Miyawaki, *et al.* 1991; Nakamura and K. Suzuki, 1984, 1986). *Scaevola taccada* grows well on coral shores with *Messerschmidtia argentea* on Saipan and Guam. In the northern Mariana Islands, very few coral shores exist and *Messerschmidtia argentea* is locally absent. *Scaevola taccada* forms only small-scale stands on MGE and ASN. Goats destroy and impact such succulent-leaved communities. The *Scaevola taccada*-community forms very dense knee-high communities on small flats above the sea cliffs. Distribution: Asancion, Maug.

2.5. Coastal Scrub

2.5.1. Vitex negundo var. bicolor-community (Table 16)

This tropical coastal dry scrub communities is characterized by *Vitex*-species growing on dry sandy soils on the strand. In the northern Marianas, it is observed only on Maug-East and Asuncion. On Asuncion, *Vitex negundo* var. *bicolor* occupies the site between the Crinetum asiaticae and Pandanetum tectorii association the coast. On Maug, *Vitex negundo* var. *bicolor*-community persist at the edge of the taller high Miscanthetum floriduli association. Its plant cover is 95 to 100 per cent and 1.5 to 2.5

Fig. 11. Capparidetum cordifoliae, on a pebble coast of Pagan.

Table 15. Scaevola taccada-community.

	1	2	3	4	5
Stand No.:	373	441	301	344	332
Month:	6	6	6	6	6
Day:	4	7	1	2	1
Locality:	MGE	ASN	ASN	MGE	ASN
Altitude(m):	60	8	10	40	15
Exposure:	.	.	.	S	.
Steepness(°):	.	.	.	35	.
Area(m2):	10	25	100	25	100
Height of vegetation(m):	-	0.8	0.8	.	0.6
Coverage(%):	70	80	80	85	90
Number of species:	3	2	4	4	4
Differentia species of comm.					
Scaevola taccada	4.5	5.5	5.5	5.5	5.5
Other species					
Cyperus javanicus	1.2	.	+.2	+.2	2.3
Zoysia matrella	.	2.3	+.2	.	2.3
Boerhavia diffusa	+	.	.	.	.
Canavalia megalantha var. *falanruwae*	.	.	+	.	.
Capparis cordifolia	.	.	.	2.2	.
Portulaca lutea	.	.	.	+.2	.
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	.	.	1.2

Table 16. Vitex negundo var. bicolor-community.

	1	2	3
Stand No.:	354	368	418
Month:	6	6	6
Day:	4	4	7
Locality:	MGE	MGE	ASN
Altitude(m):	5	165	40
Area(m2):	400	100	9
Height of vegetation(m):	2	2.5	1.3
Coverage(%):	100	95	90
Number of species:	2	4	4
Differential species of comm.			
Vitex negundo var. *bicolor*	5.5	5.5	5.5
Other species			
Morinda citrifolia	+	.	.
Ficus tinctoria var. *neo-ebudarum*	.	2.2	.
Phyllanthus marianus	.	1.2	.
Asplenium nidus	.	1.2	.
Terminalia catappa	.	.	1.1
Cyperus javanicus	.	.	+.2
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	+

Table 17. Clerodendrum inerme-community.

	1	2	3
Stand No.:	189	222	206
Month:	5	5	5
Day:	24	25	25
Locality:	PGN	PGN	PGN
Altitude(m):	5	10	10
Area(m2):	100	100	100
Height of vegetation(m):	1.2	1	1
Coverage(%):	85	100	60
Number of species:	4	3	2
Differential species of comm.			
Clerodendrum inerme	5.4	4.4	4.4
Other species			
Cyperus javanicus	2.3	.	.
Zoysia matrella	3.4	.	.
Chloris inflata	+.2	.	.
Pteris fauriei	.	3.4	.
Oxalis corniculata	.	+	.
Nephrolepis hirsutula	.	.	1.2

m high. There are no constant species throughout the these stands sampled.

2.5.2. Clerodendron inerme-community (Table 17)

Clerodendron inerme grow on Pagan and Sarigan found at the mesic or dry forest edges. Also on Pagan, *Clerodendron inerme* is situated in the wet bombing craters. The community is about 1 m high and has no constant species composition in the 3 stands sampled.

2.6. Plantation-origin scrub communities

2.6.1. Leucaena latisiliqua-community (Table 18)

Leucaena latisiliqua (= *Leucaena glauca*) is strongly reproducing at the southern Marianas Islands and the Bonin Islands (Ohba and Sugawara, 1977, Ono and Okutomi (ed.), 1985). We observed it in the northern Marianas Islands only at some sites of Pagan. Here, it dose not *Leucaena latisiliqua* does not build very large dense dominant communites as on Guam, but does spread over the surrounding areas.

2.6.2. Jatropha curucas-community (no table material)

Jatropha curcas has been planted around the residences on Pagan to form hedges. Because of its poisonous properties as a protection against grazing, goats and cattle laeve *Jatropa curcas* plants around old village sites. This creates and make markedly hedgerow-like communities.

3. Herbosa

3.1. Strand herbaceous communities

3.1.1. Vigno-Ipomoetum pes-caprae Miyawaki *et* K. Suzuki 1976 (Table 19)

The tropical trailing herb or suffruticose community is a very common sea-shore community all over the tropics. *Ipomoea pes-caprae* ssp. *brasiliensis* builds a scattered or well-covered vegetation at sandy beaches or pebble shores. We observed this well-developed community on Guguan, Asuncion and Maug but only a few stands on the other islands. This is caused by goats. On Anatahan, we observed this community grows only on the ledges of steep cliffs, where it cannot be reached by any goat. Inland sites of this community are situated within the *Wollastonia biflora* var. *canescens*-community.

3.1.2. Wollastonietum biflorae Miyawaki *et* K. Suzuki 1976 (Table 20)

(= Wedelietum biflorae Miyawaki *et* K. Suzuki 1976)

The tropical procumbent herb community is one of the typical coastal plant communities. In many situations, this *Wollastonia biflora* var. *canescens*-community is located more inland of the *Ipomoea pes-caprae* ssp. *brasiliensis*-community. Its plant cover is 60 to 100 per cent and is 0.3 to 0.8 m high. The outstanding feature of the community is the dominating growth of *Wollastonia biflora* var. *canescens* on the crest of sea cliffs. Soil conditions are richer than in the *Ipomoes pes-caprae* ssp. *brasiliensis*-community. The substrate retains some of humus. A common associated species is *Cyperus javanicus*. *Wollastonia biflora* var. *canescens* is heavily impacted by goat grazing. On most islands, the community is degenerated and often limited to rocky ledges on steep cliffs. This community is well-developed only on Asuncion, Maug and Uracas, or on the goat-free islands. Miyawaki and K. Suzuki (1976) described association Wollastonietum biflorae (=Wedelietum biflorae) from the Ryukyu Islands. In the northern Mariana Islands grows only *Wolastonia biflora* var. *canescens*. occurs. When one takes the *Wollastonia biflora* sensu-lato as the character taxon, include the *Wolastonia biflora* var. *canescens*-community into the Wollastonietum biflorae.

Table 18. Leucaena leucocephala-community.

		1
Stand No.:	-	195
Month:	-	5
Day:	-	24
Locality:	-	PGN
Altitude(m):	-	15
Area(m2):	-	100
Height of Vegetation(m):	-	5
Coverage of shrub layer(%):	-	90
Coverage of Herb layer(%):	-	60
Number of species:	-	7
Leucaena leucocephala	S	5.5
-	H	1.2
Sporobolus virginicus	H	2.3
Zoysia matrella	H	3.3
Desmodium inflatum	H	1.2
Vertonia cinerea	H	2.2
Digitaria ciliaris	H	+.2
Chloris inflata	H	+.2

3.1.3. Zoysietum matrellae ass. nov. (Table 21)

This tropical short-grass community is very dense and has nearly a 100 per cent plant cover in most of the stands. Its height is normally below 10 cm. Common associated plants are *Ipomoea pes-caprae* ssp. *brasiliensis* and *Fimbristylis cymosa*. Its habitat can be divided into two divergent environments. On the rocky shores of most of the islands, where the Zoysietum matrellae occurs more inland of the Fimbristyletum cymosae association, the Zoysietum matrellae association colonizes here the flat or gentle slopes with 2 to 10 cm deep soils.

Table 19. Vigno-Ipomoetum pes-caprae Miyawaki et K. Suzuki 1976.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stand No.:	28	29	67	446	114	115	123	130	131	158	187	351	443	116	125	127
Month:	5	5	5	6	5	5	5	5	5	5	5	6	6	5	5	5
Day:	10	10	14	7	16	16	16	16	17	17	24	4	7	16	16	16
Locality:	ANT	ANT	ANT	ASN	GGN	GGN	GGN	GGN	GGN	GGN	PGN	MGE	ASN	GGN	GGN	GGN
Altitude(m):	2	3	3	3	15	25	30	35	40	3	2	2	5	25	25	30
Exposure:	.	W	.	.	.	.	W	.	.	.	.	.	.	.	.	.
Steepness(°):	.	35	.	.	.	.	5	.	.	.	.	.	.	.	.	.
Area(m2):	150	150	160	100	900	100	250	250	50	64	250	50	40	100	600	50
Coverage(%):	65	80	35	30	80	45	40	60	60	70	15	40	40	80	80	20
Number of species:	2	3	1	1	1	3	2	1	1	4	4	2	3	4	4	4
Character species of ass. and higher units																
Ipomoea pes-caprae ssp. *brasiliensis*	4.4	5.5	3.4	3.3	5.5	3.3	3.3	4.4	4.4	2.3	2.2	3.3	3.2	2.2	1.1	1.2
Other species																
Cyperus javanicus	.	.	.	.	.	3.3	+.2	.	.	4.4	.	+	2.3	+.2	3.4	.
Emilia sonchifolia	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2.2	2.3	+
Cassytha filiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	4.5	3.3	1.3
Cocos nucifera	1.1	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
Pteris fauriei	.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vertonia cinerea	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Portulaca oleracea var. *granulato-stellulata*	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.
Phyllanthus amarus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Chloris inflata	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.
Erythrina variegata var. *orientalis*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Morinda citrifolia	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Fimbristylis cymosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3

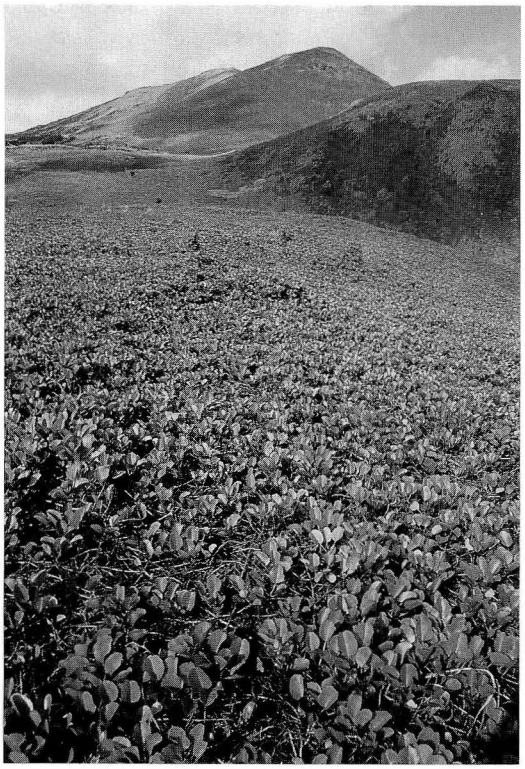


Fig. 12. *Ipomoea pes-caprae* ssp. *brasiliensis*-community, on a fresh volcanic scoria-field.

Table 20. Wollastonietum biflorae Miyawaki et K. Suzuki 1976.

	1	2	3	4	5
Stand No.:	386	345	350	405	380
Month:	6	6	6	6	6
Day:	5	2	4	5	5
Locality:	MGW	MGE	MGE	MGW	MGW
Altitude(m):	5	5	3	220	80
Exposure:	N	–	W	N	.
Steepness(°):	45	.	45	25	.
Area(m2):	50	100	100	100	100
Height of vegetation(m):	1.3	0.8	0.4	1.5	.
Coverage(%):	100	100	85	80	60
Number of species:	3	3	4	5	10
Character species of ass.					
Wollastonia biflora var. *canescens*	5.5	5.5	5.5	4.4	4.4
Other species					
Cyperus javanicus	.	2.3	2.3	2.3	2.3
Ipomoea pes-caprae ssp. *brasiliensis*	.	1.3	1.2	.	.
Boerhavia diffusa	1.2	.	.	1.2	.
Lepturus repens	+.2	.	.	.	.
Colubrina asiatica	.	.	1.2	.	.
Zoysia matrella	.	.	.	2.3	.
Pteris fauriei	.	.	.	+.2	.
Stictocardia tiliaefolia	.	.	.	.	1.1
Achyranthes canescens	.	.	.	.	1.2
Euphorbia hirta	.	.	.	.	+
Ageratum conyzoides	.	.	.	.	+
Oxalis corniculata	.	.	.	.	+
Vertonia cinerea	.	.	.	.	+
Phyllanthus amara	.	.	.	.	+
Emilia sonchifolia	.	.	.	.	+

The other location is at high elevations (300 to 610 m above sea level) on wind-swept slopes on Asuncion and Sarigan. The Zoysietum matrellae is found also near old habitation sites. In Saipan and Guam, *Zoysia matrella* is use for lawns together with *Alsycarpus vaginalis*.
Character taxon: *Zoysia matrella*.

3.1.4. Digitarietum gaudichaudii ass. nov. (Table 22)

Digitaria gaudichaudii grows as small patches within the Zoysieretum matrellae and other strand vegetation especially in stony places. *Digitaria gaudichaudii* also exist on narrow cliff ledges, where hold rich humus. The community is 60 to 95 per cent coverage and is 60 to 80 cm vegetation high. The Digitarietum gaudichaudii has no constantly associated species. The Digitarietum gaudichaudii occupies a unique ecological space. *Digitaria* and *Hedyotis* are among the most diverse plants in the Marianas Islands and characterize some of the plant communities of the Marianas.
Character taxon: *Digitaria gaudichaudii*.
Distribution: Endemic to the Mariana Islands.

3.1.5. Sesuvietum portulacoides (Table 23)

The evergreen of succulent herb community takes on a carpet-like almost monospeecific appearance, creeping or hanging from steep seashore rocks. The author observed it only Maug-North island in this survey. Very likely, it is degenerated by goat's pressure on the other islands of the northern Marianas. It can be considered a continuous pioneer community with no other associated species.
Distribution: Maug-North.

3.1.6. Crinetum asiaticae ass. nov. (Table 24)

The tropical large herb meadow grows on steep scree areas near the coast or on pebble shores. *Crinum asiaticum* is weakly protected against goat grazing. Therefore, it is only well-developed on goat-free islands on Asuncion and Maug. In Anatahan, we observed only few *Crinum asiaticum* individuals on the ledges of the sea cliffs, out of reach of goats. The Crinetum asiaticae is best-developed on Maug-North, where *Crinum asiaticum* creates over 100 m long shiny green strips on steep scree sites. *Crinum asiaticum* can reach 1.8 m high and grows in very dense stands with very few associated species.

Table 21. Zoysietum matrellae ass. nov.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Stand No.:	161	276	433b	185	186	436	300	258	156	73	106	152	318	316	257	274	188	74	110	324	317
Month:	5	5	6	5	5	6	6	5	5	5	5	5	6	6	5	5	5	5	5	6	6
Day:	18	30	7	24	24	7	1	29	18	14	15	17	1	1	28	29	24	14	15	1	1
Locality:	ALM	AGR	ASN	PGN	PGN	ASN	ASN	AGR	ALM	ANT	SRG	GGN	ASN	ASN	AGR	AGR	PGN	ANT	SRG	ASN	ASN
Altitude(m):	20	5	5	2	5	5	3	3	3	5	355	8	500	370	5	10	5	2	315	610	425
Exposure:	.	.	.	.	.	.	.	.	.	.	.	W	.	.	.	.	.	.	.	.	.
Steepness(°):	.	.	.	.	.	.	.	.	.	.	-	80	.	.	.	.	.	.	.	.	.
Area(m2):	100	20	15	250	250	100	40	15	40	2	9	10	25	50	6	30	15	4	25	25	30
Coverage(%):	100	100	60	85	80	100	95	95	95	50	85	95	20	70	80	100	90	100	100	85	20
Number of species:	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	4	4	4	4	5	6
Character species of ass.																					
Zoysia matrella	5.5	5.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	3.4	5.5	5.5	3.3	4.5	5.5	5.5	5.5	5.5	5.5	4.5	2.3
Other species																					
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	.	.	.	1.1	1.1	.	1.1	1.1	.	.	.	1.1	1.1	1.1	.	+	.	.	.
Fimbristylis cymosa	.	.	.	.	.	.	.	1.1	.	.	.	1.3	.	.	+	1.2	.	.	.	.	.
Alsycarpus vaginalis	.	.	.	+.2	2.3	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	1.2	.
Elephantopus mollis	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	2.2	.
Chloris inflatus	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	+	.	.	.
Chrysopogon aciculatus	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	1.2	.	.
Euphorbia hirta	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+
Glossogyne tenuifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
Mollastonia biflora var. *argentea*	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.
Digitaria ciliaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Desmodium triflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	1.2
Emilia sonchifolia	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Phyllanthus marianus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Hedyotis biflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Lysimachia mauritiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Vertonia cinerea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Miscanthus floridulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.
Cyperus kyllingia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.
Campylopus umbellatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.
Cheilanthes tenuifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.
Sphaenomeris biflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3

Table 22. Digitarietum gaudichaudii ass. nov.

	1	2
Stand No.:	342	411
Month:	6	6
Day:	2	5
Locality:	MGE	MGN
Altitude(m):	10	25
Area(m2):	15	25
Coverage(%):	85	60
Number of species:	4	4
Character species of ass.		
Digitaria gaudichaudii	4.5	4.4
Other species		
Lepturus repens	1.3	.
Capparis cordifolia	1.2	.
Fimbristylis cymosa	1.3	.
Portulaca oleracea var. *granulato-stellulata*	.	1.1
Lysimachia mauritiana	.	1.1
Ipomoea pes-caprae ssp. *brasiliensis*	.	+

Table 23. Sesuvietum portulacoidis ass. nov.

	1	2	3
Stand No.:	384	385	410
Month:	6	6	6
Day:	5	5	5
Locality:	MGN	MGN	MGN
Altitude(m):	3	15	5
Exposure:	N	N	N
Steepness(°):	90	5	50
Area(m2):	25	12	12
Coverage(%):	35	70	95
Number of species:	2	1	1
Character species of ass.			
Sesuvium portulacoides	3.3	4.5	5.5
Other species			
Fimbristylis cymosa	+	.	.

Character taxon: *Crinum asiaticum.*

Distribution: Asuncion, Maug, Uracas and Anatahan(fragment).

3.1.7. Cyperus javanicus-community (Table 25)

This tropical robust sedge community grows as small patchs within the *Ipomoea pes-caprae* ssp. *brasiliensis*-community or in the Fimbristyletum cymosae, where soil conditions are rich in humus. Its plant cover is usually dense and about 40 to 80 cm high.

