Primitive angiosperms in the Indian Subcontinent: taxonomic diversity and geographical distribution of Magnoliaceae Juss. (APG IV)

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Abstract

Some new insights in patterns of diversity and distribution of primitive angiospermic group led by the family Magnoliaceae in the Indian Subcontinent are presented in this article. The Subcontinent harbours nearly 10% of accepted taxa of Magnoliaceae in the world. All native taxa are restricted to the eastern region of the Subcontinent except one, *Magnolia nilagirica*, which is endemic to the Western Ghats-Sri Lanka global hotspot of biodiversity. All the remaining 24 native taxa occur in the northeastern region of India. Some of these radiate into Bangladesh, Bhutan and Nepal. About one-fourth of these taxa are endemic to India. *M. pleiocarpa* is endemic to Assam and *M. punduana* is endemic to Meghalaya. While only one species, *M. cathcartii*, is of temperate environment, four species are subtropical to temperate (*M. campbellii*, *M. doltsopa*, *M. kisopa*, *M. lanuginosa*), 9 species of predominantly subtropical and 11 species of low montane or tropical environment. All native species are of phanerophytic life-form, i.e., trees of various sizes, except one shrub, *M. globosa*. Seven introduced and two hybrid taxa also occur in the Subcontinent and of these, southern magnolia, *M. grandiflora*, is the most popular and widespread in gardens and plantations. The horse-shoe shaped mountainous terrain of the northeast India is a centre of diversity of magnolias and supposedly represents a subset of "Southeast Asian" centre of origin and diversification of this primitive angiosperm group.

Key words: *Magnoliids*, Magnoliaceae, Magnolias, India Subcontinent, Primitive angiosperms.

INTRODUCTION

The APG system of classification recognized Magnoliids as a clade of primitive angiosperms comprising Magnoliales, Laurales, Piperales and Canellales (APG IV 2016). The Order Magnoliales comprises six families, viz., Annonaceae, Degeneriaceae, Eupomatiaceae, Himantandraceae, Magnoliaceae, and Myristicaceae. Of these, Magnoliaceae comprises only two genera, viz., *Liriodendron* L. and *Magnolia* Plum. ex L. Earlier, a number of genera, such as, *Aromadendron*, *Michelia*, *Manglietia*, *Paramichelia*, *Sampacca*, *Talauma*, had been named in Magnoliaceae, but nomenclatural changes have merged them into a single genus *Magnolia*. This has rendered the already published regional floras of limited use in terms of ready availability of accepted binomials and respective synonyms, especially to the students, research scholars, ecologists and foresters in confusion.

Plant taxonomists regard Magnoliaceae as one of the most primitive angiosperm families due to its presence in early fossil records, gymnosperm-like pollen (with one aperture for germination), wood anatomy and flower structure. Some important diagnostic characteristics of Magnoliaceae are as follows: The leaves are simple in alternate or spiral arrangement. Large deciduous furry stipules generally leave scars around young branches. The bisexual, radially symmetrical flowers are large eccentric and solitary. The receptacle is swollen which hosts numerous spirally arranged floral appendages (no sign of a reduction in parts). The sepals and

Figure 1. Global distribution of genus: **A.** *Liriodendron* L.; and **B.** *Magnolia* Plum. ex L. as per Kew Science (POWO 2020)

petals are indistinguishable (often referred to as tepals). The anthers are undifferentiated from filaments. Aggregated follicles make up the cone-shaped fruit structure which house brightly coloured funiculate seeds (Every & Baracat 2009).

It is revealed that the reconstruction of the first angiospermic flower from the fossil records, 250 to 140 million years old, looked like a magnolia (Sauquet *et al.* 2017). Nonetheless, the origin of the angiosperm flower remains among the most difficult and most important unresolved topics in evolutionary biology (Frohlich & Chase 2007; Friis *et al.* 2011; Doyle 2012, 2014). The extant or living magnolias show classical ‘disjunct distribution’ in two distant geographies, *viz.*, the Americas (between Canada and Brazil in the west), and the Southeast Asia (predominantly in Indo-Malayan ecoregion in the East), and surprisingly nowhere in between (Figure 1). This has been a puzzle amongst the botanists for nearly two centuries, although some explanations for this intriguing distribution have been offered (Nooteboom 2011). Magnolias present an excellent example of allopatric speciation, according to which the new species are formed as a result of geographic isolation and new selection pressures (Sanchez-Velasquez *et al.* 2016). There has been a debate which of the two centres of the distribution is actually a centre of origin of magnolias and the conclusion that “neither of the present centres of diversity is the centre of origin” prevails currently (Nooteboom 2011).

In Indian Subcontinent, the habit of magnolias varies from shrub to large tree and none of the species is a climber. Only a subset of all magnolias found in Southeast Asia is available in Indian Subcontinent and most of it occurs in the Northeastern region. Kundu (2009) enlisted 51 taxa from Indian subcontinent but including Magnoliaceae Juss. (s.s.), Illiciaceae A.C.Sm. and Schisandraceae Blume in a preliminary checklist following old nomenclature. Khuraijam & Goel (2015) presented a reclassification of species of Magnoliaceae from India alone. This article presents an updated account of the taxonomic diversity of Magnoliaceae following APG-IV nomenclature, geographical distribution following Kew Science (POWO 2020) and conservation status of Magnoliaceae taxa (Global Tree Specialist Group 2014) that are native to or introduced into the Indian Subcontinent along with their synonyms and country-wise distributions.

