A New Species of *Ptychosperma* from Halmahera, North Moluccas

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1. The typical ultramafic heath forest in Halmahera Island, North Moluccas with the crown of palm *Hydriastele* sp. towering up above the forest canopy.

This most attractive species of *Ptychosperma* has recently been discovered in Halmahera, North Moluccas. The combination of morphological characters and its area of distribution make this new species most distinctive. It is also very decorative and would make a fine ornamental.

2. *Ptychosperma halmaherense*, showing slender and solitary habit and growing on steep terrain.

As part of an environment impact assessment undertaken in the Maba-Ferro Nickel Project, in Halmahera Timur, North Moluccas, I had the privilege to join the team as botanist to carry out the initial survey of biodiversity in the area. The initial survey took one week with the aim of gathering data of plant species occurring in the area and other related information, including distribution and conservation status. The result of the survey will enhance the preliminary data and information from previous studies and

3. Crown of *Ptychosperma halmaherense*, showing beautiful strongly-arching leaves, the crownshaft and the inflorescences.

contribute to the development of the environmental management of the project, especially in support of the post-mining rehabilitation program. The main target was the heath forest developed on ultramafic soils, which will be most affected by the mining.

The ultramafic heath forest on Halmahera is very interesting, characterized by uniform forest canopy, slightly grayish in color and composed of dwarf vegetation. In some areas there is a mosaic of forest disturbance, with clumps of dead trees caused by periodic dieback and/or forest burning (Fig. 1). This type of forest is mostly dominated by *Gymnostoma* aff. *papuana* (Casuarinaceae), *Ploiarium sessile* (Bonnetiaceae), *Leptospermum* sp. (Myrtaceae), *Hydriastele* sp. (Arecaceae), *Pandanus* sp. (Pandanaceae), *Myrsine rawecensis* (Myrsinaceae), *Calophyllum* spp. (Clusiaceae), *Gnetum gnemon* (Gnetaceae), *Podocarpus polystachyus* (Podocarpaceae), a few species of *Syzygium* (Myrtaceae) and some species of the coffee family Rubiaceae. The tree *Nageia wallichiana* (Podocarpaceae) is also found but is very rare in this forest type. *Nepenthes danseri* (Nepenthaceae) and *Carex* sp. (Cyperaceae) were abundant as ground cover on rocky outcrops and areas regenerating after burning. This composition reminded me of the ultramafic heath forest on Gag Island in the Raja Ampat Islands, in northwestern New Guinea, in which a species of *Hydriastele* is so dominant with its crowns reaching up out of the forest canopy. This spectacular scenery is not known on other islands in Raja Ampat or even in the main island of New Guinea. The discovery of a species of *Ptychosperma* in ultramafic heath forest on Halmahera is most unexpected, far from any other species in the genus (Figs. 2–7).

The genus *Ptychosperma* Labill. consists of 29 species (Dransfield et al. 2008, Zona et al. 2011) and is most abundant in New Guinea. Eleven species are distributed outside the main island of New Guinea, such as the westernmost species *P. propinquum* in Aru Island and Kei Island in Moluccas, the southernmost species *P. elegans* in Queensland, Australia, and the easternmost species *P. salomonense* in the Solomon Islands (Essig 1978). The taxonomy of the genus still remains challenging, especially at the species level (species circumscriptions, their relationships and re-assessment of infrageneric classification). For instance, from 29 accepted names of the species in the genus, only 25 names were accepted in the last revision of the genus *Ptychosperma* by Essig (1978), and another four names as dubious or confused taxa because they were described from single specimens

and/or from material cultivated in Bogor Botanic Garden, West Java, Indonesia, where the plants no longer survive.