3.2. Montane mesic grassland

3.2.1. Miscanthetum floriduli (Table 26)

The sclerophyllous tall-grass community. *Miscanthus floridulus densely* dominates communities on deep rich soils, where the native *Elaeocarpus* forests has been degenerated by grazing pressures of goats. At such places, *Miscanthus floridulus* grows up to 3 m high. In very

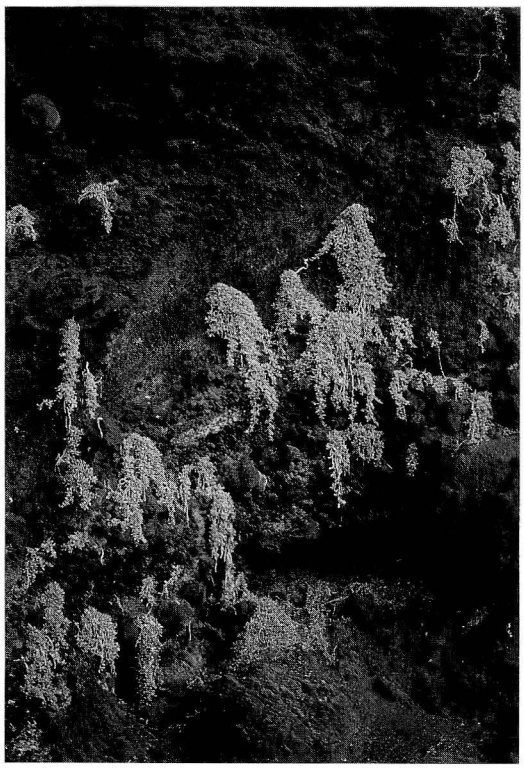


Fig. 13. Sesuvietum portuladcoides, on overhanging rock, Maug-West.

Fig. 14. Crinetum asiaticae, on steep slope near the coast, Maug-West.

Table 24. Crinetum asiaticae ass. nov.

	1	2	3	4	5
Stand No.:	347	391	392	193	445
Month:	6	6	6	6	6
Day:	6	5	5	5	7
Locality:	MGE	MGN	MGN	MGN	ASN
Altitude(m):	5	25	45	5	3
Exposure:	W	E	.	.	.
Steepness(°):	45	40	.	.	.
Area(m2):	100	100	100	100	9
Height of vegetation(m):	1.8	1.2	2	1.8	1
Coverage(%):	100	100	100	100	100
Number of species:	2	2	2	2	4
Character species of ass.					
Crinum asiaticum	5.5	5.5	5.5	5.5	5.5
Other species					
Ipomoea pes-caprae var. *brasiliensis*	+.2	.	.	.	1.1
Wollastonia biflora var. *canescens*	.	2.2	1.1	2.2	.
Zoysia matrella	.	.	.	.	2.3
Hibiscus tiliaceus	.	.	.	.	1.2

dense *Miscanthus floridulus* stands, it associates itself with almost any other plants. *Miscanthus floridulus* grows in tussock form with exposed soil between the tussocks. On account of its complete coverage of the *Miscanthus* foliage, the top soil has a very dark and dried humus layer. Each individual stand of the Miscanthetum floriduli often covers up to 100 ha. The community is very stable in terms of successional changes and continuous as the stagnant seral phase for a long period of time. On narrow ridges and on immature soil, *Miscanthus floridulus* grows to 1 to 1.5 m height. In such situations, it is mixed with *Nephrolepis hirsutula* and *Pteris fauriei*. This community covers high elevations on Anatahan, Alamagan, Pagan and Agrihan.

Character taxon: *Miscanthus floridulus*.

Distribution: All islands except Uracas.

3.2.2. Chrysopogon aciculatus-community (Table 27)

The tropical short-grass community of *Chrysopogon aciculatus* is 15 to 30 cm high dense grassland. *Chrysopogon aciculatus* grows on dry mountain ridges, where goats had a distinct disturbance impact. This grassland especially dominates in one large flat volcanic field (270 to 300 m above sea level) on Sarigan. No con-

Table 25. Cyperus javanicus-community.

	1	2	3	4	5
Stand No.:	369	377	356	362	420
Month:	6	6	6	6	6
Day:	5	5	4	4	6
Locality:	MGW	MGW	MGE	MGE	URC
Altitude(m):	30	40	35	135	40
Exposure:	.	E	.	.	.
Steepness(°):	.	40	.	.	.
Area(m2):	25	100	50	2	25
Height of vegetation(m):	0.6	.	0.7	.	.
Coverage(%):	95	100	85	15	95
Number of species:	2	3	3	4	7
Differential species of comm.					
Cyperus javanicus	5.5	5.5	5.4	2.3	2.3
Other species					
Ipomoea pes-caprae var. *brasiliensis*	.	1.1	1.1	.	.
Capparis cordifolia	1.2	.	.	.	.
Gossypium hirsutum	.	2.2	.	.	.
Vertonia cinerea	.	.	2.2	.	.
Hyptis pectinata	.	.	.	2.2	.
Euphorbia hirta	.	.	.	1.1	.
Ficus tinctoria var. *neo-ebudarum*	.	.	.	+	.
Digitaria ciliaris	.	.	.	.	2.2
Lepturus repens	.	.	.	.	1.3
Fimbristylis boninensis	.	.	.	.	1.2
Pteris fauriei	.	.	.	.	+.2
Asplenium nidus	.	.	.	.	1.1
Portulaca lutea	.	.	.	.	1.2

stant plant species are found, but at well-drained sites *Cyperus kyllingia* is present. On Sarigan, at wind-exposed ridges at 330 to 350 m elevation, *Chrysopogon aciculatus* grows as a carpet and accompany with *Psilotum nudum* (*Psilotum compactum*-form), *Nephrolepis hirsutula*, *Melastoma marabathricum* var. *mariannum* and *Dodonaea viscosa*. Such stands closely relate to the natural formation of Miscanthetum floriduli.

Distribution: Anatahan, Sarigan and Guguan.

3.3. Montane dry herbaceous fern

3.3.1. Elephantopus mollis-Nephrolepis hirsutula-community (Table 28)

The evergreen medium-tall fern-herb community cover is dense and about 40 to 80cm high. The outstanding feature of this community is an abundant growth of *Elephantopus mollis* and *Nephrolepis hirsutula*. This community can be divided into two types. One type is characterized by the presence of *Davalia solida*, and *Ischaemum longisetum* var. *raulersoniae*

Table 26. Miscanthetum floriduli ass. nov.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Stand No.:	217	250	366	284	312	59a	336	34	104	198	175	294	149	35	367	177	271	215	451
Month:	5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	5	5	6
Day:	19	28	4	30	1	13	25	11	15	19	19	31	15	11	4	19	29	19	9
Locality:	PGN	AGR	MGE	AGR	ASN	ANT	PGN	ANT	SRG	PGN	ALM	AGR	GGN	ANT	MGE	ALM	AGR	PGN	ASN
Altitude(m):	60	100	145	115	250	370	280	70	310	50	460	530	215	85	165	490	315	50	560
Exposure:	.	W	–	.	.	.	.	.	W	N	.	.	.	.	W	.	.	.	.
Steepness(°):	.	10	.	.	.	.	.	.	10	40	.	.	.	.	35	.	.	.	.
Area(m2):	200	200	100	100	25	100	200	200	100	50	100	200	200	100	100	200	100	100	400
Hight of vegetation(m):	3	2	2.5	1.8	.	4	.	2.5	1.5	1.8	2.5	3	.	1.5	1	2.5	1	.	–
Coverage(%):	90	100	100	100	95	100	100	100	100	100	100	100	100	95	80	95	100	20	90
Number of species:	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	5	5	9
Character species of ass.																			
Miscanthus floridulus	5.5	5.5	5.5	5.5	5.5	5.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	2.3	4.5
Other species																			
Nephrolepis hirsutula	.	.	.	.	2.2	.	.	1.2	.	1.2	1.2	1.1	.	1.2	.	2.2	+.2	2.3	2.3
Pteris fauriei	.	.	.	.	.	+	.	.	+	1.2	1.2	.	.	.	.	.	.	.	.
Trema orientalis var. *argentea*	.	.	.	.	.	.	3.1	.	.	.	.	.	.	.	.	.	1.1	.	.
Wollastonia biflora var. *canescens*	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	2.2	.	.	.	.
Centella asiatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	2.2
Polypodium scolopendria	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Ficus prolixa var. *carolinensis*	.	.	.	.	.	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.
Elephantopus mollis	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.
Colubrina asiatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.
Hyptis pectinata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.
Desmodium incanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.
Panicum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.
Piper guahamense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.
Digitaria ciliaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.
Psychotria marinana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.
Sporobolus fertilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.
Paspalum conjugatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3
Lunathyrium boninecola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2
Eurya japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1
Ageratum conyzoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2
Melastoma malabathricum var. *mariannum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2
Sphaenomeris biflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3

Fig. 15. Miscanthetum floriduli, 300 m elv., Anatahan.

Table 27. Chrysopogon aciculartus-community.

	1	2	3	4	5	6
Stand No.:	122	119	101	102	105	109
Month:	5	5	5	5	5	5
Day:	16	16	15	15	15	15
Locality:	GGN	GGN	SRG	SRG	SRG	SRG
Altitude(m):	15	20	300	300	353	335
Exposure:	W	–	–	–	–	–
Steepness(°):	25	–	–	–	–	–
Area(m2):	25	15	600	900	100	6
Coverage(%):	80	85	100	100	85	90
Number of species:	4	4	2	3	7	3
Differential species of comm.						
Chrysopogon aciculatus	4.4	5.5	2.3	4.5	5.5	2.3
Other species						
Cassytha filiformis	2.3	1.2	.	.	.	.
Cyperus kyllingia	.	.	4.5	2.3	.	.
Nephrolepis hirsutula	.	.	.	.	2.3	2.3
Dodonaea viscosa	.	.	.	.	1.2	3.3
Emilia sonchifolia	2.2	.	.	.	.	.
Cyperus javanicus	1.2	.	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	.	+	.	.	.	.
Desmodium triflorum	.	+	.	.	.	.
Pteris fauriei	.	.	.	1.3	.	.
Spathoglottis plicata	.	.	.	.	+	.
Melastoma malabathricum var. *mariannum*	.	.	.	.	+	.
Psilotum nudum	.	.	.	.	+.2	.
Miscanthus floridulus	.	.	.	.	1.2	.

Fig. 16. *Nephrolepis hirsutula*-rich *Elephantopus mollis*-community, just above the forest limit, 250 m elv., Asuncion.

covering the upper parts of the forest zone on Asuncion (240 to 600 m), on very young dry volcanic ash and also on dry wind-exposed ridge or on small patches within the *Pandanus tectorius* forest zone. The others type is distinguished by occurrence of weedy species like *Desmodium incanum*, *Centella asiatica*, *Hyptis pectinata* and *Cyperus cyperoides*. This second type has been observed in dry river beds on Alamagan, where humus-rich soil conditions persist. *Nephrolepis hirsutula* is a very common fern in almost every Pacific island. It may have been distributed the northern Marianas. *Elephantopus mollis* is a South-American weedy species. In Asuncion, this community plays important roll as pioneer vegetation on fresh volcanic ash fields. This community symbolizes contamination of virgin volcanic fields by exotics.

3.3.2. Melastomo-Lycopodietum cernuum ass. nov. (Table 29)

The evergreen fern-grass savanna is distinguished by the character species *Melastoma malaba thrium* var. *marianensis*, *Styphelia alamaganensis*, *Hedyotis laciniata*. This fern-rich community exists at high elevations above 480 m on Alamagan and Asuncion. The conspicu-

Table 28. elephantopus mollis-Nephrolepis hirsutula-community.

	1	2	3	4	5	6	7	8	9
Stand No.:	177	170	167	307	309	313	331	311	314
Month:	5	5	5	6	6	6	6	6	6
Day:	19	19	19	1	1	1	1	1	1
Locality:	ALM	ALM	ALM	ASN	ASN	ASN	ASN	ASN	ASN
Altitude(m):	490	300	180	85	125	355	350	240	365
Exposure:	W	W	W	SW	SW	SW	SW	SW	SW
Steepness(°):	25	20	10	20	20	25	25	25	25
Area(m2):	200	15	9	100	25	400	100	100	25
Coverage(%):	80	70	80	100	85	100	80	80	90
Number of species:	7	8	11	5	5	5	6	8	9
Differential species of community									
Elephantopus mollis	3.3	4.4	3.3	3.4	2.2	1.2	2.2	2.2	2.2
Other species									
Nephrolepis hirsutula	.	1.2	1.3	.	.	2.2	2.2	4.4	.
Davalia solida	.	.	.	.	4.4	1.2	4.4	2.2	.
Desmodium incanum	2.3	2.2	1.2	.	.	.	.	.	.
Polypodium scolopendria	.	.	.	3.4	1.2	.	.	.	1.2
Pipturus argenteus	.	.	.	1.1	+	.	.	1.1	.
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	.	.	.	.	1.2	+.2	+
Fimbristylis dichotoma ssp. *podocarpa*	1.2	.	.	.	.	.	1.2	.	.
Centella asiatica	.	1.3	1.2	.	.	.	.	.	.
Hyptis pectinata	.	+	1.1	.	.	.	.	.	.
Cyperus cyperoides	.	2.2	1.2	.	.	.	.	.	.
Emilia sonchifolia	.	.	+	.	.	.	.	.	1.2
Ischaemum longisetum var. *raulersoniae*	.	.	.	.	.	5.5	.	.	2.3
Vertonia cinerea	.	.	.	.	.	+	.	.	+.2
Dodonaea viscosa	.	.	.	.	.	.	1.2	2.2	.
Phyllanthus marianus	.	.	.	.	.	.	.	1.2	1.2
Paspalum conjugatum	3.3	.	.	.	.	.	.	.	.
Sida acuta	1.1	.	.	.	.	.	.	.	.
Cyperus kyllingia	1.2	.	.	.	.	.	.	.	.
Ageratum conyzoides	+	.	.	.	.	.	.	.	.
Machaerina mariscoides	.	1.3	.	.	.	.	.	.	.
Eclipta alba	.	+	.	.	.	.	.	.	.
Digitaria ciliaris	.	.	2.3	.	.	.	.	.	.
Oxalis corniculata	.	.	2.2	.	.	.	.	.	.
Pityrogramma calomelanos	.	.	1.3	.	.	.	.	.	.
Heliotropium indicum	.	.	1.2	.	.	.	.	.	.
Morinda citrifolia	.	.	.	+	.	.	.	.	.
Neiosperma oppositifolia	.	.	.	+	.	.	.	.	.
Scleria lithosperma	.	.	.	.	2.3	.	.	.	.
Miscanthus floridulus	.	.	.	.	.	.	.	+.2	.
Vigna marina	.	.	.	.	.	.	.	.	2.2
Euphorbia hirta	.	.	.	.	.	.	.	.	+

ous plant species are *Lycopodium cernuum*, *Nephrolepis hirsutula*, *Sphaenomeles biflora*, its floristic composition being 7 to 13 species. Its height is variable. At lower elevations its heights is 0.8 to 1.6 m and at higher elevations and wind-exposed sites 0.2 to 0.5 m. Its vegetation cover is 80 to 100%. Mainly its soil surface is covered by *Frullania apiculata* and *Campylopus umbellatus* bryophytes and *Centella asiatica*. On Alamagan, this community covers very large areas on young volcanic scoria-soil at high elevation, limited only by wind-swept cliffs or thermal grounds around fumaroles. From Kanehira's (1934 a) and Hosokawa's (1934 b) reports, this association was well-developed on the crater ridges of Alamagan. However, we observed that this association was now rare on the same ridges of Alamagan. Instead, on these places we found distinct grazing influences of goats and cattle, changing this community to exotic grass communities.

The Schoenetosum philippinensis-subassociation is differentiated from the typical association by the differential species: *Schoenus philippinensis* and *Hedyotis laciniata* occurs wind-swept cliffs on the top of Alamagan, characterized by very wet mist-laden winds and cloud cover.

The Styphelietosum alamaganensis-subassociation is differentiated by the species: *Styphelia mariannensis*, *Furulania apiculata* and *Zoysia matrella* occurs on wind swept slope and ridges of Asuncion over 640 m elevation on fresh scoria soils.

This typical subassociation is dominant on Asuncion above the 480 to 660 m elevation

Table 29. Melastomo-Lycopodietum crenuae ass. nov.

	campylopetosum umbellati											*typicum*						*paspalidetosum conjugatae*			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Stand No.:	457	459	461	325	326	327	328	326	460	454	321	180	455	330	452	453	465	456	462	463	464
Month:	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6
Day:	9	9	9	1	1	1	1	1	9	9	1	19	9	1	9	9	9	9	9	9	9
Locality:	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ALM	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN	ASN
Altitude(m):	680	680	680	645	700	710	840	590	680	590	600	480	590	735	565	595	510	640	660	530	550
Exposure:	E	.	S	.	.	.	.	SW	.	W	SW	.	.	.	W	W	W	W	.	W	W
Steepness(°):	80	.	.	.	.	.	.	35	80	25	35	.	.	.	30	25	60	40	30	30	20
Coverage(%):	1	0.4	4	25	4	9	10	9	.	40	25	2	.	50	25	15	20	.	.	400	15
Height of vegetation(m):	1	.	0.8	.	.	.	.	.	.	0.7	.	.	1	.	.	.	–	1.5	1.6	.	.
Coverage(%):	.	95	100	.	85	90	100	100	100	100	100	80	100	100	90	95	80	85	100	95	100
Number of species:	10	10	9	7	7	12	13	8	12	13	11	10	8	9	8	10	6	12	10	12	11
Character & differential species of ass.																					
Lycopodium cernuum	+.2	.	.	2.2	2.2	2.2	2.2	.	1.2	2.2	1.2	3.3	2.2	2.3	3.3	3.3	4.4	2.2	.	.	.
Melastoma malabathricum var. *marianensis*	.	1.1	.	.	.	1.1	+.2	1.2	1.1	2.2	2.3	+.2	.	3.3	2.2	.	.	+	1.1	+	1.2
Sphaenomeris biflora	2.2	.	2.2	3.3	.	2.3	.	.	.	2.3	2.3	.	.	2.3	4.4	2.3	.	3.3	3.3	3.4	2.3
Ischaemum longisetum var. *raulersoniae*	1.2	1.2	2.3	.	.	.	+.2	1.2	4.5	.	1.3	.	.	.	.	1.3	.	+.2	.	.	.
Hedyotis laciniata	1.1	+	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+.2
Gleichenia linearis	.	.	.	.	.	.	.	.	.	3.3	.	1.3	2.3	.	.	.	.	2.2	.	.	.
Differential species of subass.																					
Campylopus umbellatus	2.3	2.3	3.4	2.3	2.3	2.3	3.4	2.3	1.3	2.3	.	.	.	.	.	.	.	.	.	.	.
Davalia solida	+.2	.	2.2	.	.	.	1.2	2.2	+.2	.	1.2	.	.	.	.	.	.	.	.	.	.
Schoenus phillipinensis	2.3	4.5	3.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Styphelia marianensis	.	.	.	2.3	1.3	2.2	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lejeunea flava	.	.	.	3.4	.	1.2	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zoysia matrella	.	.	.	.	3.4	4.4	3.4	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential species of subass.																					
Paspalum conjugatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	2.2	1.3	1.2
Eurya japonica	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3.2	1.2	2.1
Oplismenus compositus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	1.2
Machaerina mariscoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	2.3
Other species																					
Nephrolepis hirsutula	.	+.2	1.2	.	1.2	.	.	.	2.2	2.2	.	.	2.2	2.2	2.3	3.3	+.2	1.2	2.3	1.2	2.3
Miscanthus floridulus	.	.	.	+.2	.	.	+	1.2	.	2.3	1.2	.	4.5	1.3	1.2	1.2	.	.	1.2	.	.
Chrysopogon aciculatus	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	1.3	1.3	.	1.3	.	2.3	.
Centella asiatica	.	+.2	+.2	.	.	+	+.2	.	1.2	1.2	.	.	2.2	.	2.2	2.2	.	1.2	2.2	2.3	2.3
Elephantopus mollis	.	.	.	2.2	2.3	1.2	+	2.2	.	.	1.3	.	.	2.2	.	.	.	.	.	.	.
Fimbristylis dichotoma ssp. *podocarpa*	.	.	.	.	.	.	+.2	.	1.2	.	.	1.3	.	.	.	.	2.3	.	.	+	1.2
Lindsaea ensifolia	.	.	.	.	+	+.2	+.2	.	.	.	.	3.4	.	.	.	.	.	1.2	.	.	.
Phyllanthus mariannus	.	.	.	.	.	1.1	.	.	.	+	.	1.2	.	.	.	+	1.2	.	.	.	.
Thelypteris opulenta	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	+.2	.	.	.	2.2	1.2	2.3
Desmodium incanum	.	.	.	.	.	.	.	.	.	+.2	.	.	+	.	.	+.2	.	1.2	2.2	.	.
Frullania apiculata	1.3	.	.	.	.	.	.	.	3.4	2.3	2.3	3.4	.	.	.	.	.	.	.	.	.
Mastigophora diclados	2.3	1.3	.	.	.	.	.	.	.	+.3	.	.	1.3	.	.	.	.	.	.	.	.
Thelypteris torresiana	.	.	.	.	.	.	.	.	.	.	2.2	.	.	2.2	.	.	.	.	.	.	.
Osmunda japonica	.	.	.	.	.	.	.	.	+	.	2.3	.	.	.	.	.	.	.	.	1.2	.
Cheilanthes tenuifolia	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.
Desmodium triflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1.3	.
Cladonia sp.	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Marchantia sp.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria pallide-fusca	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malaxis alamaganensis	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.
Lindernia crustacea	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Floribundaria floribunda	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.
Freycinetia reineckei	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.
Cyahtea aramaganensis	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.
Lunathyrium bonincola	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.
Ageratum conyzoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Limnophila fragrans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.

above the forest boundery. Physiognomically, it is a fern meadow with a vegetation height of 0.7 to 1.6 m.

