

BOTANICAL VISITS TO KRAKATAU IN 1958 AND 1963

by F. R. Fosberg

Twice, on December 20, 1958 and December 9, 1963, while visiting Java for UNESCO Humid Tropics Program activities, I had the privilege of seeing Krakatau Island volcano. The recent celebration (1983) of the 100th anniversary of the world's greatest explosion in recorded history, and the publication of the complete collected writings about the Krakatau eruption (reviewed briefly below), brought to mind observations I made on my visits, 25 and 22 years back.

Brief notes on the conditions of Anak Krakatau (Krakatau's Baby), the new cone that appeared on the site of the center of the former large volcanic cone may be of some interest. Comparison of the list of plants seen and collected on Anak in 1963 with lists recorded before and after may contribute to understanding of the ability of plants to cross water barriers and to colonize new volcanic substrata. A valuable addition to this account is a list of the collections made, at my suggestions, on Anak Krakatau in August 1971, by Professor Mildred Mathias and her colleagues, Phung Trung Ngan and W. Soengeng Reksodihardjo. Her specimens are at U.C. Los Angeles. Mine are in the U.S. National Herbarium, Smithsonian Institution, Washington, D.C.

On December 20, 1958, aboard the Indonesian oceanographic research vessel Samudera, a turn was made around Anak Krakatau, as close in as was prudent, during a period of pulsating explosive eruptions. My attention was so held by the excitement of the eruption that I did not write much down. I merely noted several Casuarina shrubs on the south slopes. A brief, edited, account of my 1958 and 1963 notes follows.

The three remnants of the original volcano, very steep and rugged, are arranged in a broken circle, densely wooded to their summits except for vertical cliffs. Time was not available to land on them. The group reminded one of Maug, in the northern Marianas, except on a much larger scale and densely wooded.

Anak, during our circuit in 1958, was in a state of continuous pulsating activity. Explosions occurred every few minutes, throwing ash and rocks to considerable heights. From the rim of a large crater smooth slopes of dark brown ash and cinders ended in low wave-cut cliffs, except at one end where the slope reached beach level. Apparently some coral debris may have been cast up here, as the top of the beach, otherwise black, is light colored. Here a small patch of Casuarina had reached tree size. Three or four similar trees were seen scattered above on the slopes. Otherwise no vegetation was seen through binoculars.

The forest on the three outer, older islands was luxuriant to the tops, except on the cliffs. Casuarina is an important component, mostly in patches. Terminalia catappa was perhaps the most important tree in area, covering much of the lower slopes. However, there were a good many other species and the vegetation was generally a dense mixed forest. No grass was visible except on the steep inner wall.

On our visit in December 1963, again under UNESCO auspices, the volcano was quiet, though producing much steam and sulphur dioxide. We were able to land at the northeast corner, where the same clump of Casuarina, seen in 1958, was now much taller. The steam, in great white billows, was mainly coming from the low south side of the crater.

From the sea, before landing, we could examine the mountain with binoculars. The crater was about one third or half the width of the island. The south side had been undercut and slumped, exposing very clear bedding of the ash. From fairly close, a scattering of small plants, grass tufts, could be seen on the slopes above the Casuarina clump, and one fair-sized Casuarina some way up toward the crater. The lowest point on the crater rim appears to be where a lava flow has come forth and down the south slope, spreading out fan-wise at the base. The flat ground around the Casuarina clump at the northeast corner is grassy, the grass extending westward along the north shore, to a smaller sparse patch of Casuarina, mostly appearing dead.

Ashore the flat area of grassy vegetation contained about 25 species, some of them only represented by one or more germinated seeds. They are listed below. Only the abundant sterile tufts of Saccharum spontaneum and a few scattered Casuarina ascended part way up the slopes. Land-crab holes were seen on the slope as much as 300 m from the sea, and dead grasshoppers even farther up.

Huge splatter-bombs have been thrown at least 2/3 the way from the crater to the sea, smaller ones even farther. Nearer the top they practically cover the slope, along with scattered pieces of a dense porphyry, several colors of scoria, some pumice, and a few enormous fusiform bombs.

Inside the crater were white bedding, and a complex of cones and vents, brightly stained with sulphur. The congealed flow seen from the sea runs along the area of cones and spills over the rim to the south. Steam and sulphur dioxide discouraged much lingering at the top. We climbed only the north slope and descended to the northwest corner.

On the flats of cinders and volcanic sand were low thickets of Casuarina and patches of tall Saccharum spontaneum, sod of Ischaemum and mats of Ipomoea pes-caprae and Canavalia rosea, which seemed to have repeatedly been almost killed, probably by fumes. Some of the Casuarina was dead or almost so, as well as the Morinda and Calophyllum. Cassytha was mostly dead. Ischaemum leaves were dead but the stems were still green. All species seen living were collected, but there were also scattered wave-cast seeds that had not germinated. Time was too limited to gather these.

