2. NATURAL HISTORY OF COUSIN ISLAND

by F. R. Fosberg

Cousin Island is one of the relatively tiny and less well known of the Seychelles Archipelago. It was known to be the home of several of the rarer species of endemic land birds of the Seychelles, and to protect these from possible extermination, the International Council for Bird Preservation bought the island in January, 1968. It is now maintained as a sanctuary where all indigenous birds are given complete protection.

I was invited by Professor W. H. Thorpe, Chairman of the British Section of the Council, to visit the island and make a preliminary reconnaissance of the vegetation, to aid in handling any management problems that might arise. Fortunately it was possible to combine a visit to the Seychelles with an already-arranged trip to Ceylon, and through the courtesy and cooperation of the U. S. Air Force, to secure transportation to the Seychelles on the weekly amphibian plane that then serviced the Satellite Tracking Station on Mahé, largest island of the group. I wish to express the appreciation of the Smithsonian Institution, as well as my own gratitude for this indispensable help. I also wish to acknowledge the courtesy and helpfulness of the Pan-American Airways personnel and the others connected with this plane service and with the Satellite Tracking Station facilities, particularly Major Martin M. Manion and Capt. J. M. Smith, U.S.A.F., then commander and administrative officer of the Station. I wish, also, to thank Dr. S. Dillon Ripley, Secretary of the Smithsonian Institution, for suggesting that I accept Dr. Thorpe's invitation to visit the island to carry out this reconnaissance.

The vegetation map of Cousin Island, fig. 2, is adapted from the map by A. W. Diamond in the Cousin Island Nature Reserve Management Plan, and published by permission, for which I am grateful.
My stay on Mahé, as well as travel to Cousin were enormously facilitated by a number of local residents of Victoria, Mahé, particularly Mr. J. F. G. Lionnet, then Director of the Department of Agriculture, Seychelles Govt., and his staff, especially Mr. S. M. Savy, Mr. Philippe Loustau-Lalanne, and Mr. R. M. Mason. Mr. Malcolm Penny, then resident ornithologist on the island, and his local staff, went to great pains to arrange my visit and make it comfortable, as well as introducing me to the island. Mr. Kantilal Jivan Shah, local intellectual and scientific enthusiast in Victoria, Mahé, extended hospitality and many courtesies.

I stayed on Cousin Island from noon, Jan. 21, 1970 to the morning of January 26, during which time I visited most parts of the island and collected 142 numbers of vascular plants, as well as 2 fungi.

This paper is a revised version of a report prepared for the International Council for Bird Preservation in 1970. The report was submitted to them in its original, preliminary form, especially lacking final identifications of a number of plant species, and has been in use by them since. Although much further work has been done on Cousin, especially by the series of managers stationed there by the ICBP, no further information has been made available to me, nor have any corrections or criticisms of the report been received. As the island is an important one for the survival of several endangered bird species, it seems desirable to publish this description of the island as it was in 1970, seen through the eyes of a non-ornithologist.

GEOLGY AND GEOGRAPHY

Cousin is irregular in shape, roughly isodiametric, covers 68 acres and has an extreme elevation of 58 m. A little less than half is occupied by a granite outcrop, the remainder is flat and just above sea level, and is called locally the "plateau". The plateau has a surface of soft phosphatic sand-stone with superficial sand and humus accumulations up to a few cm deep, or deeper where cavities are filled. This surface has been artificially roughened by the local practice of digging large pits in the phosphatic rock for planting coconuts, with piles of broken cobbles between the pits.

Judging by the character of the rock, white particles in a brown matrix, and the present abundance of both young Pisonia trees and fish-eating birds, this phosphatic layer is unquestionably a beheaded Jemo soil (Fosberg 1954). The normal "mor" humus A-horizon has been largely lost by decomposition without renewal since the Pisonia forest was cleared and coconuts planted. The thickness of the phosphatic hard-pan layer here is striking. Holes excavated in it to a depth of one meter are common. It is not clear whether these penetrated through the layer, as they are partly filled with debris and no time was available to clean one out.

The granite hill is a ridge trending WNW-ESE. The slopes vary from a gentle smooth "glacis" (local name for bare smooth rock slopes) to ledges, crags and vertical cliffs. An unusual feature is the presence of
obvious channel erosion, "lapies"-like or "rillenstein"-like fluting. This is not nearly so striking here, however as on nearby Cousins Island, or on certain cliffs on Silhouette Island, second highest of the Seychelles. On the summit ridge of this granite hill is some flat rock surface, broken by sharp ridges and monoliths.

At the north base of the granite hill, where it meets the phosphatic hard-pan layer, is an elongate depression extending across the island. In its central portion, near the well that supplies the drinking water for the island, this depression is deep enough to hold standing water and mud. Eastward toward the coast it becomes more abrupt, straight-sided. Westward it is more shallow and slopes in from both sides.

South of the granite hill around the coastal indentation called Anse Frégate is a much smaller flat area than that forming the north half of the island. Piggott (1968) implies that this has a Jémo soil, as has the north half, and Baker (1963) indicates both areas as phosphatic sandstone. Time was not available to check this adequately here, but certainly some phosphate is exposed. A depression containing a small mangrove swamp extends the length of this flat area, but not immediately against the base of the hill. On this south side the basal slopes of the hill are much more gentle, less abrupt than on the north side, although the upper slopes are steep and cliff-like. Along the beach of the eastern end of Anse Frégate is a conspicuous line of fossil beach-rock, reaching almost a meter higher than present beach level.

The "plateau" is partly lined, at the top of the beach, by a low sandy beach ridge, especially along the northwest and south and southeast sides. A broad sand flat forms a lobe projecting from the east side of the island and used as the landing, which is through the surf. The beach is very steep and falls off sharply into water several meters deep.

On the west side of Cousin rises a rugged clump of granite rocks, separated at high and medium tides from the island by about 100-150 m of water. At low spring tides a ridge of boulders is exposed, connecting the rocks with the shore. This is washed by waves from both directions. The rocks are called Roche Canon. They are of a hard granite similar to that on the island.