MATERIAL AND METHODS

This study focuses on members of Magnoliaceae Juss. growing in the Indian subcontinent. The collected specimens were studied in the Botanical Survey of India's herbaria viz. CAL and ASSAM and of own collection. The already published floras and reports were screened for preparing a checklist of the members of Magnoliaceae. The nomenclatural changes were taken into account and the latest spellings of the generic names, epithets and authorities were verified in Kew Science resources (The Plant List 2013; POWO 2020). The habitat, habit and life-forms were compiled from observation in specimens, published resources, if available, and from own observations. The country-wise distribution records were compiled from authentic published literature. Similarly, the distribution records for different states and territories in India were compiled from the regional floras and accessible research articles.

RESULTS AND DISCUSSION

The genus *Liriodendron* L. (commonly called “tulip trees”) has only two species in the world: one is restricted to Southeast Asia (*Liriodendron chinense* (Hemsl.) Sarg. with distribution in China North-Central, China South-Central, China Southeast, Vietnam) and the other is restricted to the Americas (*Liriodendron tulipifera* L. with distribution in Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Ontario, Pennsylvania, Rhode I., South Carolina, Tennessee, Vermont, Virginia, West Virginia) (POWO 2020). This genus is completely absent in the Indian Subcontinent (Figure 1A), except a few planted individuals of *L. tulipifera* in FRI campus in Dehradun and in Darjeeling. Currently, the genus *Magnolia* Plum. ex L. has 320 accepted species (327 taxa) in the world and is widely spread in both the centres of distribution with nearly one-half of the taxa in each (Figure 1B).

The Indian Subcontinent harbours nearly 10% of these accepted taxa and most of them are restricted to the northeastern region of India, Central and East Himalaya, Nepal and Bhutan, and only one species, *Magnolia nilagirica*, is present in the Western Ghats and Sri Lanka Global Hotspot of Biodiversity. The compiled list of the accepted species of the genus *Magnolia* reveals 25 native, seven introduced and two hybrid taxa in the Indian Subcontinent (Table 1). The synonyms of all these accepted taxa are provided to facilitate the easy browsing and linking of the binomials available in already published floras in the region (Hooker 1872-1897; Kanjilal *et al.* 1934; Balakrishnan 1981-1983; Deb 1981-1983; Joseph 1982; Haridasan 1985-1987; Das & Chanda 1987; Hajra *et al.* 1996; Chowdhury 2005; Giri *et al.* 2008; Singh *et al.* 2000, 2002; Barooah & Ahmed 2014; Mao *et al.* 2016, 2017).

While *M. griffithii* and *M. grandiflora* have no synonyms, *M. liliifera* has 49 synonyms which is the maximum number for the species inventoried from the Indian Subcontinent. *M. champaca*, *M. gustavi*, *M. mannii*, *M. pleiocarpa*, *M. rabaniana*, *M. sirindhorniae* have only one synonym each (Table 1). All magnolias native to the Indian Subcontinent are distributed between Tibet in the northwest and Malayan peninsula in the Southeast Asian centre of diversity. *M. pleiocarpa* (basonym: *Pachylarnax pleiocarpa* Dandy) has the narrowest distribution and is endemic to only one location, i.e., Jeypore Reserve Forest in North Lakhimpur district of Assam (Figlar & Nooteboom 2004; Global Tree Specialist Group 2014), although it is believed to occur in nearby Arunachal Pradesh (Khuraijam & Goel 2015). *M. punduana* is documented as endemic to Meghalaya (Balakrishnan 1981-1983; Haridasan 1985-1987; Iralu *et al.* 2020), but has also been listed in the flora of Arunachal Pradesh (Hajra *et al.* 1996) and flora of Manipur (Singh *et al.* 2000). *M. mannii* and *M. oblonga* are endemic to northeast India and adjoining territories in Bangladesh. On the other hand, *M. liliifera* has the widest distribution from East Himalaya to Sulawesi (Table 1). Among the introduced species, *M. grandiflora* has the broadest occurrences due to large-scale introductions. *Magnolia liliiflora* is grown in courtyard of the Buddhist monasteries and in botanic gardens in Sikkim and Darjeeling.

While only one native species, *M. cathcartii*, was temperate, four species were subtropical to temperate (*M. campbellii*, *M. doltsopa*, *M. kisopa*, *M. lanuginosa*), 9 species were subtropical and 11 species were of low montane or tropical environment (Table 1). Among introduced taxa, *M. liliiflora* is of temperate, *M. coco* and *M. obovata* are subtropical and *M. grandiflora*, *M. figo* var. *figo*, *M. montana* and *M. sirindhorniae* are of tropical or low montane environment. Two hybrid taxa, *M. × alba* and *M. × soulangeana* are cultivated in tropical regions of Asia (Table 1).

Table 1. Taxonomic diversity and nativity of Magnoliaceae in Indian Subcontinent.