Essig (1978) proposed four subgenera and two sections within the genus; they are subgenenera *Ptychosperma*, *Actinophloeus*, *Ponapea* and *Korora*, but the latter two are now included in the resurrected genus *Ponapea* based on the recent molecular phylogeny studies (Dransfield et al. 2008; Baker et al. 2009, 2010; Zona et al. 2011). Essig (1978) also proposed sections *Actinophloeus* and *Caespitosa* under subgenus *Actinophloeus* based on characters of the pistillode of the staminate flowers, rumination of the endosperm, seed shapes in cross section and the stem solitary or clustering.

Taxonomic treatment

Ptychosperma halmaherense *Heatubun* **sp. nov.,** habitu solitario et endospermio ruminato ad subgenerum *Ptychosperma* pertinens; species geographice sejuncta a Halmahera in solis serpentinis crescens; inflorescentia in 3 ordines ramificans floribus staminatis et pistillatis minimis, atropupureis, staminibus 16; fructus luteus perianthio persistenti atropurpureo distincto, endocarpio laeve non porcato; a ceteris speciebus subgenerum *Ptychospermatis* endocarpio perfecte laeve non porcato bene distincta. Typus: Indonesia, North Moluccas Province, Halmahera Timur Regency, Maba Town, PT. Buena Persada (Solway International) Nickel Mining Concession Area, Gunung Batu, 25 Feb 2011, *Heatubun 1125* (Holotypus MAN!; isotypi K!).

Solitary, pleonanthic, moderate tree palm. Stem up to 12 m tall, 5–7 cm diam.; internodes 5–7 cm long, light brown to whitish, with nodal scars conspicuous, dark brown. Leaves 9 in crown, pinnate, strongly arching, 190–200 cm long (including petiole); sheath tubular, 40–50 cm long and about 15 cm wide, smooth, greenish-brown, slightly powdery, covered by white wax; crownshaft well defined, up to 75 cm long; petiole 22–23 cm long, about 2 cm wide and 1.1 cm thick at the base, channeled adaxially, rounded abaxially; rachis arching, somewhat flat adaxially, slightly rounded abaxially; blade with regularly arranged leaflets, 25–26 on each side of the rachis, longest nearest the petiole and gradually becoming shorter towards the apex, middle leaflets erect, somewhat stiff, borne on adaxial surface of rachis, forming a V-shaped blade; leaflets single-fold with inconspicuous main vein, basal leaflets somewhat lanceolate, 55–75 cm long, 2.5 cm wide, tip acuminate with projecting dangling remains of the rein, up to 27 cm long, middle leaflets somewhat elongate, lanceolate, 44–48 cm long, 3.5–4 cm wide, tip truncate, terminal leaflets somewhat elongate, 12.5–15 cm long, 0.3–1.2 cm wide, paired or just one, tip truncate, leathery, slightly discolorous when dried, light brown adaxially, paler abaxially, conspicuous large brown ramenta on abaxial veins. Inflorescence infrafoliar, up to 65 cm long at anthesis, protandrous, branching to 3 orders, with 18–20 branches (including terminal rachilla); peduncle 10–15 cm long, dark purple to light orange with numerous minute purple-brown trichomes; prophyll about 20 × 4 cm, lanceolate, 2-keeled, leathery, cream to light brown, entirely enclosing the inflorescence, then splitting longitudinally when inflorescence expanding and still enclosed with peduncular bract, and falling before staminate flowers anthesis; complete peduncular bract about 30 × 3 cm, elongate, 2-keeled, leathery, cream to light brown, with abundant tiny purple-dot-like indumentum scattered on surface; upper peduncular bract and other bracts reduced to inconspicuous stubs, horizontal, scar-like grooves or sometimes triangular, very low; rachis purple to light orange; the first order (basal-most) branch 40–45 cm long, about 10–13 branches (including terminal rachilla), 1–7 cm between branches; rachillae numerous, 7–12 cm long, glabrous, elongate, each bearing 8–15 flowers clusters. Staminate flowers very small, elongate, bullet shaped, 5.5 × 2 mm, somewhat asymmetric; sepals 3, imbricate, keeled, rounded, about 2.2 × 2 mm, purple; petals 3, valvate, strongly keeled, 4.5 × 2 mm, elliptic, tip slightly rounded, thick and fleshy, somewhat striate, purple with cream tinge at the tip; pistillode equal in height to the stamens, sometimes inconspicuous, about 2.5 × 0.1 mm, furcate, cream; stamens 16, variable in length, 2.5–4 mm long, filaments 1.75–2 mm long, dark brown, inflexed; anthers somewhat sagittate 2.5–3 mm long, cream-colored, longer than the filaments. Pistillate flowers slightly larger than the staminate, bullet shaped, 6.5 × 6 mm; sepals 3, strongly imbricate, keeled, rounded, 3.5 × 3.5 mm, somewhat asymmetrical, thicker at the base, purple with white line along the margin; petals 3, strongly imbricate, elliptic, 5 × 4 mm, purple with a thin line along the margin; gynoecium ellipsoidal, 4.5 mm high, 2.5 mm wide, purple, stigma trifid, hairy, white at anthesis; staminodes inconspicuous; ovule basal. Fruits

