



Note on identity and distribution of *Cynometra iripa* Kostel. and *C. ramiflora* L. (Fabaceae) in the Andaman and Nicobar Islands, India

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Abstract

The present study revealed the identity and distribution of *Cynometra iripa* and *C. ramiflora* in the Andaman and Nicobar Islands, India. Of these, *C. iripa* is often classified as true mangrove species, whereas *C. ramiflora* is a mangrove associate. Apex of leaflets, length of inflorescences, length of pedicels, apex of anthers and position of fruit beak are distinguishing key characters between *C. iripa* and *C. ramiflora*. Photographs, a key to the species, and notes on nomenclatural ambiguity are provided.

Key words

Cynometra spp; Andaman and Nicobar Islands; mangroves; distribution.

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Introduction

The genus *Cynometra* L. (Fabaceae) consists of about 85 species distributed in the tropical regions (Mabberley 2008). The genus is characterised by unijugate or bijugate leaves, small bud scales, 4 calyx lobes, 5 petals, 10 stamens, and 1-seeded fruits. In India, *Cynometra* is represented by 7 species: *C. beddomei* Prain, *C. bourdillonii* Gamble, *C. iripa* Kostel., *C. malaccensis* Meeuwen, *C. ramiflora* L., *C. travancorica* Bedd., and *C. cauliflora* L. (Sanjappa 1992). Of these, taxonomical identity and distribution of *C. ramiflora* and *C. iripa* have often been

problematic as *C. iripa* was considered as a variety of *C. ramiflora* in the past (Meeuwen 1970). *Cymorium sylvestre* of Rumphius (1741: pl. 63) was described as *Cynometra ramiflora* by Linnaeus (1753), which is characterized by unijugate leaves. *Iripa* of Rheede (1682: pl. 31) was described as *Cynometra iripa* by Kosteletzky (1835), which is characterized by bijugate leaves. However, most of the subsequent botanists described *Cynometra iripa* as varietal form of *C. ramiflora*. For instance, Prain (1897) described 2 subspecies of *C. ramiflora*, subsp. *genuina* (unijugate form) and subsp. *bijuga* (bijugate form), based on number of leaflets. Furthermore, he recognized

2 varieties of subsp. *bijuga* based on leaflet size and tip shape: var. *mimosoides* (smaller leaflets with obtuse tip) and var. *heterophylla* (larger leaflets with acute to acuminate leaflets). Thus, it is noteworthy that Prain described the bijugate form of *C. ramiflora* as var. *heterophylla* and unijugate as subsp. *genuina*, whereas var. *mimosoides* was used to describe *C. iripa*. Subsequently, Prain (1903) separated var. *mimosoides* from *C. ramiflora* and treated it as a distinct species. From this, it is apparent that *C. iripa* was placed as distinct species by Prain (1903) and var. *heterophylla* and subsp. *genuina* (i.e., the unijugate and bijugate forms of *C. ramiflora* respectively) were placed under *C. ramiflora* L. In the taxonomical revision of the genus *Cynometra*, Meeuwen (1970) also treated “subsp. *genuina*” and “subsp. *heterophylla*” as synonyms of *C. ramiflora* and “var. *mimosoides*” and “subsp. *bijuga*” are treated as synonyms of *C. iripa*. Further, he also noted that “for no obvious reason, *C. iripa* was considered in the past as a variety of *C. ramiflora* and it is entirely different from *C. ramiflora*; the only character they share is a deeply rugose pod, but even the shape of the pod is different”. Ding Hou et al. (1996) also described the *Cynometra* species in Flora Malesiana based on the taxonomical revision of Meeuwen (1970).