Sl.	Accepted taxa and their known synonyms	Climate and nativity
	Native taxa	
1	<i>Magnolia baillonii</i> Pierre 1. <i>Aromadendron baillonii</i> (Pierre) Craib 2. <i>Aromadendron spongocarpum</i> (King) Craib 3. <i>Magnolia baillonii</i> var. <i>bailingia</i> Sima & H.Jiang 4. <i>Magnolia pbellocarpa</i> (King) H.J.Chowdhery & P.Daniel 5. <i>Michelia baillonii</i> (Pierre) Finet & Gagnep. 6. <i>Michelia pbellocarpa</i> (King) Finet & Gagnep. 7. <i>Paramichelia baillonii</i> (Pierre) Hu 8. <i>Talauma pbellocarpa</i> King 9. <i>Talauma spongocarpa</i> King	Low montane; Indo-Malaya
2	<i>Magnolia campbellii</i> Hook.f. & Thomson [Campbell's Magnolia] 1. <i>Magnolia mollicomata</i> W.W.Sm. 2. <i>Yulania campbellii</i> (Hook.f. & Thomson) D.L.Fu	Subtropical to Temperate; Central and East Himalaya, Myanmar and China
3	<i>Magnolia cathcartii</i> (Hook.f. & Thomson) Noot. [Cathcart's Magnolia] 1. <i>Alcimandra cathcartii</i> (Hook.f. & Thomson) Dandy 2. <i>Aromadendron cathcartii</i> (Hook.f. & Thomson) Sima & S.G.Lu 3. <i>Michelia cathcartii</i> Hook.f. & Thomson 4. <i>Michelia gustavii</i> King 5. <i>Sampacca cathcartii</i> (Hook.f. & Thomson) Kuntze	Temperate; Tibet to Indo-Malaya
4	<i>Magnolia caveana</i> (Hook.f. & Thomson) D.C.S.Raju & M.P.Nayar 1. <i>Magnolia tibetica</i> V.S.Kumar 2. <i>Manglietia caveana</i> Hook.f. & Thomson 3. <i>Manglietia microtricha</i> Y.W.Law 4. <i>Manglietia tenuifolia</i> Hung T.Chang & B.L.Chen	Subtropical; Indo-Malaya

Sl.	Accepted taxa and their known synonyms	Climate and nativity
	Native taxa	
5	<i>Magnolia champaca</i> (L.) Baill. ex Pierre [Champak tree] 1. <i>Michelia champaca</i> L.	Low montane; Indo-Malaya
6	<i>Magnolia champaca</i> (L.) Baill. ex Pierre var. <i>champaca</i> 1. <i>Champaca michelia</i> Noronha 2. <i>Magnolia membranacea</i> P.Parm. 3. <i>Magnolia membranacea</i> P.Parm. 4. <i>Michelia aurantiaca</i> Wall. 5. <i>Michelia blumei</i> Steud. 6. <i>Michelia euonymoides</i> Burm.f. 7. <i>Michelia rheedei</i> Wight 8. <i>Michelia rufinervis</i> DC. 9. <i>Michelia serices</i> Pers. 10. <i>Michelia suaveolens</i> Pers. 11. <i>Sampacca euonymoides</i> (Burm.f.) Kuntze 12. <i>Sampacca suaveolens</i> (Pers.) Kuntze	Subtropical; Tibet to Indo-Malaya
7	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.) Figlar [Manipur Magnolia] 1. <i>Magnolia excelsa</i> Jacques 2. <i>Magnolia excelsa</i> Wall. 3. <i>Michelia calcuttensis</i> P.Parm. 4. <i>Michelia doltsopa</i> Buch.-Ham. ex DC. 5. <i>Michelia excelsa</i> (Wall.) Blume 6. <i>Michelia manipurensis</i> Watt ex Brandis 7. <i>Michelia wardii</i> Dandy 8. <i>Sampacca excelsa</i> (Wall.) Kuntze	Subtropical to temperate; Tibet to Indo-Malaya
8	<i>Magnolia globosa</i> Hook.f. & Thomson 1. <i>Aromadendron griffithii</i> (Hook.f. & Thomson) Sima & S.G.Lu 2. <i>Michelia griffithii</i> (Hook.f. & Thomson) Finet & Gagnep.	Subtropical; Tibet to Indo-Malaya
9	<i>Magnolia griffithii</i> Hook.f. & Thomson [Griffith's Magnolia]	Subtropical; Assam, Bangladesh, Myanmar
10	<i>Magnolia gustavi</i> King [Gustav's Magnolia] 1. <i>Aromadendron gustavi</i> (King) Sima & S.G.Lu	Low montane; Assam, Myanmar, Thailand
11	<i>Magnolia hodgsonii</i> (Hook.f. & Thomson) H.Keng [Himalayan Magnolia] 1. <i>Liriantbe hodgsonii</i> (Hook.f. & Thomson) Sima & S.G.Lu 2. <i>Talauma hodgsonii</i> Hook.f. & Thomson	Low montane; Tibet to Indo-Malaya
12	<i>Magnolia hookeri</i> (Cubitt & W.W.Sm.) D.C.S.Raju & M.P.Nayar 1. <i>Magnolia hookeri</i> var. <i>longirostrata</i> D.X.Li & R.Z.Zhou ex X.M.Hu, Q.W.Zeng & L.Fu 2. <i>Manglietia hookeri</i> Cubitt & W.W.Sm.	Low montane; Indo-Malaya
13	<i>Magnolia insignis</i> Wall. 1. <i>Magnolia insignis</i> var. <i>angustifolia</i> (Hook.f. & Thomson) H.J.Chowdhery & P.Daniel 2. <i>Magnolia insignis</i> var. <i>latifolia</i> (Hook.f. & Thomson) H.J.Chowdhery & P.Daniel 3. <i>Magnolia shangpaensis</i> Hu 4. <i>Manglietia insignis</i> (Wall.) Blume 5. <i>Manglietia maguanica</i> Hung T.Chang & B.L.Chen 6. <i>Manglietia rufisyncarpa</i> Y.W.Law, R.Z.Zhou & F.G.Wang 7. <i>Manglietia yunnanensis</i> Hu	Low montane; Tibet to Indo-Malaya
14	<i>Magnolia kingii</i> (Dandy) Figlar 1. <i>Michelia glabra</i> P.Parm. 2. <i>Michelia kingii</i> Dandy	Subtropical; Assam, Bangladesh, Bhutan

