

ATOLL RESEARCH BULLETIN

No. 67

Vegetation and flora of Wake Island

by

F. R. Fosberg

Issued by

THE PACIFIC SCIENCE BOARD

National Academy of Sciences--National Research Council

Washington, D. C.

May 15, 1959

Vegetation and flora of Wake Island

by
F. R. Fosberg^{1/}

Introduction

Wake Island is a coral atoll lying north of the Marshall Islands at Latitude 19°17' North, Longitude 16°17' West. Although separated from Pokak, northernmost of the Marshalls by almost 550 kilometers, it is so similar to the Marshall Islands in most respects that it could almost as well be regarded as one of that group as an isolated island.

It is a low flat atoll, its land area composed of three islets, Wake, Wilkes, and Peale, forming a V open to the northwest, surrounding a lagoon, the northwest end closed by a reef. A map of the atoll, as it was prior to the war, is given by Bryan (1942, p. 208). The south-east extremity is Peacock Point, named for one of the ships of the U. S. Exploring Expedition.

Climate

The climate is described by the U. S. Weather Bureau (1957) as follows:

"The climate of Wake is maritime and is chiefly controlled by the easterly trade winds which dominate the island throughout the year. Occasionally during late fall, winter, and early spring, polar outbreaks reach the island and are marked by temperature drops of several degrees, increased cloudiness, and light to moderate showers of short duration. The winds during these outbreaks swing into the northerly directions and may reach gust velocities of forty miles per hour. After a few days the weather is modified and normality reigns again. It was during one of these outbreaks that the record low temperature of 64° F, was recorded.

"Frequent tropical disturbances (low pressure systems, aloft and/or surface) approach the island from the southeast quadrant during the late summer and early fall months. These systems bring about periods of light wind, high temperatures and humidities, and moderate to heavy rain showers. When the system is vigorous and close to the island, winds strengthen and showers may be prolonged to several hours duration. Although typhoons are not usual, two have occurred at Wake since observations were begun in 1935: October 19, 1941, and September 16, 1952. Winds were up to 140 and 180 miles per hour respectively during the storms.

"Clouds at Wake are predominately cumulus types with little difference in amounts from day to night. High cloudiness, rare during the winter months, occurs in association with fall and summer tropical disturbances.

^{1/}Botanist, U. S. Geological Survey, Washington, D. C.

"Seemingly, showers, which account for most of Wake's precipitation, occur most frequently between midnight and sunrise; however, sufficient records have not been accumulated to be certain of the diurnal nature. The sky is seldom completely overcast, nor, on the other hand, is the sky often completely clear.

"Thunderstorms are infrequent, but do occur along with the tropical disturbances, however, hail has yet to be reported at the surface. Fog, also, is unknown to Wake."

The mean annual precipitation, based on records from 1935 to 1941, 1947-1956, is given as 39.03 inches.

Soils

The soils are generally coral gravel or rubble of varied textures or in places largely coral sand, with here and there a slight coloring by humus. Under the Pisonia-Cordia forest a thin black friable humus layer lies on the coral. In one spot, the site of an old Japanese garden, is a small area of dark brownish gray fine soil. Part of this is a cemented platform of brown rock which a spectrographic analysis by Helen Worthing and Catherine Valentine, U. S. Geological Survey, showed to be phosphatic, with more than 10% phosphorus. No other consolidated rock was noticed except along the north coast of Wake Islet, where there is a long stretch of beach-rock below high tide level, overlain landward by beach conglomerate.

Vegetation

The vegetation of Wake is low and the general appearance is gray. Most of the atoll is covered by an open scrub forest, mainly of Tournefortia, except where this has been cleared to make room for the air-field and other installations. Its aspect is similar to that of Pokak Atoll in the Marshalls, but the vegetation is somewhat more luxuriant and is definitely richer in native species, as well as in the many introduced ones.

The first scientific information on the vegetation of Wake was published by Pickering (1876), an account of observations made there in 1841 by the naturalists of the U. S. Exploring Expedition, including Pickering, himself. This account notes "marks of a hurricane that had passed over the island from the Northeastward", absence of houseflies, absence of coconut palms, Pandanus, and Urticaceae, presence of rats and lizards, and that there were no certain indications of the visits of humans. No formal description of the vegetation is given but thirteen species of plants are listed, with brief notes on the occurrence of some of them. About the only difference from later accounts is that Pemphis is said to be the prevailing plant. Tournefortia is described as abundant. The plants are mentioned below under what seem to be their modern names. A few had been listed by Gray (1854). The similarity of the lists of species recorded by Pickering and that given by Christophersen (1931) based on collections

made 80 years later is striking. One species had apparently disappeared, and two additional native species were found by the later collectors. Four species had been introduced in the interval, presumably by the few casual visitors and the Japanese birdhunters.

The vegetation of Wake was very well summarized by Christophersen (1931) who wrote up the botanical results of the Tanager Expedition of 1923, though he was not a member of that party. He quoted briefly from Wilkes, who visited the atoll in 1841, and more extensively from the field notes of E. H. Bryan who was a member of the Expedition. Judging from Bryan's observations, the vegetation was in fairly natural condition at the time of his visit, though the presence of Portulaca oleracea, Nicotiana, Gossypium and, perhaps, of Ipomoea pes-caprae, suggests the influence of man. Lepidium o-waihiense, Sesuvium portulacastrum, and Heliotropium anomalum are three species found on Wake but lacking, so far as known, in the Marshall Islands flora. The last two of them are, however, known in the Marianas, and all three are found in Hawaii.

Christophersen reports 16 species of vascular plants, 12 of them probably indigenous. In the 33 years since the collections listed by him were gathered, 26 species have established themselves, at least temporarily, in a wild condition and about 47 species of cultivated plants are now growing either in pots or with some form of protection. Additionally, at least five other native plants, Fimbristylis cymosa, Portulaca samoensis, a second species of Boerhavia, Abutilon albescens, and Lepturus gasparricensis, have been found. The last may well have been Bryan's "broad-leaved bunch grass" which he apparently did not find in fertile condition. Bryan's plant could also have been Digitaria gaudichaudii which is similar when it lacks flowers and fruits.