Both *C. iripa* and *C. ramiflora* were known from Andaman and Nicobar Islands (A & N Islands). However, the identity and distribution of *C. iripa* and *C. ramiflora* are far from complete. For instance, in Forest flora of Andamans, Parkinson (1923) reported 2 varieties of *Cynometra ramiflora*—var. *heterophylla* and var. *mimosoides*. He further emphasized that terminal leaflets are much larger than the lower and acute in var. *heterophylla*, whereas in var. *mimosoides* terminal leaflets are hardly larger than the lower and obtuse. He also pointed out that the former one was very rare and latter was most common behind the mangrove swamps in the Andaman Islands. Those notes clearly indicated that his var. *heterophylla* was *C. ramiflora* and var. *mimosoides* was *C. iripa*. Subsequent to Parkinson (1923), *C. ramiflora* and *C. iripa* are reported by Dagar (1987), Dagar et al. (1991), Dagar and Singh (1999), and Debnath (2004). Among them, Dagar (1987) and Dagar et al. (1991) classified both the species as true mangroves and noted that *C. ramiflora* is common in the A & N Islands and *C. iripa* is rare, whereas Debnath (2004) classified these species as mangrove associates and noted that *C. ramiflora* is very rare and *C. iripa* is common everywhere behind the mangrove swamps. Dagar and Singh (1999) reported *C. iripa* and 3 varieties of *C. ramiflora*—var. *heterophylla*, var. *bijuga*, and var. *mimosoides*—but the descriptions are not clear. Further, none of them have given locality data for *C. ramiflora* in the A & N Islands.

In the bibliographic and distributional account on legumes of India Sanjappa (1992) reported both the species and noted that *C. iripa* is found in Odisha, West Bengal and A & N Islands, whereas *C. ramiflora* is found only in the A & N Islands. In contrast, Lakshminarasimhan (1999) reported only *C. iripa* from the A & N Islands and noted that *C. ramiflora* is not found in India

including A & N Islands. Kathiresan (2008) reported the occurrence of both *C. ramiflora* and *C. iripa* from the Sundarbans, Odisha and A & N Islands and only *C. iripa* from Maharashtra. Mandal and Naskar (2008) reported the occurrence of only *C. ramiflora* in all the mangrove habitats of India, except Lakshadweep, without description and locality data. Hence, keeping all the previous studies in view, present study was undertaken with the objective to resolve the nomenclatural ambiguity of *C. iripa* and *C. ramiflora* in the A & N Islands and to document their distribution.

Methods

Recent floristic study on species diversity and distribution of mangroves of the A & N Islands revealed the occurrences of 2 species of *Cynometra*, *C. iripa* and *C. ramiflora*. Specimens were collected to assess the numeric and multistate attributes of a wide range of vegetative and reproductive morphological characters and were identified using regional floras (Baker 1878, Brandis 1906, Prain 1903, Parkinson 1923), monographs (Meeuwen 1970, Prain 1897), and standard references (Tomlinson 1986, Giesen et al. 2006). Collected specimens were also compared with specimens deposited at the Andaman and Nicobar Regional Centre, Botanical Survey of India, Port Blair (PBL) and electronic resources such as the Angiosperm Phylogeny Website (Stevens 2001), Tropicos of Missouri Botanical Garden, REMIB (World Biodiversity Information Network), Kew Herbarium Database, Global Plants Initiative, ePIC (electronic Plant Information Centre 2002), and IPNI (The International Plant Names Index 2012). Voucher specimens of *C. iripa* (Accession No. 30939, 30940) and *C. ramiflora* (Accession No. 30941, 30942) have been deposited at PBL.

Results

Of the 51 sites surveyed, *C. iripa* was recorded at 29 sites in the Andaman Islands, whereas few individuals of *C. ramiflora* were recorded from Chidiyatapu, South Andaman (Fig. 1). None of them was recorded from the Nicobar Islands. Taxonomical description and photographs of *C. iripa* and *C. ramiflora* of A & N Islands has also been provided to facilitate identification. The distinguishing key characters of both the species are given in Table 1.

