

Population study and conservation of *Magnolia banghamii*, a narrow endemic tree in Sumatra Island, Indonesia

Iyan Robiansyah^{1*}, Enggal Primananda¹, Wendy A. Mustaqim², Yusuf Sigit Ahmad Fauzan¹, Ahmad Yudis Mahardhika¹, Zulfan Arico², Andri Yusman Persada², Jean Linsky³

¹Research Center for Plant Conservation, Botanic Gardens and Forestry, National Research and Innovation Agency, Jl.Ir.H. Juanda 13, Bogor, West Java 16003 Indonesia

²Department of Biology, Universitas Samudra, Jl. Prof. Dr. Syarief Thayeb, Langsa, Aceh 24416 Indonesia

³Atlanta Botanical Garden, GA 30309, Atlanta, GA, USA.

*Email: iyan.robiansyah@brin.go.id, iyanrobiansyah@yahoo.com

Introduction

Indonesia is habitat for 28 species of magnolia, of which six species are endemic to the country (Linsky *et al.* 2022). According to the IUCN Red List (2023), one species of Indonesian magnolia is categorized as Endangered (EN: *M. sulawesiana*), one species is Near Threatened (NT: *M. borneensis*), 5 species are Least Concern (LC), and 21 species or 75% are assessed as Data Deficient (DD). The main threats to Indonesian *Magnolia* species are habitat conversion and unsustainable biological use. For those species with DD status, further studies are required to confirm their current population status, distribution and threats.

Magnolia banghamii (Noot.) Figlar & Noot. is a narrow endemic species in Aceh Province, Indonesia. The species is known only from two specimens collected from one location in Bener Meriah, Aceh Province in 1932 (Nooteboom 1994; Figlar and Nooteboom 2004). These type specimens are incomplete as the perianth of the flower is not present. Currently, the species is assessed as DD by the IUCN Red List due to lack of information on the existing population,

threats and quality of habitat (Khela 2014). Furthermore, the species is not present in any *ex situ* collections (BGCI 2023).

In the present study, we conducted population surveys to enhance the conservation of *M. banghamii*. The objectives are to: i) assess the current population of *M. banghamii*, including its population size and structure, distribution, and habitat preferences, ii) update the conservation status of the species following the IUCN Red List categories and criteria, and iii) collect plant material to be cultivated and serve to initiate an *ex situ* collection of this species.

Materials and Methods

Surveys for *M. banghamii* were conducted using a focused survey method (Brewer 2013) at eight locations: seven locations (Bur Oregon, Mutiara Baru, RRI, Oregon Tingkem, Pantan Sile, Uning Tritit, and Rembele) in Bener Meriah Regency and one location (Tapak Moge) in Aceh Tengah Regency (Figure 1). Uning Tritit, located in the Regency of Bener Meriah, is the where the type specimens were collected. When an individual of the species was found,

its location was recorded using a GPS receiver, and its height as well as diameter at breast height (dbh) were measured. The following environmental variables were measured near each individual: elevation (m above sea level), slope, aspect/slope direction, and topography (valley, slope, or ridge). Furthermore, observed possible threats to the population of *M. banghamii* were also recorded. We collected plant materials (seeds, seedlings, and/or cuttings as encountered) to be cultivated and serve as *ex situ* collections at the Arboretum of Universitas Samudra and Bogor Botanic Gardens.

We used the results of our study to update the conservation status of *M. banghamii* according to the IUCN Red List categories and criteria (IUCN 2012). Due to data availability constraints, we only used criteria B (geographic range), C (small population size and decline), and D (very small or restricted population) to assess the extinction risk of the species. The extent of occurrence (EEO) and area of occupancy (AOO) of the species used in criterion B were calculated using GeoCAT (Bachman et al. 2011). For criterion C and D, the population size of the species was estimated based on the total number of mature individuals.