The following list includes the species recorded by J. van Borssum Waalkes in 1960 (Ann. Bogor. 4:5-64) of all species collected or observed on Anak by himself or other visitors before all the vegetation was destroyed by the 1952 eruption. Pre-1952 records are indicated by W, van Borssum Waalkes collections by W with his collection numbers; Fosberg records in 1963, with collection numbers, by FRF; and 1971 records by Mathias et al. by MEM plus collection numbers. Field notes and comments of interest are included in parentheses after the appropriate collection numbers. Adjustment of the nomenclature has been made where discrepancies between the lists are found.

Lygodium flexuosum (L.) SW.

MEM 25

Nephrolepis falcata (Cav.) C. Chr.

MEM 28

Nephrolepis hirsutula (Forst. f.) Presl

W 1068 (on slopes to 50 m)

Nephrolepis radicans (Burm. f.) Kuhn

MEM 29

Pityrogramma calomelanos (L.) Link

W 1069 (on slopes to 50 m, fair numbers seen in 1951), MEM 32

Cycas circinalis L. (*Cycas rumphii* Miq.)

W (one plant seen)

Pandanus tectorius Park.

W, FRF 44549 (only a few plants seen), MEM 30

Imperata cylindrica Beauv.

W 1081 (small area, only, on E side), FRF 44555 (rare, one tiny patch seen), MEM 21

Ischaemum muticum L.

W 1083 (fairly large number seen in 1951), FRF 44551 (very common, forming loose sod locally), MEM 24

Saccharum spontaneum L.

W 1075, FRF 44556 (commonest plant on island, mature ones on flat, smaller ones on cinder slopes), MEM 35

Spinifex littoreus (Burm. f.) Merr.

W 1070, FRF 44547 (occasional on open beach), MEM 37

Thuarea involuta (Forst. f.) R. & S.

W 1074, MEM 39

Cyperus javanicus Houtt.

W 1071, FRF 44552 (rare, one tuft seen), MEM 10

Fimbristylis cymosa R. Br.

FRF 44553 (rare, one tuft seen)

Remirea maritima Aubl.

FRF 44550 (very local in sand)

Cocos nucifera L.

W (germinating nuts seen, probably both washed ashore and planted by man), MEM 8

Nypa fruticans Wurmbr.

W

Musa paradisiaca L.

W

Eulophia pulchra (Thou.) Lindl. (*Eulophis macrostachya* Lindl.)

MEM 14

Casuarina equisetifolia L.

W 1082, FRF 44562 (common, spreading up slopes; seen in 1958),
MEM 6

Piper aduncum L.

MEM 31

Ximenia americana L.

MEM 42

Ficus septica Burm. f.

MEM 18 (observed only)

Ficus fulva Reinw. ex Bl.

MEM 17

Cassytha filiformis L.

W 1075 (fairly large numbers seen in 1951), FRF 44545 (abundant),
MEM 5 (evidently common, associated with several host plants)

Hernandia sonora L.

W (very young seedlings, only)

Albizia retusa Benth.

MEM 1

- Canavalia rosea* (Sw.) DC.
W 1077, FRF 44544 (very common), MEM 4
- Derris trifoliata* Lour.
W
- Desmodium umbellatum* (L.) DC.
W 1078, FRF 44559 (occasional), MEM 11
- Erythrina variegata* L.
W (seen earlier but not in 1951), FRF 44560 (rare, one plant seen), MEM 13
- Phaseolus* sp.
W
- Pongamia pinnata* (L.) Pierre
W, FRF 44565 (occasional), MEM 33
- Vigna marina* (Burm.) Merr.
W, MEM 40
- Murraya exotica* L.
W
- Xylocarpus granatum* Koen.
W
- Antidesma* sp.
W
- Euphorbia chamissonis* (Kl. & Gke.) Boiss.
MEM 16
- Dodonaea viscosa* L.
MEM 12 (seedling)
- Colubrina asiatica* (L.) Brongn.
MEM 9
- Cissus repens* Lam.
W
- Hibiscus tiliaceus* L.
FRF 44564 (rare), MEM 20
- Calophyllum inophyllum* L.
W 1080, FRF 44566 (occasional, mostly dead), MEM 3 (seedling)
- Barringtonia asiatica* (L.) Kurz
W (seen earlier but not seen in 1951), FRF 44567 (rare, seedlings only), MEM 2 (seedling)

Rhizophora mucronata var. *stylosa* (Griff.) Schimper (*Rhizophora stylosa* Griff.)

W

Terminalia catappa L.

W 1083, FRF 44563 (occasional), MEM 38

Melastoma malabathricum L. (*Melastoma polyanthum* Bl.)

MEM 26

Cerbera manghas L.

W, MEM 7

Ipomoea littoralis Bl. (as *Ipomoea gracilis* R. Br.)

FRF 44557 (rare, one plant in thicket), MEM 22

Ipomoea pes-caprae ssp. *brasiliensis* (L.) v. Ooststr.

W 1076, FRF 44548 (common), MEM 23

Clerodendrum inerme (L.) Gaertn.

FRF 44561 (rare, one plant seen)

Premna obtusifolia R. Br.

FRF 44558 (occasional), MEM 34

Guettarda speciosa L.

MEM 19

Morinda citrifolia L.

W 1067, FRF 44546 (occasional), MEM 27

Scaevola sericea L.