Character taxa: *Styphelia mariannensis*, *Hedyotis laciniata*, *Malaxis alamaganensis* and *Melastoma malabathricum* var. *mariannum* (also higher units).

Distribution: Asuncion and Alamagan. Endemic of the northern Marianas.

3.4. Herbaceous communities on disturbed ground

3.4.1. Pityrogramma calomelanos-community (Table 30)

The outstanding feature of this evergreen

pioneer fern community is an abundant growth of *Pityrogramma calomelanos*, distinguishable by its erect glaucous leaves, even from a distance. The plant cover is over 80 per cent and is 30 to 70 cm high. This fern community exists on dry sunny river banks in the denuded forest area of Anatahan. Through erosion, rich soil has accumulated in the habitat of *Pityrogramma calomelanos*. On Anatahan, we observed this community on landslide-slope of denuded forest by goat overgrazing. This community is the last phase of forest degeneration. The *Pityrogramma calomelanos*-community is the equivalent vegetation of the Epilobietea angustifolii class of the Temperate Forest Zone. In borader areas of *Pityrogramma calomelanos*, with more shade and wetter conditions, often *Pteris fauriei* and *Boehmeria virgata* intermix. It suggests the successional trend of the *Pityrogramma calomelanos*-community. However, the enviroment around this community changes to drier and sunnier conditions through strong grazing pressures of goats. Therefore, this pionieer community seem to continuously enlarge itself following continued degradtion. We have not observed the *Pityrogramma calomelanos*-community in goat-free islands of the northern Marianas.

3.4.2. Ageratum conyzoides-community (Table 31)

Ageratum conyzoides grows often in disturbed sites with evidence of strong overgrazing by goats on Anatahan. These sites indicate always the Aglaio-Elaeocarpetum jogae association died back and degraded to the Miscanthetum floriduli association. Around the Miscanthetum floriduli association with advance soil erosion and exposed ground surfaces, *Ageratum conyzoides* colonizes readily here the bare ground.

Table 30. Pityrogramma calomelanos-community.

	1	2	3	4	5	6	7
Stand No.:	33	212	51	164	168	62	60
Month:	5	5	5	5	5	5	5
Day:	10	24	10	19	19	13	13
Locality:	ANT	PGN	ANT	ALM	ALM	ANT	ANT
Altitude(m):	40	15	50	95	240	370	380
Exposure:	.	N	.	.	.	N	E
Steepness(°):	.	30	.	.	.	45	35
Area(m2):	6	6	160	5	20	200	100
Height of vegetation(m):	.	.	.	.	.	.	.
Coverage(%):	90	60	100	85	90	60	60
Number of species:	2	3	3	4	4	5	9
Differntial specie of community							
Pityrogramma calomelanos	5.5	4.5	5.5	3.4	5.5	4.5	2.3
Other specie							
Pteris fauriei	.	1.2	.	2.3	.	2.3	4.4
Microlepia speluncae	.	.	1.1	1.2	+.2	1.2	2.3
Boehmeria virgata	1.2	.	+	.	+	.	.
Miscanthus floridulus	.	+.2	.	.	.	.	1.3
Thelypteris torresiana	.	.	.	1.2	1.2	.	.
Digitaria ciliaris	.	.	.	.	.	+.2	1.3
Eragrostis tenella	.	.	.	.	.	+.2	.
Microstegium glabratum	.	.	.	.	.	.	2.3
Elephantopus mollis	.	.	.	.	.	.	1.1
Cyperus kyllingia	.	.	.	.	.	.	1.3
Vertonia cinerea	.	.	.	.	.	.	+

3.5. Herbaceous mantle or edge community

3.5.1. Stictocardia tiliaefolia-community (Table 32)

Tall herbaceous liana or mantle community with *Stictocardia tiliaefolia* somthering thickets and the forest edge on shaded landslide slopes. The community can reach 5 to 7 m high with dense plant cover. During the dry season (April to June) the underground parts of *Stictocardia tiliaefolia* die back in some stands. But in very wet ravines, *Stictocardia tiliaefolia* continue to thrive during the dry season. We observed this community in Sarigan at 200 to

Fig. 17. Soil erosion and *Pityrogramma calomelanos* and *Pteris fauriei* community as representative vegetation of the *Elaeocarpus*-forest, 350 m elavation, Anatahan.

Table 31. Ageratum conyzoides-community.

	1	2	3
Stand No.:	61	98	99
Month:	5	5	5
Day:	13	15	15
Locality:	ANT	SRG	SRG
Altitude(m):	370	300	300
Area(m2):	25	200	100
Coverage(%):	80	95	40
Number of species:	4	3	6
Differential species of comm.			
Ageratum conyzoides	3.4	3.4	3.4
Other species			
Oxalis corniculata	+	.	+
Cyperus kyllingia	1.2	.	.
Sporoborus fertilis	+	.	.
Nephrolepis hirsutula	.	4.5	.
Pteris fauriei	.	1.1	.
Stictocardia tiliaefolia	.	.	1.2
Portulaca oleracea var. *granulato-stellata*	.	.	1.2
Boehmeria densiflora	.	.	1.2
Mollugo pentaphylla	.	.	+

Table 32. Stictocardia tiliaefolia-community.

	1	2	3
Stand No.:	94	95	144
Month:	5	5	5
Day:	15	15	.
Locality:	SRG	SRG	GGN
Altitude(m):	210	230	140
Exposure:	N	NW	W
Steepness(°):	25	35	35
Area(m2):	400	600	100
Coverage(%):	20	85	100
Number of species:	2	3	3
Differential species of comm.			
Stictocardia tiliaefolia	3.4	3.4	3.4
Other species			
Pteris boninensis	+.2	3.3	.
Ageratum conyzoides	.	3.3	.
Blechum brownei f. *puberulum*	.	.	3.3
Coloburina asiatica	.	.	1.2

Table 33. Passiflora foetida-community.

	1
Stand No.:	227
Month:	5
Day:	25
Locality:	PGN
Altitude(m):	215
Area(m2):	25
Coverage(%):	100
Number of species:	3
Differential species of comm.	
Passiflora foetida	5.5
Other species	
Nephrolepis hirsutula	2.3
Pteris fauriei	1.2

250 m elevations and in Guguan at about 140 m elevation. The community has no constant accompanying species. Its vegetation floor is very dark and only a few plants grow here like *Pteris boninensis*. We observed the *Stictocardia tiliaefolia*-community within limited areas at this time. On Guam, *Stictocardia tiliaefolia* combines with other shrubs creating mantle communities with greater species diversity.

3.5.2. Passiflora foetida-community (Table 33)

We observed *Passiflora foetida*-community in a small gap of the *Elaeocarpus joga* forest on Pagan where *Passiflora foetida* make dense 1 m high clumps. As *Stictocardia tiliaefolia*, *Passiflora foetida* is a member of the species-rich forest-edge scrub mantle community on Guam.

3.6. Degenerate ornamental plant communities

3.6.1. Catharanthus roseus-Crotalaria pallida-community (no table)

The ruins on old village sites of Alamagan are covered by ornamental plants and weeds still prevail today. Especially, *Catharanthus roseus* spreads since its poisonous antibodies protect it against goats and cattle grazing. Coexisting garden-weeds and ruderal species are *Crotalaria pallida*, *Cleome viscosa* and *Vernonia cinerea*.

3.6.2. Triumfettia semitriloba-community (Table 34)

Triumfettia semitriloba formas distinct plant community along wayside on Alamagan. *Triumfettia semitriloba* is distinguished by its prickly fruits. It is distributed along human and animal pathways near old village sites.

4. Sporadic growing herbaceous communities

4.1. Rock ledge communities

4.1.2. Portulacetum australe ass. nov. (Table 35)

This scattered tropical succulent herb community reaches only 5–10 cm in height. It colonize narrow ledges on rocky shores or on scree, colonizing 1–10 m^2 patches. In almost all the cases, it constitutes the single species: *Portulaca australe* and a continious pionieer community. Soil is very dry and stony, a physiognomically related plant community found in the subtropics and tropics is the *Portulaca okinawensis*-community of the Ryukyu Islands.

Character taxon: *Portulaca australis*

Distribution: Agrihan, Maug, Asuncion.

4.2. Scree communities

4.2.1. Portulacetum luteae ass. nov. (Table 36)

Tropical succulent steppe or meadow. *Portu-*

laca lutea forms a dense or scattered patches of 0.2 to 10 m^2 and 5–20 cm heigh. The association grows sea level to 150 m elevation on Maug. *Portulaca lutea* is situate on rocky narrow ledges and scree, which contain some humus. The *Portulaca lutea*-association often grows around the nests of the blue-footed booby birds. Almost exclusively *Portulaca lutea* dominates, but around the nitrate-lader bird nest sites, it is mixed with *Portulaca oleracea* var. *granulato-stellulata*. This community is strongly correlated with bird activities, dependent upon bird migration and upon proximity of the nitrate-rich habitat.

Character taxon: *Portulaca lutera.*

Distribution: Maug, Uracas (Polynesia and Marcus Island).

4.2.2. Lagenophora lanata-community (Table 37)

Lagenophora lanata is a small perennials of the Asteraceae , distributed from Australia to Japan. The author observed the *Lagenophora lanata*-community only on one site at the top of Alamagan (740 m elevation). *Lagenophora lanata* grows on a small scoria flat, which is situated at the head of small gully of the inner caldera wall. *Lagenophora lanata* creates a scattered vegetation cover with *Campylopus umbel-*

Table 34. Triumfettia semitriloba-community.

	1
Stand No.:	467
Month:	6
Day:	9
Locality:	ALM
Altitude(m):	50
Area(m2):	100
Height of Vegetation(m):	1.2
Coverage(%):	100
Number of species:	5
Differential species of comm.	
Triumfettia semitriloba	4.4
Other species	
Desmodium incanum	3.4
Cocos nucifera	1.1
Paspalum dilatatum	+.2
Arbus precatorius	1.3

Table 35. Portulacetum australis ass. nov.

	1	2	3	4	5
Stand No.:	338	435	388	290	343
Month:	6	6	6	5	6
Day:	7	2	30	–	5
Locality:	MGE	ASN	MGN	AGR	MGE
Altitude(m):	5	3	2	2	3
Exposure:	N	.	.	.	.
Steepness(°):	30	.	.	.	.
Area(m2):	1	0.09	0.15	0.25	4
Coverage(%):	3	35	20	5	3
Number of species:	1	1	1	1	2
Character species of ass.					
Portulaca australis	1.1	3.3	2.3	1.3	1.3
Other species					
Portulaca oleracea var. *granulato-stellulata*	.	.	.	.	+

Table 36. Portulacetum luteae ass. nov.

	typical subass.								subass. of *Portulaca oleracea* var.						*Portulaca oleracea*-var. -community			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Stand No.:	341	390	417	418	419	425	421	426	346	349	353	374	375	376	401	378	379	438
Month:	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Day:	2	5	6	6	6	6	6	6	2	2	2	5	5	5	5	5	5	7
Locality:	MGE	MGN	URC	URC	URC	URC	URC	URC	MGE	NGE	MGE	MGW	MGW	MGW	MGN	MGW	MGW	ASN
Altitude(m):	50	10	40	10	35	20	30	20	5	10	5	60	80	100	190	95	90	3
Exposure:	N	N	.	.	.	.	.	S	.	.	.	.	.	.	S	E	.	.
Steepness(°):	40	50	.	.	.	.	.	30	.	.	.	.	.	.	5	80	.	.
Area(m2):	4	4	6	15	3	4	25	100	4	20	2	25	9	6	3	4	3	2
Coverage(%):	50	40	5	8	20	60	30	80	85	40	35	15	20	80	40	20	10	20
Number of species:	2	3	1	1	1	2	3	7	4	4	3	2	2	5	2	4	6	3
Character species of ass.																		
Portulaca lutea	3.4	3.3	1.1	1.2	2.3	3.4	1.1	2.3	2.3	2.3	2.3	2.3	3.3	1.1	.	.	.	.
Differential species of subass.																		
Portulaca oleracea var. *granulato-stellulata*	.	.	.	.	.	.	.	.	3.4	2.3	2.2	1.2	1.3	3.4	3.3	2.2	1.2	2.2
Boerhavia diffusa	.	.	.	.	.	.	.	.	3.4	2.3	.	.	.	1.1	1.2	+	1.2	.
Other species																		
Ipomoea pes-caprae ssp. *brasiliensis*	.	.	.	.	.	.	2.2	2.2	1.2	2.2	1.2	.	.	.	.	.	.	1.1
Cyperus javanicus	1.2	.	.	.	.	.	1.2	1.2	.	.	.	.	.	.	.	.	+.2	.
Lepturus repens	.	1.2	.	.	.	.	.	1.3	.	.	.	.	.	.	.	2.3	1.3	.
Emilia sonchifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	+	+	.
Digitaria ciliaris	.	.	.	.	.	1.2	.	3.4	.	.	.	.	.	.	.	.	.	.
Euphorbia hirta	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	+	.
Fimbristylis cymosa	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium nidus	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.
Fimbristylis boninensis	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.
Vertonia cinerea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2

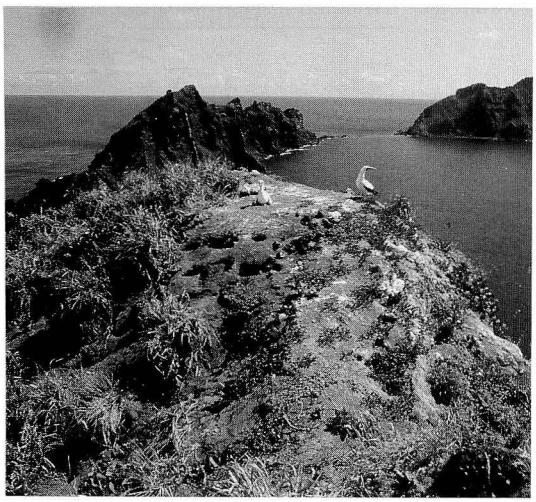


Fig. 18. Portulacetum luteae around the blue footed booby bird nest, Maug-East.

latus and *Marchantia* sp. These sites resemble alpine scree vegetation.

4.3. Sporadic herbaceous-communities on rock shores and fresh volcanic materials

4.3.1. Fimbristyletum cymosae ass. nov. (Table 38)

This tropical short-sedge community is a typical pionieer plant community at rocky shores. Its grow on steep basalt cliffs and also in fresh lava fields. Especially in Uracas, the community covers very large areas of fresh lava fields. Its cover is normally 5 to 50 per cent. *Fimbristylis cymosa* has glossy brown-green and robust leaves, each individual exhibiting a characteristic hemispherical shape. The community can be found also at high elevations, where it covers fresh volcanic lava or ash as on Uracas and Asuncion. On Uracas, the community is the most dominant vegetation type. Most stands have very few acommpanying species. However, where soils are enriched by fine sand it mixes with *Fimbristylis boninensis* forming the subassociation of Fimbristyletum cymosae fimbristyletosum boninensis. *Cyperus javanicus* grows after depressions of this associations.

Character taxon: *Fimbristylis cymosa.*

Distribution: All islands of the nothern Marianas.

4.4. Ruderal communities on tramped ground

Table 37. Lagenophora lanata-community.

	1
Stand No.:	458
Month:	6
Day:	9
Locality:	ALM
Altitude(m):	740
Area(m2):	0.25
Height of Vegetation(m):	0.08
Coverage(%):	5
Number of species:	3
Differential species of comm.	
Lagenophora lanata	1.2
Other species	
Marchantia sp.	+.2
Campyropus umbellatus	+

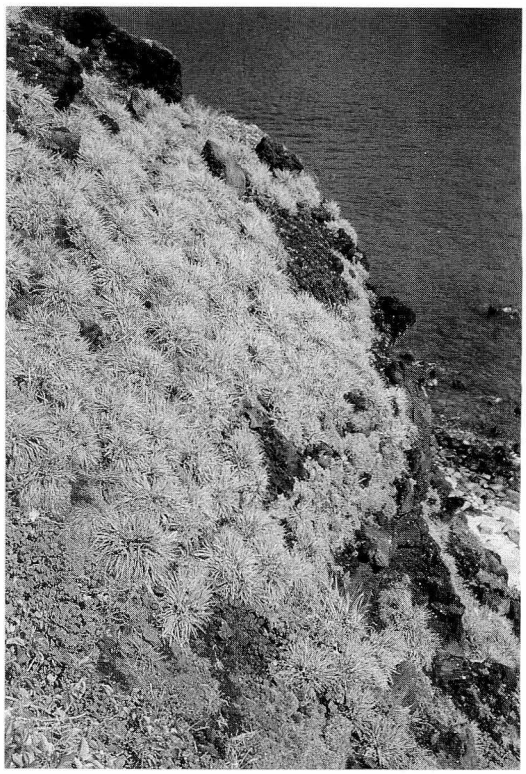


Fig. 19. Fimbristyletum cymosae on strand cliff, Maug-East.