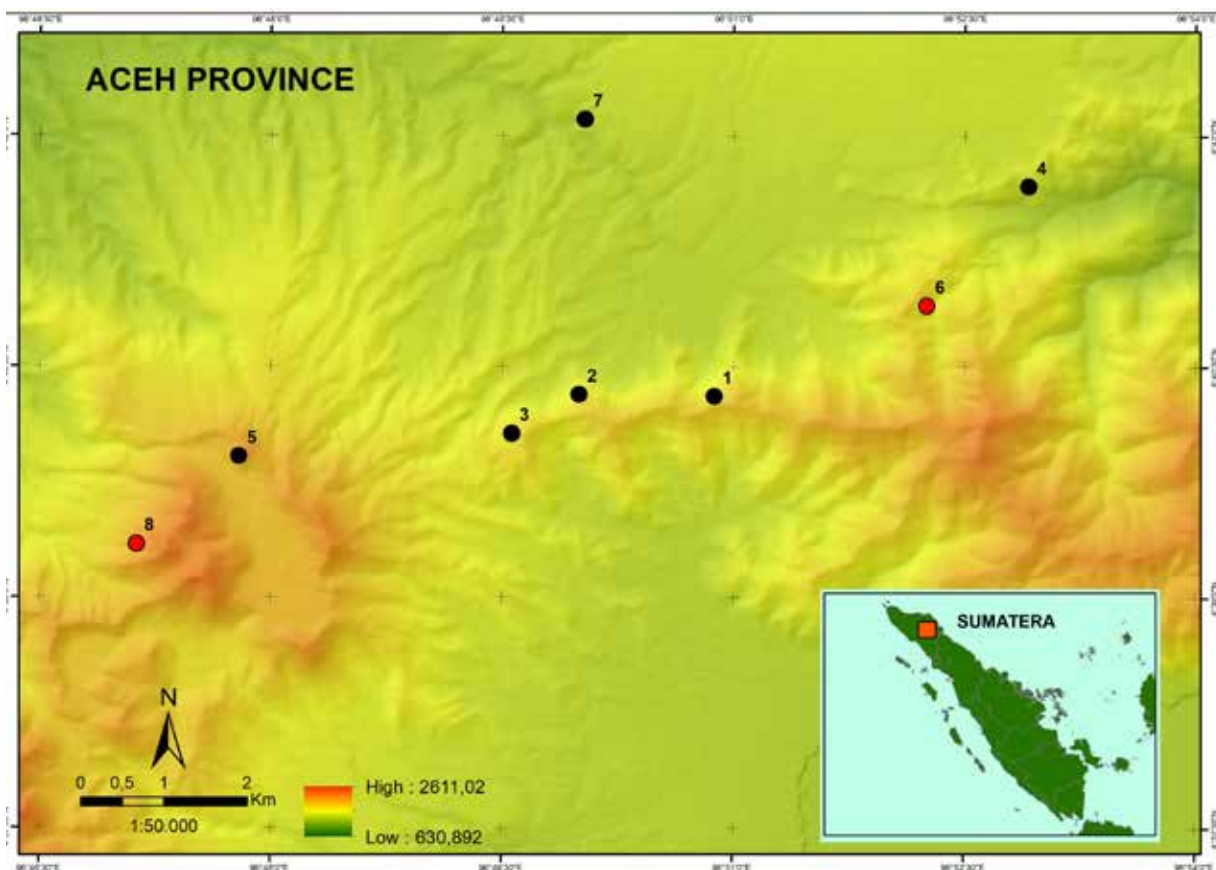


Figure 1 Survey locations of *Magnolia banghamii* in the Regency of Bener Meriah and Aceh Tengah, Aceh Province. The locations are: (1) Bur Oregon; (2) Mutiara Baru; (3) RRI; (4) Oregon Tingkem; (5) Pantan Sile; (6) Uning Tritit; (7) Rembele; (8) Tapak Moge. Red dots indicate survey locations where the species was relocated.

Results and Discussion

From the eight surveyed locations, the species was only located at its type location (Uning Tritit) and one additional new location at Tapak Moge with a total of eight individuals. Of these, only one individual was observed to be in a mature stage with dbh and height of 49 cm and 27 m, respectively (Figure 2a-e). The species preferred slope areas ($32.8 \pm 7.4^\circ$) at an elevation range of 1378-1750 m. In the present study, the species was found at a much higher elevation than the type specimens, which were collected at an elevation of c. 1100 m (Nootboom 1994). Compared to other Sumatran endemic *Magnolia*, the elevation range of *M. banghamii* is lower than of *M. calophylloides* (2000-2200 m) but similar to that of *M. sumatrae* (1500-2000 m) and *M. sumatrana* (600-1300 m) (Nootboom 1988).

The only mature individual we found in the study sites was not in the flowering or fruiting stage. Therefore, the new voucher specimens we made (Figure 2f) contained only the vegetative parts of the tree and could not be used to complete the description of the perianth, which is still unknown. Although without its generative organs, the species could be firmly identified as *M. banghamii* using the following vegetative key characters: hairy young twigs, petiole 14-50 mm with adnate stipule for at least one-third of its length, and leaves 7-12 by 3-7 cm with 10-12 pairs of secondary nerves and sparsely puberulous beneath when young. In the field, using these characters, we could differentiate *M. banghamii* from *M. champaca*, the most closely related species, which has generally larger leaves which are sparsely pubescent instead of puberulous beneath when young, a greater number of lateral veins, and pubescent rather than puberulous indument.