4 (left). Staminate flowers before anthesis of *Ptychosperma halmaherense*, showing the bullet shape typical for Ptychospermatoid palms. 5 (right). Pistillate flowers of *Ptychosperma halmaherense* at anthesis.

13–15 × 10 × 10 mm, ellipsoidal, somewhat beaked, up to 2 mm long, stigmatic remains apical, persistent, black, perianth persistent; epicarp smooth, shiny, very thin, purple and becoming bright yellow or light orange when mature; mesocarp fibrous, about 0.5 mm thick, fleshy, mucilaginous and tanniniferous; endocarp very thin, adhering closely to seed; seed somewhat ellipsoidal, 10 × 8.5 × 7 mm, without any grooves or angles, rounded in cross-section, hilum elliptical, elongate, stretching from base to apex, up to 3 mm wide, raphe branches anastomosing; endosperm deeply ruminate; embryo basal, 2.5 × 1 mm, white.

Distribution: Known only from the type of locality in East Halmahera, North Moluccas, Indonesia.

Habitat: This palm grows on very steep terrain (more than 45°) on rocky outcrops in ultramafic heath forest at an elevation of 530–550 m above sea level. This new species is adapted to the extreme conditions of the ultramafic rock and thin soils, sometimes without any apparent soil. The ultramafic rocks have produced extremely weathered Oxisol soils that are reddish yellow caused by the high concentration of iron, magnesium and other heavy metals, including nickel.

Local Name and Uses: There is no record of local names or uses for this new palm among the local people who live near the area (Maba town and Wailukum village).

Conservation Status: Critically Endangered – (CR B1ab(i)(ii)(iii)(iv)(v)c + 2a; C). This palm meets CR B1ab(i)(ii)(iii)(iv)(v)c + 2a; C criteria for threat category "Critically Endangered" (IUCN 2001), because its extent of occurrence is estimated to be less than 100 km^2 area and is known to exist at only a single location, the type locality. The population of the palm is likely to decline if current activities in the area affect the extent of occurrence, area of occupancy, area, extent and/or quality of habitat, the number of locations and subpopulations and numbers of mature individuals. Besides that, the area of occupancy is estimated to be less than 10 km^2 and is

6 (left). Pistillate flowers *Ptychosperma halmaherense* after anthesis of. 7 (right). Ripe fruits of *Ptychosperma halmaherense*, showing color contrast between fruit, perianth and stigmatic remains.

known to exist at only a single location. Moreover, the population size is estimated to number fewer than 250 mature individuals.

Specimens Examined: INDONESIA. North Moluccas Province, Halmahera Timur Regency, Maba Town, PT. Buena Persada (Solway International) Nickel Mining Concession Area, Gunung Batu, path way back from camp D to the main camp, 00°42'50.6"N, 128°06'02.6"E, 25 February 2011, *Heatubun* 1125 (Holotype MAN!; isotype K!).

