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Distribution, Growth Environment and Utilization *of Metroxylon* Palms in Vanuatu

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Abstract A filed survey was made in the northern and central islands of Vanuatu to clarify the distribution, growth environment and utilization of *Metroxylon salomonense* (Warb.) Becc. and *M. warburgii* (Heim) Becc.. Four populations of *M. salomonense* on Gaua in the Banks Islands and Malakula were found in this survey: one at the eastern site of Gaua and two at the northern site and one at the southern site of Malakula. *M. warburgii* grew on Gaua, Espritu Santo and Malakula. *M. salomonense* and *M. warburgii* were called as *takur dun* and *tagura*, respectively on Gaua. Contrarily *Metroxylon* palms were generally called as *natangura* on Malakula, while *M. salomonense* was occasionally recognised as wild *natangura* in an area in southern Malakula. On Espritu Santo, *M. warburgii* only distributed and was called as *natangura*. The soils at the growing sites of both *M. salomonense* and *M. warburgii* were well-drained, however soil moisture condition seemed to fulfill the water requirement of *Metroxylon* palms at each site. Native people had used sago (starch extracted from pith inside trunk) as an emergency food until the 1950s at least on Gaua, though sago was not used at all the sites. The most important contemporary use of *Metroxylon* palms is for house construction material such as thatch (atap) in Vanuatu and *M. warburgii* is cultivated entirely to harvest the leaves for making thatch.

Key words: Distribution, Growth Environment, *Metroxylon salomonense*, *Metroxylon warburgii*, Utilization, Vanuatu

ヴァヌアツにおける *Metroxylon* 属ヤシの分布と生育環境ならびに利用形態

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要旨　ヴァヌアツの北部および中部諸島において，*Metroxylon salomonense* (Warb.) Becc. と *M. warburgii* (Heim) Becc. の分布，生育環境および利用形態を調査した．*M. salomonense* は北部のバンクス諸島に位置するガウア島の東部地域で 1 個体群，中部のマラクラ島では北部地域に 2 個体群，南部地域に 1 個体群の計 4 個体群の生育が確認された．一方，*M. warburgii* はヴァヌアツ北・中部のいずれの島でも一般的に生育がみられた．ガウア島においては，*M. salomonense* と *M. warburgii* は *takur dun*，*tagura* とそれぞれ呼ばれているのに対して，マラクラ島では両 *Metroxylon* 植物は通常 *natangura* と呼ばれていた．しかし，マラクラ島南部の一部地域では，*M. salomonense* を wild *natangura*

として区別している例もあった．エスプリット・サント島では *M. warburgii* のみ認められ，*natangura* と呼ばれていた．各島とも，*Metroxylon* の生育地土壌は水分条件が十分であり，かつ排水は良好とみられた．現在，いずれの地域においてもサゴ(ヤシデンプン)の利用はみらないが，少なくともガウア島では 1950 年代までは救荒食として利用されていた．最も一般的な利用は屋根葺き材(アタップ)などの建築資材としてであり，*M. warburgii* はもっぱら屋根葺き材を作る葉を得るために栽培されている．

キーワード　ヴァヌアツ，生育環境，分布，*Metroxylon salomonense*，*Metroxylon warburgii*，利用

Introduction

The genus *Metroxylon* is divisible into two sections, that is, sections *Metroxylon* (*Eumetroxylon*) and *Coelococcus* (Beccari 1918, Rauwerdink 1986). The only species thought to occur in Vanuatu is *M. warburgii* (Heim) Becc., while it has recently been reported by Dowe (1989) that *M. salomonense* (Warb.) Becc. is also found in Vanuatu. Two species of section *Coelococcus, M. warburgii and M. salomonense*, are distributed in Vanuatu (Dowe 1989, Dowe and Cabalion 1996). There are some reports on the biology of *Metroxylon* palms growing in Vanuatu and the surrounding area (Dowe 1989, Dowe and Cabalion 1996, McClatchey 1999, Rauwerdink 1986). According to their findings, *M. warburgii* and *M. salomonense* in Vanuatu can be identified by branch of inflorescence, plant size (trunk length and diameter), shape of fruit and some characteristics of leaf and leaflet. However, few studies exist of the agronomic feature of *Metroxylon* palms in Vanuatu. We made a field survey to clarify the ecology and growth characteristics of *Metroxylon* palms in the northern and central islands of Vanuatu. Here, we report the distribution, growth environment, vernacular name and utilization of *M. salomonense and M. warburgii* in Vanuatu.