We observed that habitat conversion into coffee plantations, settlements, and agricultural areas is the main threat to the species (Figure 3a-c). All the individuals were found in small forest fragments located in the middle of coffee plantations. Due to extensive land clearing, half of the located individuals were in a coppice form; growing from cut stumps. Bener Meriah and Aceh Tengah are two regencies with the highest arabica coffee production in Aceh Province (BPS Provinsi Aceh 2019), with more than 679,409 people engaged in coffee farming in 2012 (Hikmah et al. 2014). In addition, we observed that most of the areas with an elevation of less than 1200 m in both regencies have been converted into settlements. This is the reason that our survey located the species in areas above 1300 m. During the survey, we observed that the species is also threatened by habitat degradation due to illegal logging activities by local people (Figure 3d).

Conservation status assessment

Based on the calculation of GeoCAT, the EOO and AOO of the species are 12 km². Under criterion B of the IUCN Red List, the species qualifies for the category of Endangered (EN) B1ab(i,ii,iii, iv)+B2ab(i,ii,iii,iv), i.e. EOO < 5.000 km² (B1), AOO < 500 km² (B2), number of locations < 5 (a), and continuing decline (b) in EOO (i), AOO (ii), area, extent and quality of habitat (iii), and number of mature individuals (iv).

As the number of mature individuals is only one, under criterion C the species could be assessed as Critically Endangered (CR) C2a(i), i.e. continuing decline (in any rate) in the population size (C2) and number of mature individuals in each subpopulation < 50 (a(i)). For criterion D, the species qualifies for CR D as the number of mature individuals < 50.

