

***Moringa hildebrandtii* (Moringaceae): a tree extinct in the wild but preserved by indigenous horticultural practices in Madagascar**

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ABSTRACT

An example of the rare phenomenon of an organism that persists in cultivation but is extinct in the wild is reported. The tree *Moringa hildebrandtii* (Moringaceae) has been thought to grow wild along the west coast of Madagascar, but field work and interviews with local inhabitants show that native populations do not occur in this area, or anywhere else on the island. However, the tree is abundantly cultivated in villages, and all herbarium collections made since its discovery in 1880 stem from such plantings. Ethnobotanical and other data suggest that the tree originally grew in the extreme southwest of the country: 1) The common name of the tree (hazomaroseranana) implies an association with this area, which was under the control of the Maroseranana people for nearly 400 years; 2) All other *Moringa* species worldwide occur in similar semi-arid habitats, which are not found elsewhere in Madagascar. Exploration for the plant should focus on this area.

KEY WORDS

conservation,
exploration,
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cultivation,
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Moringa,
Moringaceae.

RÉSUMÉ

Un exemple d'un phénomène rare consistant en la persistance en culture d'un organisme disparu dans la nature est signalé. L'arbre *Moringa hildebrandtii* (Moringaceae) est censé exister à l'état sauvage le long de la côte ouest de Madagascar ; pourtant, une prospection récente et une enquête auprès de la population n'ont pas révélé sa présence dans cette région ou dans une autre localité de l'île. Cet arbre est, cependant, fréquemment cultivé dans les villages et toutes les récoltes d'herbier effectuées depuis sa découverte en 1880 proviennent de plantations. Diverses données permettent de penser que l'arbre vivait à l'origine dans l'extrême sud-est de l'île : 1) Le nom vernaculaire de cet arbre (hazomaroseranana) implique une relation avec cette région qui était sous le contrôle des Maroseranana durant presque 400 ans ; 2) Toutes les autres espèces de *Moringa* se trouvent dans de semblables types d'habitats semi-arides qui ne se rencontrent pas ailleurs à Madagascar. Des efforts pour la redécouverte de cet arbre dans cette région devraient se poursuivre.

MOTS CLÉS

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INTRODUCTION

The survival of *Ginkgo biloba* in cultivation in China while the wild stands went extinct (e.g. MICHEL 1985) is a well-known story because it is so extraordinary: the extinction of species as a consequence of man's activities is common, while unwitting preservation of a species in cultivation is extremely rare. We have recently found that the Malagasy endemic tree *Moringa hildebrandtii* Engler appears to be another such example, now extinct in the wild but surviving in large numbers in traditional horticultural use in Madagascar. A 15-meter tall "bottle tree" with a bloated water-storing trunk and coarse tripinnate leaves (Figs. 1, 2), *M. hildebrandtii* belongs to the only genus of the family Moringaceae (VERDCOURT 1985). The thirteen species of *Moringa* are currently of wide interest because of their outstanding economic potential, with the few species studied providing nutritious leaf and fruit vegetables, high-quality seed oil, antibiotics, and water clarification agents (e.g.



Fig. 2. — Pinnae of leaves of Malagasy *Moringa* species. Large leaflets of *M. hildebrandtii* on left, compared to the much finer leaflets of *M. drouhardii* on right. Scale bar = 5 cm.



Fig. 1. — *Moringa hildebrandtii*, habit.

OLIVEIRA et al. 1999; GHASI et al. 2000; KALOGO & VERSTRAETE 2000; SALEEM & MEINWALD 2000).

It is hard to overlook the two *Moringa* species native to Madagascar's drylands, both of them large, conspicuous trees. They are planted in most settlements of the south and west of the island. The wood is very succulent and therefore not used for construction, but the trees are grown in rows as living fences and are esteemed as ornamentals because of their stature, large leaves, scented flowers, and fast growth. Residents interviewed along the west coast indicate that they plant *Moringa hildebrandtii* to mark special occasions. The tree is reported to be one of the bottle tree species that members of the Mahabo tribe plant around their graves (JUMELLE 1930). The other Malagasy endemic, *M. drouhardii* Jumelle, is also used medicinally and is often the only tree left standing when the vegetation is cleared for pasture. It is common to see gouges on the trunks of both species where the pulpy wood has been collected for medicinal use.

