Atoll research bulletin.
Washington, D.C. :[Smithsonian Press
https://www.biodiversitylibrary.org/bibliography/50708

no.312-329 (1988-1989):
https://www.biodiversitylibrary.org/item/123594

Page(s): Page 19, Page 20, Page 21, Page 22, Page 23, Page 24

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A HISTORICAL NOTE ON THE ENDANGERED SANTALUM BONINENSIS (SANTALACEAE) OF THE OGASAWARA ISLANDS: EARLY REPORTS BY TAKASI TUYAMA

BY

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ABSTRACT

Santalum boninensis (Nakai) Tuyama is an endangered plant species of the Ogasawara (Bonin) Islands of Japan. The early reports of this species made by the Japanese botanist Takasi Tuyama (1939, 1940) are presented for the first time in the English language, including his comments on the urgent need for conservation of the species.

CURRENT STATUS

The subject of this article is Santalum boninensis (Nakai) Tuyama, Botanical Magazine Tokyo 52(621): 467 (1938), with amplified description by Tuyama, op. cit. 53(625): 5 (1939); basionym: Exocarpus boninensis Nakai, Botanical Magazine Tokyo 43(513): 440 (1929). It is an endangered plant species of the present-day flora of the Bonin Islands. On Chichijima, the largest of the Bonin Island groups, S. boninensis occurs as a small shrub; on Hahajima, it grows as a large tree. S. boninensis is a hemiparasite; its host plant on Chichijima is Distylium lepidotum (Hamamelidaceae), and on Hahajima it is Hibiscus glaber (Malvaceae) (Woolliams, 1979; see also Ono & Okutomi, 1985, in which S. boninensis is listed). Its native habitat is restricted to seven localities on Chichijima and three localities on Hahajima. Each of these isolated populations has been reduced below critical size and cannot afford continual normal reproduction by spontaneous pollination (Ono et al., 1986). Interestingly, although Hibiscus glaber has not been included in an IUCN Conservation Category, Distylium lepidotum is classified as vulnerable. Various endemic plant species of the Bonin (Ogasawara) Islands are being cultivated at the Waimea Arboretum and Botanical Garden in Haleiwa, Oahu, Hawaii. However, S. boninensis is not currently in propagation at Waimea (K. Woolliams, pers. comm., 1988).

THE SETTING OF THE ISLANDS

The Bonin (Ogasawara) Islands form the southern part of a chain of islands stretching south from Japan. They consist of some twenty islands which lie between the parallels 26 30' and 27 40' N and between 142 00' and 142 15' E, with a total area of only 7500 ha. (27 sq. mi.). Geologically, the chain is continued to the south by the Volcano Islands (Kazan retto) and then by the Marianas.

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The Bonins may be divided into three groups (Tuyama, 1953):
1. The Parry, or Mukojima, Group to the north, consisting of four islets, with the highest flat-topped peak less than 100 m. (330 ft.) above sea level.
2. The central Beechey, or Chichijima, Group, consisting of eight islands, with the highest peak at about 219 m. (720 ft.) above sea level.
3. The Bailey (Coffin), or Hahajima, Group to the south, consisting of nine islands, with the highest peak about 512 m. (1680 ft.) above sea level.

The Bonins are believed to have been formed during Tertiary times (Asami, 1970) through the eruption of subterranean volcanoes. Due to severe marine erosion, the islands are now steep and hilly, with little level land, and some of the smaller islets consist merely of bare rock.

Although the island group is to the north of the north-east trade wind belt, it lies within the warm Japan Stream. Thus the Bonins are subtropical with an annual mean temperature of 23.0 C (73.4 F) (Ono et al., 1986) as compared to other places at the same latitude. There is neither snow nor frost, and the temperature never falls below 5 C (41 F). The islands are usually situated under a stable oceanic high atmospheric pressure system known as the "Ogasawara High Pressure."