The vegetation is low, scrubby, and generally sparse, as would be expected on a rather dry atoll with a rainfall of about 1000 mm. a year. It is, however, subject to two sorts of climatic vicissitudes, both of which have occurred within the present decade, namely extreme droughts and typhoons. In addition, between 1941 and 1945, Wake was almost totally devastated by military activity.

The present paper reports observations and collections made during four visits, all short, made in October 1951, April 1952, July 1952, and October 1953. My appreciation is due to Mrs. Rubie Cox, Mr. Fred Schultz, Mr. T. Dudley Musson, Mr. B. H. Hall, and Mr. Edward H. Brown, for information, transportation, and other assistance during these visits.

Judging from Bryan's description the original vegetation of the atoll was mainly a low woodland of Tournefortia (Messerschmidia), mixed here and there with Pemphis or Cordia, and with smaller areas of pure Pemphis forest and Cordia scrub, and with, on the north arm of Wake Islet, a dense forest of Pisonia, Cordia, and Tournefortia. Along the lagoon were areas of matted succulent Sesuvium and of a shrubby growth of Pemphis. Between the trees of the Tournefortia woodland was a sparse herbaceous and small shrubby growth of Lepturus, Heliotropium, Boerhavia, Lepidium, and Sida. Single small patches of Gossypium and

Ipomoea pes-caprae occurred, the latter on the site of an abandoned Japanese camp dating from 1908. Ipomoea tuba was generally distributed, twining over rocks, bushes, and trees. Because of the abundance of dead limbs and trunks noted by Bryan, it is suspected that a typhoon may have swept the island not long previously.

During the latter part of 1941 the atoll was extensively fortified by a small American force, after which it suffered an extended attack ending in its capture by the Japanese on December 23, 1941. After this the fortifications were greatly extended by the Japanese, leaving scarcely any of the ground untouched. Ditches, tank traps, platforms, ruined buildings, gun emplacements, revetments, and underground installations were almost everywhere, with refuse of all sorts very abundant. According to T. D. Musson, in 1947 the vegetation generally over the island was about a foot high, with the exception of a few small areas. During the three years of Japanese occupation the island was subjected to almost daily bombardment by American planes and occasionally by ships. Anything edible in the vegetation was consumed by the starving Japanese, who also planted gardens in some places.

By 1949, as shown by the excellent photos by Bailey and Niedrach (1951, pp. 47-62), the Tournefortia trees were already at least 3 m. tall.

In 1952, the dominant vegetation over most of the atoll was a stand of Tournefortia 3-5 m. tall. Its recent origin was obvious from the lack of trunks more than 10 cm. thick and from the fact that it grew on embankments and piles of coral rubble that clearly dated from the war. Two areas, one near the east side of the lagoon, the other just east of the Trans-Ocean Airways compound, on the southwest limb of Wake Islet appeared to represent pre-war Tournefortia forest, with larger trees than usual. The latter of these areas had, in addition to the Tournefortia, fair sized Pemphis trees on the lagoon side that may have been part of the Pemphis forest seen by Bryan in 1923. A third area also seemed to have suffered rather less than most others. This was a portion of the dense forest described by Bryan on the north limb of Wake Islet. A forest of Pisonia, with trees up to almost a meter in diameter, with some admixture of large tangled Cordia trees was still very prominent in 1952. The part of this area closest to the north beach, described by Bryan as having an impenetrable barrier of vegetation had, in 1952, only scattered herbs and bushes. Near Peacock Point were areas of a scrub growth of Cordia 1-2 m. tall, but probably grown up since the war. Scaevola sericea was mixed with the general Tournefortia woodland in some quantity only south of the air strip on the south leg of Wake Islet. Around most of the lagoon shore of Wake Islet was a broad belt of low Pemphis scrub, in places varied by Sesuvium flats. Though usually narrower, this belt in places reached 300 meters in width.

In the openings among the Tournefortia trees, in addition to the scattered native herbs and small shrubs, there was a thin dry vegetation of Euphorbia cyathophora and Cenchrus echinatus, obviously hard hit by the drought that had persisted from December to April. This had also affected noticeably most of the other plants. The Tournefortia had lost a good portion of its leaves, and, where growing on high embankments, in places looked quite dead. Pisonia and Cordia were more or less defoliated and Cordia in places dead at the tips of the branches.

Although in 1923 Bryan had noted only a single patch each of Gossypium and Ipomoea pes-caprae, in 1952 they were common in many places, especially around ruins of Japanese installations. Small grassy patches could also be seen here and there, some of them Canodon dactylon which had been planted widely the previous fall but had not become very generally established. Other patches were Paspalum vaginatum, which was apparently a recent introduction but well established.

A short visit in July 1952, after the drought had broken, showed a more luxuriant picture. The bare spaces between the trees were green with grasses and a luxuriant growth of Euphorbia cyathophora. The trees on high ground that looked dead in April were still dead in July, but the others, mostly in lower places, looked far more luxuriant than on the previous visit.

During the first three visits relatively little planting of ornamentals or garden plants was observed. A few plants, including coconut, Crinum, Dieffenbachia, Polyscias guilfoylei, and Casuarina were growing behind shelters and windbreaks around the dispensary, and a few others in pots and boxes of imported soil. At the TAL (Transocean Air Lines) Compound were more extensive attempts at gardening. Around the buildings were one coconut tree and one Pandanus tree, both at least 2 m. tall, and small plants of Casuarina, Ficus carica, Ficus rubiginosa, Euphorbia pulcherrima, Thespesia, Terminalia, Cucurbita pepo, and Catharanthus, as well as broomcorn. A number of other ornamentals and maize were growing in pots. The method of vegetable gardening used most successfully was in top soil piled about 15 cm. deep, surrounded by boards, watered well, and shaded with leafy branches of Tournefortia. In such frames were growing successfully tomatoes, lettuce, broccoli, parsley, dill, onions, beans, radishes, and cucumbers.

In September of 1952 a violent typhoon lashed the atoll. Winds reported as up to 140, or even 160, miles per hour, with gusts to 160 or 180, were experienced. A great deal of wind-driven flying gravel was observed by eyewitnesses, though it stopped as soon as water covered an area. Little topographic change resulted, as few waves actually swept the island. Some areas were covered, though, by water backed up from the lagoon. It was said by those who experienced the typhoon that all leaves, as well as some bark, were stripped from the trees apparently by flying gravel. The leaves, however, began to reappear after about 10 days. Very few trees were uprooted, though many were badly broken. The most conspicuous damage was that done by flying gravel.