EXTINCT IN THE WILD BUT ABUNDANT IN CULTIVATION

All of the fifteen or so herbarium collections that have been made of *M. hildebrandtii* since 1880 have been gathered from plantings around villages or graves rather than gathered from wild stands. The tree came to the attention of western scientists in 1880, when German explorer Johannes HILDEBRANDT collected material from plantings at Trabonjy in northwestern Madagascar (ENGLER 1902; BEENTJE 1998). Since then, a dozen other collectors have documented *M. hildebrandtii* from villages in the west and southwest of the island (dashed area in Fig. 3). KERAUDREN (1965) states that the tree grows wild along the western coast of the island south of the town of Morondava and north of Tuléar and the Onilahy River (light gray area in Fig. 3), and provides a range map distinguishing between the area of cultivation of *M. hildebrandtii* and the area where she believed it to occur spontaneously. KERAUDREN-AYMONIN (1982) gives similar information, but neither work cites specific localities, specimens, or field observations. Likewise, despite extensive knowledge of Madagascar's ornamental dryland flora, RAUH (1998) shows firsthand familiarity with the distribution of *M. drouhardii*, but offers only a reproduction of KERAUDREN's (1965) map when discussing the distribution of *M. hildebrandtii*.

Field work conducted in January to February 1998 in search of *Moringa* in western and southwestern Madagascar, and specimen data from the holdings in the herbaria K, MO, P, TAN, TEF, and others, indicate that wild stands of *Moringa hildebrandtii* do not in fact occur in the area cited by KERAUDREN (1965), KERAUDREN-AYMONIN (1982), and RAUH (1998). We found many individuals planted in villages between Tuléar and Morombe, but encountered no trees that were not closely associated with human habitation. In addition, though we interviewed over 30 local people, no one knew where the tree could be found in the wild.

We doubt that such a large, conspicuous tree could escape notice of local people, especially

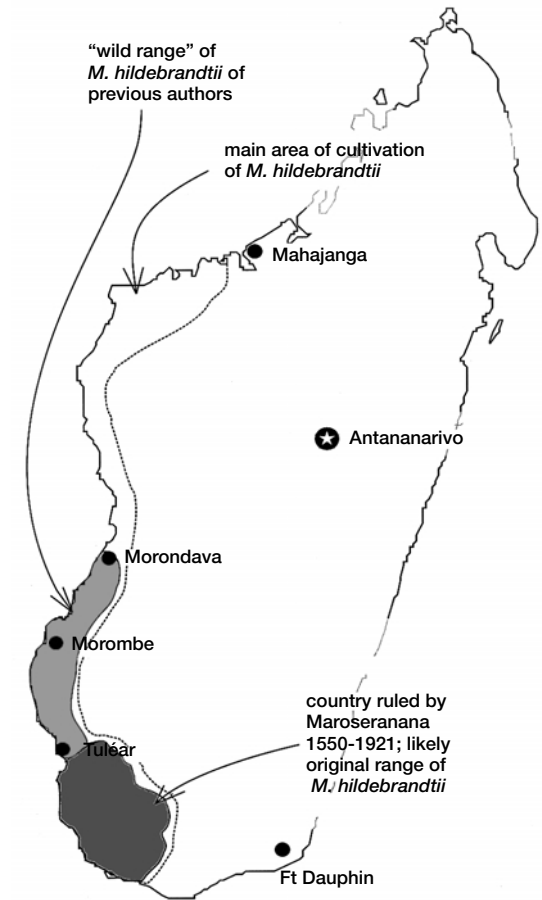


Fig. 3. — Distribution of *Moringa hildebrandtii* in Madagascar. *M. hildebrandtii* is commonly cultivated in the area delimited by a dashed line on the west coast. Previous authors have cited the light gray area between Morondava and Tuléar as being the native range of the species. It is more likely the dark gray area in the extreme southwest; searches for the tree should concentrate there.

rural Malagasy, who know their floral intimately. That *Moringa hildebrandtii* is a large tree with medicinal and ceremonial uses makes it even more unlikely that local people would be unaware of its occurrence in their area. For example, Malagasy who live near native stands of *M. drouhardii* often know the locations of the individual trees. The owner of the Arboretum d'Antsokay, a private botanical garden in Tuléar, was also unaware of any wild stands of *M. hildebrandtii* (H. PETIGNAT, pers. comm. 1998).