Research Sites and Plant Materials

A field survey was made at seven sites in the northern and central islands of Vanuatu in August 2000: two sites on Gaua in the Banks Islands, one site on Espritu Santo and four sites on Malakula (Fig. 1). Location of research sites, plant materials and their vernacular names at each site are shown in Table 1. Gaua 1 site was selected to harvest both *M. salomonense* and *M. warburgii* according to the suggestion by a local guide and Gaua 2 site was incidentally selected because we found a newly-cut palm. The site on Espritu Santo was randomly selected from a palm growing area owned by Department of Agriculture to collect plant material of *M. warburgii*. Four sites on Malakula were selected to observe both *M. salomonense* and *M. warburgii* according to information from a preliminary survey conducted by Ala and his colleagues (unpublished). Each species was identified by observing the morphological characteristics especially in the difference reported by Dowe (1989) and Dowe and Cabalion (1996) with the suggestions by the local staff of Department of Forests.

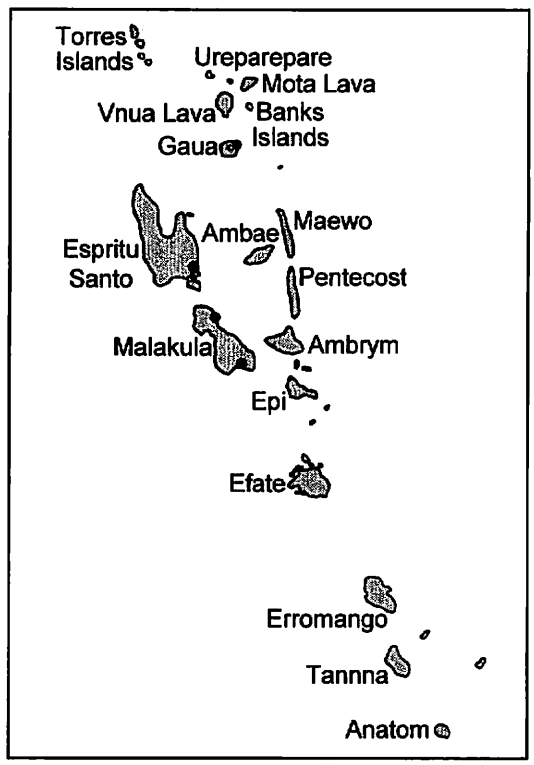

Fig. 1 Research area in Vanuatu.

Table 1 Research sites and plant materials.

Site	Latitude; Longitude	Alt. (m)	Sample	Species	Vernacular name
Gaua 1	14°15′S; 167°36′E	5	GA1–1	*M. salomonense*	*Takur dun*
			GA1–1b	*M. salomonense*	*Takur dun*
			GA1–2	*M. warburgii*	*Tagura*
Gaua 2	14°14′S; 167°35′E	10	GA2	*M. warburgii*	*Tagura*
Espritu Santo	15°29′S; 167°11′E	55	SAN1	*M. warburgii*	*Natangura*
Malakula 1	16°02′S; 167°15′E	355	MAL1	*M. salomonense*	*Natangura*
			MAL2	*M. salomonense*	*Natangura*
Malakula 2	16°02′S; 167°15′E	350	MAL3	*M. salomonense*	*Natangura*
Malakula 3	16°07′S; 167°27′E	3	LAT1–3	*M. warburgii*	*Natangura*
Malakula 4	16°06′S; 167°25′E	0	LAT2	*M. salomonense*	*Wild natangura*

Fig. 2 *M. warburgii* (GA1–2: left) and *M. salomonense* (GA1–1b: right) on Gaua.