A two day visit was made by me in October, 1953, especially to observe what recovery from the effects of the typhoon had taken place. The following account is quoted, almost verbatim, from notes made at that time:

"The present condition of the vegetation, after an unusually wet season, is one of notable luxuriance compared with April 1952 but the trees present a much more ragged appearance, with many dead branches and some tendency to lean and to be partially broken in one direction or another, depending on the locality on the island. In only a very few areas have many trees been actually uprooted, but enormous quantities of branches have been broken off and tend to make progress

through the undergrowth slow and difficult. Tangled masses of wreckage, twisted iron, bent corrugated sheets, and other debris are also strewn through the brush.

"The dead branches of trees are usually ones from which significant areas of bark have been stripped or ones that have been broken. Tournefortia and Pisonia trees suffered most, some of the latter being blown down. Cordia apparently resisted the wind more effectively, as relatively little dead wood is in evidence on it. The Cordia-Pisonia forest seems still to be quite intact, though some trees were blown down, especially Pisonia, which usually takes root where it touches the ground. The whole is quite tangled, choked with branches and fallen trees.

"The Tournefortia forest is also in most places still in reasonably good condition, but in a few places, such as east of the TAL Compound on Wake Islet and areas on the middle and east thirds of Peale Islet, it presents a very battered appearance, indeed, most of the trees being broken. The Tournefortia trees on high embankments near the TAL Compound that were dead in 1952 are now practically gone.

"There are now almost no areas of large Pemphis left, but it is difficult to tell if they were destroyed by the typhoon or by clearing to make roads and to put in other installations. The low brushy Pemphis at the east end of the lagoon was apparently killed back somewhat almost everywhere, but has largely recovered. Dead branches and top portions of plants are still very much in evidence.

"Two of the three patches of original forest that were still quite distinguishable in 1952 could not even be located this time. They apparently suffered more than the lower second growth. That near the east end of the lagoon, however, may have been destroyed by clearing. The Cordia scrub near Peacock Point is much greener and more luxuriant than before.

"The general effect of the typhoon in many places seems to have been to destroy or greatly inhibit the growth of young woody plants which were invading bare areas, so that many pioneer habitats have been maintained. This has encouraged a great spread and outstanding luxuriance of first-stage pioneers like Cenchrus echinatus, Cenchrus brownii, Boerhavia diffusa, Setaria verticillata, Euphorbia cyathophora, Eleusine indica, and Fimbristylis cymosa, and to a somewhat lesser extent, Portulaca oleracea (which seems to be hybridizing with P. lutea), Digitaria insularis, Euphorbia glomerifera, and others.

"Small but vigorous patches of Cynodon dactylon, Paspalum vaginatum, Cyperus rotundus, and Euphorbia prostrata are found here and there. Gossypium religiosum is local but widespread, and very uniform in appearance. Ipomoea pes-caprae, Portulaca lutea, Heliotropium anomalum, and Sida fallax are about as common as before. Heliotropium is colonizing actively the bare gravel flats and beaches on the west ends of Peale and Wilkes islets. Lepturus repens seems more widespread and common than before, but probably this may be due to the much wetter season. Lepturus gasparricensis, not seen before, forms a colony of perhaps 40-50 clumps near the west end of Peale Islet.

"A few scattered Scaevola bushes were seen in the brush south of the runway, and one at Peacock Point, but this species seems rarer than in 1952 and is completely gone from around the Terminal.

"Recently cleared areas come up to a thick Tournefortia scrub rather promptly. The antenna-area of the LORAN Station must be cleared every month or so. The Tournefortia sprouts grow up to about 0.8 m. in that time. The ground is dragged with a steel I-beam to break off the shoots. If this is not done the growth slows down so that they are about 1 to 2.5 m. tall after 3 or 4 months.

"The cultivated plants around the TAL Compound are growing well-- Ficus carica is up to 1.5 m. tall and bearing fruit, Terminalia catappa is 1.5 m. tall and healthy. Carica papaya, Catharanthus roseus, Casuarina equisetifolia, and Hibiscus hybrids are in good condition. Two forms of Capsicum are also in healthy condition and fruiting abundantly. Bauhinia sp. is chlorotic and badly eaten by insects. Cantaloupes are growing well and flowering and fruiting around the Communications Center, but are slightly chlorotic on exposed sides of the building. These formerly had to be pollinated by hand, but are now being visited by bees from a swarm recently brought from Honolulu. A resident reported that a single tomato plant had grown and fruited near the garbage dump. Casuarina has been planted and is growing at several places, and coconuts are being planted around all building areas. Crinum is still surviving and growing at the Dispensary.

"CAA personnel are much interested in planting around the buildings and are establishing an "arboretum and nursery" where they intend to start and grow plants. They have many cuttings and seedlings, obtained from Honolulu and Midway. Many potted plants such as Hymenocallis littoralis, Coleus scutellarioides and Casuarina are waiting to be planted out. Many of these will probably do well enough during this wet spell, but some may fail in a drought. They are being watered with brackish water from wells which is now rather fresh but which will be increasingly saline when the weather is drier. This is especially so since the wells are closely spaced, 6 or 8 of them in a row 15 m. or so apart, thus drawing excessively from one small part of the fresh-water lens."

These observations are of a rather random nature and it is a pity that they are not more up to date. The records of the presence and condition of certain exotic plants at a definite time may be of interest in later interpretation of the vegetation. From observations to date it appears that the Tournefortia woodland is a fairly stable stage in the development of vegetation in dry coral islands such as this. Undisturbed it may gradually give place to Pisonia or Pisonia-Cordia forest. With extreme fluctuations in rainfall, and especially with occasional typhoons this process is greatly retarded. Since the Tournefortia colonizes successfully bare sand and gravel, Tournefortia woodland may immediately succeed itself if destroyed by storms or other causes. Where the salinity is too high, Pemphis and Sesuvium form the normal vegetation.