FAUNA

Birds are plentiful and very tame. Many fairy terns, Gygis alba, and occasional bos'n birds, Phaethon lepturus, were nesting. Both noddies, Anous stolidus and Anous tenuirostris, were present in some numbers, as well as sooty terns, Sterna fuscata.

Of shore birds only turnstones, Arenaria interpres, and whimbrels, Numenius phaeopus, were identified with any confidence. The Cape barn owl, Tyto alba, was seen several times. What appeared to be a dimorphic egret, Egretta dimorpha, was seen once along the north coast, but this identification is not certain.
Ground doves, Geopila striata, were present in considerable numbers. The local and the introduced Madagascar subspecies of Streptopilia picturata have hybridized, according to Malcolm Penny, and a hybrid swarm of individuals ranging from almost black, or dark gray, to rich brownish red on head and back has replaced the local Seychelles turtle-dove on the island.

Both the native Seychelles weaver, Foudia seychellarum, and the Madagascar "cardinal," Foudia madagascariensis, occur in numbers on the island, but without seeming to interfere with each other. They are extremely tame, freely entering houses and foraging without obvious fear of man. Several Seychelles brush warblers, Bebrornis seychellensis, occupied territories in and immediately around the house in which we stayed at the north-east corner of the island for the first day or two of our visit, being almost equally bold and familiar as the fodies. However, after several days of human presence in the house they had retired to working in trees and bushes some yards away and seldom approached the building.

Fortunately no rats seem to have reached the island. Information received from Malcolm Penny after my return from the island indicated the presence of feral rabbits.

Lizards are, next to the birds, the obvious vertebrates to be seen. Skinks (Mabuya spp.) occur in great numbers generally. Two or three species of gecko, a large gray one (Gehyra sp.), a smaller gray one (young of large one?), and a smaller bright green one (Phelsuma madagascariensis) are frequently seen, the gray ones especially at night in the houses.

Insects are also plentiful. Both day- and night-flying mosquitoes are troublesome in the thick vegetation out of reach of the wind, and to some extent in the houses. "Blister beetles" are attracted to lights at night and may be a bother. A small species of ant occurs in great numbers. Termite nests of some size, cylindric, up to 0.5 m tall, are seen here and there.

**ORIGINAL VEGETATION**

As on all the Seychelles, as well as most islands everywhere, the vegetation of Cousin Island has been profoundly altered since the arrival of man. Sauer (1967) has drawn a partial picture of this history for the group as a whole. To the best of my knowledge no records exist of what the original vegetation of Cousin was like. Summerhayes, in his list of the flora of the Seychelles (1931), mentions only one species from Cousin. This, significantly, is Pisonia grandis.

The presence of a prominent and continuous bed of brown "Jemo" soil hardpan over the entire flat area of the island and the very common occurrence of small Pisonia grandis trees in the present vegetation, with what is known of the origin of the Jemo Soil Series (Fosberg 1954) make it possible to say with some confidence that the original vegetation of
the flat area was solid Pisonia forest. In all likelihood this was a
dense forest with a high continuous canopy, to as much as 30 m, with
massive pale soft-wood trunks, possibly up to several m diameter; there
was no undergrowth or ground vegetation, except in the peripheral zone
on and just back of the beach ridges. On the beach ridges there may well
have been a lower, dense thicket of Cordia subcordata, Guettarda speciosa,
Morinda citrifolia, and possibly locally, Thespesia populnea, tangled
with Canavalia cathartica, and lined, on the outside, by a dense fringe
of Scaevola sericea and Suriana maritima. On the sand at the top of the
beach was probably a mixture of Ipomoea pes-caprae, Sporobolus virginicus,
Boerhavia repens, and possibly Lepturus repens.

The swampy area at Anse Frégate may well have been occupied by a
mangrove swamp with Avicennia marina and Thespesia, as at present, but
probably with much larger and better formed trees. Other mangrove species
could possibly have been present.

Reconstruction of the possible original vegetation of the granite
hill with any reliability is impossible on the basis of my present knowl-
edge. On the basis of what is known of the original vegetation of the
Seychelles as a whole it is probable that the hill was much more com-
pletely forested than at present. Areas now lacking soil may have
reached this condition by continued cutting of trees and burning since
the arrival of man. The Ficus species still present there in numbers,
the Calophyllum inophyllum, and the Euphorbia pyrifolia and Phyllanthus
casticum were certainly normal components of the lowland forest of
granite areas, as still seen in the relict at La Réserve, on Silhouette.
Pisonia and Morinda may well have also been components of this, as well
as species no longer present.

In all likelihood the sparse vegetation at present on Roche Canon,
of Sporobolus virginicus, Boerhavia repens, Ipomoea pes-caprae, Portulaca
oleracea, and Achyranthes aspera may be relatively unchanged from that
originally present. Two minor species, Acrostichum aureum, present in
one deep crevice, and a small colony of Lagrezia oligomeris, may have
been there for a long time, or may be recent arrivals by wind or bird
transport. White tailed tropic-birds now nest on the rocks.

One statement of interest can be made with assurance. The Pisonia
forest which occupied the "plateau" was certainly the home of vast num-
bers of sea-birds. The thick layer of phosphatic rock covering this
area could not have been formed otherwise. The present conspicuous but
relatively small tern populations could not likely have brought about
such massive phosphatization even over long periods of time.

EXISTING VEGETATION

A determining fact in the nature and pattern of the present vegeta-
tion of the island is that coconuts have been planted wherever it was
possible that they might grow. They are now found over the entire flat
area of the island except the beach ridges and the swampy ground at Anse
Frégate, and on the slopes of the hill wherever there is a substantial pocket of soil, almost to the summit. The more recent planting on the "plateau" has largely been in pits a meter or so deep dug in the phosphate rock.

