



## *Rafflesia mixta* (Rafflesiaceae), a new species from Surigao del Norte, Mindanao, Philippines

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### Abstract

*Rafflesia mixta* Barcelona, Manting, Arbolonio, Caballero & Pelsler is described as a new species from the Caraga Region of north-eastern Mindanao, Philippines. In their general morphology, the flowers of this species most closely resemble those of *R. mira*, but they are different in details of the perigone warts and processes, disk color, and relative size of the diaphragm opening. This discovery brings the total number of Philippine *Rafflesia* species to twelve, of which four are found on the island of Mindanao.

**Key words:** Caraga Region, Mainit, Mamanwa tribe, parasitic plants, taxonomy

### Introduction

*Rafflesia* Brown (1821: 207; Rafflesiaceae) is a genus of endophytic holoparasites that exclusively infect lianas of the genus *Tetrastigma* Miquel (1863: 72; Vitaceae) and inhabit the tropical rainforests of southern Thailand, Malaysia, the Philippines, and Indonesia. In the Philippines, we currently recognize eleven species (Teschemacher 1844, Blanco 1845, Hieronymus 1885, Barcelona & Fernando 2002, Fernando & Ong 2005, Barcelona *et al.* 2006, 2008, 2009a, 2009b, 2011, Galang & Madulid 2006, Balete *et al.* 2010, David *et al.* 2012, Pelsler *et al.* 2013). Except for one, all of these are endemic to individual Philippine islands. Only *R. speciosa* Barcelona & Fernando (2002: 648) is known from two islands (Negros and Panay). Although *Rafflesia* is found in most of the larger Philippine islands, this genus has, thus far, not been reported from Bohol, Cebu, Masbate, Mindoro, Palawan, and smaller islands. Mindanao is the second largest island in the Philippine archipelago and home to three described *Rafflesia* species (Fig. 1). Of these, *R. schadenbergiana* Göppert ex Hieronymus (1885: 3) stands out by having the largest flowers of any Philippine species. *Rafflesia verrucosa* Balete, Pelsler, Nickrent & Barcelona (2010: 50) is characterized by its relatively small flowers and large warts on its perigone lobes and diaphragm, whereas flowers of *R. mira* Fernando & Ong (2005: 267) display remarkably polymorphic disk processes and a smooth diaphragm lacking ornamentation.

In April 2009, during a resource assessment project that was part of the Ancestral Domain Sustainable Development and Protection Plan (ADSDPP) for the Mamanwa (= Mamanua) tribe's Certificate of Ancestral Domain Title (CADT) application, a team led by Jerwin T. Resola and Catherine Mae Buctuan-Jandug discovered a new population of *Rafflesia* in the mountains east of Mainit in Surigao del Norte Province. In March 2014, photos of a plant from this population were posted by one of the authors of this paper (RBA) on the Co's Digital Flora of the Philippines (CDFP) Facebook Group. This group functions as a medium of correspondence between users and contributors of the CDFP website ([www.philippineplants.org](http://www.philippineplants.org), Pelsler *et al.* 2011 onwards). CDFP is a citizen science project in which amateurs, students, and professional botanists edit an online checklist of Philippine vascular plants and illustrate it with in situ photographs that are deposited at the PhytoImages website (Nickrent *et al.* 2006 onwards). During subsequent fieldwork in April, May, and June 2014, flowers and buds of this species were collected and preserved. Morphological studies showed that these flowers are distinct from all presently known *Rafflesia* species in several characters that traditionally have been used for species delimitation in this genus. Assuming that these morphological differences are an indication of reproductive isolation, we name and describe these plants here as a new species under a biological species concept (Mayr 2000). This new addition brings the total number of Philippine *Rafflesia* species to twelve.