The Vascular Flora

Plants have been collected on Wake Island by the U.S. Exploring Expedition in 1841, Pollock and his associates on the Tanager Expedition in 1923, R. J. Branckamp in 1936, Mr. Torrey Lyons in 1940, F. R. Fosberg in 1951, 1952 and 1953, and by Dr. and Mrs. John Z. Gaston, in 1952 and 1953. Possibly other collections have been made of which we have no record. Vascular plants have been recorded from Wake Island by Gray (1854), Pickering (1876), Bryan (1926), Christophersen (1931), Drummond-Hay (1939), Bryan (1942), and Fosberg (1955 a, b). In the present paper I have tried to collect together the records from all of these accounts, and to cite specimens from my own collections and those of others if I have examined them. A few species have been added from what seem to be reliable sight records even though no specimens were collected. Older records, made under names other than those used in the present list, are referred to their presumed modern equivalents, but with the older name given in parentheses. The fact that a species was recorded in my 1955 list is not mentioned here unless there has been a name change. Unfortunately I have not been able to examine any of the Gaston collections, and only a few of the Pollock, Branckamp, and Lyons ones, all of which are housed in the Bishop Museum. The collections cited below are deposited in the U. S. National Herbarium except those of Pollock, Branckamp, and Lyons. Species believed to have been introduced by man, rather than naturally, are indicated by an asterisk.

PANDANACEAE

*PANDANUS TECTORIUS Park.

Pandan, or Screw Pine.

A single tree 2 m. tall seen in 1952, planted in housing area. Characterized by stilt roots, thick, irregular branches, and linear leaves several feet long, with spiny margins and midrib.

GRAMINEAE

*CENCHRUS BROWNII R. & S.

Sand Bur, or Bur Grass.

A pioneer grass with bur-like fruits, similar to and often confused with the next, but the fruits are more numerous in narrower, longer, more compact spikes. Fosberg 34929.

*CENCHRUS ECHINATUS L.

Sand Bur, or Bur Grass.

A very common early pioneer weed, quickly covering open places; the fruit is a most annoying bur which scratches the skin and clings to clothing. Fosberg 33624.

*CHLORIS INFLATA Link

Finger Grass.

A common pioneer grass with several bristly purple spikes ascending from the top of the stem. Fosberg 34923.

*CYNODON DACTYLON (L.) Pers.

Bermuda Grass.

Certainly introduced and established since Bryan's visit in 1923, though possibly before the war; much more of it planted in 1951, according to local information. Forms dense mats of rhizomes, flowering stems slender, erect, with 3-4 radiating slender spikes. Fosberg 34931. (Bryan 1942, p. 213.)

**DACTYLOCTENIUM AEGYPTIUM* (L.) Reich. Crowfoot Grass.

A tufted depressed grass with 4-5 stiff, pointed, thick flower-spikes radiating from the tips of the stems. Common in open situations. Fosberg 33617.

**DIGITARIA CILIARIS* (Retz.) Koel. Tropical Crab Grass.

A slender spreading grass with very slender divergent spikes of flowers. Not abundant but found on Peale Islet repeatedly since 1940. Branckamp s.n. in 1936; Lyons 10; Fosberg 34936.

DIGITARIA GAUDICHAUDII (Kunth) Henr.

A rare strand grass, otherwise known only from the Marianas and possibly introduced from there, with broad leaves and close clusters of stiff spikes. This may be the "broad-leaved bunch-grass" mentioned by Bryan (Christophersen 1931, pp. 7-8), though it also may have been Lepturus gasparricensis, as vegetatively they look much alike. Lyons 13. (Bryan 1942, p. 213.)

**DIGITARIA INSULARIS* (L.) Henr. Sour Grass.

An aggressive pioneer grass, forming erect bunches, the inflorescence a cluster of somewhat nodding, silky spike-like racemes. This has been known for a long time in Hawaii and has, since the war, appeared in a number of Micronesian islands, probably transported with war materials. Fosberg 34476. (Fosberg 1955a, as Tricachne insularis (L.) Nees)

**ELEUSINE INDICA* (L.) Gaertn. Goose Grass.

A very common grass around dwellings and installations, forming rather coarse spreading tufts, inflorescence a cluster of flattened spikes spreading from the end of the stem. Fosberg 33623.

**ERAGROSTIS AMABILIS* (L.) W. & A. Love Grass.

A spreading delicate grass with very fine open flower clusters, usually dark purplish; common in open places, especially gardens and around dwellings and installations. Fosberg 34459.

**ERAGROSTIS POAEOIDES* Beauv. ex R. & S.

A rare tufted prostrate grass, similar to the preceding but with pale, longer spikelets of flowers; found once at the end of the airstrip, not found previously in the Pacific Islands. Fosberg 34458.

LEPTURUS GASPARRICENSIS Fosb.

A coarse bunchgrass with broad leaves and rather coarse jointed flower spikes, occurring in a restricted area toward the west end of Peale Islet, known only from here and from Pokak Atoll, in the Marshalls. Possibly the "broad-leaved bunchgrass" mentioned by Bryan (Christophersen 1931). Fosberg 34940. (Fosberg 1955a, as Lepturus sp.; Fosberg 1955b, p. 293).

LEPTURUS REPENS var. *SEPTENTRIONALIS* Fosb. Bunch Grass.

The common bunch grass, forming erect tufts with fine leaves and long slender spikes that become disjointed when ripe. U. S. Expl. Exped. s.n. in 1841; Branckamp s.n. in 1936; Lyons 10; Fosberg 33627, 34462, 34941, 34942, 34943, 34944, 34950. (Pickering 1876, p. 247, as Lepturus; Christophersen 1931; Bryan 1942, p. 213; Fosberg 1955a, all three as Lepturus repens (Forst.) R. Br.; Fosberg 1955b.)

*PASPALUM VAGINATUM Sw.

Salt Grass.

A wiry creeping, mat-forming grass, somewhat coarser than bermuda grass, forming patches locally. Fosberg 34932, 34949.

*SETARIA VERTICILLATA (L.) Beauv.

Bristly Foxtail.

A loose somewhat spreading grass with bristly pointed flower clusters that, when ripe, cling to clothing and thus cause the seeds to be scattered about; occurs very locally in semi-shaded areas. Fosberg 34470.