Sl.	Accepted taxa and their known synonyms	Climate and nativity
	Native taxa	
15	<i>Magnolia kisopa</i> (Buch.-Ham. ex DC.) Figlar [Kisopa Magnolia] 1. <i>Michelia doltsopa</i> subsp. <i>kisopa</i> (Buch.-Ham. ex DC.) J.Li 2. <i>Michelia kisopa</i> Buch.-Ham. ex DC. 3. <i>Sampacca kisopa</i> (Buch.-Ham. ex DC.) Kuntze	Subtropical to temperate; India, Nepal, Tibet
16	<i>Magnolia lanuginosa</i> (Wall.) Figlar & Noot. 1. <i>Magnolia velutina</i> (DC.) Figlar 2. <i>Michelia lanceolata</i> E.H.Wilson 3. <i>Michelia lanuginosa</i> Wall. 4. <i>Michelia velutina</i> DC. 5. <i>Sampacca lanuginosa</i> (Wall.) Kuntze	Subtropical to temperate; India, Nepal, Tibet, China
17	<i>Magnolia liliifera</i> (L.) Baill. [Egg Magnolia] 1. <i>Aromadendron oreadum</i> (Diels) Kaneh. & Hatus. 2. <i>Blumia candollei</i> Nees 3. <i>Lirianthe liliifera</i> (L.) Sima & S.G.Lu 4. <i>Lirianthe poilanei</i> Sima & S.G.Lu 5. <i>Lirianthe pulgarensis</i> (Elmer) Sima & S.G.Lu 6. <i>Liriodendron liliiferum</i> L. 7. <i>Magnolia andamanica</i> King 8. <i>Magnolia andamanica</i> (King) D.C.S.Raju & M.P.Nayar 9. <i>Magnolia candollei</i> (Blume) H.Keng 10. <i>Magnolia craibiana</i> Dandy 11. <i>Magnolia eriostepta</i> var. <i>poilanei</i> Dandy ex Gagnep. 12. <i>Magnolia forbesii</i> King 13. <i>Magnolia kunstleri</i> King 14. <i>Magnolia mutabilis</i> (Blume) H.J.Chowdhery & P.Daniel 15. <i>Magnolia odoratissima</i> Reinw. ex Blume 16. <i>Magnolia pachyphylla</i> Dandy 17. <i>Magnolia pulgarensis</i> Dandy 18. <i>Magnolia pumila</i> Andrews 19. <i>Magnolia rumphii</i> (Blume) Spreng. 20. <i>Magnolia splendens</i> Reinw. ex Blume 21. <i>Magnolia thamnodes</i> Dandy 22. <i>Manglietia celebica</i> Miq. 23. <i>Manglietia thamnodes</i> (Dandy) Gagnep. 24. <i>Talauma andamanica</i> King 25. <i>Talauma athliantha</i> Dandy 26. <i>Talauma borneensis</i> Merr. 27. <i>Talauma candollei</i> Blume 28. <i>Talauma celebica</i> Koord. 29. <i>Talauma forbesii</i> King 30. <i>Talauma gitingensis</i> Elmer 31. <i>Talauma gracilior</i> Dandy 32. <i>Talauma inflata</i> P.Parm. 33. <i>Talauma javanica</i> P.Parm. 34. <i>Talauma kunstleri</i> King 35. <i>Talauma liliifera</i> (L.) Kurz 36. <i>Talauma longifolia</i> (Blume) Ridl. 37. <i>Talauma macrophylla</i> Blume ex Miq. 38. <i>Talauma miqueliana</i> Dandy 39. <i>Talauma mutabilis</i> Blume 40. <i>Talauma nhatrangensis</i> Dandy 41. <i>Talauma oreadum</i> Diels	Low montane; East Himalaya to Sulawesi