Distribution and Growth Environment

1. Distribution

We found four populations of *M. salomonense* on Gaua in the Banks Islands and Malakula: one population consisted of two adult palms, i.e. palms having inflorescence, at the eastern site of Gaua (Gaua 1); two populations at the northern site of Malakula, one population consisted of two adult palms and four young palms before trunk formation (Malakula 1), and the other one population consisted of one young palm having trunk 1 m in length and two young palms before trunk formation (Malakula 2); one population consisted of two adult palms and three young palms before trunk formation at the southern site of Malakula (Malakula 4) (Table 1). Dowe (1989) and Dowe and Cabalion (1996) reported that *M. salomonense* grows on the islands of Vanua Lava and Ureparepare in the Banks Islands. Through this survey, it was confirmed that *M. salomonense* grew also on the other island of the Banks Islands and the central island. According to Dowe (1989), *M. warburgii* grows on the islands of Vanua Lava, Espritu Santo, Malakula, Pentocost, Erromango and Efate, occurring naturally on most islands between Tanna and the Torres Islands. We also found populations of *M. warburgii* in many sites on Gaua, Malakula and Espritu Santo. Although we did not conduct a field survey on Efate, we found young seedlings of *M. warburgii* at a local market in Port Vila (refer to the following section for further details).

The difference in morphological characteristics between *M. salomonense* and *M. warburgii* is apparent after trunk formation. *M. salomonense* is larger than *M. warburgii* in palm size such as trunk length and trunk diameter, then rachillae are pendulous in *M. salomonense* but erect in *M. warburgii* (Dowe 1989, Dowe and Cabalion 1996). Referring to this information on morphological difference, it was easy to identify each species in this survey. Except for Gaua 1 site, the population of *M. salomonense* at each site was distant from the population of *M. warburgii*. Besides, the population of *M. salomonense* at Gaua 1 site included only adult palms. Fig. 2 shows *M. salomonense* and *M. warburgii* on Gaua (Gaua 1).

2. Growth environment

Referring to the soil environments of *Metroxylon* palms under our study, Gaua soil with heavy texture derived from Quaternary volcanics, Espritu Santo soil with gravelly surface from uplifted coral limestone and Malakula soil with dark and heavy clayey texture from basic volcanic rocks, respectively. Elevation of the research sites varied from 0 to 355 m above the sea level (Table 1). Gaua 1, Gaua 2, Malakula 1, Malakula 2 and Malakula 3 site were area remote from the mainstream of life, and Espritu Santo and Malakula 4 site were near populated area. Malakula 3 and Malakula 4 site were close to the coast. According to Dowe (1989) and Dowe and Cabalion (1996), on Vanua Lava, a small population of *M. salomonense* occurs on the well drained southeastern coral terrace fringed with mangroves (*Rhizophora sp.*) at 1–5 m a.s.l.. They also reported that *M. warburgii* grew in colonies in swamps, bordering watercourses, seepage areas to well drained slopes and coral terraces from sea-level to 500 m a.s.l., usually as a semi-emergent but occasionally as an emergent component. In this survey, the populations of *M. salomonense* were found at 0 to 355 m a.s.l., and the populations of *M. warburgii* were found at 5 to 55 m a.s.l.. The north-easternmost island including Gaua get more than 4,000 mm of rainfall per year, but those in the south receive just over half and Espritu Santo is deluged by 2,300 mm per year on average (O'byrne and Harcombe 1999). The dry season is from May to November and the rainy season is from December to April in Vanuatu. This field survey was conducted in mid dry season. The soils at the growing sites of both *M. salomonense* and *M. warburgii* were well-drained, however soil moisture regime seemed to fulfill the water requirement of *Metroxylon* palms then throughout the year at all the sites.

Vernacular Name and Utilization

1. Vernacular name

Vernacular names of *Metroxylon* at each site are shown in Table 1. According to Cabalion (1989),