It is not now known whether any effort was made to keep the understory cleared, but it is probable that this was done to some extent on the "plateau", especially toward the east and north sides, as here the Morinda, Pisonia, Neisosperma and other tree saplings are not large. Fairly large understory trees of these species, as well as Calophyllum, and shrubs of Phyllanthus found toward the base of the granite hill suggest that there may have been less clearing out of brush in that area, at least in recent years.

The canopy of coconut crowns, while reasonably complete, is rather irregular and not dense. An understory of Morinda, Pisonia, Carica papaya, occasional Ficus nautatum, Calophyllum, Ricinus, Neisosperma, and, near the base of the hill, other species, is conspicuous and locally dense. The Carica is especially common and of all ages. Its fruit, while very small, is quite sweet and palatable. A dense herbaceous layer, 1 to even 2 meters tall is found throughout this forest. It includes Achyranta aspera, Amaranthus dubius, Kalanchoe pinnata, Asystasia multiflora, Nephrolepis multiflora, and, in a local area of a few acres in the northeast part, Mirabilis jalapa. Along trails and near dwellings other species are common in the forest, such as Synedrella nodiflora, Cyperus kyllingia, Portulaca oleracea, Stenotaphrum micranthum, Digitaria spp., Eragrostis tenella var. insularis, Phyllanthus ananus, Euphorbia hirta, Acalypa indica, Vernonio cinerea, Eleusine indica, Cyperus ligularis, Turnera ulmifolia and others, mostly exotic weeds.

Along the north base of the hill, where a depression extends across the island, generally moist, and in places with mud or standing water, the forest is generally more luxuriant and many cultivated exotic species have been planted, mostly in small numbers. These include Mangifera indica, Annona squamosa, Annona muricata, Artocarpus altillis, Coffea arabica, Eugenia aqua, Manihot esculenta, Dioscorea alata, Moringa oleifera, Colocasia esculenta, Averrhoa bilimbi, Bambusa vulgaris, Musa sapientum, Persea americana, Citrus sp., Cucurbita moschata, Capsicum frutescens, Quisqualis indica and Alocasia macrorrhiza. Only the last three have shown much tendency to become naturalized and to spread. Certain weeds, in addition to those noted above, are found in this wet area. These include Panicum maximum, Cyperus polystachyos, Ludwigia octovalvis, Cyperus sp., Commelina diffusa, Panicum (Cyrtococcum) patens and Heliotropium indicum.

At its western end, this depression becomes broad and shallow and is covered by a forest of Pisonia, not, however, of very large trees. A similar forest, but much mixed with Morinda, Calophyllum and Carica, as well as some coconuts, is found near, but not at, the eastern end of the depression. The eastern end is occupied by a thicket of low Thespesia with a few Avicennia shrubs in the bottom of a shallow ravine where it reaches the back of the beach.
The mangrove depression at Anse Frégate is narrow at the east end and filled with a row of very bushy Avicennia. Westward it broadens and becomes dominated by Thespesia, likewise not very tall. The Thespesia, where growing in the wet area of the swamp, produces exposed arching roots which may possibly serve as pneumatophores. The pneumatophores of the Avicennia are the usual slender, vertical "upside-down roots", produced in numbers over an area of even broader radius than that of the crown of the tree. Around the margins of the depression are masses of the large, leathery fern Acrostichum aureum, up to 1.5 or even 2 m tall. Otherwise the only subordinate layer of vegetation is a locally prominent stand of Avicennia seedlings a few cm tall.

Back of the mangroves, in addition to coconuts, is an irregular thicket of Morinda, Pisonia and Scaevola, tangled with Canavalia and Ipomoea macrantha, with one small patch of Phyllanthus acidus.

Inside the beach ridges along most of the north and east coasts of the "plateau" and south of the mangrove at Anse Frégate is an open zone, under the coconuts, with very sparse undergrowth or none, only a few scattered shrubs of Morinda, Pisonia, Neisosperma and Carica, but with dense herbaceous growth varying from Achyranthes, Amaranthus and Asystasia a meter tall to a much lower mosaic of Boerhavia repens, Sporobolus virginicus, and Stenotaphrum dimidiatum, all in relatively pure stands, with local patches of Catharanthus roseus, Stachytarpheta jamaicensis, Abutilon indicum, Gossypium hirsutum, Dactyloctenium aegyptium, Panicum (Brachiaria) sp., and scattered individuals of Turnera ulmifolia, Datura metel, Ricinus communis, and Cassia occidentalis. The dense areas of Boerhavia repens are of interest in that where crowded, the Boerhavia instead of being very prostrate and elongate, has shorter ascending stems with fewer inflorescences and denser foliage. This zone is said to have resulted from the pasturing of hogs by the previous owner. It seems very likely to grow up soon to undergrowth similar to that farther inland in the coconut forest if all disturbance is removed.

On the beach ridge, which extends around the "plateau" with gaps only in and near the dwelling areas, is an interrupted row of giant old Casuarina trees, up to 30 m tall, buttressed at base, laying down a carpet of "needles" which locally seems to discourage, somewhat, the normal herbaceous layer. Between and under these is generally a "hedge" or low thicket of Scaevola and Suriana. Here and there are a very few fairly large Guettarda trees. Toward the west end, and especially in a fairly large gap in the Casuarina, the beach ridge is covered by a dense thicket, up to 4-5 m tall, of Cordia subcordata, Pisonia grandis and Scaevola sericea. A similar thicket, mainly Pisonia and some Scaevola occupies the southern end of the beach ridge on the east coast. Here the Casuarina trees form a small grove, extending a few meters inland, rather than only a row at the top of the beach. The Casuarina is not reproducing itself except very locally where otherwise unvegetated beach sand, in full sun, supports stands of seedling Casuarina and/or Scaevola.

On the outer slopes of the beach ridges and outer edges of the sand flats where there are no ridges, Sporobolus virginicus, Boerhavia repens
and Ipomoea pes-caprae tend to spread down onto the top of the beach, or onto berms or terraces formed on them. The rhizomes of Sporobolus growing toward the sea send up characteristic straight rows of shoots. The elongate stems of Boerhavia here spread in a very prostrate manner from root crowns. The Ipomoea forms loose mats which locally extend back onto the sand flats where the beach ridge is lacking.