Key to existing species of *Cynometra* species in the A & N Islands

- 1a Leaves 2-jugate, upper leaflets not much unequal; rachis of inflorescences 0.2–0.35 cm long; flowers with bent style; fruits rugose with prominent lateral beak. *C. iripa*
 1b Leaves 1- or 2-jugate, upper leaflets much larger than lower; rachis of inflorescences 1–2 cm long, flowers with straight style; fruits rugose with sub-terminal beak. *C. ramiflora*

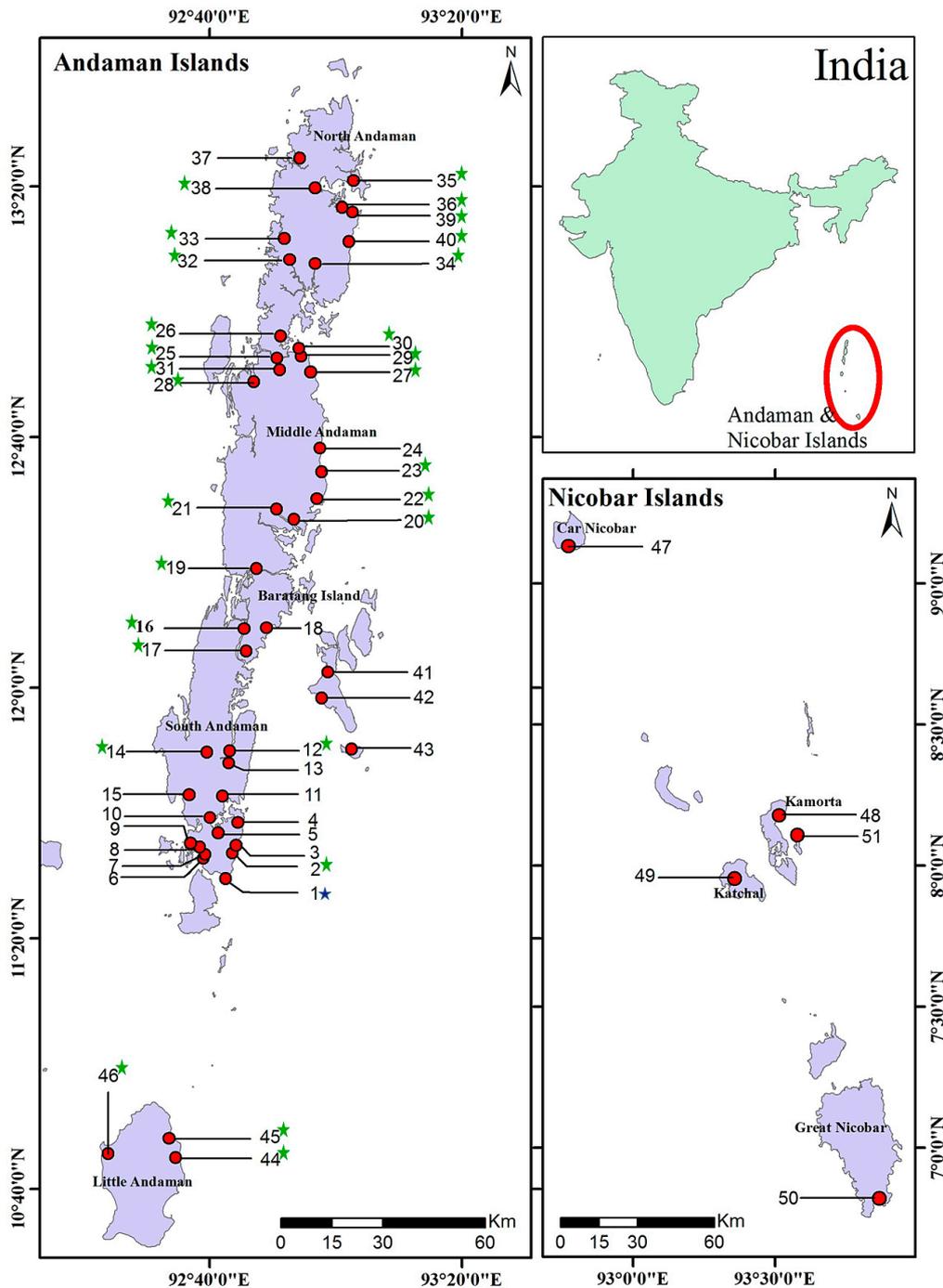


Figure 1. Map showing study area. Red spots indicate sites surveyed in A & N Islands, green star indicates localities of *Cynometra iripa*, and blue star indicates locality of *C. ramiflora*. **South Andaman:** 1. South bay; 2. Chidiyatapu; 3. Burmanallah; 4. Beadonabad; 5. Corbyn’s Cove; 6. Sippighat; 7. Manjeri; 8. Guptapara; 9. Manglutan; 10. Wandoor; 11. Ograbraj; 12. Bambooflat Creek; 13. Wright Myo creek; 14. Shoal Bay Creek; 15. Jirkatang-Tirur; 16. Middle Strait; 17. Wrafter’s Creek; 18. Baludera. **Middle Andaman:** 19. Kadamtala Creek; 20. Yerrata Creek; 21. Shyamkund Creek; 22. Dhaninallah Creek; 23. Rangat Bay; 24. Panchawati; 25. Austin Creek; 26. Mohanpur Creek; 27. Karmatang Creek; 28. Chainpur Creek; 29. Rampur; 30. Danapur; 31. Tugapur. **North Andaman (Diglipur):** 32. Parangara Creek; 33. Kishorinagar Creek; 34. Kalighat Creek; 35. Smith Island; 36. Ariel bay; 37. Radhanagar; 38. Lakshmpur; 39. Durgapur; 40. Ramnagar. **Havelock Island:** 41. Govindnagar; 42. Radhanagar; 43. Neil Island. **Little Andaman:** 44. V.K. Pur Creek; 45. Dugong Creek; 46. Jackson Creek. **Nicobar Islands:** 47. Car Nicobar; 48. Kamorta; 49. Katchal; 50. Campbell Bay; 51. Trinket Island.