The Bonin Islands are isolated from other landmasses by more than 1,000 km. (620 mi.) and, as noted by Ono et al. (1986), have never been historically connected to any landmass. The flora is thought most closely related to that of Indo-Malaya and South China; but, as stated by Tuyama (1953), "an old and latently strong connection between the Oceanic and Polynesian floras must be noticed." Forests are dominated by subtropical hardleaf evergreen trees and shrubs such as those listed in Ono et al. (1986) and Tuyama and Asami (1970): Machilus, Morus, Hibiscus, Pouteria, Ochrosia and Boninia, the latter a rutaceous plant and one of the islands' two endemic genera of flowering plants. About 500 species, including some varieties, of vascular plants have been reported. Of these, about 43% are considered endemic (Yamazaki, 1970), or more than 50% of the shrubs and trees (Tuyama, 1970). In their 1979-1982 survey, Ono and Kobayashi (1980, 1985), Ono et al. (1986) recorded over 260 species and varieties of vascular plants of which they considered 112, or 43.1%, to be endemic. Additional floristic studies of the islands are referenced by DeFilipps (1987).

HISTORICAL PERSPECTIVE

The Bonin Islands are thought to have been first sighted by the Spaniard Villalobos around 1543 (Cholmondeley, 1915), but Spain never pushed her claim. The earliest well-authenticated visit by the Japanese was that of the merchant Chozaemon in 1670. Following this visit, the islands were named the Gunin, or Uninhabited, Islands; the later Western name of Bonin is probably a corruption of Gunin (Naval Intelligence Division, 1945).

The first authenticated Western visitors were American and English whalers in the 1820's. Of the later visits, one of the most important was that of Captain Beechey in 1826, whose account of the islands long remained one of the principal sources of information; during his visit he proclaimed British sovereignty on the group. Commodore Perry, on his voyage of 1853, disregarded the British claim and purchased land for an American coaling station; in the process he drew up a simple code of laws for the settlers.

After an unsuccessful Japanese colonizing venture in 1861, a second expedition arrived in 1875 and renewed a declaration of Japanese sovereignty. Two years later the Bonins were formally annexed, with neither Britain nor the United States disputing the action. All of the settlers were offered Japanese citizenship, but only Japanese settlers were allowed to enter from that time on. During this period of colonization, as mentioned by Tuyama (1953), "Owing to the dense population and the inadequate forestry administration, the original forest of the Bonin Group was mostly destroyed. Of the total area, 20% is cultivated field, 10% grassy field or barren rocks, 65% bushy wood, and the tall forests which maintain the original features are seen only in restricted areas in Peel and Bailey Islands."

During World War II, the inhabitants were removed from the islands. United States military occupation followed the war along with settlement by some European inhabitants. According to Ono et al. (1986), for the 25 years during and after the war, while almost entire islands were left uninhabited, many introduced weeds, trees and escaped crops invaded the islands, destroying the original vegetation. Ono goes on to say "After restoration of the islands to Japan in 1968, former inhabitants began to return and the population has been increasing gradually; now about 1800 people live on the two islands of Chichijima and Hahajima. Since the restoration to Japan, most parts of the islands have been designated as a National Park. However the vegetation of the islands is still under heavy pressure from human impact. The most important factors are over-grazing by naturalized sheep, reduced water supply, and competition with naturalized or escaped weeds and crops."

HISTORICAL LITERATURE AND TUYAMA'S ORIGINAL REMARKS ON S. boninensis

The first official Japanese expedition to the Bonin Islands was made by the Tokugawa government, soon after the first recorded reports of the islands made by castaways in 1670. A report of this expedition was never published, due to Japan's strict seclusion policy; the Tokugawa government did not wish the population to be informed of foreign affairs. The first published account of the Bonins was not made until 1786 by the patriot Shihei Hayashi, whose book San Goka Tsu Ran Dzu Setsu (A General Sketch of the Three Countries, with Illustrations) included a short account of the islands. A copy of the book was taken out of Japan and brought to Siberia by a Dutchman, and then translated by the German philologist J. Klaproth and published in the French language in 1832. An extract from this translation appeared in Francis Lister Hawks' Narrative of the Expedition of an American Squadron to the China Seas and Japan, 1856. This translation refers to a "red sandal wood" tree in the Bonin Islands.