A few trees, lacking elsewhere, such as Hibiscus tiliaceus, Spondias purpurea and Barringtonia, are planted around dwellings along these coasts.

The vegetation of the granite area is much more varied and locally diverse, and patterns are less obvious and are difficult to define. The species are predominantly indigenous and, with the exceptions of Morinda citrifolia and Pisonia grandis, among trees, and Achyranthes aspera, Asystasia sp., Nephrolepis multiflora, and Ipomoea pes-caprae, are not those which have much importance in the "plateau" vegetation.

The gentler lower slopes are mostly wooded with a low mixture of Morinda and Pisonia, with some Ficus nautarum and Ficus sp., Calophyllum, Euphorbia pyrifolia and Phyllanthus casticum, with, of course, planted Cocos nucifera. On the lower west slopes Pandanus balfourii is locally abundant or even dominant, and elsewhere Calophyllum may be dominant. A patch of Fourcroya foetida is found on a rather low gentle slope on the northwest corner of the hill. Locally Passiflora foetida is abundant, climbing in bushes. On the south side Panicum (Cyrtoecoccum) sp. is abundant in patches with Asystasia. In open scrub and forest there is frequently a dense ground layer of Nephrolepis multiflora.

The lower east slopes of the hill are gentle, and have scattered Pisonia and Morinda, but are mainly open and completely dominated by Achyranthes. The slopes end in alternating bare rock ridges and sandy coves. The coves have Pisonia, Cocos, and Casuarina trees and small sand flats or storm beaches covered by Ipomoea pes-caprae, Achyranthes, and Asystasia, with small clumps of herbs such as Fimbriystylis cymosa, Cleome viscosa and Cenchrus echinatus. There is little Scaevola or Suriana here.

On the middle west slopes is an area dominated by planted Eucalyptus camaldulensis, reaching 20 or more meters in height. Elsewhere the middle slopes are either ledgy and jointed, and support an open growth of Ficus nautarum, Morinda, Calophyllum, and a very few small Casuarina, or they are smooth "glacis" or bare rock, with little soil except in crevices and pockets. Here are occasional Euphorbia pyrifolia. A few slopes on the north side are covered by a blanket of Coleus subfruteosus. Sedges of several species occur in crevices and pockets. Clumps and patches of Panicum maximum are also found here, and Nephrolepis multiflora in crevices and accumulations of soil.

The higher slopes, where they are not steep, bare "glacis" or cliffs, have irregular clumps of Ficus nautarum, Pandanus balfourii and Calophyllum, with a herbaceous layer of Asystasia and Nephrolepis, or especially on steeper southwest slopes, a rather dense scrub of Euphorbia pyrifolia, and Nephrolepis.
Near the top of the hill, on the southwest side especially, are relatively flat areas covered by a tall dense scrub or scrub forest of Euphorbia pyrifolia, Phyllanthus casticum, Ficus nataarum and Pandanus balfourii, choked beneath with Nephrolepis up to 2 m deep. Here are the highest coconuts, a few small trees. Openings in this scrub are dominated by Fimbristylis cf. consanguineus.

The summit ridge, little higher than this flat area, has sparse vegetation, where any at all. Where some sand has accumulated in longitudinal grooves is, surprisingly, Ipomoea pes-caprae, with Achyranthes, a little Cenchrus echinatus, Fimbristylis spp., wisps of Panicum maximum, and scattered bushes of Euphorbia pyrifolia.

The vegetation of Roche Canon was mentioned above as possibly being in approximately its original condition. Most of the rocks are bare, but locally on the larger peak are thick masses of Sporobolus virginicus, and Achyranthes aspera, and lesser mats of Boerhavia repens. A little Portulaca oleracea grows around the edges of these mats, and also in sheltered spots on the smaller peak. Here it reaches a gigantic size, up to 0.7–0.8 m tall. On top of the smaller peak, in sheltered crevices, are a few plants of Lagreza oligomeroides, possibly brought on the feet of seabirds from far-away Aldabra. Otherwise, except for a tiny tuft of Acrostichum in a deep crevice, the rocks are completely bare.

Management of vegetation

As is well shown by the history of the Seychelles, vegetation can be profoundly changed by the activities of man. This has happened in the past to the vegetation of Cousin, resulting in the confused patterns described above.

All vegetation is intrinsically dynamic, that is, it constantly changes to some extent, even if left to itself. Long established natural vegetation tends to change only slowly or fluctuate about internal equilibria. This situation is altered, even naturally, by severe storms, volcanic eruptions, lightning fires, landslides, and other catastrophic events, as well as by changes in animal populations, and perhaps rarely, by plant diseases. Wherever man has gone he has accelerated change and upset existing equilibria, usually in a haphazard, unplanned and destructive manner. The result is that any vegetation that has been influenced by man tends to be in a state of relatively active change. Such change goes on, once the disturbance has been effected, regardless of what man does from then on. He can influence the direction of the change but he finds it difficult, if not impossible, to maintain precisely the status quo. Attempts to do so, if even moderately effective, require the expenditure of very considerable effort and constant attention. Guided change, on the other hand, may require relatively little effort, if it is in the direction of the existing trend in any situation. If the desired change is contrary to such trends, it may require large expenditures of effort indeed, and with no assurance of success.
Carrying out policies intended to influence, in whatever manner, the processes of change in vegetation is commonly called vegetation management. Hence, it is impossible to recommend any form of management until appropriate policies have been established to further the objectives of the Cousin Island Preserve. Certain alternatives may be discussed and possible consequences pointed out. It must be noted that my familiarity with Seychelles vegetation and the Seychelles environment is limited to what could be learned in two weeks, so any suggestions should be accepted with due caution.

