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琉球西表島の植生に就いて

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Notes on the Vegetation of Iriomote-Zima Ryukyu Islands¹⁾

By

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A brief visit was made to Iriomote-jima, southernmost large island of the Ryukyu Archipelago on June 26–28, 1956, through the courtesy of Major Russell A. Broner, U.S.A., Chief of the Yaeyama Civil Administration Team. This provided an opportunity to make some superficial observations on the vegetation of the island. Little chance was afforded to get into the interior, and most of the examination was done from boats offshore and in the Nagara River. Several short forays were made on shore, principally around villages and on the small island of Hoka Banare Shima. Walks were taken overland between Funaura and Urauchi villages and between Sonai and Shirahama villages. The east, north, and west coasts were examined from the boat, the latter mostly from less than 0.5 km. offshore, and some stretches from much closer. Good binoculars were available.

This sort of examination of course yielded no basis for a detailed description of the vegetation, but certain patterns were evident. Since so little information is available about the vegetation of this island it seems desirable to place these notes on record.

Certain background information may be quoted from D. E. Flint and R. A. Saplis' unpublished memorandum (1955), Reconnaissance Geology of Iriomote with some additions:

"Iriomote-jima is located at latitude 24°26' to 24°15' north and longitude 123°56' to 123°40' east. It is in the Yaeyama-retto near the southern limit of the Ryukyu chain and about 130 miles due east of northern Taiwan". Trails and in a few places, roads connect villages along parts of the coast. "Access to the interior of the island is limited to poorly marked foot trails". However, in the vicinity of Shirahama several new trails have recently been opened up by the Yaeyama Development Corporation, a Japanese company.

1) Publication authorized by the Director, U. S. Geological Survey.

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Topography and relief "Iriomote is characterized by a highly dissected terrain consisting of many narrow flat-topped and steep sided ridges. Most of the island rises over 300 meters above sea level with occasional peaks over 400 meters; the highest peak is Komi-dake (470 meters). Rather than having any definite mountain ranges, the whole island appears to rise to one general level with several peaks.

"A narrow 50 meter terrace borders the island on all the coasts except the south. Remnants of a higher terrace are suggested in places.

"Local relief in the interior of the island varies from 100 to 200 meters. On the terraces the relief is about 10 to 20 meters, the lesser figure being found on the limestone terraces.

"Most of the coast line is steeply cliffed, in some places only a few feet high and in others rising over 300 meters. However, cliffs on the northern and eastern coasts generally do not rise above 50 meters as there is a prominent terrace at that altitude.

"Off-shore coral reefs completely surround the island. Their width is greatest along the northern and eastern coasts, in places as much as 2 miles. The narrowest reefs are found off-shore from the highest cliffs.

Drainage "Several large streams from the principal drainage network; three, the Kuira-kawa, Nakara-kawa, and Urauchi-kawa empty on the west coast, and three, the Shiira-gawa, Maera-gawa, and Nakama-gawa empty on the east coast. These streams are navigable only where they are tidal.

Geology "The foundation of Iriomote is a core of Paleozoic rocks which are exposed in the northeastern portion of the island. However, the bulk of the island consists of the sandstones of the Yaeyama formation. Volcanic rocks, chiefly tuffs and some agglomerate, are found adjacent to the Paleozoic rocks. Veneering limestones are found on some of the terraces."

Climate Data on the climate of Iriomote are scarce. However, records extending over a long period are available for nearby Ishigaki. These indicate that the temperature varies between extremes of 43° and 96°F. with an annual mean of 74°. Monthly means below 70° hold for the months of December through March and near 80° from June through September. Three years' figures for Iriomote give an annual mean of 77° with about the same distribution of cooler months as on Ishigaki. The mean monthly relative humidity varies between 76% and 84%. The months with 80% or above are March through September. Three years' observations on Iriomote give comparable figures of 79% to 86% for mean monthly humidity with no marked

seasonal variation. The winds are monsoonal in character, blowing from the north and northeast from September to March, gradually shifting eastward and southward from then till June, and from the south from June until the end of August. Thus there are no marked windward or leeward aspects to the island. Gales and typhoons are occasional and often very destructive. Otherwise the winds are gentle to moderate in strength. Cloudy days are frequent and the mean annual cloudiness at Ishigaki is 69%. The figure for Iriomote, based on only 3 years records, is 80%. A higher figure such as this is to be expected, as clouds hang over this island many times when Ishigaki is clear or mostly so. Rainfall, which is perhaps the most important factor for vegetation, averages 87.4 inches on Ishigaki, being well distributed through the year. Figures for Iriomote for only 3 years give the much higher figure of 111 inches. This may be too high, but perhaps not. Both of these figures are for coastal stations. The mountains on both islands undoubtedly get much more precipitation than the figures indicate.