4.4.1. Eleusinetum indicae Pignatti 1953 (Table 39)

Annual ruderal plant community: Eleusinetum indicae is a pantropic ruderal plant community at trampled sites . However the Eleusinetum indicae association is rather rare today in the northern Marianas, because human occupancy has not created severely trampled site conditions. The relevees were taken at a bathi-

Table 38. Fimbristyletum cymosae ass. nov.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Stand No.:	433	412	431	416	33a	245	275	337	259	299	256	413	414	415	241	242	113	43a	315	244	67	233	155	162	232	234	444	77	153	75	387	237	150
Month:	6	6	6	6	5	5	5	6	5	6	5	6	6	6	5	5	5	5	6	5	5	5	5	5	5	5	6	5	5	5	6	5	5
Day:	7	6	6	6	10	28	30	2	29	1	28	6	6	6	27	27	16	11	1	27	14	25	18	18	25	25	7	14	18	14	5	27	17
Locality:	ASN	URC	URC	URC	ANT	AGR	AGR	MGE	AGR	ASN	AGR	URC	URC	URC	PGN	PGN	GGN	ANT	ASN	PGN	ANT	PGN	ALM	ALM	PGN	PGN	ASN	ANT	ALM	ANT	MGN	PGN	GGN
Altitude(m):	5	30	75	40	5	10	3	5	3	3	10	30	30	40	8	10	10	3	3	3	3	3	2	2	15	10	3	2	5	5	5	5	5
Exposure:	.	-	.	.	.	.	.	N	.	.	.	.	.	.	.	W	.	.	.	.	.	W	S	S	S	W	.	N	S	E	N	W	W
Steepness(°):	.	-	.	.	.	.	.	45	.	.	.	.	.	.	.	60	.	.	.	.	.	75	90	80	70	90	.	90	90	80	60	45	85
Area(m2):	9	100	100	400	9	3	4	100	4	50	2	4.5	2500	50	100	25	100	5	25	50	10	4	10	25	25	4.5	4	15	20	3	3	15	9
Coverage(%):	3	5	30	70	1	20	45	40	15	5	30	80	35	80	80	25	35	5	5	70	30	5	5	15	5	15	15	15	20	5	75	70	20
Number of species:	1	1	1	1	1	1	1	1	1	1	1	2	2	3	2	2	2	2	3	3	5	2	3	3	4	6	2	2	2	3	3	3	3
Character species of ass.																																	
Fimbristylis cymosa	1.3	2.2	3.3	4.5	1.1	2.3	3.4	3.3	1.3	1.2	2.3	4.5	3.4	4.5	5.5	2.3	3.4	1.3	1.3	4.5	2.3	1.2	1.2	1.2	1.2	2.2	+.2	1.3	2.3	1.2	4.5	4.5	2.3
Other species																																	
Fimbristylis boninensis	.	.	.	.	.	.	.	.	.	.	.	3.4	2.3	1.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea pes-caprae																																	
ssp. *brasiliensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	1.1	2.2	+	+	1.1	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Hedyotis foetida																																	
var. *mariannensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1.2	1.2	+.2	1.1	.	.	.	.	.	.	.
Cyperus javanicus	.	.	.	.	.	.	.	.	.	.	.	.	.	2.3	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+.2	.
Pteris fauriei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	+.2	1.2	2.2	.	.	.	.	.	.
Portulaca australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.	+.2	.	1.2	.	.	.
Wollastonia biflora																																	
var. *canescens*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	+.2	.	.	.	+
Hedyotis strigulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	1.2	.	.	.
Lysimachia mauritiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	2.2	.	.
Emilia sonchifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepturus repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.3	.	.	.	.	.	.	.	.	.	.	+	.	.
Phyllanthus marianus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Zoysia matrella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
Sphaenomeris biflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.
Chloris inflata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.
Vertonia cinerea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Table 39. Eleusinetum indicae Pignatti 1953.

	1	2
Stand No.:	166	179
Month:	5	5
Day:	19	19
Locality:	ALM	ALM
Altitude(m):	100	510
Area(m2):	2	25
Coverage(%):	75	60
Number of species:	4	2
Character species of ass.		
Eleusine indica	4.5	2.3
Other specie		
Elephantopus mollis	+	.
Eragrostis tenella	+.2	.
Desmodium incanum	+.2	.
Cyperus cyperinus	.	3.3

ng/drikling site for cattle on Alamagan.

Altitudinal Distribution of Plant Communities and Vegetation Zone.

The above-mentioned plant communities are classified into four groupes according to their elevations.

1. Sea shore zone. (0 to 10 m elevation facing ocean)

Limited to sea shore: Sesuvietum portulacoidis, Crinetum asiaticae, Portulacetum australe, *Scaevola taccada*-community.

Strand communities: Vigno-Ipomoetum pescaprae, Capparidetum subcordatae.

Seashore + high elevation fresh scoria: Zoysietum matrellae, Fimbristyletum cymosae.

Seashore + heavily NO_3-enriched: Portulacetum luteae.

2. Lowland zone. (up to 250 m elevation)

Plantation: Cocos nucifera-community.

Mesic forest: Pandanetum tectorii, Hibiscetum tiliaceae.

Climax forest: *Terminalia catappa*-community, *Pisonia grandis*-community.

3. Upland zone. (100 to 550 m elevation)

Meadow: Miscanthetum floriduli, *Nephrolepis hirsutula-Elephantopus mollis*-community.

Humid scrub: Boehmerietum virgatae

Cliamx forest: Aglaio-Elaeocarpetum jogae.

4. Summit zone.

Scree: *Lagenophora lanata*-community.

Meadow: Melastomo-Lycopodietum cernuae.

(Climax scrub: *Eurya japonica*-community).

Based upon of these elevation distribution paterns one can recognize the following climax vegetation zonations:

A. Lowland zone or *Blechum-Terminalia catappa*-community-zone(0 to 250 m).

B. Upland zone or Aglaioi-Elaeocarpetum jogae-zone (250 to 550 m elevation).

C. High mountain zone or Melastomo-Lycopodietum cernuum-zone (over 550 m).

High mountain zones are characterized also by other plant species as *Osmunda japonica* (Asuncion), *Styphelia mariannensis* (Alamagan and Asuncion), *Schoenus philippinensis* (Alamagan), *Eurya japonica* (Alamagan and probably also Agrihan), *Boehmeria densiflora* (Pagan, Alamagan, Agrihan) and others. On a well-vegetated Alamagan and Agrihan, the forest is limited by a conspicuous line at 550 m to 600 m elevation. Above this line, the dominating *Eurya japonica*-scrub according to Hosokawa's report (1934b) is today destroyed by goats. The higher peaks of Agrihan are now covered by low scrub communities according to our long distance-observations. The summit areas are covered very often by clouds in our survey period of May to June. These vegetation changes and climate conditions suggest, that there is a discontinuity and abrupt change in temperature at about 550 m elevation.

Distribution of the Plant Communities in the Islands and Island Type

Each islands of the northern Marianas Islands has a different history of its volcanic activities. These historical phenomena are reflected in floristic and vegetational composition of the individual islands. The distribution of the distinguished plant communities of each island are integrated in Table 40. One can divide the northen Marianas Islands into three groupes as follows:

a. Active volcanic islands.

Forest communities have yet developed. *Fimbristylis*-stage.

Uracas.

b. Young volcanic islands.

Most mature forest communites is *Pisonia grandis*-community, *Blechum-Terminalia catappa*-community. *Pisonia*-stage. Sarigan, Guguan, Maug, Asuncion and the northen part of Pagan.

c. Matured volcanic islands.

Climax forest is Aglaio-Elaeocarpetum jogae. Elaeocarpus-stage. Anatahan, Alamagan, Agr-

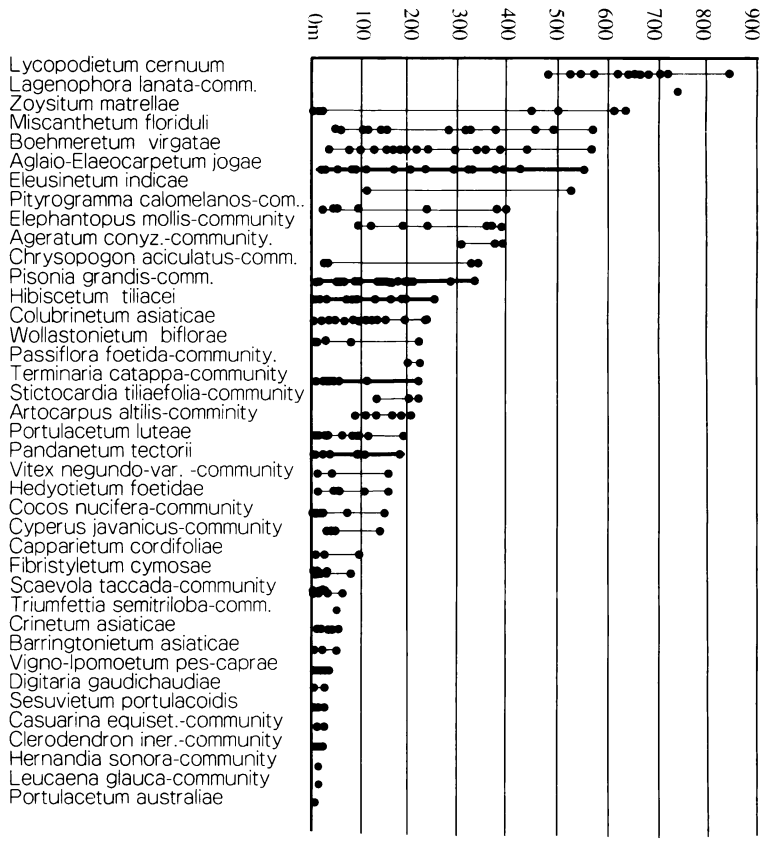


Fig. 20. Elvational distribution of plant communities, dots indicate relivees.

ihan and the souther part of Pagan.

Classification of Plant Communities

Synsystematics are one of the most important aspects of the classification of plant communities of the Braun-Blanquet School of Phytosociology.

The Braun-Blanquet classification is based upon comparison of the total floristic composition of plant communities. Each stand or each community is characterized by the specific combination of individual taxa. We collected about 470 releves in this survey. Associations are classified as well as communities. Difficulties exist in integrating these communities by Braun-Blanquet's method into higher syntaxa. One is lack the knowledge of similar plant communities on a regeonal basis. Secondly, the floristic composition of the northern Marians is young and relatively poor. Such isolated islands are often exposed to a single species in very different communities. Consequently, each plant community has very few faithful "character" species. For these limitations, only a provisory calssification can be proposed at this time.

1. Strand vegetation

Almost all the strand plant communities are pantropical and cosmopolitan. Many authors have already proposed the Braun-Blanquet syntaxonomical hierarchy, which has to be accepted or modified for the northern Marianas.

Class: Philoxeretea Miyawaki *et* K. Suzuki 1976

Character taxa: *Philoxeris, Sesuvium.*

Pantropical stony strand communities.

Order: Philoxeretalia Miyawaki *et* K. Suzuki 1976

Alliance: Philoxerion Miyawaki *et* K. Suzuki 1976

Sesuvium portulacoides-community

Table 40. Distribution of the main plant communities of the norhtern Marianas.

	large islands heavy grazing				smaller islands no grazing				fresh volcano
	ANT	PGN	AGR	ALM	ASN	MGN	SRG	GGN	URC
Hibiscetum tiliaceae	x	x	x	x	x	x	x	x	.
Miscanthetum floriduli	x	x	x	x	x	x	x	x	.
Zoysietum matrellae	x	x	x	x	x	x	x	x	.
Pandanetum tectorii	x	x	x	.	x	x	.	x	.
Vigno-Ipomoetum pes-caprae	x	x	.	.	x	x	.	x	.
Capparidetum cordifoliae	x	x	.	.	.	x	x	.	.
Portulacetum australeae	x	.	x	.	x	x	.	.	.
Pipturo-Colubrinetum asiaticae	x	.	.	.	x	.	x	.	.
Phyllantho-Hedyotietum foetidae var.	x	x	.	.	.	x	.	.	.
Blechum-Terminalia catappa-community	.	.	.	x	x	x	.	x	.
Wollastonietum biflorae	x	x	.	.	.	x	.	.	.
Melastomo-Lycopodietum cernuae	.	.	.	x	x	.	.	.	.
Aglaio-Elaeocarpetum jogae	x	x	x	x	.	.	.	.	.
*Artocarpus artilis-community	x	.	x	x	.	.	.	.	.
Boehmerietum virgatae	x	.	x	x	.	.	.	.	.
*Pitylogramma calomelanos-community	x	x	.	x	.	.	.	.	.
Barringtonietum asiaticae	x	.	x	.	.	.	.	.	.
*Casuarina equisetifolia-community	.	x	x	.	.	.	.	.	.
Hernandia sonora-community	x	.	.	.	.	.	.	.	.
*Leucaena leucocephala-community	.	x	.	.	.	.	.	.	.
*Eleusinetum indicae	.	.	.	x	.	.	.	.	.
Pisonia grandis-community	.	.	.	.	x	x	x	x	.
Scaevola taccada community	.	.	.	.	x	x	.	.	.
Vitex negundo var. bicolor-community	.	.	.	.	x	x	.	.	.
Crinetum asiaticae	.	.	.	.	x	x	.	.	.
Stictocardia tiliaefolia-community	.	.	.	.	.	.	x	x	.
*Chrysopogon aciculatus-community	.	.	.	.	.	.	x	x	.
Digitarietum gaudichaudiae	.	.	.	.	.	x	.	.	.
Clerodendron innerme-community	.	.	.	.	.	x	.	.	.
Fimbristyletum cymosae	x	x	x	x	x	x	x	x	x
Sesuvietum portulacoidis	.	.	.	.	.	x	.	.	x
Cyperus javanicus-community	.	.	.	.	.	x	.	x	x
Portulacetum luteae	.	.	.	.	x	x	.	.	x
Elephantopus mollis-Nephrolepis-community	.	.	.	x	x	.	.	.	.
Ageratum conyzoides-community	x	.	.	.	.	.	x	.	.

including in listing with * plantation-origin introduced, exotic communities.

Class: Scaevolo-Ipomoetea pes-caprae Knapp 1957

Order: Scaevolo-Ipomoetalia prov.

Alliance: Scaevolion taccadae Miyawaki *et* K. Suzuki 1976

Scaevoletum taccadae

Alliance: Ipomoion pes-caprae prov.

Vigno-Ipomoetum pes-caprae Miyawaki *et* K. Suzuki 1976

Zoysietum matrellae ass. nov.

Fimbristyletum cymosae ass. nov.

Portulacetum luteae ass. nov.

Capparidetum cordifoliae ass. nov.

Wollastonietum biflorae Miyawaki *et* K. Suzuki 1976

Crinetum asiaticae ass. nov.

Class: undistinguished

Portulacetum australis ass. nov.

2. Forest and scrub

Class: Colubrinetea asiaticae class nov. prov.

Character taxa: *Colubrina asiatica*, *Melochia villosissima*, *Cordia subcordata*, *Pipturus argenteus*.

Order: Colubrinetalia asiaticae ordo nov. prov.

Character taxa: same as the class.

Distribution: southeast Pacific Islands.

Alliance: Colubrinion asiaticae all. nov.

Character taxa: same as the order.

Pipturo-Colubrinetum asiaticae ass. nov.

Stictocardia tiliaefolia-community

Class: Hibisco-Pandanetea Miyawaki *et* K. Suzuki 1976

Order: Hibisco-Pandanetalia Miyawaki *et* K. Suzuki 1976

Alliance: Melothrio-Hibiscion tiliacei Miyawaki *et* K. Suzuki 1976

Hibiscetum tiliacei ass. nov.

Alliance: Pandanion tectorii Miyawaki *et* K. Suzuki 1976

Pandanetum tectorii Miyawaki *et al.*, 1974

Class: Terminalio-Calophylletea Ohba *et* Sugawara 1977

Order: Terminalietalia catappae Ohba *et* Sugawara 1977

Table 41. Synoptic table of strand communities.

Philoxeretea Miyawaki et K.Suzuki 1976
1 = Sesuvietum portulacoidis ass. nov.
class undistinguished
2 = Portulacetum australis ass. nov.
Scaevolo-Ipomoetea pes-caprae Knapp 1957
3 = Portulacetum luteae ass. nov. typicm
4 = Portulacetum luteae ass. nov.
subass. of Portulaca oleracea var. glanulato-stellulata
5 = Vigno-Ipomoetea pes-caprae Miyawaki et K.Suzuki 1976
6 = Fimbristyletum cymosae ass. nov.
7 = Zoysietum matrellae ass. nov.
8 = Capparidetum cordifoliae ass. nov.
9 = Phyllantho-Hedyotietum foetidae var. mariannensis ass.nov.
10 = Wollastonietum biflorae Miyawaki et K.Suzuki 1976
11 = Scaevola taccada-community
12 = Digitarietum gaudichaudiae ass. nov.

	1	2	3	4	5	6	7	8	9	10	11	12
Number of relivee:	3	5	8	6	16	33	21	12	8	5	5	2
Character species of ass.												
Sesuvium portulacoides	3	.	.	.	.	.	.	.	.	.	.	.
Character species of ass.												
Portulaca australis	.	V	.	.	.	+	.	+	I	.	.	.
Character species of Ipomoetea pes-caprae												
Ipomoea pes-caprae												
ssp. *brasiliensis*	.	.	II	III	V	II	II	III	.	II	.	.
Lepturus repens	.	.	II	.	.	r	.	.	II	I	.	1
Lysimachia mauritiana	.	.	.	.	.	+	r	.	I	.	.	1
Character species of ass.												
Portulaca lutea	.	.	V	V	.	.	.	.	.	.	I	.
Differntial species of subass.												
Portulaca orelacea												
var. *granulato-stellulata*	.	I	.	V	+	.	.	+	.	.	.	1
Character species of ass.												
Fimbristylis cymosa	1	.	I	.	.	V	I	.	II	.	.	1
Character species of ass.												
Zoysia matrella	.	.	.	.	.	r	V	.	I	I	IV	.
Character species of ass.												
Capparis cordifolia	.	.	.	.	.	.	.	V	.	.	I	1
Character species of ass.												
Hedyotis foetida												
var. *mariannensis*	.	.	.	.	.	I	.	+	V	.	.	.
Phyllanthus marianus	.	.	.	.	+	r	.	+	IV	.	.	.
Character species of ass.												
Wollastonia biflora												
var. *canescens*	.	.	.	.	.	+	r	+	II	V	.	.
Character species of ass.												
Scaevola taccada	.	.	.	.	.	.	.	.	.	.	V	.
Character species of ass.												
Digitaria gaudichaudii	.	.	.	.	.	.	.	.	.	.	.	2
Other species												
Cyperus javanicus	.	.	II	.	III	+	.	II	I	IV	IV	.
Emilia sonchifolia	.	.	.	I	II	r	r	.	I	.	.	.
Pteris fauriei	.	.	.	.	+	I	.	III	II	I	.	.
Boerhavia diffusa	.	.	.	III	.	.	.	+	.	II	I	.
Chloris inflata	.	.	.	.	+	r	+	+	.	.	.	.
Vertonia cinerea	.	.	.	.	+	.	r	I	.	I	.	.
Digitaria ciliaris	.	.	II	.	.	.	r	+	.	.	.	.
Euphorbia hirta	.	.	.	I	.	.	+	.	.	I	.	.
Fimbristylis boninensis	.	.	I	.	.	+	.	.	.	.	.	.
Hedyotis biflora	.	.	.	.	.	+	r	.	.	.	.	.
Sphaeneomeris biflora	.	.	.	.	.	r	r	.	.	.	.	.
Miscanthus floridulus	.	.	.	.	.	.	r	.	I	.	.	.
Asplenium nidus	.	.	I	.	.	.	.	.	.	.	.	.
Cocos nucifera	.	.	.	.	I	.	.	.	.	.	.	.
Morinda citrifolia	.	.	.	.	+	.	.	.	.	.	.	.
Erythrina variegata												
var. *orientalis*	.	.	.	.	+	.	.	.	.	.	.	.
Cassytha filiformis	.	.	.	.	I	.	.	.	.	.	.	.
Cyperus kyllingia	.	.	.	.	.	.	r	.	.	.	.	.
Cheilanthes tenuifolia	.	.	.	.	.	.	r	.	.	.	.	.
Desmodium triflorum	.	.	.	.	.	.	+	.	.	.	.	.
Elephantopus mollis	.	.	.	.	.	.	I	.	.	.	.	.
Glossogyne tenuifolia	.	.	.	.	.	.	+	.	.	.	.	.
Phyllanthus marianus	.	.	.	.	.	.	r	.	.	.	.	.
Campylopus umbellatus	.	.	.	.	.	.	r	.	.	.	.	.
Chrysopogon aciculatus	.	.	.	.	.	.	+	.	.	.	.	.
Alsycarpus vaginalis	.	.	.	.	.	.	I	.	.	.	.	.
Heteropogon contortus	.	.	.	.	.	.	.	.	I	.	.	.
Nephrolepis hirsutula	.	.	.	.	.	.	.	.	II	.	.	.
Pteris vittata	.	.	.	.	.	.	.	.	II	.	.	.
Colubrina asiatica	.	.	.	.	.	.	.	.	.	I	.	.
Oxalis corniculata	.	.	.	.	.	.	.	.	.	I	.	.
Achyranthes canescens	.	.	.	.	.	.	.	.	.	I	.	.
Phyllanthus amarus	.	.	.	.	.	.	.	.	.	I	.	.
Stictocardia tiliaefolia	.	.	.	.	.	.	.	.	.	I	.	.
Ageratum conyzoides	.	.	.	.	.	.	.	.	.	I	.	.
Canavalia megalantha												
var. *falanruwae*	.	.	.	.	.	.	.	.	.	.	I	.