Reasonable alternative management paths that might be followed fall roughly into four sorts. Granting effective protection from outside influences, they are (1) non-interference, allowing present trends to continue without active efforts to direct, accelerate, or retard change; (2) the deliberate introduction of additional plant species; (3) the deliberate elimination or reduction of species now present, presumably the exotics; (4) attempts to alter (or "ameliorate") in some manner the physical or biological environment. These will be discussed briefly in order.

1. As pointed out above, change in the vegetation is going on and will continue. Allowing present trends to continue is certainly the easiest and least expensive policy that could be adopted. It would be presumptuous to assume that I know what all of these trends are, or what their immediate or ultimate outcome will be. However, one or two things seem likely.

As suggested above, the relatively open zone around the "plateau" inside the beach ridge is very likely to grow up in a short time to resemble the thicker undergrowth farther inland. Since the Casuarina does not seem to be reproducing very effectively, and since several wind-thrown trees were noticed, it is likely that over a period of many years the stately row of giant Casuarina will be replaced by a few localized thickets or groves of this species and occasional isolated trees. The beach ridge hedge and thickets will likely become taller and, at least on the beach side, denser, and may occupy areas not now covered by woody plants. A strip of Scaevola seedlings now to be seen in front of the resident scientist's house represents the initiation of such vegetation in one place where it is now absent.

It seems most likely that the understory in the coconut plantation on the "plateau" will in time thicken and greatly increase in height, eventually replacing the coconuts. The papaya, now so abundant, will disappear, except possibly around dwellings and along the more established paths. The ultimate result, a long time from now, will probably be the reestablishment of the Pisonia forest that originally occupied the area. This course could be changed, over a very long time, by the development of a Neisosperma forest, which, in the Central Pacific atolls, seems capable of replacing the Pisonia forest completely. It is not known if this could happen in the western Indian Ocean. The former existence of extensive Pisonia forests here suggests that such replacement is at least not inevitable. The replacement of the coconut forest by Pisonia is
contingent on continued complete harvest of the coconut crop, as at present. If the nuts are allowed to lie on the ground and germinate an impenetrable thicket of young coconut palms will result, probably crowding out everything else in time, unless one or other of the existing coconut pests reaches the island and alters the situation, which would be rather likely, sooner or later.

Change in the vegetation on the granite hill would seem to be rather slow. Soil is absent in many areas and thin in most others. The granite weathers very slowly, and humus breaks down rapidly under tropical conditions. The trend will doubtless be toward the spread of forest and the increase in stature and density of the forest now there, but the process will certainly be slow. Fire could set it back drastically. The presence of the *Eucalyptus* grove no doubt increases the probability of fire.

The composition of the vegetation in the depression at the north base of the granite hill will probably change rapidly, with some of the planted species dying out as a result of competition, the effects of scale insects and mealy bugs, or simple unsuitability in an increasingly densely forested environment. Which species will persist is hard to know, but at present three -- *Quisqualis indica*, *Alocasia macrorrhiza* and *Capsicum frutescens* seem to be on the increase, and *Manihot esculenta*, at least, seems on the way out.

2. There seems little use in discussing the introduction of additional species. There are a great many thousand available, and no one has any reliable information on the probable consequences of introducing any of them. There is always a strong possibility that introduction of any species without its natural enemies will result in an uncontrolled increase, which is usually disastrous for some or many existing species. The end result is likely to be impoverishment, rather than enrichment of the habitat. However, it is likely that species will be introduced, either accidentally or deliberately. People seem to have a missionary zeal in this direction that is not influenced by reason, past bad experience, or good advice. One can only recommend against ill-considered introductions and hope the plants die if they are brought in.

3. The eventual elimination of at least certain of the exotics now present will probably be advisable. This should not be hasty or ill-considered. It should be undertaken only after a full understanding of the relationships of the birds to the plants in question is achieved. Elimination of any species should, also, only be considered after it is determined, possibly by experiment, what of the existing species present will fill the niche vacated.

The only species that I would venture to propose for elimination would be the *Eucalyptus*, and possibly the *Cenchrus*, and these only after a careful study of their role in the present situation.

These remarks do not, of course, apply to permitting the disappearance of species by natural causes. A species on its way out will
likely go, unless a determined effort is made to save it. This should probably only be made if it should be found that one of the birds for which the Reserve was set up is dependent on the threatened plants.

4. Alterations of the habitat are likely to be both difficult and expensive if done rationally and carefully. Likewise the consequences are not fully predictable. Fertilization, the application of pesticides, changing drainage patterns, thinning of vegetation, selective reduction of a particular species, erecting wind-breaks are all possible alterations. There is no pressing reason to undertake any of these, and past experience elsewhere has shown that unanticipated results and side-effects are likely. It is suggested that only after the fullest consideration of all aspects, and for the most pressing reasons, should any such course be adopted.

REFERENCES


Sauer, J. D. 1967. Plants and Man on the Seychelles coast.... 1-132, Madison, Wis.


SYSTEMATIC LIST OF PLANTS

All collection numbers are Fosberg's. Plant names preceeded by an asterisk are those regarded as introduced by man into Cousin.

POLYPODIACEAE

Acrostichum aureum L.

Sparingly at edges of mangrove swamp at Anse Frégate (52090). One tiny clump in deep crack on Roche Canon (52080).
Nephrolepis multiflora (Roxb.) Jarrett

Very common to abundant everywhere except on beach ridges and sand flats. Especially abundant on granite slopes (52159).

Polypodium scolopendria Burm. f.

Rare, seen only in depression near well, on base of tree (52110), and on stone wall of tortoise pen (52097).

Pandanaceae

Pandanus balfourii Martelli

Common on slopes and top of granite hill (52092, 52093).

Gramineae

*Bambusa vulgaris Wendl.

Two clumps in depression near well (52106); undoubtedly planted.

*Cenchrus echinatus L.

Small colonies on top of granite hill (52160) and on beach at east end of granite hill (52188). Possibly brought by birds.

*Dactyloctenium ctenoides (Steud.) Bosser

Common generally except in densest forest, especially just back of beaches (52177).