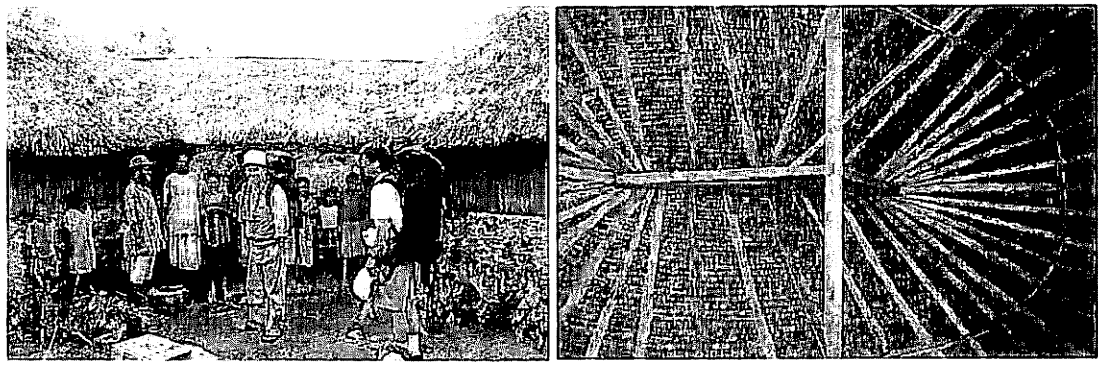

Fig. 3 Bungalow used as base camp on Gaua. The roof was thatched using leaflets of *Metroxylon* palm.

Metroxylon has many names throughout the Archipelago. Dowe and Cabalion (1996) reported common names and vernacular names of *Metroxylon* in Vanuatu as follows: *natangura* or *natankore* (common name) and *bia* or *naru* (vernacular name) for *M. salomonense; natakura, natangura* or *natangora* (common name) and *nut, net, nëtato, natalawa, talawa, doll'ou, tangura, tangurai, tangula, tsuku, wataghor, tangara, nyat, sökora* or *notah* (vernacular name) for *M. warbrgii*. In this survey, we confirmed that *M. salomonense* and *M. warburgii* were called as *takur dun* and *tagura*, respectively on Gaua. Contrarily *Metroxylon* palms were generally called as *natangura* on Malakula, while *M. salomonense* was occasionally recognised as wild *natangura* in an area in southern Malakula. On Espritu Santo, *M. warburgii* only distributed and was called as *natangura*.

2. Utilization

Trunk

Sago, i.e. palm starch extracted from pith inside trunk, was not used at all the sites. Dowe (1989), Cabalion (1989) and Dowe and Cabalion (1996) reported that the pith of *Metroxylon* is not extracted as a source of raw carbohydrate in Vanuatu. On the other hand, Cabalion (1989) introduced the use of *Metroxylon* as a food source in Vanuatu according to the literature as follows: the use of *Metroxylon* starch was only a recently introduced practice in Vanuatu (Guillaummin); *M. warburgii* was used as a food plant in Vanuatu, but without further details (Jardin); the species was cultivated as well as occurring naturally (Schmid, Flora of Erromango); the starch was extracted in remote localities (Guiart). Barrau (1959) noted that on Pentecost and Tanna, the extraction of starch can be encountered and then mentioned that the presence of *Metroxylon* in Vanuatu was due to its introduction by man as a food source.

Through this survey it was confirmed that sago had been used until the 1950s at least on Gaua. According to a farmer who has owned a palm growing area on Gaua, native people had used sago of *Metroxylon* palms as an emergency food when major crops such as taro or yam had been damaged by cyclone or the other hazards. The usual cyclone season is December to March in Vanuatu (on average 2.5 cyclones a year), and any given part of the country receives some damages each year from either wind or rain, which makes cyclones by far the country's worst natural hazard (O'byrne and Harcombe 1999). The native people had dissolved sago with hot water and added soup with vegetables and/or beans. Their cooking style of sago was considered to be similar to *sinongi* or *papeda* in the eastern archipelago of Indonesia.

Leaf

Leaves of *Metroxylon* palms were used for thatch in traditional houses (Fig. 3). Native people make thatch (atap) using leaflets of *Metroxylon* palms and stem of *Miscanthus*. Dowe (1989) and Dowe and Cabalion (1996) also reported that the use of leaflets of *Metroxylon* palms for thatch in Vanuatu. On Gaua, thatch 2 m length was 50VT (VT: vatu, monetary unit in Vanuatu, 100VT = US$0.73 in August 2000), that was the same value with 500 g of pol-

Fig. 4 Seedlings of *M. warburgii* sold at a local market near the port in Port Vila, Efate.