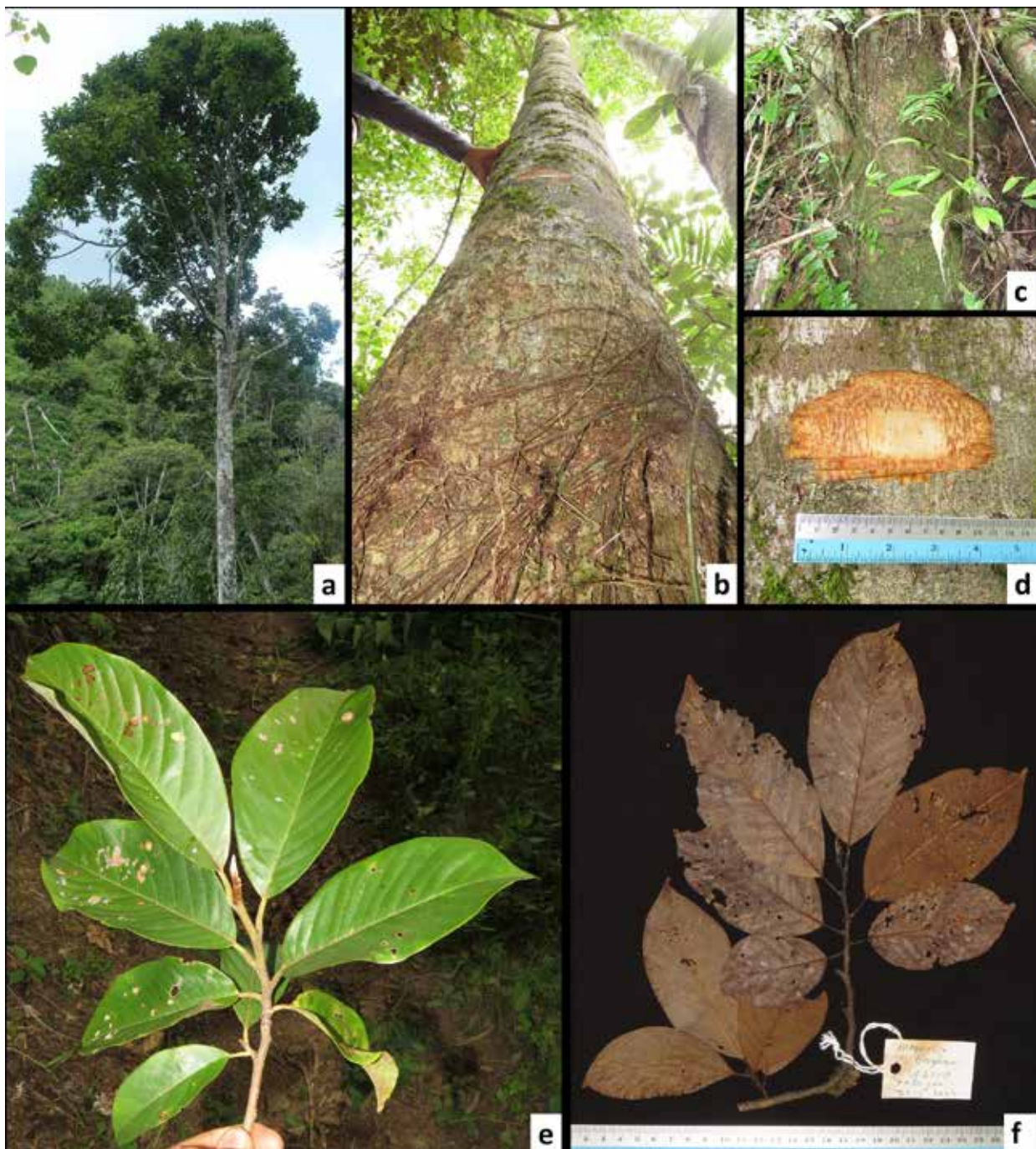


Figure 2 Morphological appearances of the mature individual of *Magnolia banghamii* observed in the study sites: habit (a), trunk (b) buttress root (c), inner bark (d), leaves (e) and herbarium voucher (f).

Since only the criteria for the highest category of threat that the taxon qualifies for should be listed, here we propose CR C2a(i), D as the conservation status of *M. banghamii*. Under this category, the species is considered to be facing an extremely high risk of extinction in the wild. Comprehensive and immediate conservation actions are required to ensure the survival of the species and its habitats.

Species conservation

The areas where the species is located are unprotected. Therefore, increasing the protection of these areas is urgently needed to support the conservation of the species *in situ*. To ensure the future survival of the species, *ex situ* conservation of the species is also required as the threats are still ongoing. Therefore, one wild seedling of the species has been collected

and is currently cultivated at the Arboretum of Universitas Samudra (Figure 4). This *ex situ* collection will serve as a material source for population reinforcement programs and is effective media for public awareness campaigns. Further surveys are recommended to confirm the species population size and structure, distribution, and threats. This work contributes to conservation goals under the Global Conservation Consortium for *Magnolia* including identifying species of greatest conservation concern, developing high conservation value *ex situ* collections and increasing awareness of *Magnolia* conservation issues.

Acknowledgments

The study was fully supported by The Magnolia Society International (MSI) Research Fund 2022.



Figure 3 The main threats to the population of *Magnolia banghamii*: coffee plantation (a), settlement (b), agricultural fields (c), and illegal logging (d)..

We would like to thank Lembaga Penelitian, Pengabdian Kepada Masyarakat dan Penjaminan Mutu (LPPM PM) Universitas Samudra for acquiring the research permit.

References

1. Bachman S, Moat J, Hill AW, De La Torre J, Scott B. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys*, 150:117-126.
2. BGCI. 2023. PlantSearch online database. Botanic Gardens Conservation International. Richmond, U.K. Available at https://tools.bgci.org/plant_search.php. Accessed on 12 February 2023.
3. BPS Provinsi Aceh. 2019. Provinsi Aceh Dalam Angka 2019. Aceh, Indonesia: Badan Pusat Statistik Provinsi Aceh.
4. Brewer S. 2013. How to survey an area for threatened tree species. Cambridge, UK: Fauna & Flora International.
5. Figlar RB, Nootboom HP. 2004. Notes on Magnoliaceae IV. *Blumea* 49(1):87-100.
6. Hikmah, Hamzah A, Nasir M. 2014. Anal-

isis produksi dan ekspor komoditas kopi arabica di Kabupaten Bener Meriah dan Kabupaten Aceh Tengah. *Jurnal Ilmu Ekonomi: Program Pascasarjana Unsyiah* 2(2):22-30.

7. IUCN. 2012. IUCN red list categories and criteria. Version 3.1. IUCN, Gland, Switzerland.
8. IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. <https://www.iucnredlist.org> Accessed on 13 February 2022.
9. Khela S. 2014. *Magnolia banghamii*. The IUCN Red List of Threatened Species 2014: e.T15112410A15112413. <https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T15112410A15112413.en>. Accessed on 13 February 2022.
10. Linsky, J., Crowley, D., Beckman Bruns, E., Coffey, E.E.D. (2022). Global Conservation Gap Analysis of Magnolia. Atlanta, GA.
11. Botanical Garden Nootboom HP. 1994. *Michelia banghamii* (Magnoliaceae), a new species from Sumatra. *Blumea*, 38: 334.
12. Nootboom HP. 1988. Magnoliaceae. *Michelia*. *Flora Malesiana* 1(10):598-605.



Figure 4 *Ex-situ* collection of *Magnolia banghamii* cultivated at the Arboretum of Universitas Samudra, Aceh Province.