Digitaria horizontalis Willd.

Here and there along paths in edges of forest (52066).

*Digitaria radicosa (Presl) Miq.

One patch seen at northeast corner of island near path (52175), and occasionally near dwellings (52101).

*Eleusine indica (L.) Gaertn.

Occasional clumps and patches along trails and near dwellings (52098).

Enteropogon sechellensis (Baker) Dur. & Schinz

General but not abundant in open places (52172).

*Eragrostis tenella (L.) Beauv.

Very rare, found once in path near dwelling on north coast (52167).
Eragrostis tenella var. insularis Hubb.
Occasional in and along paths (52095, 52176).

*Panicum maximum Jacq.
Abundant in standing water in depression near well (52105), common here and there on granite hill, occasional elsewhere. Panicles used by local people to make brooms.

*Panicum (Brachiaria) miliformis Presl.
Common along trails and near dwellings, northeast part of island (52072).

Panicum (Cyrtococcum) patens L.
Abundant on lower slopes of granite hill, and especially at Anse Frégate (52050), occasional elsewhere.

Sporobolus virginicus (L.) Kunth
Abundant around all coasts, on rocks and sand flats, forming a dense sod (52032); on Roche Canon (52078) forming deep masses.

Stenotaphrum dimidiatum (L.) Brongn.
Locally abundant on sand flats along coasts (52033).

Stenotaphrum micranthum (Desv.) Hubb.
Common in small patches in coconut plantation on phosphate rock, especially along paths (52099).

CYPERACEAE

Bulbostylis barbata C.B.Cl.
Occasional in rock crevices and soil pockets on and near top of granite hill (52060, 52055, 52140).

Cyperus distans L.f.
In wet places, as in depression near well (52104).

Cyperus dubius Rotbh.
Scattered generally, nowhere seen abundant (52062).

*Cyperus kyllingia Endl.
Common in forest along paths (52061), sparingly elsewhere.
Cyperus ligularis L.

Generally but sparingly distributed principally in open and semi-open places (52119).

*Cyperus polystachyos Rottb.

Very sparingly distributed, especially along paths (52087).

Cyperus polyphyllus Vahl

Generally but sparingly distributed in open and semi-open places (52058).

Fimbristylis cymosa R. Br.

One tiny colony back of beach at east end of granite hill (52186). A giant form.

Fimbristylis cf. consanguineus Kunth

Common on and near top of granite hill in depressions and crevices in rock (52059, 52054).

PALMAE

*Cocos nucifera L.

Planted everywhere where there is sufficient soil. The nuts are harvested as they fall.

ARACEAE

*Alocasia macrorrhiza (L.) Schott

Naturalized abundantly in and near depression along the north base of granite hill (52181).

*Colocasia esculenta (L.) Schott

Planted locally in mud of depression near well (52115).

COMMELINACEAE

*Commelina diffusa Burm. f.

Very abundant in depression, north of granite hill (52118), also at Anse Frégate. Seldom seen flowering.
BROMELIACEAE

*Ananas comosus (L.) Merr.

Solitary plants or small clumps at several places, as on granite slopes above well (52164).

LILIACEAE

*Crinum asiaticum L.

Two clumps just back of beach near dwellings (52184), not flowering.

*Furcraea foetida (L.) Haworth

Small patch on slopes near northwest base of granite hill (52135).

*Hymenocallis littoralis (Jacq.) Salisb.

Several clumps in edges of forest near dwellings (52171), not flowering.

DIOSCORACEAE

*Dioscorea alata L.

One vigorous plant in depression at foot of granite hill west of well (52126), not flowering.

MUSACEAE

*Musa sapientum L.

Planted abundantly in depression at north base of granite hill (52108).

CASUARINACEAE

*Casuarina equisetifolia L.

A single interrupted row of large old trees on beach ridges almost around the island (52168), locally in one or two places forming small groves. Reproducing in only one or two places on bare sand.

MORACEAE

*Artocarpus altillis (Park.) Fosb.

Two small trees planted in depression at north base of granite hill (52133).
Ficus avi-avi Bl.

One small tree seen on east side of tortoise pen, northeast of well (52143), sterile.

Ficus nautarum Baker

Very common on granite hill (52142, 52154), occasional elsewhere.

Ficus aff. thoningii Bl.

Occasional to common on slopes of granite hill (52084, 52134), rare elsewhere, as at Anse Frégate.

NYCTAGINACEAE

Boerhavia repens L.

Very abundant everywhere on flats back of beaches (52145, 52146), occasional elsewhere at low elevations, also on Roche Canon (52077).

*Mirabilis jalapa L.

Very common in an area within the coconut plantation in from the north coast (52180).

Pisonia grandis R. Br.

Generally common, locally abundant on "plateau" (52063), extending somewhat up on the granite slopes. Undoubtedly formed solid forests over lowlands in pre-human time, judging by the extent of the phosphatic soil and hard-pan of the Jemo series.

AMARANTHACEAE

Achyranthes aspera L.

One of the most ubiquitous plants on the island, especially abundant back of beach ridges and in coconut plantation, but found generally at all elevations; an especially vigorous form of the species (52173).

*Amaranthus dubius Mart. ex Thell.

Found generally at low elevations, especially common near houses and paths (52034) but well distributed even in the dense coconut forest.

Lagrezia oligomeroides (C. H. Wright) Fosberg

One tiny colony on Roche Canon (52075), not seen elsewhere, nor is there any published record from the Seychelles. Very similar to, if not identical with, the plant common on Aldabra.
AIZOACEAE

Mollugo oppositifolia A. DC.

One small colony in dry depression at Anse Frégate near edge of mangrove swamp (52086).

PORTULACACEAE

Portulaca oleracea L.

Very generally distributed except in densest forest and on top of granite hill, especially abundant along paths (52120), very large plants on Roche Canon (52079).

ANNONACEAE

*Annona muricata L.

Several trees planted in depression at north base of granite hill, near well (52111).