Fig. 5 Fallen fruits in the forest of *M. warburgii* on Malakura.

ished rice (cv. Calrose) imported from Australia. To prevent insect, thatches are sometimes soaked in seawater prior to the use. On the other hand, petiole and rachis removed the leaflets are often used as a rafter. The rafter made of petiole and rachis is found in northern Pentecost according to Cabalion (1989). Moreover, he introduced that the leaves are used for making tile, basket and matting on Pentecost (Cabalion 1989). However, we did not find such use of leaves of *Metroxylon* palms at any sites in this survey. Parts of leaves of *Metroxylon* are used to make brooms, string and for grater (to prepare banana and taro for *lap lap*: refer to the following section for further details) (O'byrne and Harcombe 1999). The most important contemporary use of *Metroxylon* palms is for house construction material in Vanuatu.

Fruit

Endosperm of *Metroxylon* seed is very hard and called as palm ivory. Palm ivory of *M. amicarum* (H. A. Wendl.) Becc. (ivory nut palm) has been used as a material for button and the other handcrafts in the Caroline Islands. Recently, people in Vanuatu have used the endosperm (palm ivory) of *M. warburgii* as a carving material. A cottage industry based on the carving of *natangura* seeds into jewellery and ornaments has appeared in Port Vila (O'byrne and Harcombe 1999). This is a new form of art in Vanuatu and is called as hand-carved *natangura* jewellery. Besides, traditional carvings are done in wood or bone in Vanuatu. Many of the images depicted in the contemporary hand-carved palm ivory of *M. warburgii*, such as traditional fishhook or some items designed from nature and custom, are reminiscent of traditional carvings (Island Spirit, Issue 11. Air Vanuatu (Port Vila) 20–21, June 2000). Developed by the Foundation for the Peoples of the South Pacific, this new industry aims to increase employment opportunities for young Vanuatuan living in the capital (O'byrne and Harcombe 1999). Dowe (1989) also reported that the hard endosperm of *M. warburgii* is occasionally used as vegetable ivory. Another new industry is the sale of *natangura* seeds to nurseries worldwide (O'byrne and Harcombe 1999).

Seedling

Young seedlings of *M. warburgii* were sold at the local market 'Bon Marche' next to the port in Port Vila (Fig. 4). The price of seedling was 100VT per plant, which was the same as that of 1 kg of polished rice (cv. Calrose) imported from Australia or 400 g of taro harvested in rural area on Efate. Dowe (1989) mentioned that *M. warburgii* is cultivated on Futuna and Aneityum. People on Efate have used the seedlings as a planting material to cultivate and then harvest leaves for making thatch.

The seedlings were sold as the planting material, which was considered to relate with propagation characteristics of *M. warburgii* that can be propagated from only seeds. This is different from sago palm (*M. sagu* Rottb.) that can be propagated from both offshoots (suckers) and seeds. Germination of

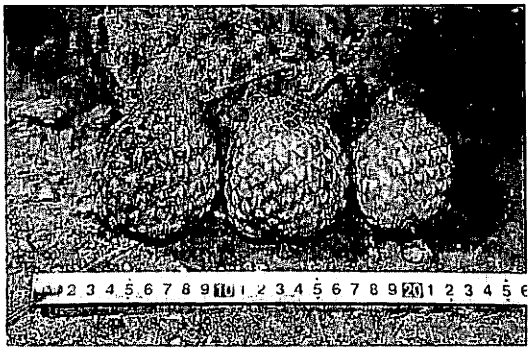

Fig. 6 Germinated fruits on the tree of *M. warburgii* prior to falling.

sago palm seed is generally poor (Alang and Krishnapilly 1986, Ehara et al. 1998, 2001, Flach 1984, Jaman 1985, Jong 1995, Jonson and Raymong 1956). Contrarily, Cabalion (1989) also reported that *Metroxylon* in Vanuatu germinates very easily.

Many fruits that fell off from the tree were found in the forest of *M. warburgii* on Malakula, and then we recognised that almost all the fruits germinated (Fig. 5). Moreover, we found some fruits germinated before falling (Fig. 6). It was therefore considered that *M. warburgii* bore viviparous seeds. Through this survey it was clear that seed of *M. warburgii* showed the high germinability. According to staff of Department of Forests, Malakula, the fate of seedlings is still by chance. The survival of very young seedlings may be attributed to the season, and its survival percentage in the dry season will be low compared with that in the rainy season.