Sl.	Accepted taxa and their known synonyms	Climate and nativity
	Native taxa	
17	<i>Magnolia liliifera</i> (L.) Baill. [Egg Magnolia] [<i>contd.</i>] 42 <i>Talauma pulgarensis</i> Elmer 43 <i>Talauma pumila</i> (Andrews) Blume 44 <i>Talauma reticulata</i> Merr. 45 <i>Talauma rubra</i> Miq. 46 <i>Talauma rumphii</i> Blume 47 <i>Talauma soembensis</i> Dandy 48 <i>Talauma sumatrana</i> A.Agostini 49 <i>Talauma undulatifolia</i> A.Agostini	Low montane; East Himalaya to Sulawesi
18	<i>Magnolia mannii</i> (King) Figlar 1. <i>Michelia mannii</i> King	Low montane; Assam, Bangladesh
19	<i>Magnolia nilagirica</i> (Zenker) Figlar [Nilgiri Magnolia] 1. <i>Michelia glauca</i> Wight 2. <i>Michelia nilagirica</i> Zenker 3. <i>Michelia ovalifolia</i> Wight 4. <i>Michelia pulneyensis</i> Wight 5. <i>Michelia walkeri</i> Wight 6. <i>Sampacca nilagirica</i> (Zenker) Kuntze	Low montane; India, Sri Lanka
20	<i>Magnolia oblonga</i> (Wall. ex Hook.f. & Thomson) Figlar 1. <i>Michelia lactea</i> Buch.-Ham. ex Wall. 2. <i>Michelia oblonga</i> Wall. ex Hook.f. & Thomson 3. <i>Sampacca oblonga</i> (Wall. ex Hook.f. & Thomson) Kuntze	Subtropical; Assam, Bangladesh
21	<i>Magnolia pealiana</i> King 1. <i>Aromadendron pealianum</i> (King) Sima & S.G.Lu 2. <i>Michelia pealiana</i> (King) Finet & Gagnep.	Low montane; Assam (Jeypore Reserve Forest), Endemic
22	<i>Magnolia pleiocarpa</i> (Dandy) Figlar & Noot. 1. <i>Pachylarnax pleiocarpa</i> Dandy	Subtropical; Endemic to Lakhimpur in Assam
23	<i>Magnolia pterocarpa</i> Roxb. 1. <i>Lirianthe grandiflora</i> Spach 2. <i>Lirianthe pterocarpa</i> (Roxb.) Sima & S.G.Lu 3. <i>Liriodendron grandiflorum</i> Roxb. 4. <i>Liriodendron indicum</i> Spreng. 5. <i>Magnolia spheonocarpa</i> Hook.f. & Thomson 6. <i>Michelia macrophylla</i> D.Don 7. <i>Sphenocarpus pterocarpus</i> (Roxb.) K.Koch 8. <i>Talauma roxburghii</i> G.Don	Subtropical; Central Himalaya to Bangladesh
24	<i>Magnolia punduana</i> (Hook.f. & Thomson) Figlar [Pandua Magnolia] 1. <i>Michelia punduana</i> Hook.f. & Thomson 2. <i>Sampacca punduana</i> (Hook.f. & Thomson) Kuntze	Subtropical; Endemic to Meghalaya and Arunachal Pradesh
25	<i>Magnolia rabaniana</i> (Hook.f. & Thomson) D.C.S.Raju & M.P.Nayar 1. <i>Talauma rabaniana</i> Hook.f. & Thomson	Low montane; NE India, Myanmar
	Introduced and hybrid taxa	
26	<i>Magnolia x alba</i> (DC.) Figlar [White Champaca; hybrid of <i>M. champaca</i> and <i>M. montana</i>] 1. <i>Michelia</i> × <i>alba</i> DC. 2. <i>Michelia</i> × <i>longifolia</i> Blume 3. <i>Sampacca</i> × <i>longifolia</i> (Blume) Kuntze	Cultivated in tropical regions of East Asia; origin uncertain
27	<i>Magnolia coco</i> (Lour.) DC. [Dwarf or Coconut Magnolia] 1. <i>Lirianthe coco</i> (Lour.) N.H.Xia & C.Y.Wu 2. <i>Liriodendron coco</i> Lour. 3. <i>Liriopsis pumila</i> Spach ex Baill. 4. <i>Talauma coco</i> (Lour.) Merr.	Subtropical; S. China to N. Vietnam, Taiwan

Sl.	Accepted taxa and their known synonyms	Climate and nativity
	Native taxa	
28	<i>Magnolia grandiflora</i> L. [Southern Magnolia]	Low montane to Subtropical; USA
29	<i>Magnolia figo</i> (Lour.) DC. var. <i>figo</i> [Banana shrub] 1. <i>Liriodendron figo</i> Lour. 2. <i>Michelia figo</i> (Lour.) Spreng.	Low montane; China, Korea
30	<i>Magnolia liliiflora</i> Desr. [Lily Magnolia] 1. <i>Lassonia quinquepeta</i> Buc'hoz 2. <i>Magnolia atropurpurea</i> Steud. 3. <i>Magnolia discolor</i> Vent. 4. <i>Magnolia gracilis</i> Salisb. 5. <i>Magnolia liliiflora</i> f. <i>nigra</i> (G.Nicholson) Geerinck 6. <i>Magnolia plena</i> C.L.Peng & L.H.Yan 7. <i>Magnolia polytepala</i> Y.W.Law, R.Z.Zhou & R.J.Zhang 8. <i>Magnolia purpurea</i> Curtis 9. <i>Magnolia quinquepeta</i> (Buc'hoz) Dandy 10. <i>Talauma sieboldii</i> Miq. 11. <i>Yulania japonica</i> Spach 12. <i>Yulania liliiflora</i> (Desr.) D.L.Fu	Warm to cold temperate; China
31	<i>Magnolia montana</i> (Blume) Figlar [Japanese cucumber tree] 1. <i>Michelia eicicatrissata</i> Miq. 2. <i>Michelia montana</i> Blume 3. <i>Sampacca montana</i> (Blume) Kuntze	Low montane; W. Malesia to Lesser Sundalands (Bali)
32	<i>Magnolia obovata</i> Thunb. 1. <i>Houpoea obovata</i> (Thunb.) N.H.Xia & C.Y.Wu 2. <i>Magnolia glauca</i> Thunb. 3. <i>Magnolia birsuta</i> Thunb. 4. <i>Magnolia bonogi</i> P.Parm. 5. <i>Magnolia boonoki</i> Siebold 6. <i>Magnolia hypoleuca</i> Siebold & Zucc.	Subtropical; Japan
33	<i>Magnolia sirindhorniae</i> Noot. & Chalermglin 1. <i>Michelia sirindhorniae</i> (Noot. & Chalermglin) N.H.Xia & X.H.Zhang	Tropical or low montane; Thailand
34	<i>Magnolia</i> × <i>soulangeana</i> Soul.-Bod. [Saucer Magnolia; hybrid of <i>M. denudata</i> and <i>M. liliiflora</i>] 1. <i>Magnolia</i> × <i>brozsonii</i> Millais 2. <i>Magnolia</i> × <i>lenneana</i> (Lem.) Koehne 3. <i>Magnolia</i> × <i>lennei</i> Van Houtte 4. <i>Yulania</i> × <i>lenneana</i> Lem. 5. <i>Yulania</i> × <i>soulangeana</i> (Soul.-Bod.) D.L.Fu	Cultivated in tropical regions of East Asia; South Central China to N. Vietnam, Taiwan