The next person to become interested in the presence of this sandalwood was the Japanese botanist Takasi Tuyama. Although the first mention of a sandalwood in the Bonins may have been as early as 1832 (Klaproth translation), Tuyama notes that this is actually a "mistranslation" which refers instead to Melia (Meliaceae), rather than a species of Santalum. Presumably, in the original Japanese publication by Hayashi in 1786, the plant in question also was a mahogany misrepresented as a sandalwood. Therefore, no true Santalum was known to occur in the Bonin Islands until the "Exocarpus," later transferred to Santalum, was described by Nakai in 1929 following his field observations of it in 1928 (Tuyama, 1951). Following are relevant, edited excerpts from Tuyama's 1939 and 1940 articles describing and commenting upon the original discovery of S. boninensis, published for the first time in English. Dr. F. Raymond Fosberg (1950) has described the circumstances under which the translations of Tuyama's articles were made.

"It is quite interesting to find a species of Santalum within the dominion of Japan; particularly in war time when importation of sandalwood is restrained, its discovery attracts much attention. It was first discovered by Mr. H. Toyoshima, Director of Ogasawara Forestry Office. He guided Prof. Nakai, who was coaching students of Tokyo University at the time, to Kominato, Fukurosawa-mura, Chichi Shima, where Ligustrum ovalifolium is said to occur. It was a small rocky hill, situated near the sea and where Commodore Perry landed years ago. There was nothing of much interest except Hibiscus tiliaceus. The plant in question was a small shrub with opposite leaves. Prof. Nakai at once assumed it belonged to Santalaceae, and confirmed it is parasitic on the root of Hibiscus tiliaceus. He afterwards found many more individuals of the same plant on rocky hills between Kiyose to Okumura. On the herbarium specimens sent by Mr. Toyoshima, a name, Exocarpus boninensis, was given. Afterwards, I have a recollection of having a branch given to me by Prof. Nakai himself at Kominato.

"Several years later I was entrusted to investigate the flora of the Bonins, but did not have an opportunity of seeing fresh flowers. In the spring of 1936, specimens of flowers were sent by Mr. M. Okabe, Technician at the Forestry Office of the Island. On examination, a question arose whether

the plant belongs to Santalum. The fact was informed to Mr. Okabe, and to Dr. K. Watanabe who is a student of parasitic plants; meanwhile I was taking a cautious attitude. In May the following year ample material was sent by Mr. Okabe, and as a result it was confirmed that the plant belongs to Santalum. Having been sanctioned by Prof. Nakai, a new combination Santalum boninense was published."

TUYAMA (1939) ON THE DISTRIBUTION OF Santalum boninensis

"Observations of S. boninensis have since been extended by Mr. Toyoshima and others, and according to Mr. Okabe's investigation, it occurs on Chichi Shima: Mikadsuki-yama, Miyano-hama, Kiyose, Oku-mura, Asshi-yama, Fukiage-dani, and Renju-dani; on Haha Shima: Higashi-dai and Minami-saki, and there are 616 individuals more than 1 m. tall. This species occurs, like other species of Santalum, on dry, stony hills with good drainage and in full sun.

"The host plants are Hibiscus tiliaceus (reported by Nakai), Osteomeles lanata, Rhaphiolepis integerrima, Juniperus taxifolia, Distylum lepidotum (so far by Tuyama), Wikstroemia pseudoretusa, Osmanthus insularis, Hibiscus glaber, Pandanus boninensis, Trachelospermum foetidum, Miscanthus boninensis (so far by Okabe). (It seems the plant is not selective as to host, but so far Sideroxylon ferrugineum growing near by has not been confirmed to be a host.)"