*Annona squamosa L.

Commonly planted along depressions at north base of granite hill (52123), fruiting abundantly.

LAURACEAE

*Persea americana Mill.

One tree bearing fruit, planted near well in depression at north base of granite hill (52128).

CAPPARIDACEAE

*Cleome viscosa L.

A few dwarfed plants in crevices on summit of granite hill (52052) and a small colony back of beach at east end of granite hill (52185).

MORINGACEAE

*Moringa oleifera Lam.

One or two trees planted in depression at east base of granite hill (52131).
**CRASSULACEAE**

*Kalanchoe pinnata* (Lam.) Pers.

Very abundant almost everywhere in lowlands (52109), especially on old stone walls and in small openings in woods.

**LEGUMINOSAE**

*Adenanthera pavonina* L.

One tree on northwest slope of granite hill not far below top (52162).

*Caesalpinia bonduc* Roxb.

A single seedling at top of beach at east end of granite hill (52187), not seen elsewhere.

*Canavalia cathartica* Thou.

Very common, climbing in trees over most of western half of island (52138).

*Cassia occidentalis* L.

Common in open and semi-open places, especially near dwellings (52069).

*Sesbania cf. cannabina* (Retz.) Roxb.

Common at Anse Frégate (52051), seen once or twice elsewhere near dwellings.

*Vigna unguiculata* (L.) Walp.

Planted in garden around dwelling (52100).

**OXALIDACEAE**

*Averrhoa bilimbi* L.

Several trees in depression at north base of granite hill (52112), fruiting.

**RUTACEAE**

*Citrus aurantifolia* (Christm.) Swingle

Seen but not collected on lower north slope of granite hill, rare.
*Citrus sinensis (L.) Osbeck

Oranges said to be present but not seen on this visit.

*Citrus "calamondin"?

Occasional near well at base of north slope of granite hill (52124), fruit resembling a lime but not sour ("Bigaradier").

SURIANACEAE

Suriana maritima L.

Locally common on beach ridges (52065).

EUPHORBIACEAE

*Acalypha indica L.

Very common along trails and around dwellings (52070) in open and semi-shade.

*Euphorbia hirta L.

Common along paths (52122), around dwellings, and in open spots generally.

*Euphorbia prostrata Ait.

One small colony in path near dwelling (52148) at northeast corner of island.

Euphorbia pyriformis Lam.

Common on granite hill, dominant in scrub near top (52056, 52053, 52136, 52155, 52156, 52157).

*Euphorbia thymifolia L.

Local in path along north coast near dwellings (52030).

*Manihot esculenta Crantz

One poor plant in depression at north base of granite hill, doubtless planted (52127).

*Phyllanthus acidus (L.) Skeels

A few trees at Anse Frégate (52089), well inland, large one probably planted, smaller ones spontaneous.
*Phyllanthus amarus* Schum. & Thonn.

Common along paths and in openings near dwellings (52082, 52121).

*Phyllanthus casticum* Willem.

Common on slopes of granite hill, very common near top, less so in coconut plantation not far from base of hill (52031, 52129, 52158).

*Ricinus communis* L.

Generally common in lowlands, especially near paths and in semi-open places (52165).

**ANACARDIACEAE**

*Mangifera indica* L.

Two or three trees planted near well in depression at north base of granite hill (52113).

*Spondias purpurea* L.

One tree at manager's house on east coast (52183).

**MALVACEAE**

*Abutilon indicum* (L.) Sweet

Local along path on north coast near dwellings (52068).

*Gossypium hirsutum* L.

Here and there along paths in semi-open areas, especially near dwellings along north coast (52073).

*Hibiscus tiliaceus* L.

One small clump near dwelling on north coast (52170).

*Sida acuta* Burm. f.

A few plants near dwellings on east coast (52094).

*Thespesia populnea* (L.) Sol. ex Correa

Abundant in and around mangrove swamp at Anse Frégate (52085) and at east end of depression at north base of granite hill; a form with rather large pyriform fruit.
GUTTIFERAE

Calophyllum inophyllum L.

Common on slopes of granite hill (52141), uncommon elsewhere.

TURNERACEAE

*Turnera ulmifolia L.

Common in edges of coconut plantation, especially near northeast corner of island (52035).

CARICACEAE

*Carica papaya L.

Abundant in coconut plantation, especially in more open areas (52096).

PASSIFLORACEAE

*Passiflora foetida L.

Common on lower slopes of granite hill (52083, 52151).

*Passiflora suberosa L.

Occasional in edges of coconut plantation, on back slopes of beach ridges, and on semi-open sand flats near coasts (52169).

CUCURBITACEAE

*Cucurbita moschata Duch.

Planted in and near depression at north base of granite hill (52163), also near dwellings.

*Momordica cf. charantia L.

Planted in garden at manager's house, trained up on trellis, large fruit hanging through trellis; not collected.

COMBRETACEAE

*Quisqualis indica L.

Well established in depression at north base of granite hill (52132).

*Terminalia catappa L.

One tree seen but not relocated, probably near well; possibly an error in identification.
LECITHIDACEAE

*Barringtonia asiatica* (L.) Kurz

One small tree at manager's house on east coast (52182).

MYRTACEAE

*Eucalyptus camaldulensis* Dehn.

Abundantly planted on middle slopes of west end of granite hill (52137, 52150).

*Eugenia aquea* L.

One large tree planted at well, north base of granite hill (52114), fruiting freely.

ONAGRACEAE

*Ludwigia octovalvis* (Jacq.) Raven

Common in standing water and mud in depression at north base of granite hill (52116).

UMBELLIFERAE

*Centella asiatica* (L.) Urb.

One small colony near well, in depression at north base of granite hill (52107).

APOCYNACEAE

*Catharanthus roseus* (L.) Don

Well established here and there in lowlands, especially in semi-open areas and groves back of beach ridges (52147).

*Neisosperma oppositifolia* (Lam.) Fosb. & Sachet

Occasional in lowlands, especially on flats just back of beach ridges (52067).