*SORGHUM DOCHNA var. TECHNICUM (Koern.) Snowd. Broomcorn.

Persisting, in 1952, very sparingly around old Japanese garden-sites, also seen at TAL Compound.

*ZEA MAYS L.

Maize, or Indian Corn.

Grown in drum of soil at TAL Compound in 1952; reached maturity but was very spindly and with only abortive ears.

UNIDENTIFIED GRASS

Pickering, 1876, p. 247, reported "Gramen incert., (No. 1; compare Tarawan coral-islands). Single stemmed, and large-leaved; resembling young Phragmites." There is nothing at present on Wake that would even remotely answer to this description.

CYPERACEAE

FIMBRISTYLIS CYMOSA R. Br.

A low tufted bright green grass-like plant, with open brownish clusters of flower-spikes on slender stems rising above the leaves; occurring very commonly from extreme pioneer situations to wooded places. It was surprising that this was not mentioned from Wake in the earlier descriptions, as it is most likely native and usually occurs abundantly wherever it is found. Fosberg 33619, 34457, 34478. (The Wake Island plant belongs to the form recently segregated from F. cymosa as F. atollensis St. John. It is, however, too close to what has been called F. spathacea Roth, and Kern, eminent student of sedges of the Malaysian area regards the whole complex as belonging to one species. Probably the plants of the Pacific atolls and seashores may constitute a good variety, distinguished from F. spathacea by smooth nuts and from F. cymosa by two stigmas and plano-convex nuts, but as yet this study is unpublished and it seems best to call the whole group simply F. cymosa.)

PALMAE

*COCOS NUCIFERA L.

Coconut Palm.

A few not too healthy seedlings which were planted in the shelter of the buildings were eliminated by the typhoon, but many have been re-planted.

ARACEAE

*CALADIUM sp.

Mentioned by E. H. Bryan (m.s.) as planted about houses.

*DIEFFENBACHIA sp. Dumb-Cane.
One potted plant seen in 1952.

*SCINDAPSUS AUREUS (Lind. & Andre) Engl. Pothos.
One or two potted plants seen in 1952.

PONTEDERIACEAE

*EICHHORNIA CRASSIPES (Mart. & Zucc.) Salms-Laub. Water Hyacinth.
One plant seen in a large cistern in 1952, said to be the only one remaining of a large number, the rest of which had been taken by the inhabitants to decorate aquaria.

BROMELIACEAE

*ANANAS COMOSUS (L.) Merr. Pineapple.
A rooted crown seen growing in a box of soil in 1952.

AGAVACEAE

*CORDYLINE TERMINALIS (L.) Kunth Ti.
Seen growing in pots in 1952.

*SAMSEVIERIA ROXBURGHIANA Schultes Bowstring Hemp.
Seen growing in pots in 1952.

AMARYLLIDACEAE

*ALLIUM sp. Onion.
Seen growing in protected garden at TAL Compound in 1952.

*CRINUM sp. Crinum Lily.
Seen growing at dispensary in 1952 and 1953, but not flowering. May be distinguished from the spider lily by the spiral arrangement of the rosette of lance-shaped leaves and the lack of a web between the stamens.

*HYMENOCALLIS LITTORALIS (Jacq.) Salisb. Spider Lily.
Growing in pots in nursery in 1953, waiting to be planted out. The leaves of this are packed in a tight row, rather than spirally as in Crinum, and are linear and blunt at the apex.

CASUARINACEAE

*CASUARINA EQUISETIFOLIA L. Ironwood.
Planted, doing well around TAL Compound and buildings elsewhere in 1953; a tree superficially resembling a pine, but with "needles" jointed and bearing rings of tiny scales.

MORACEAE

*FICUS CARICA L.

Fig.

Planted around the TAL Compound, 1.5 m. tall and fruiting in 1953; recognizable by its roughish leaves with finger-like lobes. Fosberg 34466.

*FICUS RIBIGINOSA Desf.?

One small plant growing at the TAL Compound in 1952. Fosberg 34467.

POLYGONACEAE

*COCCOLOBA UVIFERA (L.) L.

Sea-Grape.

A coarse shrub with large round leathery leaves and edible grape-like fruits; rare but apparently naturalized in woody vegetation on Wake and Peale Islets, where it apparently survived the typhoon, as the clump on Peale Islet was 2.5 m. tall in 1953. Fosberg 34471, 34935.

NYCTAGINACEAE

BOERHAVIA DIFFUSA L.

A prostrate mat-forming plant with long reddish stems radiating from a thick fleshy root-crown, leaves obtuse, pale beneath, flowers pink; common generally. Fosberg 33626, 34453. (Pickering 1876?; Drummond-Hay 1939; Bryan 1942, p. 213.)

BOERHAVIA sp.

Similar to the above but with pointed leaves and white flowers, common in open places on sand. A distinctive species, known from Wake and the Northern Marshalls, perhaps also from Johnston I., usually referred to B. diffusa, but probably an undescribed species. Fosberg 34454, 34947. (Pickering 1876?; Christophersen 1931, as B. diffusa L.; Drummond-Hay 1939; Fosberg 1955a, as Boerhavia, form with leaves as in B. mutabilis R. Br.)

*BOUGAINVILLEA SPECTABILIS Willd.

Bougainvillea.

Mentioned by E. H. Bryan (m.s.) as a garden plant.

PISONIA GRANDIS R. Br.

Puka.

One of the principal species in the patch of low forest on the north-west leg of Wake Islet, a tree with thick white trunk, very soft wood; large green leaves, clusters of greenish flowers and club-shaped spiny glutinous fruits. Fosberg 34472. (Bryan 1926, p. 8; Christophersen 1931 as Ceodes sp.; Drummond-Hay 1939; Bryan 1942, p. 213.)

AMARANTHACEAE

*AMARANTHUS DUBIUS Mart.

Amaranth Pigweed.

Erect herb with slender nodding spikes of tiny green flowers; occasional along roadsides in scrub on Peale Islet. Fosberg 34938.