W 1079 (common, but much eaten by grasshoppers), FRF 44568
(occasional), MEM 38

Chromolaena odorata (L.) King & Rob. (*Eupatorium odoratum* L.)

FRF 44554 (occasional), MEM 15

Wollastonia biflora (L.) DC. (*Wedelia biflora* (L.) DC.)

MEM 41

Since this paper was written an excellent article on Krakatau, by Ian W. B. Thornton (Ambio 13:216-225, 1984), has come to my attention. This article summarizes what was on record as to the recolonizations over the 100 years following the great explosion in 1883, and adds observations made during the Hull University Expedition in 1983, by J. R. Flenley and K. Richards, as well as by the author himself, on three visits.

It may seem superfluous to publish the observations made in 1958, 1963 and 1971, after the excellent Thornton account. However, the

information offered here was not available to Thornton, and partially fills in the period between two total or almost total sterilizations of Anak Krakatau by major eruptions (1952 and 1972). It is unfortunate that a collection made by Kostermans at some time between 1952 and 1963 could not have been included. According to Kostermans (personal communication in 1964) the specimens collected were incorporated into the Bogor herbarium and no list of them was preserved. Retrieval of the record of species with any degree of completeness would be impractical. It is hoped that the results of the series of investigations, 1982-1984, mentioned by Thornton, at least so far as they concern Anak Krakatau plants, may be assembled and studied with an aim to better understand the processes of dispersal, establishment, increase, decrease, and disappearance, chance and probability, in relation to succession. A more balanced comparison with the detailed studies of Surtsey (Iceland) may then be possible.

Thornton (p. 224) quotes Tagawa (1983) as listing Nephrolepis tomentosa v.A.v.R. as one of the dominant pioneers on lava flows. I have listed three other Nephrolepis species as present, one in 1951, the others in 1971. I have not been able to consult a specimen of N. tomentosa from anywhere, nor have I seen the Anak Krakatau collections of any of the four. So I cannot comment on the possibility that all of these records may be different identifications of the same species in this extremely difficult genus. Also quoted as occurring on ash-covered lava flows is Melastoma affinis. This may very probably be the same as what I have recorded as M. malabathricum L. sensu lato.

A definitive study of the flora and successional vegetation of Anak should include comparison of all of the actual specimens previously gathered there. In this way, only, can we be sure of how many and which species we are dealing with.

Appended are several lists that indicate changes in the Anak flora since the appearance of this new volcanic cone in 1930.

Species present previous to 1951:

Nephrolepis hirsutula
Hernandia sonora
Pityrogramma calomelanos
Thuarea involuta
Cycas circinalis
Antidesma sp.
Cerbera manghas
Cissus repens
Derris trifoliata
Murraya exotica
Musa paradisiaca
Nypa fruticans
Phaseolus sp.
Xylocarpus granatum
Vigna marina

Species present in 1963:

Canavalia rosea
Cassytha filiformis
Morinda citrifolia
Spinifex littoreus
Ipomoea pes-caprae ssp. *brasiliensis*
Pandanus tectorius
Remirea maritima
Ischaemum muticum
Cyperus javanicus
Fimbristylis cymosa
Chromolaena odorata
Imperata cylindrica
Saccharum spontaneum L. var. *klagha*
Ipomoea littoralis
Premna obtusifolia
Desmodium umbellatum
Erythrina variegata
Clerodendrum inerme
Casuarina equisetifolia
Terminalia catappa
Hibiscus tiliaceus
Pongamia pinnata
Calophyllum inophyllum
Barringtonia asiatica
Scaevola sericea

Species present in 1963 but not found in 1971:

Remirea maritima
Fimbristylis cymosa
Clerodendrum inerme

Species present in 1971, but not found in 1963:

Albizia retusa
 Cerbera manghas
 Cocos nucifera
 Colubrina asiatica
 Dodonaea viscosa
 Eulophia pulchra
 Euphorbia chamissonis
 Ficus fulva
 Ficus septica
 Guettarda speciosa
 Lygodium flexuosum
 Melastoma malabathricum
 Nephrolepis falcata
 Nephrolepis radicans
 Piper aduncum

ABSTRACT

An up-to-date checklist of the reptiles and amphibians of Mauritius, Rodrigues, Round Island and the Mascarene Islands is presented. The checklist includes collecting sites and localities where living specimens had been reported by old settlers, sailors, or travellers and also included.

RESUME

Une liste à jour des reptiles et amphibiens de l'île Maurice ainsi que de Rodrigues, de l'île Ronde et des îles Mascareignes est présentée. Et également les sites et localités où des spécimens vivants ont été rapportés par les anciens de ces îles, les voyageurs et les navigateurs.

ACKNOWLEDGEMENTS

The small Mascarene islands, Round Island, Rodrigues, Reunion and particularly Round Island, are all rich in reptiles and amphibians. They supported a poor but interesting and peculiar reptile fauna. Over the past three centuries with the advent of man followed by large settlements, the reptile populations of these islands, the island species in particular, have suffered considerably from degradation of their natural habitats and from the introduction of non-native species.

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