Alliance: Terminalion catappae Ohba *et* Sugawara 1977

Hernandietum sonorae-community

Barringtonia asiatica-community

Class: Elaeocarpetea jogae class nov.

Character taxa: *Elaeocarpus joga*, *Freycinetia reineckei*, *Eugenia palumbis*, *Zeuxine fritzi*, *Nervilla aragoana*.

Distribution: the western Caroline Islands and the Mariana Islands.

Order: Aglaio-Elaeocarpetlia jogae ordo nov.

Character taxa: *Aglaia mariannensis*, *Guamia marianensis*, *Psychotoria mariana*, *Ochrosia mariannensis*, *Merilliodendron megacarpum*, *Piper guahamense* and *Artocarpus mariannensis*.

Distribution: Endemic to the Mariana Islands.

Alliance: Aglaio-Guamion mariannae

Character taxa: same as order.

Aglaio-Elaeocarpetum jogae ass. nov.

Distribution: Endemic to the Mariana Islands.

Pisonia grandis-community

Blechium brownei f. *puberulum-Terminalia catappa*-community

The Elaeocarpo jogae-Parinarietum palauensis Nakamura and K. Suzuki (1986) of the Palau Islands belongs to this class and build new alliance and new order.

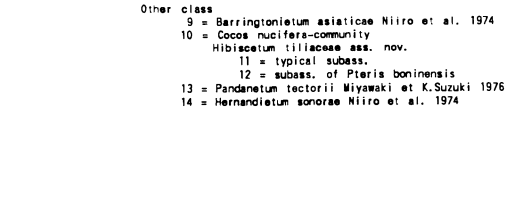
3. Grassland and fern communities

Class: Miscanthetea floriduli class. nov.

Character taxa: *Miscanthus floridulus*, *Nephrolepis hirsutula*, *Chrysopogon acicularis*, *Melastoma malabathricum*, *Machaerina mariscoides*, *Thelypteris opulenta* and *Lindsaea ensifolia*.

Distribution: Tropical and subtropical islands of western Pacific.

Table 42. Synoptic table of forest communities.



Number of relevee:	1 8	2 10	3 10	4 7	5 10	6 11	7 6	8 6	9 8	10 11	11 5	12 11	13 8	14 1
Character species of class														
Aglaia marianensis	V	IV	IV	.	V	II	II	.	.	+	.	II	.	.
Elaeocarpus joga	II	IV	IV	.	.	.	.	IV	.	.	.	.	.	.
Freycinetia reineckei	II	II	IV	.	.	.	.	II	II	+	.	II	.	.
Eugenia palumbis	II	.	.	.	.	+	.	.	.	.	.	.	.	.
Zeuxine fritzii	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Nervilla aragoana	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Character species ass.														
Psychotria mariana	III	II	III	.	.	.	.	.	I	.	.	+	.	.
Cyathea aramaganensis	II	I	IV	.	.	.	.	I	.	.	.	.	.	.
Premna obtusifolia	II	III	.	.	.	+	.	.	.	.	.	.	I	.
Differential species of subass.														
Sideroxylon glomeratum	IV	.	.	.	.	+	.	.	.	.	.	.	.	.
Differential species of subass.														
Piper guahamense	.	.	IV	.	.	.	.	II	I	.	.	+	.	.
Melanolepis multiglandulosa														
var. *glabratum*	.	.	IV	.	.	.	.	.	II	.	.	.	.	.
Angiopteris evecta	I	.	III	.	.	.	.	.	.	.	.	.	.	.
Differential species of community														
Pisonia grandis	.	.	.	V	V	.	V	.	.	.	.	.	.	.
Differential species of sub-community														
Ochrosia marianensis	II	.	.	.	IV	.	.	.	.	II	.	.	.	.
Differential species of community														
Terminalia catappa	II	.	.	.	.	V	V	I	.	.	.	.	I	.
Blechum brownei f. *puberulum*	.	.	.	.	+	II	V	II	.	.	.	.	.	1
Differential species of community														
Artocarpus altilis	.	.	.	.	.	.	.	V	I	.	.	.	.	.
Character species of ass.														
Barringtonia asiatica	.	.	.	.	.	.	.	.	V	+	.	.	.	.
Character species of ass.														
Hernandia sonora	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Other species														
Pandanus tectorius	III	III	III	.	+	III	IV	I	II	+	.	.	V	.
Hibiscus tiliaceus	.	.	IV	.	I	+	I	II	II	+	V	V	TI	.
Cocos nucifera	.	+	+	.	.	.	.	IV	IV	V	.	.	I	.
Ficus tinctoria	III	III	IV	I	III	II	IV	I	II	.	.	+	I	1
Pteris boninensis	V	V	V	III	IV	IV	II	V	V	V	.	V	.	1
Morinda citrifolia	IV	IV	IV	III	I	IV	III	II	I	+	.	I	.	.
Asplenium nidus	I	.	+	II	+	III	V	II	.	.	.	.	I	1
Nephrolepis hirsutula	II	III	+	.	+	I	.	I	I	.	.	I	.	.
Polypodium scolopendria	.	+	+	.	.	III	III	I	.	I	.	I	II	1
Neiosperma oppositifolia	II	.	.	I	.	I	I	.	.	+	.	+	II	.
Erythrina variegata														
var. *orientalis*	II	.	II	.	+	II	III	III	.	.	.	.	.	.
Vertonia cinerea	I	.	.	.	.	+	.	I	.	+	I	.	.	.
Scleria lithosperma	I	+	.	.	.	.	.	.	.	.	.	+	I	.
Microlepia speluncae	.	II	II	.	.	.	.	II	II	.	.	II	.	.
Oplismenus compositus	.	II	I	.	.	.	.	III	II	.	.	I	.	.
Ficus prolixa														
var. *carolinensis*	.	.	I	.	I	I	I	I	.	.	.	.	.	.
Colubrina asiatica	I	+	.	.	.	.	II	.	.	.	.	.	I	.
Elephantopus mollis	I	.	.	.	.	.	.	II	.	+	.	I	.	.
Trema orientalis														
var. *argentea*	.	.	IV	.	.	+	II	II	.	.	.	.	.	.
Stictocardia tiliaefolia	.	.	+	.	.	+	I	III	.	.	.	.	.	.
Mucuna platyphylla	.	.	I	.	.	.	.	IV	I	.	.	II	.	.
Carica papaya	.	.	.	III	.	+	I	.	.	.	.	.	I	.
Ipomoea pes-caprae														
ssp. *brasiliensis*	.	.	.	.	.	I	.	.	I	I	.	.	III	1
Boehmeria virgata	.	I	I	.	.	.	.	I	.	.	.	.	.	.
Cyperus javanicus	.	.	.	.	.	II	.	.	.	.	I	.	I	.
Hernandia sonora	.	.	.	.	.	.	.	I	I	.	.	+	.	.
Eupatorium odoratum	I	.	.	.	.	.	.	I	.	.	.	.	.	.
Bolbitis quoyana	I	.	.	.	.	.	.	.	.	.	.	I	.	.
Piper betle	I	+	.	.	.	.	.	.	.	.	.	.	.	.
Geniostemma hoeferi	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Polyscias grandifolia	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Macaranga thompsonii	.	+	.	.	.	.	.	I	.	.	.	.	.	.
Colocasia esculenta	.	+	.	.	.	.	.	.	.	+	.	.	.	.
Cyperus kyllingia	.	+	.	.	.	.	.	I	.	.	.	.	.	.
Canavalia megalantha														
var. *falanruwae*	.	.	+	.	.	I	.	.	.	.	.	+	.	.
Lunathyrium boninense	.	.	II	.	.	.	.	III	.	.	.	.	.	.
Musa sapientum	.	.	I	.	.	.	.	I	.	.	.	.	.	.
Ophioglossum reticulatum	.	.	+	.	.	.	.	I	.	.	.	.	.	.
Clerodendrum inerme	.	.	.	.	+	.	I	.	.	.	.	.	.	.
Pipturus argenteus	.	.	.	.	.	II	III	.	.	.	.	.	.	.
Miscanthus floridulus	.	.	.	.	.	+	.	I	.	.	.	.	.	.
Thelypteris torresiana	.	.	.	.	.	.	.	.	.	.	.	II	I	.
Asplenium unilaterale	I	.	.	.	.	.	.	.	.	.	.	.	.	.
Thelypteris opulenta	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Microstegium glabratum	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Cynometra ramiflora	.	.	.	I	.	.	.	.	.	.	.	.	.	.
Davallia solida	.	.	.	.	I	.	.	.	.	.	.	.	.	.
Abrus precatorius	.	.	.	.	.	.	I	.	.	.	.	.	.	.
Panicum sp.	.	.	.	.	.	.	I	.	.	.	.	.	.	.
Dioscorea alata	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hymenocallis littoralis	.	.	.	.	.	.	.	.	.	.	I	.	.	.
Diplazium proliferum	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Thelypteris opulenta	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Benincasa hispida	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Asplenium unilaterale	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Pteris fauriei	.	.	.	.	.	.	.	.	.	.	.	.	II	.
Mollastonia biflora														
var. *canescens*	.	.	.	.	.	.	.	.	.	.	.	.	I	.
Hedyotis corymbosa	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Psilotum nudum	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Ageratum conyzoides	.	.	.	.	.	.	.	.	.	.	.	.	.	1

Order: Miscanthetalia floriduli ordo nov.

Character taxon: same as class.

Alliance: Miscanthion floriduli all. nov.

Character taxa: same as order.

Miscanthetum floriduli ass. nov.

Nephrolepis hirsutula-Elephantopus mollis-community

Melastomo-Lycopodietum cernuae ass. nov.

Chrysopogon aciculatus-community

Very characteristic and abundunt *Miscanthus floridulus*-grassland community can find any corformity vegetation class. The *Melastoma marianum-Dicranopteris pedata*-community by Nakamura and Suzuki (1986) of the Palau Islands belongs to this alliance, order and class.

4. Weed communities

Class: Amarantho-Emilietea Knapp 1965

Triumfettia semitriloba-community

Ageratum conyzoides-community

Cyperus javanicus-community

Class: Eleusino-Tribuletea Knapp 1965

Character taxa: *Eleusine indica*, *Tribulus terrestris*, *Gomphrena dispersa.*

Distribution: tropic and subtropic area of the world.

Order: Eleusino-Gomphrenetalia Knapp 1965

Alliance: Eleusinion indicae Leonard 1952

Eleusinetum indicae Pignatti, 1953

The following communities need more regional observations to identify their category of vegetation classification.

Pityrogramma calomelanos-community

Passiflora foetida-community

Flora

The vascular flora of the northern Marianas are being studied by the Japanese botanists R. Kanehira (1934, 1935) and T. Hosokawa (1934–1953) in the Japanease territories under the mandate period of the Marianas Islands. After World War II, many US botanists visited these islands. Fosberg, Falanruw and Sachet (1975) and Fosberg, Sachet and Oliver (1979, 1987, 1982) compiled all the previous surveys of vascular floras. Laureson and Rinehert (1989) published a practical handbook of woody plants of the northern Marianas. Nevertheless, the vascular flora of the northern Marianas Islands are not well observed for its difficulties of access. The author collected in this expedition 450 specimens of vascular taxa. It contains some of new records for the northern Mariana Islands

Tab. 43. Synoptic table of grass- and fern-communities.

Miscanthetea floridulae class. nov.
Melastomo-Lycopodietum crenuae ass. nov.
1 = campylopetosum umbellati
2 = typicum
3 = paspaletosum conjugatae
4 = Elephantopus mollis-Nephrolepis hirsutula-comm.
5 = Chrysopogon acicularis-community
6 = Miscanthetum floridulae ass. nov.

	1	2	3	4	5	6
Number of relevee:	11	6	4	9	6	19
Character species of ass.						
Melastoma malabathricum var. *mariannum*	IV	III	4	.	I	+
Lycopodium cernuum	IV	V	1	.	.	.
Hedyotis laciniata	II	I	1	.	.	.
Thelypteris opulenta	+	I	3	.	.	.
Sphaenomeris biflora	III	III	4	.	.	.
Malaxis alamaganensis	+	.	.	.	.	.
Differential species of subass.						
Campylopus umbellatus	V	.	.	.	.	.
Davalia solida	III	.	.	III	.	.
Styphelia marianensis	II	.	.	.	.	.
Zoysia matrella	II	.	.	.	.	.
Lejeunea flava	II	.	.	.	.	.
Schoenus philippinensis	II	.	.	.	.	.
Differential species of subass.						
Paspalum conjugatum	.	.	4	I	.	+
Eurya japonica	+	.	3	.	.	+
Oplismenus compositus	.	.	2	.	.	.
Machaerina mariscoides	.	.	2	I	.	.
Character species of class						
Nephrolepis hirsutula	III	V	4	III	II	III
Chrysopogon aciculatus	+	II	2	.	V	.
Miscanthus floridulus	III	IV	1	I	.	V
Ischaemum longisetum var. *raulersoniae*	V	I	1	II	.	.
Gleichenia linearis	+	II	1	.	.	.
Other species						
Centella asiatica	III	III	4	II	.	I
Desmodium incanum	+	II	2	II	.	+
Elephantopus mollis	III	I	.	V	.	+
Fimbristylis dichotoma ssp. *podocarpa*	I	II	2	II	.	.
Ipomoea pes-caprae ssp. *brasiliensis*	+	.	.	II	I	.
Phyllanthus marianensis	I	III	.	II	.	.
Lindsaea ensifolia	II	I	1	.	.	.
Frullania apiculata	II	I	.	.	.	.
Osmunda japonica	I	.	1	.	.	.
Thelypteris torresiana	+	I	.	.	.	.
Mastigophora diclados	II	I	.	.	.	.
Cheilanthes tenuifolia	+	I	.	.	.	.
Lunathyrium boninensis	.	I	.	.	.	+
Ageratum conyzoides	.	I	.	.	.	+
Desmodium triflorum	.	.	2	.	II	.
Cyperus kyllingia	.	.	.	I	II	.
Emilia sonchifolia	+	.	.	II	I	.
Hyptis pectinata	.	.	.	II	.	+
Digitaria ciliaris	.	.	.	I	.	+
Polypodium scolopendria	.	.	.	II	.	+
Dodonaea viscosa	.	.	.	II	II	.
Pteris fauriei	.	.	.	.	I	II
Cladonia sp.	+	.	.	.	.	.
Marchantia sp.	+	.	.	.	.	.
Setaria pallide-fuscaum	+	.	.	.	.	.
Lindernia crustacea	.	I	.	.	.	.
Freycinetia reineckei	.	I	.	.	.	.
Cyathtea aramaganensis	.	I	.	.	.	.
Floribundaria floribunda	.	I	.	.	.	.
Pipturus argenteus	.	.	.	II	.	.
Cyperus cyperoides	.	.	.	II	.	.
Vertonia cinerea	.	.	.	II	.	.
Scleria lithosperma	.	.	.	I	.	.
Vigna marina	.	.	.	I	.	.
Pityrogramma calomelanos	.	.	.	I	.	.
Sida acuta	.	.	.	I	.	.
Neiosperma oppositifolia	.	.	.	I	.	.
Morinda citrifolia	.	.	.	I	.	.
Ageratum conyzoides	.	.	.	I	.	.
Heliotropium indicum	.	.	.	I	.	.
Oxalis corniculata	.	.	.	I	.	.
Eclipta alba	.	.	.	I	.	.
Cassytha filiformis	.	.	.	.	II	.
Psilotum nudum	.	.	.	.	I	.
Cyperus javanicus	.	.	.	.	I	.
Spathoglottis plicata	.	.	.	.	I	.
Wollastonia biflora var. *canescens*	.	.	.	.	.	I
Trema orientalis var. *argentea*	.	.	.	.	.	I
Sporobolus fertilis	.	.	.	.	.	+
Colubrina asiatica	.	.	.	.	.	+
Panicum sp.	.	.	.	.	.	+
Psychotria mariana	.	.	.	.	.	+
Ficus prolixa var. *carolinensis*	.	.	.	.	.	+
Piper guahamensis	.	.	.	.	.	+

such as *Osmunda japonica*, *Ophioglossum reticulatum*, *Lagenophora lanata*, *Cyrtandra agrihanensis* Ohba sp. nov. and *Malaxis alamaganensis* S. Kobayashi sp. nov.

Collecting List

Collected specimens are preserved in the Herbarium of the Natural History Museum & Institute, Chiba (CBM-BS). Bold specimen numbers indicate the listed accession numbers of the CBM-BS herbarium. For the designation notes see Fig. 2.

An asterisk indicates that the plant is considered to be introduced by human activities from other floristic regions to the Islands.

The species names mostly follow Fosberg, Sachet and Oliver (1979, 1982, 1987).

Family Psilotaceae

1. *Psilotum complanatum* Swartz

AGRIHAN: route k (CBM-BS-59107); route l–On *Elaeocarpus* trunk, 400 m (CBM-BS-59061); route l–250 m (CBM-BS-59092).

2. *Psilotum nudum* (L.) Beauv.

ALAMAGAN: route u (CBM-BS-59228); route u (CBM-BS- 59228). ASUNCIUON: route n (CBM-BS-59021). SARIGAN: route d–Summit ridge in the *Chrysopogon aciculatus* grassland, 450 m (CBM-BS-58902).

Family Polypodiaceae

3. *Belvisia spicata* (L.f.) Mirabel ex Copeland

ANATAHAN: route a–On *Elaeocarpus* trunk, 220 m (CBM-BS-58812).

4. *Lepisorus boninensis* (Christ) Ching

New to Micronesia.

AGRIHAN: route k (CBM-BS-59127), AGRIHAN: route l (CBM-BS-59057).

5. *Polypodium punctatum* (L.) Swartz

SARIGAN: route d–In Subcrater, 390 m (CBM-BS-58904).

6. *Polypodium scolopendria* Burmann f.

AGRIHAN: route k (CBM-BS-59114); route l (CBM-BS-59091). ANATAHAN: route a–In wet valley, 210 m (CBM-BS- 58815). ASUNCION: route n (CBM-BS-59199). GUGUAN: route e–New volcanic ash field (CBM-BS-58923); route f (CBM-BS-58951).

Family Athyriaceae

7. *Diplazium proliferum* (Lam.) Thouars

New to the Mariana Islands.

ANATAHAN: route a–Moist ravine, 210 (CBM-BS-58814).

8. *Lunathyrium bonincola* (Nakai) H.Ohba

New to Micronesia.