ORIGINAL NATIVE RANGE OF *M. HILDEBRANDTII*

Members of the genus *Moringa* have been found wild in dry tropical habitats in various parts of Africa and Asia, but all collections of *Moringa hildebrandtii* come from Madagascar, and it seems certain that the species is native there (VERDCOURT 1985, and references therein). Though clearly a distinct species based on leaf, bark, and floral characteristics (e.g. KERAUDREN-AYMONIN 1982), as well as DNA sequence data (OLSON unpubl.), *Moringa hildebrandtii* shares numerous features in its habit and floral morphology to the other Malagasy species *M. drouhardii*. Wood anatomy (OLSON & CARLQUIST in press), floral development, and DNA sequence analysis (OLSON unpubl.) suggest that the two Malagasy species are more closely related to each other than to other *Moringa* species, supporting the idea that they evolved from a common ancestor on Madagascar.

Ethnobotanical information suggests that the native range of *Moringa hildebrandtii* was the extreme southwest of the island. From 1550 to 1921, this region was the dominion of the Maroseranana, the collective name for the descendants of King Olombetsitoto (POIRIER 1953; dark gray area in Fig. 3). *Moringa hildebrandtii* is known to members of the Sakalavan'i Menabe tribe, which now occupies most of the west coast of Madagascar, by the common name "hazomaroseranana" or "hazmaroserana" derived from "hazo" (tree) and "Maroseranana," meaning tree of the Maroseranana family or region. We visited areas in the former Maroseranana country southeast of Tuléar, and though *M. hildebrandtii* is commonly cultivated, again no one knew where it could be found in the wild. Local people were however aware of the stands of *Moringa drouhardii* in their areas. The southeast of the island supports similar habitats, but *M. hildebrandtii* does not seem to be cultivated there, and we located no wild populations.

Evidence of a more circumstantial nature based on the habitat preferences of the other 12 *Moringa* species also points to the area south rather than north of the Onilahy River as being the most likely in which *M. hildebrandtii* originally occurred.

Worldwide, all other *Moringa* species occur in areas with very short rainy seasons and low, open vegetation. In Madagascar, such areas occur only in the extreme southwest south of the Onilahy, the island's driest region. The other native Malagasy *Moringa* species is restricted to this region and it seems likely that the original range of *M. hildebrandtii* was also within the area. It is reasonable to discount the eastern rainforests and central highlands as potential areas in which the tree might be found, because *M. hildebrandtii*, like all members of the family, is a heat-loving xerophyte. Furthermore, no *Moringa* species is known from relatively tall and moist vegetation formations similar to the dry deciduous forests (*sensu* LOWRY et al. 1997) of western and northwest Madagascar, so it seems unlikely that *M. hildebrandtii* occurred there. Though the possibility remains that *M. hildebrandtii* still grows wild in an area not considered by us or previous authors, we recommend that searches for the tree focus on the southwest. The scope of such searches can be greatly enhanced by interviewing local people about the presence of the tree in their area. Likewise, the memory of local people could help to ascertain whether or not an apparently wild stand is in fact a relic of an abandoned settlement.