- *AMARANTHUS GRAECIZANS L. Amaranth Pigweed.
A depressed, small-leafed annual weed, collected on Peale Islet.
Branckamp s.n. in 1936. (Bryan 1942, p. 213.)
- *AMARANTHUS TRICOLOR L. Amaranth Pigweed.
Erect plant, similar to A. dubius but spike not nodding; persisting
around old Japanese garden site. Fosberg 34452.
- *AMARANTHUS VIRIDIS L. Chinese spinach.
Sprawling herb with small clusters of tiny green flowers; persisting
around old Japanese garden site. Fosberg 34446.

AIZOACEAE

- SESUVIUM PORTULACASTRUM L. Seaside Purslane.
A prostrate very fleshy plant with glossy green leaves, reddish
stems, and rose-pink flowers; common generally in low saline places,
forming a continuous mat just above lagoon level inside the passage at
east end of Peale Islet. Fosberg 34461. (Gray 1854, p. 142; Pickering
1876, p. 247; Christophersen 1931, p. 11; Drummond-Hay 1939, Bryan 1942,
p. 213, as pickle-weed.)

PORTULACACEAE

- PORTULACA LUTEA Sol. Giant Purslane.
Very fleshy herb with thick stems grayish near the base, ascending
to erect, leaves broad at apex, flowers large, yellow, with many stamens;
common generally in open places in scrub. Fosberg 34468. (Gray 1854,
p. 139, as P. oleracea; Pickering 1876, p. 247, as Portulaca; Christo-
phersen 1931, p. 11; Drummond-Hay 1939; Bryan 1942, p. 213.)

- *PORTULACA OLERACEA L. Purslane.
Similar to P. lutea but depressed, more slender, brownish green,
stems not grayish at base, flowers small, with 12-17 stamens; occasional
on bare ground around terminal and elsewhere, more abundant after the
typhoon, apparently hybridizing with P. lutea. The Pacific plants have
different seeds from the European plants and may be a distinct native
species. This has been in Wake at least since 1923, when Pollock found
it. Fosberg 33620. (Christophersen 1931, p. 12; Drummond-Hay 1939;
Bryan 1942, p. 213.)

- PORTULACA SAMOENSIS v. Poelln.
A prostrate plant with tuberous root, narrow pointed fleshy leaves
with copious tufts of long hair at the base, and bright yellow flowers;
rare in open places. This is a native Pacific Island species but possibly
might be introduced on Wake, as it was not found earlier. Fosberg 34460.

CRUCIFERAE

- *BRASSICA OLERACEA var. ITALICA Plenck. Broccoli.
Grown in sheltered raised beds of soil, watered well, at TAL Com-
pound in 1952.

LEPIDIUM O-WAIIENSE C. & S.

Scurvy Grass.

A small rather stiff erect cress-like plant, noted by Bryan in 1923 as forming part of the undergrowth on the western parts of Wilkes and Peale Islets, and collected on all islets by Pollock, but in 1953 seen only in a flourishing colony on steep banks around "Lake Peale", a pond on Peale Islet. Fosberg 34930. (Pickering 1876, p. 247; Christophersen 1931, p. 13; Drummond-Hay 1939; Bryan 1942, p. 213.)

*RAPHANUS SATIVUS L.

Radish.

Grown in raised sheltered beds at TAL Compound in 1952.

CRASSULACEAE

*SEMPELVIVUM TECTORUM L.

Hen-and-Chickens.

Seen in pot in housing area in 1952.

*KALANCHOE PINNATA (Lam.) Pers.

Air Plant.

This, with two other unidentified species of Kalanchoe seen growing in pots in housing area in 1952.

LEGUMINOSAE

*BAUHINIA sp.

Orchid Tree.

Seen in pot at TAL Compound in 1952, still there in 1953 but chlorotic and badly eaten by insects; may be recognized by its leaves which are divided into two lobes at the apex.

*PHASEOLUS VULGARIS L.

Bean.

Grown in raised, sheltered garden bed at TAL Compound in 1952; mentioned by Drummond-Hay, 1939, as growing in hydroponic cultures.

EUPHORBIACEAE

*CODIAEUM VARIEGATUM (L.) Bl.

Croton.

Seen in pot at TAL Compound in 1952.

*EUPHORBIA CYATHOPHORA Murr.

Dwarf Poinsettia.

A herb up to 0.5 m. tall, with milky sap, top leaves, under the flower clusters, partly brilliant scarlet; very abundant in open places, mostly almost dead in dry period in April, 1952, but flourishing after rains in July. Fosberg 34474. (Commonly but incorrectly referred to as Euphorbia heterophylla L., which is a related species much less common in the Pacific.)

*EUPHORBIA GLOMERIFERA (Millsp.) Wheeler Spurge.

A delicate erect milky herb or slender shrub, arching at tips, with tiny white flowers; common around Terminal in 1951, had spread widely in open ground and was common after the typhoon in 1953. Fosberg 33618, 33622. (Commonly but apparently incorrectly called E. hypericifolia L.)

- *EUPHORBIA HIRTA L. Hairy Spurge.
A small arching milky hairy herb with pointed leaves and clusters of tiny white flowers; local on bare ground around Terminal. Fosberg 33628.
- *EUPHORBIA PROSTRATA Ait. Prostrate Spurge.
A tiny prostrate purplish plant with milky sap; rare in open gravel on Wake Islet in 1952, occasional in bare spots on Peale Islet in 1953. Fosberg 34455, 34939.
- *EUPHORBIA PULCHERRIMA Willd. Poinsettia.
Small plants seen at TAL Compound in 1952.
- *PHYLLANTHUS AMARUS Schum. & Thonn.
Reported as a weed by E. H. Bryan (1942) (as P. niruri L.), probably P. amarus but specimen not seen.