The magnolias occur in phanerophytic life-forms, i.e., shrubs or trees of various sizes. The herbs and climbers are unknown. In Indian Subcontinent, all native species are trees of various sizes barring only one species, viz., *Magnolia globosa*, which is a shrub (Table 2). Of the remaining 24 native species, five are small to intermediate trees, seven are intermediate-sized trees, six are intermediate to large trees, and six are large trees. Among introduced magnolias in the region, two are large trees, two are intermediate trees and one is a shrub. Of 25 native species, only six are deciduous and the remaining 19 species are evergreen. Among introduced magnolias in the region, five are evergreen and two are deciduous (Table 2). Of two hybrid taxa, one is evergreen and one is deciduous. Cicuzza *et al.* (2007) estimated that 22% of magnolias in the world are critically endangered (CR), 41% endangered (EN), 16% vulnerable (VU), 5% near threatened (NT), 6% of least concern (LC), about 6% have insufficient data (DD) and

about 94 species are not evaluated (NE). The conservation status of nearly one-half of species in the Indian Subcontinent is known as per IUCN system (Table 2). *M. pleiocarpa* and *M. sirindhorniae* are critically endangered, *M. gustavi* and *M. pealiana* are endangered, *M. mannii*, *M. nilagirica* and *M. punduana* are vulnerable, and *M. campbellii*, *M. globosa*, *M. hodgsonii*, *M. insignis*, *M. liliifera* and *M. grandiflora* are of least concern. Three species are data deficient and 18 taxa are yet to be evaluated. Almost all native species are in their habitats in the subcontinent.

Table 2. Life-form (habit), phenology and threatened status of Magnoliaceae taxa found in Indian subcontinent.

Taxon name	Life-form/ Habit	Phenology	Threatened status
Native taxa			
1. <i>Magnolia baillonii</i>	Large tree	Evergreen	NE
2. <i>Magnolia campbellii</i>	Intermediate to large tree	Deciduous	LC
3. <i>Magnolia cathcartii</i>	Large tree	Evergreen	NE
4. <i>Magnolia caveana</i>	Intermediate tree	Evergreen	NE
5. <i>Magnolia champaca</i>	Intermediate to large tree	Evergreen	NE
6. <i>Magnolia champaca</i> var. <i>champaca</i>	Large tree	Evergreen	NE
7. <i>Magnolia doltsopa</i>	Small to intermediate tree	Deciduous	NE
8. <i>Magnolia globosa</i>	Shrub	Deciduous	LC
9. <i>Magnolia griffithii</i>	Intermediate to large tree	Evergreen	DD
10. <i>Magnolia gustavi</i>	Large tree	Evergreen	EN B1ab(i,iii)
11. <i>Magnolia hodgsonii</i>	Small to intermediate tree	Evergreen	LC
12. <i>Magnolia hookeri</i>	Intermediate to large tree	Evergreen	NE
13. <i>Magnolia insignis</i>	Intermediate to large tree	Evergreen	LC
14. <i>Magnolia kingii</i>	Intermediate tree	Evergreen	NE
15. <i>Magnolia kisopa</i>	Intermediate tree	Deciduous	NE
16. <i>Magnolia lanuginosa</i>	Intermediate to large tree	Deciduous	NE
17. <i>Magnolia liliifera</i>	Intermediate tree	Evergreen	LC
18. <i>Magnolia mannii</i>	Intermediate tree	Evergreen	VU B1ab(i,iii)
19. <i>Magnolia nilagirica</i>	Intermediate tree	Evergreen	VU B1ab(i,iii)
20. <i>Magnolia oblonga</i>	Large tree	Evergreen	NE
21. <i>Magnolia pealiana</i>	Small to intermediate tree	Evergreen	EN B1ab(i,iii)
22. <i>Magnolia pleiocarpa</i>	Large tree	Evergreen	CR B1ab(i,iii)
23. <i>Magnolia pterocarpa</i>	Small to intermediate tree	Deciduous	NE
24. <i>Magnolia punduana</i>	Small to intermediate tree	Evergreen	VU B1ab(i,iii)
25. <i>Magnolia rabaniana</i>	Intermediate tree	Evergreen	DD
Introduced and hybrid taxa			
26. <i>Magnolia</i> × <i>alba</i>	Intermediate tree	Evergreen	NE
27. <i>Magnolia coco</i>	Shrub	Evergreen	NE
28. <i>Magnolia grandiflora</i>	Large tree	Evergreen	LC
29. <i>Magnolia figo</i> var. <i>figo</i>	Shrub	Evergreen	NE
30. <i>Magnolia liliiflora</i>	Shrub to small tree	Deciduous	DD
31. <i>Magnolia montana</i>	Large tree	Evergreen	NE
32. <i>Magnolia obovata</i>	Intermediate tree	Deciduous	NE
33. <i>Magnolia sirindhorniae</i>	Intermediate tree	Evergreen	CR B1ab(i)
34. <i>Magnolia</i> × <i>soulangeana</i>	Intermediate tree	Deciduous	NE