Discussion and Conclusion

As described above, the use of sago (palm starch) was not often even during the 1950s in Vanuatu. This situation may be related with the traditional dietary habit there. Taro and yam are the most important staple food in Oceania (Bellwood 1978) and the cultivation of root crops flourishes in Melanesia (Yabuuchi 1972). About 80% of the population in Vanuatu primarily engaged in subsistence farming of food crops such as taro and yam (O'byrne and Harcombe 1999). One of the most popular daily foods in Vanuatu is *lap lap* that is a sort of pudding of yam and/or banana cooked between two stones. Except for taro and yam with banana, most villagers in Vanuatu produce cash crops such as coconut (for copra), cacao, kava and vegetables as well (O'byrne and Harcombe 1999). Copra and kava are the major export earners, worth 40.5% and 21.1% of total export in 1998, respectively, according to Vanuatuan Reserve Bank. On the other hand, the Vanuatun Government recognise the importance of *M. warburgii* as thatching material and recommend to cultivate *M. warburgii*. Furthermore, the new industries such as *natangra* jewellery using *Metroxylon* seeds and the sell of the seeds to nurseries are expected to increase employment opportunities.

According to Cabalion (1989), there appears to be little use of *Metroxylon* as a medicinal plant in Vanuatu. Moreover, he introduced that *Metroxylon* was used as a source of starch as well as a source of salt on Espritu Santo (Cabalion 1989). Edible starch had been obtained after extraction from crushed pith with water and removal of floating salty matter which was later used as condiment in cooking (Cabalion 1989). During the 1940s native people from interior of Espritu Santo had got salt from the pith of *Metroxylon* palms (Cabalion, personal communication). These utilization methods of *Metroxylon* palms for salt as well as starch might be specific in Vanuatu. However, we could not confirm such use in detail through this survey. Townsend et al. (1973) reported that the Sani-Hiowe people of the Wogamus River in New Guinea have developed a technique for preparing a salt ash from the midribs of the sago palm. We have been analysing the mineral content of each organ. The next report will consider in detail the mineral nutrients of the *Metroxylon* palms growing in Vanuatu.

Dowe (1989), Dowe and Cabalion (1996) confirmed the distribution of *M. salomonense* to the Banks Islands located in the northern part of Vanuatu, but common throughout the Solomon Islands and Bougainville Island of eastern Papua New Guinea. *M. warburgii* occurs naturally on most islands in Vanuatu, as well as the Santa Cruz Group of the Solomon Islands (Dowe and Cabalion 1996). From this survey, the distribution of *M. salomonense* is

limited as small populations on the northern island (Gaua of Banks Islands) and the central island (Malakula), and *M. warburgii* is distributed on all the islands where we visited. Dissemination of *Metroxylon* species through the south-west Pacific has been enhanced by the trading patterns and migrations of Melanesians and Polynesians who undoubtedly have introduced these useful plants to areas where they may not have been previously growing (Barrau 1960). The selection of superior wild forms which are preferred for thatch and other leaf uses had been recorded (Yen 1982). We have got an interesting information from this survey about native people's preference of *Metroxylon* species for using the leaf. According to a farmer who has owned the *Metroxylon* palms growing site at the southern site of Malakula (Malakula 4), inhabitants there do not prefer to use the leaf of *M. salomonense* because of its less strength. In addition, the growing sites of *M. salomonense* are located in remote places which are difficult to access except for Malakula 4 site. Considering these facts, the differences in distribution and growing area including size of population between *M. salomonense* and *M. warburgii* in Vanuatu might be attributed to their origin and distributors' preference for utilization.

Through this field survey, it is confirmed that *M. salomonense* distributes also on Gaua of the Banks Islands and Malakula, and *M. warburgii* grows widely in the northern and central islands of Vanuatu. The soils at *Metroxylon* growing sites are well-drained, however soil moisture condition seems to fulfill the water requirement of *Metroxylon* palms at each site. Moreover, the most important contemporary use of *Metroxylon* palms is for house construction material in Vanuatu, and *M. warburgii* is cultivated to harvest leaves mainly for making thatch.

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