Soils The soils are mainly fine sands resulting from weathering of the sandstones of the prevalent Yaeyama formation. They are yellowish brown, with little humus accumulation. Thin but richer soils occur on the limestones around the coast. Light calcareous sandy soils are formed on beach ridges and slightly elevated beaches and flats. Mangrove swamps and paddy fields have deep, fine muddy or mucky soils.

Vegetation

Little previous information is available on the vegetation and, so far as known, no special studies of it have been made. Flint and Saplis are here quoted in full:

"A dense rain forest covers the entire island. Because of the heavy tree cover, the undergrowth is very light in most places. However, in areas which receive much sunlight a heavy undergrowth results, much of it bamboo. Vegetation on the terraces includes cultivated fields and grassland."

An as yet unpublished account by E. H. Walker, who visited the island on a plant collecting trip in 1951, describes the vegetation of the Iriomote as follows:

"The island is almost entirely forested, most of it by essentially the same broadleaved evergreen forest which covers the higher parts of northern Okinawa. Thus *Castanopsis*, *Quercus*, *Machilus*, *Actinodaphne*, *Neolitsea*, *Schima*, *Ternstroemia* and *Diospyros*, perhaps also *Cinnamomum*, are the dominating species, but especially the first. These forests have been relatively little cut, for the population is

small, the island being considered very unhealthy. Under Japanese control these forests were held as a forest reserve. The silted portions of the many estuaries and bays are mangrove swamps. When the land fills in and becomes too high for the tidal influence to maintain mangrove forests, *Pandanus* and associated species of the littoral forest take over. The banks of tidal streams are lined with trees including *Castanopsis luchuensis*, *Heritiera littoralis* (Sterculiaceae), *Pandanus*, *Arenga tremula*, *Macaranga* spp., *Ficus retusa*, *Styrax japonica*, *Rhododendron*, *Cerbera*, *Fraxinus*, *Barringtonia racemosa*, *Ardisia sieboldii* (Myrsinaceae), *Ilex* spp., *Schefflera octophylla*, *Textoria iriomotensis* (Araliaceae), *Symplocos*, *Syzygium*, and many others. There are also numerous shrubs, tree ferns, vines, and scattered mangroves where local conditions permit. The climbing pandanus, *Freycinetia*, is conspicuous. But the most outstanding remembrance of Iriomote's vegetation is the forest canopy of mixed broadleaved evergreen trees. The top surface is knobby and uneven, for many trees raise rounded crowns above the general level, the whole hiding the mountains like a verdant mantle. Second-growth forests have grown up where deforestation has occurred, except perhaps on some of the exposed headlands where grass-like growth with a few pines occurs."

The only other account of the vegetation seen was a report of a field trip to inspect the forest resources of the Ryukyu Islands, by Lt. Col. H. B. Donaldson, dated June 15, 1948, submitted as a memorandum for record to the Natural Resources Section, GGQ of Supreme Commander for the Allied Powers. Special attention was paid to the timber resources, past and current production and problems. Some information on vegetation was included, mostly in accord with that given here and adding little to it. Sizes of hardwood trees at altitudes above 600–800 feet are given as 2–3 feet. Important genera are listed. That *Paulownia* is considered an important component of the forest is notable.

As is seen from the paragraph quoted from Walker, almost the entire island is covered by a dense broadleaved evergreen forest. This is probably not montane rain-forest in the strict sense, but more nearly a moist-evergreen-forest, at least at middle altitudes. Information is lacking on its character at altitudes above 200 m. except that examination of high altitude aerial photos shows little significant variation. Sizeable areas of dwarf bamboo apparently exist on some of the higher peaks and slopes, at least near the northeast corner. The slopes are forested down to sea level except where there are vertical cliffs and on certain areas cleared by man.