Notes: This new species differs from all species in the genus *Ptychosperma* based on the seed morphology, by having a seed without any grooves or angles, fully rounded in cross-section, elliptical hilum elongate from base to the tip and the raphe branches anastomosing. Furthermore, the combination of purple flowers and yellow or light orange fruits is unknown elsewhere in the genus.

Ptychosperma halmaherense belongs to subgenus *Ptychosperma* (*sensu* Essig 1978) based on pistillode of staminate flowers equaling or exceeding stamens in length, fruits small (less than 22 mm long), endosperm ruminate, stem always solitary and inflorescence with upper peduncular bract and rameal bracts reduced to inconspicuous stubs and scarlike grooves; other species in the subgenus are *P. salomonense* Burret, *P. elegans* (R. Br.) Blume, *P. gracile* Labill., *P. rosselense* Essig, *P. tagulense* Essig, *P. ramosissimum* Essig, *P. caryotoides* Ridl. and *P. mooreanum* Essig.

Ptychosperma propinquum (Becc.) Becc. is the nearest species in the area of distribution of the genus. Based on the distribution map provided by Essig (Essig 1978: 448), *P. propinquum* is distributed from the islands of Tanimbar, Kei and Aru in the southeastern Moluccas north to the islands of Misool, Salawati and Batanta in Raja Ampat, Northern New Guinea. I have visited and collected specimens of *P. propinquum* from Salawati Island, Batanta Island, north coast Bird's Head Peninsula and Arguni Bay but have never seen it in Misool Island. However, the distinction between *P. halmaherense* and *P. propinquum* is very clear. *Ptychosperma propinquum* belongs to Essig's subgenus *Actinophloeus* section *Caespitosa,* which is characterized by clustering stems, leaflets irregularly arranged, inflorescence green, upper peduncular bract and rameal bracts prominent and endosperm homogenous. These characters are in marked contrast to *P. halmaherense.*

Ptychosperma halmaherense is the first ultramafic species ever reported in the genus and the westernmost species of the genus.

Since conservation is a major issue, the presence of threatened and endangered species in a mining concession must be taken into serious consideration. The existence of an endemic palm *P. halmaherense* with its conservation status critically endangered on Halmahera is a sensitive issue. Halmahera is one of the most important nickel mining areas in Indonesia, and the mining contributes much to the local economy and also generates a massive impact for regional and national economies. However, conservation and preservation of the endemic flora must be a high priority. The conservation and preservation of this new endemic palm species could be implemented by *in situ* and *ex situ* programs. For *in situ*, I would suggest that the habitat of *P. halmaherense* is demarcated as an enclave within the mining concession and protected. This forest enclave would be a good representation of ultramafic heath forest and would be a "small natural monument" with *P. halmaherense* as a flagship species. In the future, this enclave also would support the post-mining rehabilitation program by providing seeds and seedlings for reclamation activities. The habitat of *P. halmaherense* covers a small area with steep slopes on hillsides but still has good representation of the ultramafic heath vegetation.

For *ex situ* conservation, the approach is much easier to implement. Seeds from this new palm should be propagated first in the nearest town or other places within Halmahera Island, then widening to botanical gardens and then to palm collectors or hobbyists. It is important to involve local communities to increase their awareness about their unique biodiversity and conservation in general. They will get some small economic benefit by selling this beautiful palm to the palm collectors or even to the mining company for reclamation. By doing this, the local communities will be motivated to maintain it. Collaboration between the mining company and local community will be essential for any such schemes. It is hoped that the Corporate Social Responsibility (CSR) scheme – a form of corporate self-regulation integrated into a business model that encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere – will act as the bridge that will bring all of us to our goals, namely, that the nickel ores will be mined, the welfare of people will increase and this endemic palm will still stand.

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