

## THREE MORE MANGROVE TREES GROWING LOCALLY IN NATURE IN FRESHWATER

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### SUMMARY

In Christmas Island (Indian Ocean) the mangrove trees *Bruguiera gymnorrhiza* (L.) Sav., *B. sexangula* (Lour.) Poir. (Rhizophoraceae) and *Heritiera littoralis* Ait. (Sterculiaceae) are found inland near freshwater springs at some 20–30 m altitude, far from the beach. It is concluded that the inland stands of these trees came into being during the upheaval of the island.

There is some doubt about the specific distinction of *Heritiera globosa* Kostermans from *H. littoralis*.

It is well known that mangrove plants can be grown outside their habitat in freshwater in greenhouses (Van Steenis, 1958). In the tropics this cultivation in a freshwater swamp is also successful in the Bogor Botanic Gardens, as Teysmann (1857: 368) initiated long ago and which can still be observed at the present day.

In nature the occurrence of mangrove plants inland in freshwater is rare and therefore new records are worthy of mention.

In my essay on the plant-geography of Java (1965) I have recorded the occurrence of coastal plants inland; it appeared that these localities are mostly salty places, salt wells or mineral springs, or places which are temporarily salty in the dry season (asinans) when salty water moves to the land surface through strong evaporation.

Among the species mentioned from Java there are two consistent herbaceous mangrove plants, viz. *Acrostichum aureum* Sw. and *Acanthus ilicifolius* L. Besides in salty inland localities they are also found in a number of freshwater localities which have been chemically tested and found to have the normal amount of minerals for freshwater.

I could record (1963) inland freshwater occurrence of a tree, viz. *Sonneratia caseolaris* (L.) Engl. in West New Guinea, along the banks of Sentani Lake, near Hollandia, at c. 75 m altitude, and along the banks of the Tami R., the outlet of the lake. This occurrence is clearly a relict from the time that Sentani Lake was a lagoon, which became an inland lake by secular tectonic rise.

Recently my attention was drawn to a casual remark in a singularly attractive, richly illustrated booklet by Howard Gray (1981) on the biology of Christmas Island (Indian Ocean), situated at some 300 km south of West Java, when he remarked (l.c.

48): 'A mangrove stand at Hosnie's Spring is apparently unique and of considerable biological interest.' This, and other springs, emanate at the junction where the permeable upper limestone cap of the island rests on the non-permeable basalt which forms the core of the island, the whole island being secularly raised. This is the so-called first terrace.

In an internal report on Christmas Island by A.N. Gillison (CSIRO, Canberra, Division of Land Use Research) it is mentioned that *Bruguiera gymnorrhiza* (L.) Sav. and *Heritiera littoralis* Ait. occur in such inland spring areas, which he suggested to be of brackish water. Correspondence with Mr. John Hicks, the present Conservator of Christmas Island, revealed that the chlorine content of the substrate mud is between 0.04 and 0.025%, a marked contrast with the c. 3% of that in seawater.

According to him the water is not different from spring water elsewhere on the island which is used for domestic drinking purpose.

By the courtesy of the Director of the Royal Botanic Gardens, Kew, I could study a specimen of each of these two species, kindly selected by Mr. L. L. Forman, all collected by Mr. D. A. Powell and correctly identified by Mr. Forman.

It seems interesting to put the data of the labels on record.

*Bruguiera gymnorrhiza* (L.) Savigny. *D. A. Powell 9*, coll. flowers and seedlings, 24-5-68. First Terrace, one mile south of Steep Point, 160 yards inland, at about 60–80 feet altitude, on basalt-limestone contact where fresh water provides an all-year round soakage for the small area, a stand of about 100 trees. Trees possess small breathing roots.

*Bruguiera sexangula* (Lour.) Poir. The same place. Four tubes with flowers marked no. 637 were sent by Mr. Powell to Mr. L. L. Forman. Of these Mr. Forman found that 13 belonged to *B. gymnorrhiza*, but 6 definitely to *B. sexangula*, which trees grow apparently mixed. Their identity was found correct by Dr. Ding Hou. The flowers were gathered from the ground, as it appeared impossible to collect directly from a particular tree, due to the fact that the stand is compact and the high canopy structure overlaps and interlocks.

*Heritiera littoralis* Aiton. *D. A. Powell 33*, coll. seedlings and loose fruits, 18-6-68. First Terrace, immediately below Ross Hill Garden, southern end, on a fault exposing basalt-limestone contact, at 60–230 ft altitude, a stand of about 200 trees, in an isolated group.

I checked the identity with the key provided by Kostermans (1959) and found some difficulty because in lead 9 (l.c. p. 473) one is asked whether the fruit has a 'rudder-like crest, no special terminal wing' leading to *H. littoralis*. This holds for one fruit of the carpological collection. However, another fruit of that collection has a distinct terminal curved wing of c. 1 cm long, and that leads to *H. globosa* Kostermans, an endemic mangrove species of Borneo. The two other fruits of the carpologica are precisely intermediate between the two mentioned above. This casts some doubt on the specific distinction of *H. globosa* from *H. littoralis*.

Kostermans stated that *H. globosa* is sometimes found far inland along the big rivers, but this holds for several other mangroves too. It does not indicate, however, that they are growing in freshwater, as in these rivers there is a lower body of salt

water which remains remarkably sharply demarcated from the freshwater layer over it. This body of salt water is according to Hardenberg (1937) in Tami R., South Borneo, some 90 km upstream; in larger tidal rivers it may extend still farther; it makes part of the normal hydrological regime of these Bornean lowland rivers. Hence, it is not always clear that these mangrove stands found in the fringe forest along these rivers root in salt or freshwater.

Finally it should be explained how these two mangrove trees arrived inland. The upward dispersal of the large and heavy nuts of *Heritiera* from the coast might eventually by diffusionists be ascribed as a rare instance of actual recent dispersal. But this idea seems idle, as such dispersal is impossible for the very large diaspores of the *Bruguiera*.

It must be concluded that in Christmas Island the same happened as in New Guinea with the *Sonneratia*, namely that the original stands in the back-mangrove could gradually adapt themselves locally to the soakage of freshwater during the secular tectonic rise of the island and became elevated and separated from the coastal mangrove fringe. Judging from the numbers of trees estimated the freshwater habitat is distinctly congenial to them.

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