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## References

- Balete, D.S., Pelser, P.B., Nickrent, D.L. & Barcelona, J.F. (2010) *Rafflesia verrucosa* (Rafflesiaceae), a new species of small-flowered *Rafflesia* from eastern Mindanao, Philippines. *Phytotaxa* 10: 49–57.  
<http://dx.doi.org/10.11646/phytotaxa.10.1.8>
- Barcelona, J.F. & Fernando, E.S. (2002) A new species of *Rafflesia* (Rafflesiaceae) from Panay Island, Philippines. *Kew Bulletin* 57: 647–651.  
<http://dx.doi.org/10.2307/4110994>
- Barcelona, J.F., Cajano, M.O. & Hadsall, A.S. (2006) *Rafflesia baletei*, another new *Rafflesia* (Rafflesiaceae) from the Philippines. *Kew Bulletin* 61: 231–237.
- Barcelona, J.F., Pelser, P.B., Cabutaje, E.M. & Bartolome, N.A. (2008) Another new species of *Rafflesia* (Rafflesiaceae) from Luzon, Philippines: *R. leonardi*. *Blumea* 53: 223–228.  
<http://dx.doi.org/10.3767/000651908x608197>
- Barcelona, J.F., Co, L.L., Balete, D.S. & Bartolome, N.A. (2009a) *Rafflesia aurantia* (Rafflesiaceae): a new species from northern Luzon, Philippines. *Gardens' Bulletin Singapore* 61:17–27.
- Barcelona, J.F., Pelser, P.B., Balete, D.S. & Co, L.L. (2009b) Taxonomy, ecology, and conservation status of Philippine *Rafflesia*. *Blumea* 54: 77–93. <http://dx.doi.org/10.3767/000651909x474122>
- Barcelona, J.F., Fernando, E.S., Nickrent, D.L., Balete, D.S. & Pelser, P.B. (2011) Redefinition of *Rafflesia leonardi* and an updated key to Philippine *Rafflesia* (Rafflesiaceae). *Phytotaxa* 24: 11–18.
- Barcelona, J.F., Nickrent, D.S., LaFrankie, J.V., Callado, J.R.C. & Pelser, P.B. (2013) Co's Digital Flora of the Philippines: Plant identification and conservation through cybertaxonomy. *Philippine Journal of Science* 142: 57–67.
- Blanco F.M. (1845) *Flora de Filipinas*, ed. 2. M. Sanchez, Manila, 619 pp.
- Brown, R. (1821) An account of a new genus of plants, named *Rafflesia*. *Transactions of the Linnean Society of London* 13: 201–234.  
<http://dx.doi.org/10.1111/j.1095-8339.1821.tb00062.x>
- David, M., de Jesus, A.C. & Barcelona, J.F. (2012 '2011') *Rafflesia of the Philippines: a story of adventure, appetite, and affinity*. Energy Development Corporation (EDC), Manila. 180 pp.
- Fernando, E.S. & Ong, P.S. (2005) The genus *Rafflesia* R.Br. (Rafflesiaceae) in the Philippines. *Asia Life Sciences* 14: 263–270.
- Fernando, E.S., Co, L.L., Lagunsad, D.A., Gruezo, W.S.M., Barcelona, J.F., Madulid, D.A., Lapiz, A.B., Texon, G.I., Manila, A.C. & Zamora, P.M. (2008) Threatened plants of the Philippines. *Asia Life Sciences Supplement* 3: 1–52.
- Galang, R. & Madulid, D.A. (2006) A second new species of *Rafflesia* (Rafflesiaceae) from Panay Island, Philippines. *Folia Malaysiana* 7: 1–8. <http://dx.doi.org/10.2307/4110994>
- Hieronymus, G. (1885 '1884') Über *Rafflesia schadenbergiana* (Göppert). *Ein Beitrag zur Kenntnis der Cytinaceen*. Breslau. Reprinted in *Bulletin du Congrès international de botanique et d'horticulture de St. Pétersbourg* (1884, published 1885) 35–36 and as: Über eine neue, von Dr. A. Schadenberg und O. Koch auf Süd-Mindanao entdeckte Art der Gattung *Rafflesia*. *Gartenflora* 34 (1885) 3–7, t. 1177.

- IUCN (2001) *IUCN Red List Categories: Version 3.1*. IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, U.K., ii + 30 pp.
- Madulid, D.A., Tandang, D.N. & Agoon, E.M.G. (2006 '2005') *Rafflesia magnifica* (Rafflesiaceae), a new species from Mindanao, Philippines. *Acta Manillana* 53: 1–6.
- Mayr, E. (2000) The biological species concept, in: Wheeler, Q.D. & Meier, E. (eds.) *Species concepts and phylogenetic theory: a debate*. Columbia University Press, New York, pp. 17–29.
- Miquel, F.A.W. (1863) Ampelideae novae. *Annales Museum Botanicum Lugduno-Batavi* 1: 72–101.
- Nickrent, D.L., Costea, M., Barcelona, J.F., Pelsner, P.B. & Nixon, K. (2006 onwards) PhytoImages. Available from: <http://www.phytoimages.siu.edu>.
- Pelsner, P.B., Barcelona, J.F. & Nickrent, D.L. (eds.) (2011 onwards) Co's Digital Flora of the Philippines. Available from: <http://www.philippineplants.org>.
- Pelsner, P.B., D.L. Nickrent, J.R.C. Callado & Barcelona, J.F. (2013) Mt. Banahaw reveals: The resurrection and neotypification of the name *Rafflesia lagascae* (Rafflesiaceae) and clues to the dispersal of *Rafflesia* seeds. *Phytotaxa* 131: 35–40.  
<http://dx.doi.org/10.11646/phytotaxa.131.1.6>
- Teschemacher, J.E. (1844) On a new species of *Rafflesia*, from Manilla. *Boston Journal of Natural History* 4: 63–66.