This montane forest is generally of low stature, perhaps 10–15 m.

and has a closed dense canopy, making the undergrowth thin or absent. Many tree species enter into its composition, but in most areas *Quercus cuspidata* Thunb. (*Castanopsis cuspidata* (Thunb.) Schottley), is the most prominent species, recognizable from a distance by a rather dull, dark green color. In deep ravines and valleys the stature of the forest is greater and it is more luxuriant, with ferns and *Freycinetia* vines more abundant. Here it might more nearly be considered a rain-forest.

Steep slopes are abundantly marked by landslide scars, in varying stages of revegetation. These scars are numerous enough to have provided a chronologically continuous open habitat available for the persistence of pioneer species in the otherwise closed forest. They are mostly covered by a dense growth of *Gleichenia* and *Dipteris* ferns, which are light green against the dark green oak forest.

Along the northern half of the east coast the forest in places reaches the sea, but much of the coastal terrace is cleared and in grass. The seaward faces of truncated spurs are also treeless and grassy, giving a pattern of inverted triangular scallops of light green (probably *Imperata* or cogon grass) against the dark green of the forest.

The north coast is less disturbed, the forest reaching the sea except for intermittent flattish park-like terraces covered by grass and scattered trees, mostly pine. Headlands are wooded or scrub-covered. Conspicuous vertical cliffs, high on the slopes, seem bare of vegetation. Several large deep valleys appear to have larger trees and a more uneven canopy than on the ridges and slopes, where the canopy is smoother and finer textured.

Along parts of this coast there are erosion remnants of undercut elevated reef limestone. These are covered by a dense scrub, largely *Pandanus*.

The west coast is more heavily populated and the vegetation of the terraces, headlands, and valleys is disturbed and modified by man's activities. Here enough opportunity for observation was afforded to discern a fairly regular pattern in the existing vegetation.

Much of the actual coastline is made up of vertical sandstone cliffs up to 50 m. high, topped in places by terraces. These alternate with stretches of beach and beach ridge across valley mouths and with areas of low cliffs and terraces of extremely rough eroded limestone. Behind these features rise steep mountain slopes culminating in peaks and high ridges at altitudes of 200 to 400 m.

Here on the high slopes there is the usual oak forest, with lighter green landslide scars. In the deep valleys this forest is wetter and more luxuriant, with larger trees, *Quercus cuspidata* descending even to the water's edge. Ferns exist in great profusion, especially on

very steep slopes and bluffs. There are occasional tree ferns and many other very large ferns. *Freycinetia* festoons the trees, along with other vines, but epiphytes are not as abundant as would be expected from the general luxuriance of the terrestrial fern vegetation.

The river banks in their tidal portions are lined with *Barringtonia racemosa* (Willd.) Roxb., *Pandanus*, *Mallotus paniculatus* (Lam.) M.-A., and other swamp trees. A little way downstream from the head of tidal influence are flats which are covered by swampy thicket several meters high, principally of *Pandanus*, with some mangroves on the edges. The mangroves in these parts of the streams which are fresh water or almost so are mostly *Bruguiera conjugata* (L.) Merr. and *Lumnitzera racemosa* (Willd.) Willd., with some *Xylocarpus* and *Rhizophora*. Much of the area of these flats has been cleared and converted to paddy fields. Lower down the rivers, as saline and tidal influences increase, the *Pandanus* is more and more replaced by mangroves, the *Rhizophora* makes up a greater proportion of the vegetation. Well up the river the mangrove trees are 3-4 m. tall (above high tide level). Toward the river mouth their stature decreases as the mangrove swamp area increases, until just above the river mouths there may be large areas of mangrove, principally *Rhizophora*, between 1 and 2 m. tall. *Excoecaria agallocha* L., the poison mangrove, is generally common along the river margins the entire length of tidal influence. The poison sumac, *Rhus succedanea* L., is also found along much of the banks, except in the mangrove swamps proper. These two species cause dermatitis on contact with some people.

On ridges extending down toward the sea, especially near villages, the disturbance due to human activity becomes evident and the oak forest is gradually replaced by thicket with scattered fairly large pine trees, or occasionally by fairly extensive groves of pines. This gives way, lower down, to a dense, head-high growth of swordgrass, *Miscanthus floridulus* (Labill.) Warb., with scattered pines; *Pandanus* thickets on steep places and in ravines, there mixed with other shrubs and trees. The headlands and offshore islands may be covered by cogon grass, *Imperata cylindrica*, with or without pines and scattered *Pandanus* thickets. On some headlands there is *Miscanthus*, and on Amatori Bay, at least, some low hills overlooking the sea are covered with bamboo thickets.