Of seven countries in the Indian Subcontinent, the magnolias occur in Nepal, Bhutan, India, Bangladesh and Sri Lanka, and are absent in Pakistan and Maldives (Table 3). The maximum number of taxa occur in India (34 species) followed by Bhutan (13 species), Bangladesh (10 species) and Nepal (10 species). The ranges of the Western Ghats-Sri Lanka global hotspot of biodiversity harbour only one species, *M. nilagirica*. This species has been claimed to occur in Assam (Barooah & Ahmed 2014) which is doubtful and needs affirmation. The remaining 24 native species occur in Central Himalaya (Nepal), East Himalaya (Sikkim, Bhutan and Arunachal Pradesh), and northeastern region of India (Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura). Not a single species occurs in all five countries in the Subcontinent (Table 3). Three species, viz., *M. doltsopa*, *M. hodgsonii* and *M. pterocarpa* occur in four countries. Of species found in Nepal, all are shared with India and nine species with Bhutan (except *M. insignis*). Bhutan shares all its species with India and only four species with Bangladesh (*M. doltsopa*, *M. hodgsonii*, *M. kingii*, *M. pterocarpa*). Bangladesh shares all its species with India (Table 3). Succinctly, the northeastern region of India is the centre of diversification of magnolias in the Indian Subcontinent and is a subset of “Southeast Asian” centre of origin and diversification of this primitive angiosperm group. A total of six species (*M. caveana*, *M. gustavi*, *M. hookeri*, *M. pealiana*, *M. pleiocarpa*, and *M. punduana*) are endemic to India if only political boundaries are to be considered (Table 3).

Table 3. Country-wise distribution of Magnoliaceae taxa in the Indian Subcontinent.

Taxon name	Nepal	Bhutan	India	Bangladesh	Sri Lanka
Native taxa					
1. <i>Magnolia baillonii</i>			P	P	
2. <i>Magnolia campbellii</i>	P	P	P		
3. <i>Magnolia cathcartii</i>		P	P		
4. <i>Magnolia caveana</i>			P		
5. <i>Magnolia champaca</i>			P	P	
6. <i>Magnolia champaca</i> var. <i>champaca</i>			P	P	
7. <i>Magnolia doltsopa</i>	P	P	P	P	
8. <i>Magnolia globosa</i>	P	P	P		
9. <i>Magnolia griffithii</i>			P	P	
10. <i>Magnolia gustavi</i>			P		
11. <i>Magnolia hodgsonii</i>	P	P	P	P	
12. <i>Magnolia hookeri</i>			P		
13. <i>Magnolia insignis</i>	P		P		
14. <i>Magnolia kingii</i>		P	P	P	
15. <i>Magnolia kisopa</i>	P	P	P		
16. <i>Magnolia lanuginosa</i>	P	P	P		
17. <i>Magnolia liliifera</i>		P	P		
18. <i>Magnolia mannii</i>			P	P	
19. <i>Magnolia nilagirica</i>			P		P
20. <i>Magnolia oblonga</i>			P	P	
21. <i>Magnolia pealiana</i>			P		
22. <i>Magnolia pleiocarpa</i>			P		
23. <i>Magnolia pterocarpa</i>	P	P	P	P	
24. <i>Magnolia punduana</i>			P		
25. <i>Magnolia rabaniana</i>		P	P		

Taxon name	Nepal	Bhutan	India	Bangladesh	Sri Lanka
Introduced and hybrid taxa					
26. <i>Magnolia × alba</i>			P		
27. <i>Magnolia coco</i>			P		
28. <i>Magnolia grandiflora</i>	P	P	P		
29. <i>Magnolia figo</i> var. <i>figo</i>			P		
30. <i>Magnolia liliiflora</i>	P	P	P		
31. <i>Magnolia montana</i>			P		
32. <i>Magnolia obovata</i>			P		
33. <i>Magnolia sirindhorniae</i>			P		
34. <i>Magnolia × soulangeana</i>			P		
Total taxa	10	13	34	10	1

[Note: The states of Pakistan and Maldives do not have species from Magnoliaceae; P, present]

In northeast India, magnolias are confined to the horse-shoe shaped mountainous terrain encircling the Assam Valley involving the States of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya and foot hills of Assam (Table 4). Assam tops the list in terms of presence of maximum number of magnolias (26 taxa), which is closely followed by Arunachal Pradesh (21 taxa). Manipur, Meghalaya and Nagaland have 15, 13 and 11 taxa respectively. Mizoram and Sikkim has eight taxa each. A few sporadic occurrences of magnolias are reported from Tripura. Seven native species, viz., *M. campbellii*, *M. cathcartii*, *M. champaca*, *M. doltsopa*, *M. hodgsonii*, *M. kisopa*, and *M. lanuginosa* occur in Darjeeling district of West Bengal which is an adjoining territory to the state of Sikkim in East Himalaya. In addition, introduced species like *M. coco*, *Magnolia figo*, *M. grandiflora* and *M. liliiflora* are also growing in Darjeeling Terai and Hills (Das & Chanda 1987; Bhujel 1996; Das & Ghosh 2009). Outside northeast India, *M. liliifera* is reported from Andaman & Nicobar Islands, although *M. champaca* is introduced there. *M. nilagirica* is the only magnolia present in Western Ghats. Rare occurrences of *M. champaca* and *M. hodgsonii* are known from the foothills of central Himalayas (Table 4).