CONVOLVULACEAE

*Ipomoea pes-caprae* (L.) R. Br.

Common to abundant on beach ridges and sand flats along coast (52189), also on granite hill on open rock slopes and summit (52161), also on Roche Canon (52076). The form seems intermediate between ssp. *pes-caprae* and ssp. *brasiliensis*.
Ipomoea macrantha R. & S.

Common on south coast, at Anse Frégate (52049), and back of beaches at east end of granite hill.

Ipomoea cf. venosa R. & S.

Occasional on slopes of granite hill, on low granite area west of Anse Frégate (52091) and near dwelling inland from east coast (52103). A curious abnormal form with deeply lobed corolla was collected on the west slope of granite hill (52152).

BORAGINACEAE

Cordia subcordata Lam.

Common generally on beach ridges (52064).

*Heliotropium indicum L.

Very rare in wet depression near well at north base of granite hill (52117). This is an unusually glabrous form of this normally hirsute, widespread weedy species. There are various specimens from Indian Ocean localities intermediate in hairiness between this and the coarser more hirsute ordinary forms.

Tournefortia argentea L. f.

One small bush at top of beach on north coast (52174).

VERBENACEAE

Avicennia marina L.

Common in mangrove swamp at Anse Frégate (52048) and local at east end of depression at north base of granite hill.

*Stachytarpheta jamaicensis (L.) Vahl

Common back of beach ridges in semi-open areas and around dwellings (52074).

LABIATAE

Coleus subfruticosus Summ.

Locally very abundant on lower north slopes of granite hill, completely covering some rock slopes (52057).
SOLANACEAE

Capsicum frutescens L.
Locally common in depression at north base of granite hill (52125), occasional elsewhere in lowlands along paths and near dwellings.

*Datura metel L.
Common near dwellings, especially along east coast (52190).

*Nicotiana tabacum L.
Two or three plants seen in garden near manager's house.

*Solanum melongana L.
Sparingly planted in gardens and around dwellings (52144).

ACANTHACEAE

Asystasia multiflora Klotzsch
Very abundant generally (52153, 52166).

*Justicia gendarussa Burm. f.
One tiny colony at Anse Frégate (52088).

RUBIACEAE

*Coffea arabica L.
A few trees planted in depression at north base of granite hill (52130).

Guettarda speciosa L.
A very few scattered trees on beach ridges and flats behind beaches (52178).

*Medyotis cymbosa (L.) Lam.
Very local in paths, both on phosphate rock and on granite (52081, 52139).

Morinda citrifolia L.
Very common everywhere (52179), an important component of most woody vegetation,
GOODENIACEAE

Scaevola sericea Vahl

Locally abundant along beach ridges (52047), tending to form a tall hedge on ridge, or fringe seaward of other vegetation.

COMPOSITAE

*Synedrella nodiflora (L.) Gaertn.

Locally common along paths and near dwellings (52102).

*Vernonia cinerea (L.) Less.

Common along paths (52071), near dwellings and in open weedy places.

ADDENDUM TO SYSTEMATIC LIST

Information on changes in the flora has been provided from several Cousin Island Research Station scientific administrators' reports and from Technical Report No. 16, by G. M. and H. V. Bathe, since the above version of the plant list was prepared. The following species may be added to the list on the basis of these notes. I have not seen the specimens supporting these observations.

Lemna sp. (Lemnaceae)

Common in The Pond.

*Saccharum officinarum L. (Poaceae)

Planted in depression, N. E. base of Granite Hill.

*Haemanthus multiflorus Martyn (Liliaceae, s. l.)

Persisting around abandoned house back of N. shore.

*Peperomia pellucida (L.) H.B.K. (Piperaceae)

Found around paths on Parve Plateau; said to be native but surely not, as this is an American species.

*Gliricidia sepium H.B.K. (Fabaceae)

Planted near house.

*Euphorbia tirucalli L. (Euphorbiaceae)

Near houses.

1 Apparently the "plateau," flat north half of island.
Hibiscus surattensis L. (Malvaceae)
(as H. swatensis, a name not listed in Index Kewensis).

Found in S. E. end of depression at base of Granite Hill.

Rhizophora mucronata Lam.

In coastal brackish water on south and east coasts.

Many miscellaneous notes on the vegetation occur in these reports. They should be collected together and summarized for publication after a period of years, as trends of change may be established.

In the account of the fauna, above, I inadvertently omitted mentioning the presence of five giant tortoises, presumably brought from Aldabra Island, confined in an enclosure surrounded by a low stone wall. I was not able to learn how long they had been there, but the enclosure was obviously not new. The tortoises seemed in good health but were not successfully breeding. The enclosure was located on the "plateau" between the dwellings and the depression at the foot of the granite hill.
Figure 1. Coeval Island, vegetation types. Adapted by photographer, Iowa.

map by A. W. Remsen.

1. Tall herbs on flat sandy coast. Characteristic species Passiflora suberosa, Boerhavia repens.


3. Open woodland regenerating through coastal tall herbs; intermediate between types 1 and 4.


5. Tall closed plateau woodland. Taller and more open (ground layer) than type 4. Ficus nautarum replaces Phyllanthus casticum.

6. Low-lying woodland near the coast, subject to tidal inundation. Avicennia marina, Thespesia populnea, Ipomoea macrantha.


10. Tall herbs on the top and southwest slopes of the hill. Nephrolepis multiflora.

11. Herbs on the northeast slopes of the hill. Cyperus polyphylla, Cyperus ligularis.

12. Groves or individual trees of Casuarina equisetifolia.


14. Open Pisonia regenerating through dense Asystasia sp. under Cocos nucifera.

15. Very varied vegetation, almost entirely planted, in the depression at the foot of the hill; on deep soil, much of it under standing water according to rainfall. Not sampled.


17. Not sampled.
Figure 3. Cousin Island, vegetation types. Adapted, by permission, from map by A. W. Diamond.