MALVACEAE

- ABUTILON ALBESCENS Miq.
Shrub 1 m. tall with velvety leaves, orange flowers and hairy papery fruit segments; one plant seen in 1952 near old Japanese installation. Fosberg 34451. (Generally referred to A. indicum (L.) Sweet, from which it differs in aspect, much larger flowers, and different fruit, probably actually closer to A. asiaticum (L.) D. Don.)
- *GOSSYPIUM RELIGIOSUM L. Wild Cotton.
A spreading reclining shrub with grayish leaves, light yellow flowers, and diminutive cotton-producing fruits. Bryan reported one clump in 1923, but in 1952 fairly common especially around old Japanese installations on Wake Islet. Native in the Pacific, but rare and known from very few specimens, probably but not certainly an introduced plant on Wake, first found there in 1923. Fosberg 34469. (Christophersen 1931, p. 13, as G. hirsutum var. religiosa Watt; Drummond-Hay 1939; Bryan 1942, p. 213, also as G. hirsutum var. religiosa.)
- *HIBISCUS (ornamental hybrids) Hibiscus.
Seen in 1953 at TAL Compound, growing very well.
- SIDA FALLAX Walp. Ilima.
A gray-leafed shrub with dull orange flowers; scattered generally in sparse scrub and in openings, about as abundant after the typhoon as before. Fosberg 34945. (Gray 1854, p. 161; Pickering 1876, p. 247; Christophersen 1931, p. 13; Drummond-Hay 1939; Bryan 1942, p. 213.)
- *THESPESIA POPULNEA (L.) Sol. ex Correa Milo, or Portia Tree.
Seen in 1952 planted at TAL Compound.

PASSIFLORACEAE

- *PASSIFLORA sp. Water Lemon.
"Some kind of water lemon seen in the 1940's" according to E. H. Bryan (m.s.).

CARICACEAE

*CARICA PAPAYA L.

Papaya.

Seen growing at TAL Compound, in 1952 said to reach only a few dm. in height and then to die, but in 1953 appeared in good condition.

CUCURBITACEAE

*CUCUMIS MELO L.

Cantaloupe.

Growing well and fruiting around Communications Center in 1953. Formerly had to be hand pollinated, but later a swarm of bees was brought from Honolulu and these visited the blossoms regularly, according to local information.

*CUCURBITA PEPO L.

Pumpkin.

Growing in raised sheltered garden plot at TAL Compound in 1952; a squash is also mentioned by Drummond-Hay (1939) as growing in hydroponic culture.

LYTHRACEAE

PEMPHIS ACIDULA Forst. f.

A closely branched shrub or small tree with very hard wood, small leaves with an astringent taste, and white flower, that is one of the dominant plants on certain areas of the island, forming scrubby forests locally east and south of the lagoon and scrub around the lagoon margin. (Gray 1854, p. 601; Pickering 1876, p. 247; Bryan 1926, p. 8; Christophersen 1931, p. 14; Drummond-Hay 1939; Bryan 1942, p. 213.)

COMBRETACEAE

*TERMINALIA CATAPPA L.

Indian Almond.

A tree with large obovate leaves which turn red before falling and somewhat flattened egg-shaped fruits with a keel along one side and a point; seen planted around the TAL Compound in 1952. It survived the typhoon and was growing well in 1953.

MYRTACEAE

*EUCALYPTUS CITRIODORA Hook.

Lemon-Scented Eucalyptus.

Seen growing in a pot at TAL Compound in 1952.

ARALIACEAE

*POLYSCIAS GUILFOYLEI (Cogn. & March.) Bailey Hedge Panax.

Seen growing in pot at Dispensary in 1952. Said to grow well, reaching a height of two feet in calm season, only to be cut down almost to ground by dry winds during windy weather.

UMBELLIFERAE

- *ANETHUM GRAVEOLENS L. Dill.
Seen growing in raised, sheltered garden plot at TAL Compound in 1952.
- *APIUM PETROSELINUM L. Parsley.
Seen growing in raised, sheltered garden plot at TAL Compound in 1952.

SAPOTACEAE

- *CHRYSOPHYLLUM CAIMITO L.? Star Apple.
Seen growing in pot at TAL Compound in 1952.

APOCYNACEAE

- *CATHARANTHUS ROSEUS (L.) G. Don Periwinkle.
A small erect herb 3-4 dm. tall, with opposite oblong leaves and terminal clusters of flowers, varying on different plants from white to magenta; first reported in 1940 by Torrey Lyons, seen growing in sheltered places around TAL Compound and Dispensary in 1952 and 1953, rare in open places elsewhere in 1952 but apparently not so widespread in 1953. Fosberg 34456.

CONVOLVULACEAE

- *IPOMOEA BATATAS (L.) Poir. Sweet Potato.
Said to have grown luxuriantly at the Dispensary when sheltered from wind, but parts exposed to wind were killed instantly. Later insects ate the whole patch. Also seen in 1952 persisting, but rare, around old Japanese garden site on Wake Islet. Fosberg 34449.
- *IPOMOEA PES-CAPRAE ssp. BRASILIENSIS (L.) v. Ooststr. Beach Morning-glory.
A prostrate extensively spreading creeper with leaves with two rounded lobes at the tip and rose-purple flowers. Bryan reported one patch, near an old Japanese encampment near the east end of Peale Islet in 1923 (Christophersen 1931, p. 8); it is now common locally in many parts of Wake and Peale Islets. Although commonly regarded as native in most tropical strand habitats, it is probably introduced on Wake Atoll. Fosberg 34473. (Christophersen 1931, p. 14; Bryan 1942, p. 213, both as Ipomoea pes-caprae (L.) Roth.)
- IPOMOEA TUBA (Schlecht.) Don Moon Flower.
An extensive creeper and climber with heart-shaped leaves and large white flowers which open at night; very common generally. Fosberg 33614. (Pickering 1876, p. 247, as "Ipomoea turpethum?"; Christophersen 1931, p. 14, as Calonyction grandiflorum (Jacq.) Choisy; Drummond-Hay 1939, as morning-glory; Bryan 1942, p. 213, as Ipomoea grandiflora.)

BORAGINACEAE

CORDIA SUBCORDATA Lam.

Kou.

A shrub or small tree with ovate or elliptic rather large leaves and showy brilliant orange flowers; dominant or codominant in two vegetation types, the Pisonia-Cordia forest and the Cordia scrub, both on Wake Islet, occasional elsewhere. Fosberg 34480. (Pickering 1876, p. 247, as Cordia; Christophersen 1931, p. 14; Drummond Hay 1939, Bryan 1942.)

HELIOTROPIUM ANOMALUM H. & A.

Beach Heliotrope.