AGRIHAN: route l, 120 m (CBM-BS-59089). ALAMAGAN: route g (CBM-BS-58871).

9. *Lunathyrium petersonii* (Kunze) H. Ohba

AGRIHAN: route l (CBM-BS-59059).

Family Dryopteridaceae

10. *Ctenitis subglandulosa* (Hance) Ching

AGRIHAN: route l (CBM-BS-59098).

11. *Microlepia speluncae* (L.) T.Moore

AGRIHAN: route l (CBM-BS- 59090). ANATAHAN: route a–In moist ravine, 210 m (CBM-BS-58809); route b, 120 m (CBM-BS-58835).

12. *Thelypteris* sp.

ANATAHAN: route c, 80 m (CBM-BS-58846).

13. *Thelypteris ogasawarensis* (Nakai) H. Ito ex Honda

New to Micronesia.

ASUNCION: route n–In moist lava cavity, elv. 600 m (CBM-BS-59032).

14. *Thelypteris guamensis* (Holttum) Fosberg et Sachet

ALAMAGAN: route g (CBM-BS-58880). ANATAHAN: route a–In wet valley, 210 m (CBM-BS-58795); route b, In ravine, 70 m (CBM-BS-58822).

15. *Thelypteris opulenta* (Kaulfuss) Fosberg

AGRIHAN: route l, 250 m (CBM-BS-59072); route l, 250 m (CBM-BS-59076). ALAMAGAN: route g (CBM-BS-58881). ANATAHAN: route a–In wet valley, 210 m (CBM-BS-58794); route c–In ravine, 80 m (CBM-BS-58845).

16. *Thelypteris torresiana* (Gaudichaud) Alston

AGRIHAN: route l, 250 m (CBM-BS-59077); route l (CBM-BS-59087); route l (CBM-BS-59088). ALAMAGAN: route g (CBM-BS-58860); route g (CBM-BS-58864). ANATAHAN: route a–In moist ravine, 210 m (CBM-BS- 58817); route b–In ravine, 70 m (CBM-BS-58824).

17. *Thelypteris unita* (L.) C. V. Morton

ALAMAGAN: route g (CBM-BS-58868); route u (CBM-BS-59233). ASUNCION: route n (CBM-

BS-59023).

Family Lomariopsidaceae

18. *Bolbitis quoyana* (Gaudichud) Ching

AGRIHAN: route k (CBM-BS-59124). ALAMAGAN: route g (CBM-BS- 58885). ANATAHAN: route a–In moist ravine, 210 m (CBM-BS-58818).

Family Aspleniaceae

19. *Asplenium nidus* L.

GUGUAN: route f (CBM-BS-58946). URACAS: route s (CBM-BS-59187).

20. *Asplenium unilaterale* Lamarck

AGRIHAN: route l (CBM-BS- 59073). ALAMAGAN: route g (CBM-BS- 58883). ANATAHAN: route a–In moist ravine, 210 m (CBM-BS-58808).

Family Pteridaceae

21. *Cheilanthes tenuifolia* (Burman f.) Swartz

ALAMAGAN: route u–Around fumarole (CBM-BS-59206).

22. *Lindsaea obtusa* J. Smith

AGRIHAN: route l (CBM-BS-59064).

23. *Pteris excelsa* Gaud.

New to the Marianas Islands.

AGRIHAN: route l–In moist ravine, under *Elaeocarpus joga*-forest 400 m (CBM-BS-59058).

24. *Pteris boninensis* H. Ohba

AGRIHAN: route l (CBM-BS- 59071). ANATAHAN: route a–In moist ravine, 230 m (CBM-BS-58816); route b–In ravine, 70 m (CBM-BS-58825), GUGUAN: route f (CBM-BS- 58935); route f (CBM-BS- 58936). PAGAN: route h (CBM-BS-58972-2).

25. *Pteris fauriei* Hieron.

ASUNCION: route n (CBM-BS-59197). MAUG-EAST: route p (CBM-BS-59160), SARIGAN: route d, SW–On rocky ridge, 250 m (CBM-BS-58890), PAGAN: route h (CBM-BS- 58972 & 59055). URACAS: route s (CBM-BS-59188).

26. *Pteris vittata* L.

PAGAN: route h–Shomushon to east coast, on dry sunny cliff (CBM-BS-58978).

Family Vittariaceae

27. *Vittaria incurvata* Cavanilles

SARIGAN: route d, SW–On rocky ridge, 390 m (CBM-BS-58905).

Family Parkeriaceae

28. **Pityrogramma calomelanos* (L.) Link

ANATAHAN: route b–dry place, 120 m (CBM-BS-58826). ANATAHAN: route c, 200 m (CBM-BS-58840). ALAMAGAN: route g (CBM-BS-58869).

Family Oleandraceae

29. *Nephrolepis hirsutula* (Forster f.) Presl

AGRIHAN: route k (CBM-BS-59113). ALAMAGAN: route g (CBM-BS-58876). ASUNCION: route n (CBM-BS-59035). GUGUAN: route e–New volcanic ash field (CBM-BS-58915); route f (CBM-BS- 58933). PAGAN: route h (CBM-BS-58981). SARIGAN: route d–Rocky ridge, 100 m (CBM-BS-58901). URACAS: route s (CBM-BS-59182).

Family Davalliaceae

30. *Davallia solida* (Forster f.) Swartz

AGRIHAN: route k (CBM-BS- 59110. ALAMAGAN: route g (CBM-BS-58872). ASUNCION: route n (CBM-BS- 59017). GUGUAN: route f (CBM-BS-58950).

Family Lindsaeaceae

31. *Lindsaea ensifolia* Swartz

ALAMAGAN: route g (CBM-BS-58878); route g–Around fumarole, 450 m (CBM-BS-58967); route u (CBM-BS-59225).

32. *Sphaenomeris biflora* (Kaulf.) Y. Akasawa

ASUNCION: route n (CBM-BS-59028).

33. *Sphaenomeris chinensis* (L.) Maxon

ALAMAGAN: route g (CBM-BS-58866); route g (CBM-BS- 58875); route u (CBM-BS- 59235). ASUNCION: route n (CBM-BS-59029).

Family Cyatheaceae

34. *Cyathea aramaganensis* Kanehira

From Minami-iwo-jima (the Volcano Islands) described *Cyathea tuyamae* H. Ohba (H. Ohba 1983), its has branched trunks as *Cyathea aramaganensis*. Foliage character of these two species very resembled each other. Probably *Cyathea tuyamae* is synonym of *Cyathea aramaganensis*.

AGRIHAN: route l (CBM-BS- 59070). ALAMAGAN: route g–In valley, 300 m (CBM-BS-58961). ANATAHAN: route c–NNW slope, 350

m (CBM-BS-58848). ASUNCION: route n (CBM-BS- 59020). PAGAN: route i (CBM-BS- 59050. SARIGAN: route d–In thick *Miscanthsu floridulus* grassland , 380 m (CBM-BS-58907).

Family Hymenophyllaceae

35. *Trichomanes javanicum* var. *boryanum* (Kunze) Fosberg

New record to the northern Marianas.

AGRIHAN: route l–In very moist ravine, 400 m. (CBM-BS-59063).

Family Gleicheniaceae

36. *Gleichenia linearis* (Burman f.) C. B. Clarke

ALAMAGAN: route g–Around fumarole, 450 m (CBM-BS-58958); route u (CBM-BS-59236).

Family Angiopteridaceae

37. *Angiopteris evecta* (Forster f.) Hoffmann

AGRIHAN: route k, W part (CBM-BS-59015); route l (CBM-BS- 59056), AGRIHAN: route l (CBM-BS- 59100). ALAMAGAN: route g–In valley, 280 m (CBM-BS-58968).

Family Osmundaceae

38. *Osmunda japonica* Thunb.

New record to Micronesia.

ALAMAGAN: route u (CBM-BS-59234). ASUNCION: route n (CBM-BS-59030).

Family Ophioglossaceae

39. *Ophioglosum reticulatum* L.

New record to the northern Marianas, determined by M. Nishida.

AGRIHAN: route l–In moist ravine under *Elaeocarpus joga*-forest, 400 m (CBM-BS-59065).

Family Selaginellaceae

40. *Selaginella ciliaris* (Retzius) Spring

ALAMAGAN: route u (CBM-BS-59209)–new locality.

Family Lycopodiaceae

41. *Lycopodium cernuum* L.

ALAMAGAN: route g, 420 m (CBM-BS-58884); route g–Around fumarole, 450 m (CBM-BS- 58964). ASUNCION: route n (CBM-BS-59024).

Fig. 21. Branched stem of *Cyathea aramaganensis*, Anatahan.

Family Ulmaceae

42. *Trema orientalis* (L.) Bl. var. *argentea* (Planchon) Lauterbach

ANATAHAN: route a–in *Miscanthus floridulus*-grassland, 150 m (CBM-BS-58813). GUGUAN: route e–New volcanic ash field (CBM-BS-58929); route f (CBM-BS-58945).PAGAN: route h (CBM-BS-58998). SARIGAN: route d–Rocky ridge, 200 m (CBM-BS-58887).

Family Moraceae

43. **Artocarpus altilis* (Parkinson) Fosberg

ALAMAGAN: route u (CBM-BS-59202).

44. *Ficus prolixa* Forst. var. *carolinensis* (Warburg) Foster

ASUNCION: route n (CBM-BS-59193). GUGUAN: route e–New volcanic ash field (CBM-BS-58927). MAUG-NOIRTH: route r (CBM-BS-59176). PAGAN: route h (CBM-BS-58990). SARIGAN: route d–Rocky ridge, 150 m (CBM-BS-58898).

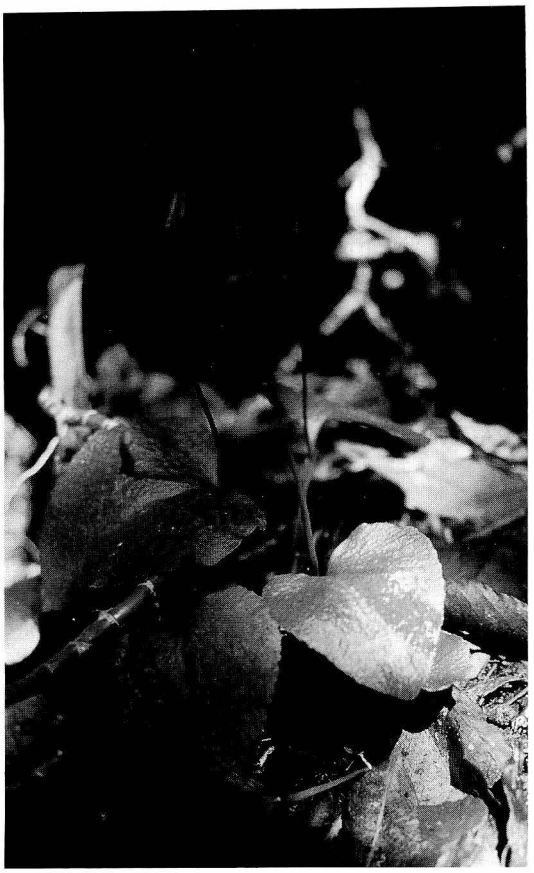


Fig. 22. *Ophioglossum reticulatum* under *Elaeocarous joga*-forest, elv. 450 m, Agrihan.

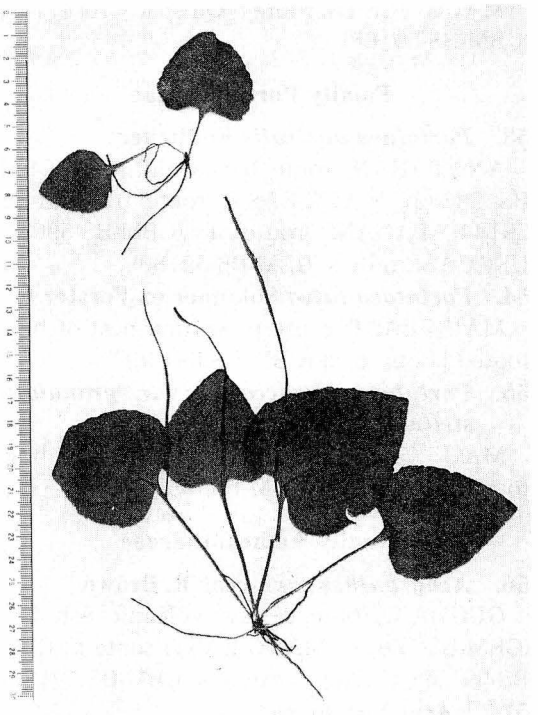


Fig. 23. *Ophioglossum reticulatum.*

45. *Ficus tinctoria* Forster f.

ANATAHAN: route a, 180 m (CBM-BS-58819); route c, 120 m (CBM-BS-59244). GUGUAN: route f (CBM-BS-58942). PAGAN: route h (CBM-BS-59001). SARIGAN: route d–Rocky ridge, 150 m (CBM-BS-58899).

Family Urticaceae

46. *Boehmeria densiflora* Hook. et Arn.

AGRIHAN: route l–On dry ridge with *Ischaemum longisetum* var. *raulersoniae* 450 m (CBM-BS-59069).

47. *Boehmeria virgata* (Forster f.) Guillemin

AGRIHAN: route k (CBM-BS-59014 & 59129). ALAMAGAN: route g (CBM-BS-58863); route u (CBM-BS-59221). ANATAHAN: route a–In moist ravine, 210 m (CBM-BS- 58805); route b–in ravine, 120 m (CBM-BS-58823).

48. *Pipturus argenteus* (Forster f.) Wedell

AGRIHAN: route k (CBM-BS-59118). ASUNCION: route n (CBM-BS-59018). GUGUAN: route e–New volcanic ash field (CBM-BS-58924); route f (CBM-BS-58932). MAUG-EAST: route o (CBM-BS-59140).

Family Polygonaceae

49. *_Antigonon leptopus_ Wight et Arnott

PAGAN: route h (CBM-BS-58975).

Family Nyctaginaceae

50. *Boerhavia repens* L.

MAUG-EAST: route o–Around nest of blue-footed booby bird (CBM-BS-59138). MAUG-WEST: route q (CBM-BS-59164).

51. *Pisonia grandis* R. Brown

ALAMAGAN: route g, 300 m (CBM-BS-58956). GUGUAN: route f (CBM-BS- 58944). MAUG-EAST: route p (CBM-BS-59156). MAUG-NORTH: route r (CBM-BS-59171). SARIGAN: route d–Rocky ridge, 150 m (CBM-BS-58897).

Family Aizoaceae

52. *Sesuvium portulacastrum* L.

MAUG-NORTH: route r–On shady rock, 10 m (CBM-BS-59168).

Family Portulacaceae

53. *Portulaca australis* Endlicher

ANATAHAN: route b–Sea cliff, 5 m (CBM-BS- 58832). MAUG-EAST: route p (CBM-BS-59144). PAGAN: route i (CBM-BS-59051). URACAS: route s (CBM-BS-59180).

54. *Portulaca lutea* Solander ex Forster f.

MAUG-EAST: route p–Around nest of blue-footed booby bird (CBM-BS-59146).

55. *Portulaca oleracea* L. var. *granulato-stellulata* v. Poelln.

MAUG-EAST: route p–Around nest of blue-footed booby bird (CBM-BS-59145).

Family Amaranthaceae

56. *Achyranthes canescens* R. Brown

GUGUAN: route e–New volcanic ash field (CBM-BS-58917). MAUG-EAST: route p (CBM-BS-59152). URACAS: route s (CBM-BS-59181).

57. **Amaranthus* sp.

AGRIHAN: route l (CBM-BS-59097).

Family Lauraceae

58. *Cassytha filiformis* L.

GUGUAN: route e–New volcanic ash field (CBM-BS- 58922). PAGAN: route h (CBM-BS-58991).

59. **Persea americana* Miller

PAGAN: route h (CBM-BS-58980).

Family Hernandiaceae

60. *Hernandia sonora* L.

AGRIHAN: route k (CBM-BS-59115).

Family Piperaceae

61. *Peperomia mariannensis* DC.

Endemic to Marianas.

AGRIHAN: route k (CBM-BS-59119). ALAMAGAN: route g (CBM-BS- 58870). ANATAHAN: route c–on *Elaeocarpus joga* trunk, 350 m (CBM-BS-58836).

62. **Piper betle* L.

AGRIHAN: route k, W part (CBM-BS-59012). ALAMAGAN: route g (CBM-BS-58852). PAGAN: route i (CBM-BS-59046). SARIGAN: route d–Lava Plateau, 350 m (CBM-BS-58910).

63. *Piper guahmensis* C. DC.

Endemic to Marianas.

AGRIHAN: route k, W part (CBM-BS-59013).

Family Theaceae

64. *Eurya japonica* Thunb.

(=*Eurya japonica* Thunb. var. *nitida* (Korthals) Thislton-Dyer)

AGRIHAN: route l, 450 m (CBM-BS-59068). ALAMAGAN: route g (CBM-BS-58873); route u (CBM-BS-59231).

Family Clusiaceae

65. *Calophyllum inophyllum* L.

PAGAN: route h (CBM-BS-58976).

Family Capparidaceae

66. *Capparis cordifolia* Lamarck

ANATAHAN: Route a, 5 m (CBM-BS-58792). PAGAN: route h–South coast of Shomushon (CBM-BS- 59053). SARIGAN: route d–Rocky ridge, 150 m (CBM-BS-58895).

67. **Cleome viscosa* L.

ALAMAGAN: route g–Village ruin, 50 m (CBM-BS-58963); route u (CBM-BS-59203).

Family Fabaceae

68. **Abrus precatorius* L.

ALAMAGAN: route g, 80 m (CBM-BS-58857).

69. **Bauhinia monandra* Kurz

PAGAN: route h (CBM-BS-59009).

70. *Canavalia megalantha* Merrill

GUGUAN: route f (CBM-BS-58949). MAUG-EAST: route p (CBM-BS-59154).

71. **Cassia occidentalis* L.

PAGAN: route h (CBM-BS-58989)

72. **Crotalaria pallida* Aiton

ALAMAGAN: route g–Village ruin, 50 m (CBM-BS-58962); route u (CBM-BS-59216). SARIGAN: route d, SW–Rocky ridge, 150 m (CBM-BS-58896).

73. *Cynometra ramiflora* L.

SARIGAN: route d–Rocky ridge, 250 m (CBM-BS-58892).

74. **Desmodium incanum* DC.

ALAMAGAN: route g, 420 m (CBM-BS-58853); route u (CBM-BS-59219). PAGAN: route h (CBM-BS-58996).

75. **Desmodium triflorum* L.

ALAMAGAN: route g (CBM-BS-58862). GUGUAN: route e–New volcanic ash field (CBM-

BS-58921).

76. *Erythrina variegata* L. var. *orientalis* (L.) Merrill

SARIGAN: route d–Plateau, 360 m (CBM-BS-58906).

77. *Mucuna platyphylla* Gray

AGRIHAN: route l–In *Hibiscus tiliaceus*-thecket (CBM-BS-59132). ANATAHAN: route a, 220 m (CBM-BS-58800).

78. *Vigna marina* (Burman) Merrill

ASUNCION: route n–In fresh scoria-field, 320 m (CBM-BS-59036).

Family Oxalidaceae

79. **Oxalis corniculata* L.

ALAMAGAN: route g (CBM-BS-58856).

Family Euphorbiaceae

80. **Acalypha indica* L.

ALAMAGAN: route g, Village ruin, 50 m (CBM-BS-58955).

81. *Claoxylon marianum* Mueller-Arg.

ANATAHAN: route a (CBM-BS-58804).

82. *Euphorbia hirta* L.

MAUG-EAST: route p (CBM-BS-59150).