Table 4. Distribution of Magnoliaceae in different States of India based on the reports in regional floras.

Taxon name	AR	AS	MN	ML	MZ	NL	SK	TR	WB	AN	IN
Native taxa											
1. <i>Magnolia baillonii</i>	P	P		P	P			P			
2. <i>Magnolia campbellii</i>	P	P	P			P	P		P		
3. <i>Magnolia cathcartii</i>		P	P			P	P		P		
4. <i>Magnolia caveana</i>	P	P		P							
5. <i>Magnolia champaca</i>	P	P	P	P		P		P	P		P
6. <i>Magnolia champaca</i> var. <i>champaca</i>				P	P						
7. <i>Magnolia doltsopa</i>	P	P	P	P	P	P		P	P		
8. <i>Magnolia globosa</i>	P	P							P		
9. <i>Magnolia griffithii</i>	P	P	P			P					
10. <i>Magnolia gustavi</i>	P	P									
11. <i>Magnolia hodgsonii</i>	P	P	P	P	P		P		P		P
12. <i>Magnolia bookeri</i>	P	P	P								
13. <i>Magnolia insignis</i>	P	P	P	P		P					
14. <i>Magnolia kingii</i>	P	P	P	P			P				
15. <i>Magnolia kisopa</i>	P		P			P	P		P		
16. <i>Magnolia lanuginosa</i>	P	P	P			P			P		
17. <i>Magnolia liliifera</i>		P					P	P		P	

Taxon name	AR	AS	MN	ML	MZ	NL	SK	TR	WB	AN	IN
18. <i>Magnolia mannii</i>	P	P									
19. <i>Magnolia nilagirica</i>		P*									P
20. <i>Magnolia oblonga</i>	P	P		P	P	P					
21. <i>Magnolia pealiانا</i>	P	P									
22. <i>Magnolia pleiocarpa</i>		P									
23. <i>Magnolia pterocarpa</i>	P	P		P				P			
24. <i>Magnolia punduana</i>	P*		P*	P							
25. <i>Magnolia rabaniana</i>	P	P		P	P	P					
Introduced and hybrid taxa											
26. <i>Magnolia × alba</i>			P								
27. <i>Magnolia coco</i>			P						P		
28. <i>Magnolia grandiflora</i>	P	P	P	P	P	P	P	P	P	P	P
29. <i>Magnolia figo</i> var. <i>figo</i>		P							P		
30. <i>Magnolia liliiflora</i>							P		P		
31. <i>Magnolia montana</i>		P			P			P			
32. <i>Magnolia obovata</i>		P									
33. <i>Magnolia sirindhorniae</i>											P
34. <i>Magnolia × soulangeana</i>									P		P
Total taxa	21	26	15	13	8	11	8	7	13	2	6

[Acronyms: AR, Arunachal Pradesh; AS, Assam; MN, Manipur; ML, Meghalaya; MZ, Mizoram; NL, Nagaland; SK, Sikkim; TR, Tripura; WB, West Bengal (mainly Darjeeling district); AN, Andaman & Nicobar Islands; IN, rest of India; P, present; *, doubtful]

The magnolias in northeast India occur mostly in tropical and subtropical rainforests and their abundances are moderate to low, signifying their rarity (Shankar & Tripathi 2017; Shankar 2017, 2019). For instance, in tropical rainforests of Meghalaya, *M. bodgsonii*, *M. champaca*, and *M. insignis* were encountered with densities of 5.3, 1.2 and 0.4 stems ha⁻¹, respectively (Shankar & Tripathi 2017). In these forests, the dominant associates were *Boehmeria glomerulifera*, *Castanopsis armata*, *Cinnamomum tamala*, *Itea macrophylla*, *Macropanax undulatus*, *Oreocnide integrifolia*, *Persea odoratissima*, *Schima wallichii* and *Syzygium tetragonum*. In *Shorea robusta*-dominated forests of eastern India, *M. champaca* and *M. bodgsonii* are common magnolias, but with low densities. For instance, *M. champaca* with 3 stems ha⁻¹ and *M. bodgsonii* with 0.5 stems ha⁻¹ occurred in Mahananda Wildlife Sanctuary in Darjeeling (Shankar 2001). Here, the associate species were *Amoora rohituka*, *Cryptocarya floribunda*, *Dillenia pentagyna*, *Leea* spp., *Mallotus philippensis*, *Schima wallichii*, and *Terminalia belerica* (Shankar 2001). In 'Khasi Hill Sal' forest ecosystem in Meghalaya, *M. champaca* occurred with a density of 0.2 stems ha⁻¹ (Tripathi & Shankar 2014). These results indicate that the magnolias are rare in natural forests and their populations are threatened.

CONCLUSIONS

The fossil and historical records reveal that the magnolias have lived and adapted to very diverse climates, i.e., from very cold to very warm. The magnolias were once dominant in the northern hemisphere (Heywood 1978), but descended towards south and are now predominant in southeast Asia as a result of changes in the climate. The deciduous, temperate species are derived from evergreen, warm-temperate species as an adaptation to the climate (Hebda & Irving 2004). In general, the magnolias have lost their dominance in most habitats, as also found in this study. Once dominant in high latitudes of northern hemisphere, magnolias now remain plants of occasional or rare occurrence in many habitations. The unfolding of complex global climate change scenario due to exploding human population pressure poses enormous uncertainty for future as to how will the remaining species and their assemblages respond to maintaining or altering their populations and distributions in both protected and distressed environments.

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