A low silvery leafed fleshy herb or dwarf shrub with dense clusters of yellowish-white very fragrant flowers; common generally in bare places and openings in scrub, one of the first pioneer plants to appear on beaches. Fosberg 33625. (Pickering 1876, p. 247, as "(Pentacarya? No. 2, or compare) Tournefortia"; Bryan 1926, p. 8; Christophersen 1931, p. 14; Drummond-Hay 1939; Bryan 1942, p. 213.)

TOURNEFORTIA ARGENTEA L. f.

Tree Heliotrope.

A low rounded tree or shrub with fleshy obovate silvery or frosty appearing leaves and clusters of small fragrant white flowers; dominant in the vegetation of the largest parts of all three islets. Commonly called "scaviola" on the island, which seems to be a corruption of Scaevola, the name of another plant of vaguely similar appearance. This usage should be discouraged as it is likely to be confusing. Fosberg 33625. (Pickering 1876, p. 247, as Tournefortia; Bryan 1926, p. 8; Christophersen 1931, p. 15; Fosberg 1955a, as Messerschmidia argentea (L. f) Johnst., which is the correct name if this plant is separated from the other species of Tournefortia of tropical America as a different genus and associated with a diminutive Siberian plant of alkaline or salty places. This question is not yet settled.)

LABIATAE

*COLEUS SCUTELLARIOIDES L.

Coleus.

Seen growing in pot in nursery in 1953, would probably not survive under Wake Island conditions without protection.

SOLANACEAE

*CAPSICUM ANNUUM L.?

Pepper.

A plant probably belonging to this species seen growing well, flowering and fruiting, in protected garden plot at TAL Compound in 1953.

*CAPSICUM FRUTESCENS L.

Chili-Pepper.

Growing well and fruiting at TAL Compound in 1952 and 1953, apparently survived the typhoon. This is the pepper with very small carrot-shaped very hot fruits.

*NICOTIANA TABACUM L.

Tobacco.

An erect somewhat greasy-feeling herb, up to 6-8 dm. tall, with pink flowers; rare, persisting in 1952 around old Japanese garden site, status in 1952 very much as reported by Christophersen thirty years earlier. Fosberg 34448. (Christophersen 1931, p. 15; Bryan 1942, p. 213.)

*SOLANUM LYCOPERSICUM L.

Tomato.

Growing in raised sheltered garden plot at TAL Compound in 1952, in 1953 one plant said to have grown and fruited near the garbage dump; mentioned by Drummond-Hay (1939) as being grown in hydroponic culture.

GOODENIACEAE

SCAEVOLA SERICEA Vahl

Scaevola; beach magnolia.

A low rounded shrub with bright green leaves, white flowers that appear to have been torn in half, and white fleshy fruits; occasional in scrub vegetation on Wake Islet, especially along the air strip and near Peacock Point, much less common in 1953 than in 1952, and less common in 1952 than appears from Bryan's notes in 1923 (Christophersen 1931, pp. 6-7); not seen on either Wilkes or Peale Islets in 1952 or 1953, but reported from Wilkes by Christophersen. Fosberg 33616. (Pickering 1876, p. 247, as Scaevola; Bryan 1926, p. 8; Christophersen 1931, p. 15; Bryan 1942, p. 213; Fosberg 1955a, p. 21, the last four as Scaevola frutescens (Mill.) Krause. This name is based on a specimen from the West Indies which belongs to a different species.)

COMPOSITAE

*CONYZA BONARIENSIS (L.) Cronq.

Horse Weed.

A tall coarse herb with many heads of tiny whitish flowers; rare along roadsides on Wake Islet. Fosberg 34463.

*LACTUCA SATIVA L.

Lettuce.

Seen growing in raised sheltered garden plot at TAL Compound in 1952; reported by Drummond-Hay (1939) as grown in hydroponic culture.

*PLUCHEA ODORATA (L.) Cass.

An aromatic grayish pubescent shrub with clusters of heads of small pale purplish flowers; common in waste places and openings, especially near the airstrip. Fosberg 33621.

*SONCHUS OLERACEUS L.

Sow-Thistle.

An erect milky herb with pale yellow flowers; a rare weed around dwellings and along roadsides. Fosberg 34464, 34483.

The Cryptogamic Flora

Very few cryptogams are known to have been collected on Wake Island. Two brackish water green algae may be recorded, both tentatively identified by Wm. Randolph Taylor.

CLADOPHORACEAE

RHIZOCLONIUM HOOKERI Kg.?

Forming filamentous green masses in brackish pools in bomb craters, Wake Islet. Fosberg 34479.

ULVACEAE

ENTEROMORPHA FLEXUOSA (Walf.) J. Ag.?

Forming a dense turf on bottom of an intermittent pool, varying with tide, without water when collection was made, in bottom of an inland artificial depression. Fosberg 34475.

- - - - -

References Cited

- Bailey, A. M., and Niedrach, R. J. Stepping stones across the Pacific. Museum Pict. 3: 1-63, 1951.
- Bryan, E. H. Insects of Hawaii, Johnston Island, and Wake Island. Bishop Mus. Bull. 31: 1-94, 1926.
- Bryan, E. H. American Polynesia and the Hawaiian Chain. 1-253, Honolulu, 1942.
- Bryan, E. H. Plants found on Wake Island. unpub. m.s.
- Christophersen, E. Vascular plants of Johnston and Wake Islands. Bishop Mus. Occ. Pap. 9(13): 1-20, 1931.
- Drummond-Hay, Lady Hay. A trip to Wake Island. China Jour. 30: 333-339, 1939.
- Fosberg, F. R. Northern Marshall Islands Expedition, 1951-1952. Land Biota: Vascular plants. Atoll Res. Bull. 39: 1-22, 1955a.
- Fosberg F. R. Pacific forms of Lepturus R. Br. (Gramineae). Bishop Mus. Occ. Pap. 21: 285-294, 1955b.
- Gray, A. Botany, Phanerogamia, Part I: in U. S. Expl. Exped. 15: 1-777, 1854.
- Pickering, C. Geographical distribution of animals and plants: in U. S. Expl. Exped. 19(2): 1-524, 1876.
- U. S. Dept. of Commerce, Weather Bureau. Local climatological data... 1956, Wake Island. 4 pp., Asheville, 1957.