83. **Jatropha curcas* L.

PAGAN: route h (CBM-BS-58994).

84. *Macaranga thompsonii* Merrill

Endemic to Marianas.

ANATAHAN: route c, broad ridge, 230 m (CBM-BS-58839).

85. *Melanolepis multiglandulosa* (Reunw. ex Bl.) Reichb. f. et Zoll. var. *glabrata* (Mueller-Argovirens) Fosberg

AGRIHAN: route k (CBM-BS-59011). ANATAHAN: route b–forest edge, 80 m (CBM-BS-58827). PAGAN: route h (CBM-BS-59002).

86. **Phyllanthus amarus* Schumacher et Thonnig

ALAMAGAN: route g (CBM-BS-58882); route u (CBM-BS-59217).

87. *Phyllanthus marianus* Mueller-Arg.

Endemic to Marianas.

ALAMAGAN: route g, Around fumarole, 450 m (CBM-BS-58959); route u (CBM-BS-59204). ASUNCION: route n (CBM-BS-59033). MAUG-EAST: route p (CBM-BS-59159). MAUG-WEST: route q (CBM-BS-59166). PAGAN: route h (CBM-BS-58979).

88. *Phyllanthus* sp.

MAUG-EAST: route o (CBM-BS-59133).

Family Meliaceae

89. *Aglaia mariannensis* Merrill

Endemic to Marianas.

AGRIHAN: route k (CBM-BS-59128). ALAMAGAN: route g, 250 m (CBM-BS-58954). ANATAHAN: route a, 220 m (CBM-BS-58793); route c–broad ridge, 210 m (CBM-BS-58837); route c (CBM-BS-59243). PAGAN: route h (CBM-BS-58984). SARIGAN: route d–Rocky ridge, 280 m (CBM-BS-58894). GUGUAN: route f (CBM-BS-58943).

Family Sapindaceae

90. *Dodonaea viscosa* L.

ASUNCION: route n (CBM-BS-59034). SARIGAN: route d–Lava Plateau, 380 m (CBM-BS-58908).

Family Rhamnaceae

91. *Colubrina asiatica* (L.) Brongniart

ANATAHAN: route c (CBM-BS-58841). MAUG-EAST: route o (CBM-BS-59141); route p (CBM-BS-59158). MAUG-WEST: route q (CBM-BS-59163). PAGAN: route h (CBM-BS-58999).

Family Elaeocarpaceae

92. *Elaeocarpus joga* Merr.

Endemic to Micronesia. *Elaeocarpus pachycarpus* Koidz. (Minami-iwo-jima, the Volcano Islands) and this species resembles each other.

AGRIHAN: route l, 420 m (CBM-BS-59060). ALAMAGAN: route g, 300 m (CBM-BS-58966). ANATAHAN: route a–on flat ridge, 220 m (CBM-BS-58798); route c–NNW slope, 350 m (CBM-BS-58847). PAGAN: route i (CBM-BS-59045).

Family Tiliaceae

93. *Grewia crenata* (Forster) Schinz et Guill.

AGRIHAN: route l (CBM-BS-59130). PAGAN: route h (CBM-BS-59006).

94. **Triumfettia semitriloba* Jacquin

ALAMAGAN: route g (CBM-BS-58874); route u (CBM-BS-59208).

Family Malvaceae

95. **Abutilon indicum* Sweet

MAUG-NORTH: route r (CBM-BS-59173).

96. ****Abutilon theophrasti* **Medicus
MAUG-WEST: route q (CBM-BS-59165).

97. ****Gossypium hirtum* **L.
MAUG-EAST: route p–On dry rocky ridge (CBM-BS-59151).

98. ****Hibiscus abelmischus* **L.
ANATAHAN: route b, 60 m (CBM-BS-58829).

99. ***Hibiscus tiliaceus*** **L.**
PAGAN: route h (CBM-BS-58992). SARIGAN: route d–Rocky ridge, 200 m (CBM-BS-58889).

100. ****Sida acuta* **Burmann f.
ALAMAGAN: route g (CBM-BS-58865).

Family Stercuriaceae

101. ***Melochia villosissimus*** **var.** ***compacta*** **(Hochr.) Fosberg**
MAUG-NORTH: route r (CBM-BS-59170), AGRIHAN: route l (CBM-BS-59093). PAGAN: route h (CBM-BS-58988).

Family Thymeraeaceae

102. ***Wikstroemia elliptica*** **Merrill**
New to the northern Marianas.
AGRIHAN: route k (CBM-BS-59125).

Family Passifloraceae

103. ****Passiflora foetida* **L. var. ***hispida*** **(DC) Killip**
PAGAN: route i (CBM-BS-59042).

Family Caricaceae

104. ****Carica papaya* **L.
GUGUAN: route f (CBM-BS-58952).

Family Cucurbitaceae

105. ****Benincasa hispida* **(Thunb.) Cogniaux
ANATAHAN: route b, ravine bed, 80 m (CBM-BS-58831).

Family Myrtaceae

106. ***Eugenia palumbis*** **Merrill**
Endemic to Marianas.
PAGAN: route h (CBM-BS-59007).

107. ***Eugenia reinwardtiana*** **(Blume) DC**
GUGUAN: route f (CBM-BS-58948).

Family Lecythiaceae

108. ***Barringtonia asiatica*** **(L.) Kurz**
AGRIHAN: route k (CBM-BS-59108).

Family Melastomataceae

109. ***Melastoma malabathricum*** **L. var.** ***marianum*** **(Naudin) Fosberg et Sachet**
Endemic to Marianas.
ALAMAGAN: route g–round fumarole, 450 m (CBM-BS-58953); route u (CBM-BS-59205). ASUNCION: route n (CBM-BS- 59025). SARIGAN: route d–Lava Plateau, 380 m (CBM-BS-58909).

Family Combretaceae

110. ***Terminalia catappa*** **L.**
ANATAHAN: route c, 100 m (CBM-BS-59242). GUGUAN: route f (CBM-BS-58947). MAUG-WEST: route q (CBM-BS-59162).

Family Araliaceae

111. ***Polyscias grandifolia*** **Volkens**
AGRIHAN: route l (CBM-BS-59099). PAGAN: route i (CBM-BS-59039).

Family Umbelliferae

112. ***Centella asiatica*** **(L.) Urban**
ALAMAGAN: route g (CBM-BS-58851). PAGAN: route h(CBM-BS-58971).

Family Epacridaceae

113. ***Styphelia marianensis*** **(Kanehira) Kanehira et Hatusima**
Endemic to the northern Marianas.
ASUNCION: route n–In *Lycopodium cernuum*-meadow (CBM-BS-59027)-new locality.

Family Primulaceae

114. ***Lysimachia mauritiana*** **Lamarck**
AGRIHAN: route l, 5 m (CBM-BS- 59082). MAUG-NOIRTH: route r (CBM-BS-59177). PAGAN: route i (CBM-BS-59048).

Family Sapotaceae

115. ***Pouteria obovata*** **(R. Brown) Baehni**
GUGUAN: route f (CBM-BS-58938 & 58939). PAGAN: route h (CBM-BS-58973).

Family Loganiaceae

116. ***Geniostoma micranthum*** **A. DC.**
AGRIHAN: route k (CBM-BS-59105). ALAMAGAN: route g, 350 m (CBM-BS-58965). PAGAN: route i (CBM-BS-59044).

Fig. 24. *Melastoma malabathricum* var. *marianensis*, Asuncion, 650 m elevation.

Fig. 25. *Styphelia marianensis*, Asuncion.

Family Apocynaceae

117. ****Cataranthus roseus* **Don

ALAMAGAN: route u (CBM-BS-59214).

118. *Neiosperma obtusifolia* (Lam.) Fosberg et Sachet

PAGAN: route h–Sea coast of Shomushon (CBM-BS-59054). SARIGAN: route d–Rocky ridge, 150 m (CBM-BS-58891).

119. *Ochrosia marianensis* A. DC.

Endemic to Marianas.

PAGAN: route h (CBM-BS-59005).

Family Rubiaceae

120. *Aidia cochinchinensis* Lour.

PAGAN: route h (CBM-BS-58985).

121. *Hedyotis biflora* (L.) Lamarck

AGRIHAN: route k (CBM-BS-59117); route l, 5 m (CBM-BS-59080), AGRIHAN: route l, 50 m (CBM-BS-59085). ALAMAGAN: route u (CBM-BS-59218). ANATAHAN: route a–near village ruin, 50 m (CBM-BS-58797). PAGAN: route h (CBM-BS-58969).

122. ****Hedyotis corymbosa* **(L.) Lamarck

ALAMAGAN: route g, 200 m (CBM-BS-58957); route u (CBM-BS-59224). PAGAN: route h (CBM-BS-59000).

123. *Hedyotis foetida* (Forst. f.) J. E. Sm. var. *marianensis* (Merrill) Fosberg

ANATAHAN: route a–Sea cliff, 5 m (CBM-BS-58796). GUGUAN: route e–New volcanic ash field (CBM-BS-58918). MAUG-NOIRTH: route r (CBM-BS- 59174). PAGAN: route h (CBM-BS-58974).

124. *Hedyotis laciniata* Kanehira

Endemic to the northern Marianas.

ALAMAGAN: route u–Around fumalore (CBM-BS-59229).

125. *Morinda citrifolia* L.

ANATAHAN: route a, 15 m (CBM-BS-58810). GUGUAN: route e–New volcanic ash field (CBM-BS-58919). MAUG-EAST: route p (CBM-BS-59157). SARIGAN: route d–Rocky ridge, 100 m (CBM-BS-58900).

126. *Psychotria hombroniana* (Baillon) Fosberg

Endemic to the Marianas.

AGRIHAN: route k (CBM-BS-59126). ALA-

MAGAN: route u (CBM-BS-59230).

127. *Psychotria mariana* Bartling

AGRIHAN: route k, W part (CBM-BS-59010). ALAMAGAN: route g (CBM-BS-58858). ANATAHAN: route b–In Barringtonia forest, 120 m (CBM-BS- 58830). PAGAN: route h (CBM-BS-58997).

Family Convolvulaceae

128. *Stictocardia tiliaefolia* (Desr.) Hall. f.

GUGUAN: route f (CBM-BS-58931). MAUG-NOIRTH: route r (CBM-BS-59172). SARIGAN: route d–Rocky ridge, 200 m (CBM-BS-58893).

Family Boraginaceae

129. *Cordia subcordata* Lam.

MAUG-NOIRTH: route r (CBM-BS-59178).

130. **Heliotropium indicum* L.

PAGAN: route h (CBM-BS-58986).

Family Verbenaceae

131. *Callicarpa candicans* (Burm. f.) Hochr. var. *paucinervia* (Merr.) Fosberg

ALAMAGAN: route u–Sea coast (CBM-BS-59237).

132. *Clerodendron inerme* (L.) Gaertner

PAGAN: route h (CBM-BS-58995).

133. *Premna obtusifolia* R. Brown

ANATAHAN: route a–On flat ridge, 220 m (CBM-BS-58799); route b, 120 m (CBM-BS-58828); route c , 200 m (CBM-BS-59245). ASUNCION: route n (CBM-BS-59016). GUGUAN: route f (CBM-BS-58940). SARIGAN: route d–Rocky ridge, 250 m (CBM-BS-58888).

134. *Vitex negundo* L. var. *bicolor* (Willd.) Lam

MAUG-EAST: route o (CBM-BS-59142); route p (CBM-BS-59153).

Family Lamiaceae

135. *Hyptis pectinata* (L.) Poiteau

ALAMAGAN: route g (CBM-BS-58859).

Family Solanaceae

136. **Capsicum frutescens* L.

AGRIHAN: route k (CBM-BS-59109).

137. **Physalis minima* L.

AGRIHAN: route l (CBM-BS- 59095). ALAMAGAN: route g–Village ruin, 50 m (CBM-BS-58960). MAUG-EAST: route p (CBM-BS-59147).

Fig. 26. *Hedyotis laciniata* around fumarole, 650 m elv., Alamagan.

URACAS: route s (CBM-BS-59190).

138. *Solanum guamensis* Merrill

New record to the northern Marianas, endemic to Marianas.

MAUG-NORTH: route r (CBM-BS-59179).

Family Scrophulariaceae

139. *Limnophila fragrans* (Forst. f.) Seem.

ALAMAGAN: route u–Around fumalore (CBM-BS-59207).

140. *Lindernia crustacea* (L.) F. von Mueller

ALAMAGAN: route u–Around fumalore (CBM-BS- 59212). PAGAN: route i (CBM-BS-59047).

Family Acanthaceae

141. *Blechum brownei* f. *puberulum* Leonard

ANATAHAN: route a–In *Elaeocarpus* forest, 220 m (CBM-BS-58802). GUGUAN: route f (CBM-BS-58937). MAUG-EAST: route p (CBM-BS-59149).

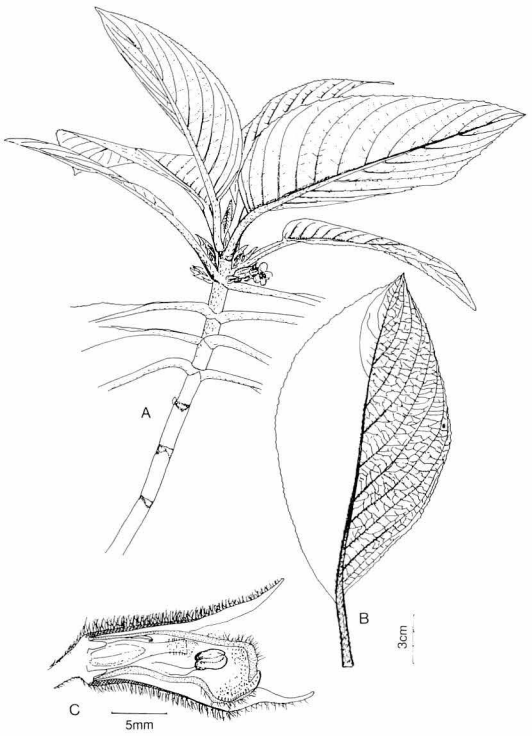


Fig. 27. *Cyrtandra agrihanensis*, a, Plant b, Side view of flower. c, Longitudinal section of young flower.

Fig. 28. *Cyrtandra agrihanensis.* Lateral view of flower.

Family Gesneriaceae

142. *Cyrtandra agrihanensis* Ohba sp. nov.

Planta fruticulosa, erecta 0.5–1.2 m alata. Caulis circiter 8 vel 12 mm diametro, partibus junioribus dentissime albo- vel castaneo-lanatibus. Folia opposita, lucido-viridissima, in juventuus, supra ad costam nervosque parce pilosis, in adulto supra glabria, subtus dentissime castaneo-lanata, oblonga ad obovato-oblonga, 22–30 cm longa, 12–14 cm lata, apice obtuse rotundato, basi cuneatis, margine apiculato-serrato, nervis primariis utrinque 10 vel 12, petiolo 5–10 cm longo, dense albo- vel castaneo-lanato. Flores axillaribus, fasciculatibus, bracteibus, lanceolatibus, 15–25 mm longi, 3–5 mm lati, lanati, pedicelli 8–14 mm longi, dentissime villosi, calycibus campanulatibus, 10 mm longis, 4-lobatis, lobis 10 mm longis, corollae tubo cylindraceo, 10 mm longo, extus dentissime albo-hirsuto, 4-partito, lobis obtusis, supra pubescentis, stamina perfecta 2 et imperfecta 2, spernio tubo affixa, anthera alba, 3 mm longa, disco cupulari 1.5 mm alto, ovalio ovoideo, glabro, stylis 4–5 mm longis, supernio glandulifero, stigmae dilatatae. Capsula ellipsoidea, circiter 18 mm longis, 6–7 mm diametro, seminia numerosissima, minuta. Hab. In insula AGRIHAN (450 m alt.) Mariannae borealis. (leg. T. Ohba, 28 mai. anno 1992-Holotypus in herbario Musei et Instituti Historiae Naturalis Chibae. (CBM-BS-59104).

This new species was found by Dr. C. G. Rice of the member of this expedition. It grows in very moist ravine under *Boehmeria virgata*-scrub with *Angiopteris evecta*, *Bolbitis quoyana*, *Pteris exilis* and *Asplenium unilaterale*. Form allied species can distinguish as follows:

1. Perfect stamens 4; leaf margin obscurely crenulate or almost entire ..... *C. todaiensis* Kanehira (Caroline Isl.)
1. Perfect stamens 2; leaf margin serrate or dentate 2
2. Calyx 5–6 mm long, 5-lobed 5
3. Peduncle glabrous; lateral veins of leaves 15–20 pairs ..... *C. yayeyamae* Ohwi (Ryukyu)
3. Peduncle pubescent; lateral veins of leaves 7–10 pairs ..... *C. umbellifera* Merrill (Formosa & Philippines)
2. Calyx 10–18 mm long, 4- or 5-lobed; peduncle pubescent; lateral veines of leaves 7–8 pairs 4
4. Calyx 5-lobed, 18 mm long, glabrous; corolla tube glabrous ..... *C. urvillei* C. B. Clarke (Caroline Isl.)

4. Calyx 4 lobed, pubescent, 10–11 mm long 5
5. Corolla tube glabrous, surface of corolla lob glabrous; style glabrous; lateral veins of leaves 7–9 pai .....*C. ponapensis* Kanehira (Caroline Isl.)
5. Corolla tube pubescent, surface of corolla lob tuberculate; upper part of style has glandular hair; lateral veins of leaves 10–12 pairs.....*C. agrihanensis* sp. nov. (N-Marianas)

Family Goodeniaceae

143. *Scaevola taccada* (Roxburgh) Gaertner

ASUNCION: route n (CBM-BS-59031); route n (CBM-BS-59192). MAUG-EAST: route o (CBM-BS-59135).

Family Asteraceae

144. **Ageratum conyzoides* L.

ANATAHAN: route c, disturbed place, 320 m (CBM-BS-58844).

145. *Blumea* sp.

AGRIHAN: route k (CBM-BS-59112); route l, 420 m (CBM-BS-59062).

146. **Eclipta alba* (L.) Hassk.

AGRIHAN: route l (CBM-BS-59096). ALAMAGAN: route g (CBM-BS-58855).

147. **Elephantopus mollis* Humboldt, Bonplanad et Kunth

AGRIHAN: route l (CBM-BS-59075).

148. **Emilia sonchifolia* (L.) DC.

ASUNCION: route n (CBM-BS-59195). GUGUAN: route e–New volcanic ash field (CBM-BS-58925).

149. *Glossogyne tenuifolium* (Lessing) Cassini

ASUNCION: route n–In fresh scoria-field (CBM-BS-59026).

150. *Lagenophora lanata* A. Cunn.

New record for Micronesia.

ALAMAGAN: route u–On small scree, 740 m (CBM-BS-59223).

151. **Synedrella nodiflora* (L.) Gaertner

ALAMAGAN: route g, NNW slope (CBM-BS-58849).

152. **Vernonia cinerea* (L.) Lessing

ASUNCION: route n (CBM-BS-59194). GUGUAN: route e, New volcanic ash field (CBM-BS-58916). PAGAN: route h (CBM-BS-58993).

153. *Wollastonia biflora* (L.) DC. var. *canescens* (Gaudichaud) Fosberg

AGRIHAN: route l, 10 m (CBM-BS- 59083). GUGUAN: route f (CBM-BS- 58941). MAUG-EAST: route o (CBM-BS-59139); route p (CBM-BS-59155).

Family Amaryllidaceae

154. *Crinum asiaticum* L.

MAUG-EAST: route o (CBM-BS-59137). MAUG-NORTH: route r (CBM-BS-59169).

Family Flagellariaceae

155. *Flagellaria indica* L.