PROSPECTS AND OPPORTUNITIES

Searching for wild *Moringa hildebrandtii* in southwestern Madagascar, particularly in the areas around Ampanihy, Ankazoabo, Betioky, and Ejeda, should be a priority for biologists. But given that no scientist has ever found wild *M. hildebrandtii* in the nearly 120 years since its discovery, and that local people have no memory of where the tree grew, it is possible that the species has been extinct in the wild for a long time, perhaps even before the first European botanists began collecting in Madagascar in the mid-1600s (DORR 1997). Despite the catastrophic loss of biodiversity occurring throughout Madagascar and the rest of the tropics, our assessment for the continued survival of *M. hildebrandtii* in cultivation is good. It is frequently planted in villages all along the west coast of the island, and produces seeds abundantly. The tradition of planting the trees as

ornamentals and for medicine appears to be thriving and should continue to do so as long as the traditions of local people remain intact, especially those of the descendants of the Maroseranana, for whom the tree is part of their cultural identity. However, the interactions of *M. hildebrandtii* with its physical environment and the other organisms with which it originally occurred seem lost forever. Moreover, because it is not clear where wild *M. hildebrandtii* grew, it is impossible to contemplate reintroducing individuals to the wild.

While *M. hildebrandtii* and *Ginkgo biloba* are not extinct, they are entirely dependent on humans for survival. Though the role that such species had in their wild state has been lost, plants surviving only in cultivation still can provide material for numerous basic and applied investigations. In the case of *Moringa*, much research has focused on the Indian *Moringa oleifera*, while the other 12 species remain almost unexamined. The horticultural practices of rural Malagasy have given us an opportunity that should not be missed.

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REFERENCES

BEENTJE H.J. 1998. — J.M. Hildebrandt (1847-1881): notes on his travels and plant collections. *Kew Bull.* 53: 835-856

DORR L.J. 1997. — *Plant collectors in Madagascar and the Comoro Islands*. Royal Botanic Gardens, Kew.

ENGLER A. 1902. — Contribuzioni alla conoscenza della flora dell'Africa orientale. *Annuario Reale Ist. Bot. Roma* 9: 241-256.

GHASI S., NWOBODO E. & OFILI J.O. 2000. — Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam. in high-fat diet fed wistar rats. *Journal of Ethnopharmacology* 69: 21-25.

JUMELLE M.H. 1930. — Les *Moringa* de Madagascar. *Annales du Musée Colonial de Marseille*, sér. 4, 8: 1-20.

KALOGO Y. & VERSTRAETE W. 2000. — Technical feasibility of the treatment of domestic wastewater by a CEPS-UASB system. *Environmental Technology* 21: 55-65.

KERAUDREN M. 1965. — Le genre "*Moringa*" en Afrique et à Madagascar (Affinités systématiques, intérêt biogéographique). *Webbia* 19: 815-824.

KERAUDREN-AYMONIN M. 1982. — Moringaceae: 33-40, in H. HUMBERT (ed.), *Flore de Madagascar et des Comores*. Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie, Paris.

LOWRY II P.P., SCHATZ G.E. & PHILLIPSON P.B. 1997. — The classification of natural and anthropogenic vegetation in Madagascar: 93-123, in GOODMAN S.M. & PATTERSON B.D. (eds.), *Natural change and human impact in Madagascar*. Smithsonian Inst. Press, Washington & London.

MICHEL P.-F. 1985. — *Ginkgo biloba: l'arbre qui a vaincu le temps*. Art du Vivant, Editions du Félin, Paris.

OLIVEIRA J.T.A., SILVEIRA S.B., VASCONCELOS I.M., CAVADA B.S. & MOREIRA R.A. 1999. — Compositional and nutritional attributes of seeds from the multiple purpose tree *Moringa oleifera* Lamarck. *Journal of the Science of Food and Agriculture* 79: 815-820.

OLSON M.E. & CARLQUIST S. in press. — Stem and root anatomical correlations with life form diversity, ecology, and systematics in *Moringa* (Moringaceae). *Botanical Journal of the Linnean Society*.

POIRIER M.Ch. 1953. — Généalogie des rois Maroseranana du sud de l'Onilahy. *Bulletin Trimestriel Acad. Malgache*, 18 June: 29-35.

RAUH W. 1998. — *Succulent and xerophytic plants of Madagascar*, volume 2. Strawberry Press, Mill Valley, California.

SALEEM R. & MEINWALD J. 2000. — Synthesis of novel hypotensive aromatic thiocarbamate glycosides. *Journal of the Chemical Society-Perkin Transactions* 1: 391-394.

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