Back of the villages and in the bottoms of small valleys are often small areas of rice fields and garden patches. The older villages have many trees along the streets and around the houses. Among these *Garcinia*, *Morus*, and *Calophyllum* are common. Other lowland areas back of the beach may be occupied by *Imperata* grass or by

mixed tangled thickets. Sand flats are characterized by littoral thickets of *Casuarina*, *Pandanus*, *Hernandia*, *Bischofia*, *Hibiscus tiliaceus* L., *Erythrina* and other trees. Low rolling hills on the terraces near the coast, if of sandstone, may be covered by coarse grass mixed with *Dianella*, *Gleichenia*, scattered shrubs and a few pines. If the hills are of limestone, they are covered by dense thickets in which *Ficus*, *Arenga*, *Pipturus*, *Hibiscus*, *Erythrina*, *Macaranga*, *Melanolepis*, *Pandanus*, *Mallotus*, *Pouteria*, *Cycas*, *Musa*, and *Alocasia* are prominent. Between the limestone outcrops are small cultivated patches of sugar cane and sweet potatoes. Terrace surfaces with more soil are generally farmed.

The sandstone cliffs are mostly bare, but with patches of scrub, mostly of *Pandanus* and *Scaevola*. Limestone cliffs and ledges are ordinarily covered by dense scrub of the above two plants but with an admixture of various other small trees and shrubs, notably *Diospyros ferrea*, *Pouteria*, *Hibiscus*, and *Carmona*, spiny difficult to traverse or climb.

On pitted rocks at the foot of the limestone cliffs at and just above high tide level is a special dwarfed vegetation of a compact diminutive shrub, *Limonium arbusculum* (Maxim.) Mak., a grass, *Ischaemum aureum* (H. & A.) Hack., and a number of small succulent halophytic plants such as *Hedyotis*, *Sedum*, *Angelica*, *Carmona*. This vegetation disappears abruptly where the rocks change from limestone to sandstone. Only one or two of these small plants are found on the bases of the sandstone cliffs, namely *Hedyotis* and *Ischaemum*, and there not at all commonly. In addition, though, several ferns, *Pteris*, *Sphenomeris*, and *Adiantum* inhabit the crevices in the sandstone.

The beach ridges, mostly of low dunes, are covered by a very characteristic scrub or scrub forest of *Scaevola*, *Pandanus*, *Hernandia*, *Pouteria*, *Guettarda*, *Hibiscus*, *Calophyllum*, *Allophylus*, *Premna*, *Wedelia*, *Messerschmidia* and occasionally *Casuarina*. This is very dense and ordinarily penetrable only by cutting. However, where the trees are large, especially where *Hernandia* and *Calophyllum* are dominant, the canopy is thick but undergrowth is thin or lacking and walking is easy.

At the top of the beaches is a narrow belt of low, mostly mat-forming plants, such as *Ipomoea pes-caprae* (L.) Sweet, *Ipomoea littoralis* Bl., *Spinifex*, *Vitex*, *Ischaemum muticum* L., *Sesuvium*, *Thuarea*, and *Chenopodium*. This vegetation attenuates into bare sand beach.

In the shallow water of the bays and on sandy parts of the roof flat are areas of sea-grass sod, of coarse *Enhalus* in water not exposed

by low tide, or of *Cymodocea* and *Thalassia* in shallower places. The mat of rhizomes is well buried in the sand. On rocky reef flats a growth of brown algae is in places conspicuous.

The above account presents only a most generalized picture and places may be found where it does not fit. It should be kept in mind that almost no work has been done toward adequately describing the vegetation.

A more detailed reconnaissance would be highly desirable before the lumbering operations contemplated by the Yaeyama Development Corporation produce significant inroads on the forest vegetation of the interior. Such a reconnaissance, to be effective, would require at least 3 months working time and adequate aerial photo coverage, preferably at 1:12,000 or larger scale. Work in the interior would be rigorous and difficult, and should be planned for the driest season. A motor boat in good working order and of shallow draught would be an absolute essential, as water transport is the only practical means of contact with the different coastal points from which access to the interior could be gained. Camping on the beach would be essential in order not to lose too much time in travel to and from the base camp.