AGRIHAN: route l (CBM-BS-59131).

Family Poaceae

156. **Bambusa vulgaris* Schrader ex Wendland

ANATAHAN: route a–In valley, 160 m (CBM-BS-58807).

157. *Bothriochloa* sp.

PAGAN: route h (CBM-BS-58983).

158. **Chloris inflata* Link

ALAMAGAN: route u (CBM-BS-59215).

159. *Chrysopogon aciculatus* (Retzius) Trinius

ANATAHAN: route b–dry ridge, 100 m (CBM-BS- 58821). PAGAN: route i (CBM-BS-59043). SARIGAN: route d–Lava Plateau, 350 m (CBM-BS-58911).

160. **Digitaria ciliaris* (Retz.) Koel.

ASUNCION: route n (CBM-BS-59037). URACAS: route s (CBM-BS-59189).

161. *Digitaria gaudichaudii* (Kunth) Hernard

ASUNCION: route n (CBM-BS-59196). MAUG-EAST: route o (CBM-BS- 59143). MAUG-NOIRTH: route r (CBM-BS-59175).

162. *Digitaria radicosa* (Prsl) Miq.

ALAMAGAN: route g (CBM-BS-58867). ANATAHAN: route b–On ravine bed, 70 m (CBM-BS- 58833). PAGAN: route h (CBM-BS-59003).

163. **Eragrostis tenella* (L.) Beauv.

ANATAHAN: route b, 70 m (CBM-BS-58834); route c (CBM-BS-59241).

164. *Heteropogon contortus* (L.) Beauv.

ASUNCION: route n (CBM-BS-59019). GUGUAN: route e–New volcanic ash-field (CBM-

BS-58928).

165. *Ischaemum longisetum* Merrill var. *raulersoniae* Fosberg et Sachet

AGRIHAN: route l, 450 m (CBM-BS-59067). ALAMAGAN: route u (CBM-BS-59232).

166. *Lepturus repens* (Forster) R. Brown

AGRIHAN: route k (CBM-BS-59111). ASUNCION: route n (CBM-BS-59200). MAUG-EAST: route o (CBM-BS- 59134). URACAS: route s (CBM-BS-59184 & 59185).

167. *Microstegium glabratum* (Brongn.) A. Camus

AGRIHAN: route k (CBM-BS-59120); route l (CBM-BS-59066).

168. *Miscanthus floridulus* (Labill.) Warburg ex Schumann et Lauterbach

AGRIHAN: route k (CBM-BS-59121). ANATAHAN: route a–On ridge, 150 m (CBM-BS-58811). ANATAHAN: route c, 340 m (CBM-BS-58842). PAGAN: route h (CBM-BS-58987).

169. *Oplismenus compositus* (L.) Beauv.

AGRIHAN: route l (CBM-BS- 59074). ANATAHAN: route a–In *Elaeocarpus* forest. (CBM-BS-58803). PAGAN: route h (CBM-BS-58970).

170. *Oplismenus hirtellus* (L.) Beauv.

SARIGAN: route d–Lava Plateau, 360 m (CBM-BS-58912).

171. *Paspalum orbiculare* Forster

ALAMAGAN: route g, 420 m (CBM-BS-58854).

172. **Setaria pallide-fusca* (Schumacher) Stapf et Hubb.

ALAMAGAN: route u (CBM-BS-59226).

173. **Sporobolus fertilis* (Steudel) Clayton

ANATAHAN: route c (CBM-BS-58843).

174. *Zoysia matrella* Merrill

AGRIHAN: route l, 10 m (CBM-BS- 59079). ASUNCION: route n (CBM-BS- 59198). SARIGAN: route d–Rocky ridge, 360 m (CBM-BS-58903).

Family Araceae

175. **Colocasia esculenta* (L.) Schott

PAGAN: route i–in moist ravine (CBM-BS-59040).

Family Pandanaceae

176. *Freycinetia reineckei* Warburg

PAGAN: route i (CBM-BS-59038).

177. *Pandanus tectorius* Parkinson

ANATAHAN: route c, 120 m (CBM-BS-58838). PAGAN: route i (CBM-BS-59049).

Family Cyperaceae

178. *Cyperus cyperoides* O. Kunth

ALAMAGAN: route u (CBM-BS-59222).

179. *Cyperus javanicus* Houttuyn

AGRIHAN: route k (CBM-BS-59116). ANATAHAN: route a, 60 m (CBM-BS-58806). GUGUAN: route e, New volcanic ash field (CBM-BS- 58920). MAUG-EAST: route p (CBM-BS-59161). PAGAN: route h (CBM-BS- 59008). URACAS: route s (CBM-BS-59186).

180. **Cyperus kyllingia* Endlicher

ALAMAGAN: route g (CBM-BS-58850). SARIGAN: route d–Lava Plateau, 360 m (CBM-BS-58913).

181. *Cyperus polystachyos* Rottboell

ALAMAGAN: route u (CBM-BS-59227). PAGAN: route h (CBM-BS-58977).

182. *Fimbristylis boninensis* Hayata

GUGUAN: route e–New volcanic ash field (CBM-BS-58926). SARIGAN: toute d–Coast (CBM-BS-58886). URACAS: route s (CBM-BS-59191).

183. *Fimbristylis cymosa* R. Brown

AGRIHAN: route l, 10 m (CBM-BS- 59078). ALAMAGAN: route u (CBM-BS-59210). GUGUAN: route e–New volcanic ash field (CBM-BS- 58914). PAGAN: route i (CBM-BS- 59041). URACAS: route s (CBM-BS-59183).

184. *Fimbristylis dichotoma* (L.) Vahl var. *podocarpa* (Nees et Meyen) T. Koyama

ALAMAGAN: route g–Around fumalore (CBM-BS-58877); route u (CBM-BS-59220).

185. *Machaerina mariscoides* (R. Brown) J. H. Kern

New record to the northern Marianas.

ALAMAGAN: route u (CBM-BS-59213).

186. *Schoenus philippinensis* (Palla) Kuekenthal ex merrill

ALAMAGAN: route u (CBM-BS-59211).

187. *Scleria lithosperma* (L.) Swartz

GUGUAN: route f (CBM-BS-58934). PAGAN: route h (CBM-BS-58982).

Family Musaceae

188. **Musa sapientum* L.

AGRIHAN: route l (CBM-BS-59101).

Family Orchidaceae

189. *Coelogyne guamensis* Ames

New record to the northern Marianas.

AGRIHAN: route k, Epiphyte (CBM-BS-59106).

190. *Dendrobium guamense* Ames

New record to the northern Marianas.

AGRIHAN: route l (CBM-BS-59094).

191. *Didymoplexis fimbriata* Schlechter

New record to the northern Marianas.

AGRIHAN: route k–Under *Elaeocarpus joga*-forest (CBM-BS-59122).

192. *Malaxis alamaganensis* S. Kobayashi

See S. Kobayashi (1994) in this issue.

ALAMAGAN: route u (CBM-BS-59238).

193. *Nervilia aragoana* Gaudichaud

AGRIHAN: route l (CBM-BS-59102).

194. *Spathoglottis micronesiaca* Schlechter

ANATAHAN: route a–In *Miscanthus*-grassland, 260 m (CBM-BS-58801).

195. *Taeniophyllum marianense* Schlechter

AGRIHAN: route l (CBM-BS- 59086). ANATAHAN: route a–on *Elaeocarpus* trunk, 220 m (CBM-BS-58820).

196. *Zeuxine fritzii* Schlechter

Fig. 29. *Dendrobium guamense.* a, Plant. b, flower from side. c, Lip from side. d, Top of ovary, e, Free posirion of lip. f, Dorsal sepal. g, Petal. h, Lateral sepal.

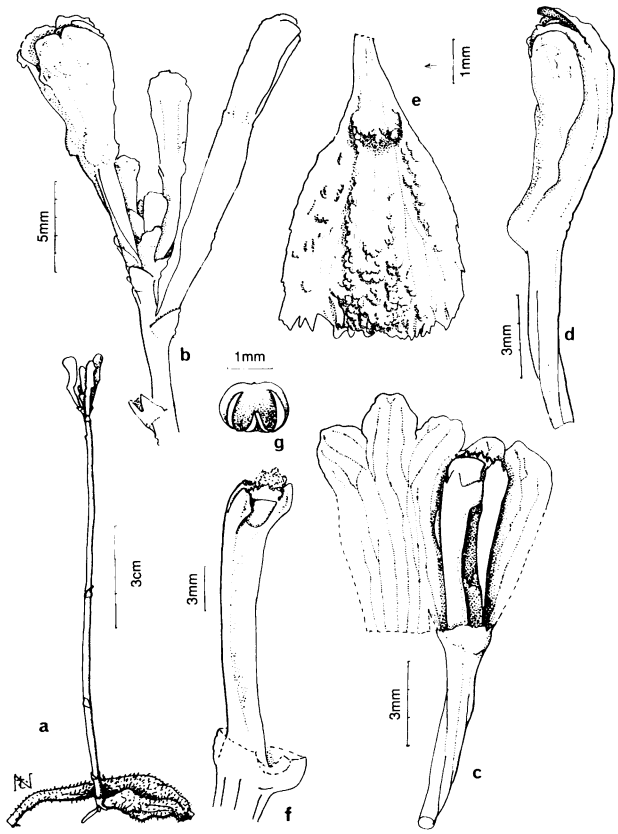


Fig. 30. *Didimoplexis fimbriata*, Plant. b, Inflorescens. c, Lip, pertially expanded, column and ovary. d, Young flower from side. e, Lip, expanded. f, Column. g, Anther.

New record to the northern Marianas.

AGRIHAN: route 1–Under *Elaeocarpus joga*-forest (CBM-BS-59103).

Acknowledgments

I wish like to express my sincere gratitude to Prof. Makoto Numata, director of Natural History Museum and Institute, Chiba, who supported our project in every way possible. I have pleasure in to acknowledge the hospitality and encouragement of the members of the Izu-Mariana Project Team of the Natural History Museum and Institute, Chiba. I am grateful to Prof. R. W. Becking for helpful and important suggestions and observations and critical reading of the manuscript. I would also like to extend my sincere thanks to Dr. Lynn Raulerson and Mrs. Agnes F. Rinehart for kind support and valuable advice during my herbarium research at the University of Guam. Thanks are also extended Dr. Makoto Nishida (Ophioglossum) and Dr. Toshiyuki Nakaike (Pteridophyta) for their determination of plant specimens. To Ms. Matsuko Nakajima, Hayama, Kanagawa, the author appreciates for her drawings of *Dendrobium guamense* and *Didymoplexis fimbriata*.

References

Ash, J. 1992. Vegetation ecology of Fiji: present, and future perspectives. Pac. Sci. 46(2): 111–127.

Barrau, J. 1963. Plants and the migration of Pacific peoples. 136 pp. Bishop Mus. Press.

Carlquist, S. 1967. The biota of long dispersal. V. Plant dispersal to Pacific Islands. Bull. Torrey Bot. Club 94(3): 129–162.

Falanruw, M. C., T. G. Cole and A. H. Ambacher. 1989. Vegetation survey of Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands. U.S. Dept. Agr. Forest Service, Pacific Southwest

Forest and Range Exp. Sta. Res. Bull. PSW-27, 11 pp.

Fosberg, F. R. 1992. Vegetation of the Society Islands. Pac. Sci. 46(2): 232–250.

Fosberg, F. R., M. V. C. Falanraw and M.-H. Sachet 1977. Additional Records of Vascular Plants from the Northern Mariana Islands. Micronesica 13(1): 27–31.

Fosberg, F. R., V. C. Falanruw and M.-H. Sachet 1980. Additional records of vascular plants from the Northern Mariana Islands. 2. Micronesica 16(2): 211–214.

Fosberg, F. R. and J. E. Canfield. 1980. Noteworthy Micronesian plants. 3. Micronesica 16(2): 189–200.

Fosberg, R. F., M-E. Sachet and R. L. Oliver. 1979. A geographical checklist of the Micronesian Dicotyledonae. Micronesica 15(1–2): 41–295.

Fosberg, R. F., M-E. Sachet and R. L. Oliver. 1982. A geographical checklist of the Micronesian Pteridophyta and Gymnospermae. Micronesica 18(1): 23–82.

Fosberg, R. F. M-E. Sachet and R. L. Oliver. 1993. Flora of Micronesia, 5: Bignoniaceae-Rubiaceae. Smith. Contr. Bot. 81: 1–135.

Fosberg, R. F. and L. Raulerson. 1990. Noteworthy Micronesian plants 6. Micronesica 23(2): 139–152.

Fosberg, R. F. and M. V. C. Falanruw. 1975. Noteworthy Micronesian plants 1. Micronesica 11(1): 77–80.

Fosberg, R. F. and M.-H. Sachet. 1975. Noteworthy Micronesian plants 2. Micronesica 11(1): 81–84.

Fosberg, R. F. and M-E. Sachet. 1975. Flora of Micronesia, 1: Gymnospermae. Smith. Contr. Bot. 20: 1–15.

Fosberg, R. F. and M-E. Sachet 1975. Flora of Micronesia, 3: Convoluvulaceae. Smith. Contr. Bot. 36:1–33.

Fosberg, R. F. and M-E. Sachet. 1980. Flora of Micronesia, 2: Casuarinaceae, Piperaceae and Myricaceae. Smith. Contr. Bot. 24: 1–28.

Fosberg, R. F. and M-E. Sachet 1981. Flora of Micronesia, 4: Caprifoliaceae-Compositae. Smith. Contr. Bot. 46: 1–71.

Fosberg, R. F. and M-E. Sachet 1980. Systemtic studies of Micronesian Plants. Smith. Contr. Bot. 40: 1–40.

Foucault, de B. 1987. Contributions a l'etude phytosociologique des paysage de Guadeloupe (Antilles francaises): La vegetation des plages et des falaises littorales. Phytocoenologia 15(3): 397–418.

Foucault, de B. 1991. Nouvell consideration sur la vegetation de la Guadeloupe (Antilles francaises), Phytocoenologia 19(4): 445–478.

Hosokawa, T. 1934a. Phytogeographical relationship between the Bonin and the Marianne Islands laying stress upon the distribution of the families, genera and special species of their vernacular plants. J. Soc. Trop. Agric. 6(2): 201–209, 6(4): 657–670.

Hosokawa, T. 1934b. Preliminary account of the Vegetation of the Marianne Islands Group. Bull. Biogeogr. Soc. Japan 5: 124–172.

Imanishi, K. (ed.) 1944. Ponape, ecological studies. 504 pp. Shoko-shoin. Tokyo.

Kanehira, R. 1933. Flora Micronesica. 468 pp. Fukuoka.

Kanehira, R. 1934a. Expedition to Northern Mariana Islands. Shokubutsu to Dobutsu 2(5): 913–922.

Kanehira, R. 1934b. New or noteworthy trees from Micronesia VII. Bot. Mag. Tokyo 48: 730–736.

Kanehira, R. 1935. An enumeration of Micronesia plants. Journ. Dep. Agr. Kyushu Imp. Univ. 4(6): 237–464.

Menard, H. W. 1972. History of the ocean basins. *In* Robertson, E. (ed.), The Nature of the Solid Earth, pp. 440–460. New York. McGraw-Hill.

Miyawaki, A., K. Suzuki, Tseng-Chieng Huang and Chen-Meng Kuo. 1991. Pflanzensoziologische Untersuchungen in Taiwan (Republic of China), Erster Bericht: Kuesten-Vegetation und immergruene Laubwaelder auf dem Berg Nan-Fong-San. Hikobia Suppl. 1: 221–233.

Merrill, E. D. 1914. An enumeration of the plants of Guam. Philippine Journ. Sci. 9: 17–155.

Merrill, E. D. 1919. Additions of the Guam. Philippine J. Sci. 15: 539–544.

Miyawaki, A. (ed.) 1989. Vegetation of Japan. 10. Okinawa and Ogasawara., 676 pp. Shibundo co. Ltd. Tokyo.

Miyawaki, A. and K. Suzuki. 1976. Vegetation der Duenen und der Korallenbauten auf den Ryukyu-Inseln, Japan. Bull. Inst. Envirom. Sci. Technol. Yokohama Nat. Univ. 2(1): 153–151.

Morgan, W. J. 1972. Deep mantle convection plumes and plate motions. Amer. Ass. Petrol. Geol. 56: 203–213.

Nakamura, T. and K. Suzuki. 1984. Studies on the plant communities of the Yap Islands—Plant ecological studies of the Micronesia I—. Journ. Phytogeogr. Taxon. 32: 19–30.

Nakamura, T. and K. Suzuki. 1986. Studies on the

plant communities of the Palau Islands—Plant ecological studies of the Micronesia III—. Journ. Phytogeogr. Taxon. 34: 40–54.

Niiro, Y., K. Miyagi, K. Shunjo and H. Shimabukuro. 1974. Vegetation of Yaeyama Islands. Ecol. Study Nat. Conserv. Ryukyu Isl. 1: 5–36.

Ohba, H. 1971. A taxonomic study on Pteridophytes of the Bonin and Volcano Islands. Sci. Rep. Tohoku Univ. Fourth Ser. Biology 36: 45–127.

Ohba, H. 1983. The higher plant flora of Minami-Iwojima Island (Ins. San Augustino), the Volcano Group of Islands, Japan. Nature of Minami-Iwojima pp. 61–143.

Ohba, T. and H. Sugawara. 1977. Vegetation der Bonin-Inseln (Ogasawara-Inseln). Naturkundliche Untersuchungen ueber die Strassenbau-Planung auf dem Haha-Jima in der Bonin-Inseln, pp. 3–68. Tokyo, Japan.

Okutomi, K. 1983. Vegetation of Minami-Iwojima Island. Nature of Minami-Iwojima pp. 151–189.

Ono, M. and K. Okutomi (ed.). 1985. Endemic species and vegetation of the Bonin Islands. 268 pp. Kamakura.

Radovsky, F. J. , P. H. Raven and S. H. Sohmer (ed.). 1984. Biogeography of the tropical Pacific. Bishop Mus. Special Publication No. 72. 221 pp.

Raulerson, L. and A. F. Rinehart. 1991. Trees and shrubs of the Northern Mariana Islands. 120 pp. Saipan.

Raulerson, L. and A. F. Rinehar.t 1992. Ferns and orchids of the Mariana Islands 138 pp. Guam.

Stone, B. C. 1965. Revision of *Capparis spinosa* and its African, Asiatic, and Pacific Relatives. Micronesica 2(1): 25–45.

Stone, B. C. 1967. The genus Pandanus in Micronesia, I. The Marianas Species. Micronesica 3(2): 107–128.

Stone, B. C. 1970. The flora of Guam, A manual for the Identification of the vascular plants of the Island. Miconesica 6: 1–659.

Tayama, R. 1936. Topography, geology and coral-reefs of the North Mariana Group.Bull. Inst. Geol. Palaeont., Univ. Tohoku Imp. Univ. 23: 1–88.

Thaman, R. R. 1992. Vegetation of Nauru and the Gilbert Islands: Case studies of poverty, degradation, disturbance, and displacement. Pac. Sci. 46(2): 128–158.

Walter, H. 1955. Die Klimadiagramkarte als Mittel zur Beurteilung der Klimaverhaeltnisse fuer oekologische, vegetationskundliche und landwirtscahftliche Zwecke. Ber. Dtsch. Bot. Ges. 68: 331–344.

Whistler, W. A. 1992. Flowers of the Pacific island seashore, a guide to the littoral plants of Hawaii, Thahiti, Samoa, Tonga, Cook Islands, Fuji and Micronesia. 154 pp. Honolulu, Hawaii.

Whistler, W. A. 1992. Vegetation of Samoa and Tonga. Pac. Sci. 46(2): 159–178.