TUYAMA'S PLEAS FOR CONSERVATION OF S. boninensis

"As a rule, the plants of an island isolated in an ocean, and having no connection with other lands, present a unique aspect. The older the island the longer the period of isolation, and therefore, the stronger the degree of uniqueness. The Galapagos Islands near Central America, Islas Juan Fernandez off the coast of Chile, and the Hawaiian Islands are regarded as examples of this. If we are to pick an example among the Japanese Archipelago, the Bonin Islands present a good one. Such isolated groups of islands are usually regarded as remnants of larger islands or remains of a continent. On such islands, one often finds numerous rare species of plants, but the number of individuals is rather small and the area of distribution is limited to certain valleys or mountain summits.

"The plants of this genus (Santalum) have been prized from olden times in China and India as the material of Buddhistic images or perfume, and on that account merchant ships of many countries, contending with each other, went over to Fiji and Hawaii to obtain material. It is recorded that some of them even carried on war with the aborigines for the purpose. It has therefore resulted in reckless cutting. In Hawaii there occur eight species of this genus, and they were apparently fairly abundant, but at present no large specimens are seen, and they stand on the brink of extirpation. That of Juan Fernandez (S. fernandezianum) has been totally annihilated. The Bonin species has been found comparatively recently, perhaps due to the less degree of fragrance, yet it is doubtless necessary to conserve it.

"Santalum boninense is a very interesting species from the systematic and phytogeographical points of view. If analysis of its properties is favorable, it will be of industrial importance, and requires good protection. In Formosa the cultivation of S. album is said to do rather poorly, which may be improved by comparing with S. boninense in the Bonins. The Santalum on Juan Fernandez became extinct, without the knowledge of cause, within one year, and that on Hawaii and Fiji has been almost exterminated as a result of the indiscriminate felling, and young saplings only are seen now. According to Rock (1916), propagation by seed has not been successful on Hawaii.

"According to An Outlook of the Bonin Islands and Forests edited and published by the Bonin Government, 1914, "In the 2nd year of Bunkyu (1862) 40 immigrants arrived from the Island of Hachijo, they, from the fear of vermin in the luxuriant forests, destroyed the forests by fire. On the other hand, the Japanese Government, with a view to acting up to the principles of reclamation, let the immigrants select land on their own accord, provided them with bounty, gave them agricultural

implements and household utensils, paid building expenses or supplied them with staple commodity. Thus, the treatment of the immigrants went beyond bounds, resulting in a vicious custom. Many of them, therefore, received bounty on the pretext of reclamation, acquired precious wood, or burned forests to grow the Judas ear (or Jew's ear, the edible fungus Auricularia auricula-judae), or felled priceless trees secretly. Thus, the forests of the Bonins had been almost completely disafforested during the 20 years from 1876 up to 1899, when forest management was started." According to Mr. Okabe, "An old man, who has been residing on these islands for years, says, about 1890-1891 when sugar manufacture sprang up and much fuel was required, he remembers having burnt some wood with an aroma."

"If a comparison is made (between such deforestation and the original state of the vegetation) with the Narrative of the Expedition of an American Squadron to the China Seas and Japan (1856), a striking difference can be noted. It runs as follows: "The course was up the ridge of the hill, and as it continued to the summit the vegetation became more and more profuse, until the expanding tops of the palms, the crowding together of the trunks of the trees, and the dense network of the hanging vines, so blotted the sun that the path was covered with a deep shade, through the darkness of which the eye could hardly penetrate to a greater distance, in any direction, more than twenty or thirty feet."

Recent observations (Woolliams et al., 1979; Ono et al., 1986) have confirmed that S. boninensis has survived to the present time in its precarious position as a member of the Ogasawara flora, and it continues to require protective measures to ensure its existence in the future.

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