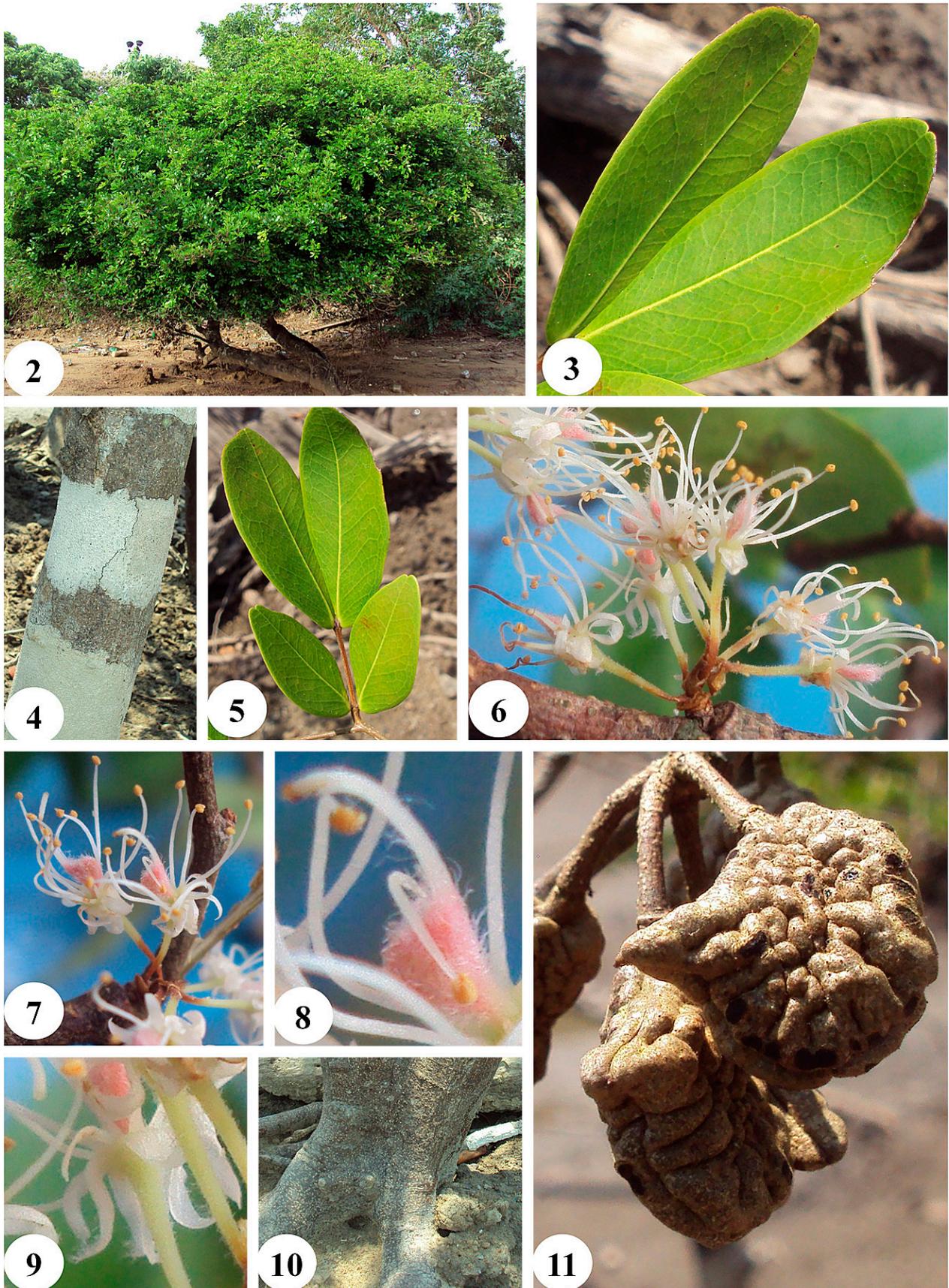
Cynometra iripa Kostel. Allg. Med.-Pharm. Fl. 4: 1341. 1835.

Figures 2–11

C. ramiflora var. *mimosoides* Baker in Hooker’s Fl. Brit. India. 2: 267. 1878; Parkinson, For. Fl. Andaman Islands. 123. 1923. *C. ramiflora* ssp. *bijuga* Prain var. *mimosoides* Prain, J. Asiatic Soc. Bengal 66 (1): 198. 478; 66 (2): 478. 1897. *C. mimosoides* Prain, Rec. Bot. Surv. India 2: 303.

1903; Brandis, Ind. Trees 708. 1906; Gamble, Fl. Pres. Madras 3: 414. 1919. *C. bijuga* var. *mimosoides* Merr., Philip. J. Sc. (Bot) 5: 36. 1910.

Tree: evergreen, spreading, 3–10 m high. Bark: smooth, brown-grey, patchy, finely fissured. Leaves: 2jugate, alternate; leaflets green, coriaceous, glabrous, margin entire, mid vein off centered, elliptic, apex obtuse with notched



Figures 2–11. Morphological features of *Cynometra iripa*. **2.** Habit. **3.** Leaflets with blunt emarginate tip. **4.** Bark. **5.** Leaf with 2 pairs of leaflets. **6.** Inflorescence. **7.** Flowers. **8.** Hairy ovary and bent style. **9.** Reflexed calyx lobes. **10.** Stem base. **11.** Wrinkled pod with lateral beak.

Table 1. Comparison of diagnostic characters of *Cynometra iripa* and *C. ramiflora*.

Characters	<i>C. iripa</i>	<i>C. ramiflora</i>
Leaflet size	Lower pair smaller than upper, not much varied	Upper pair much larger than lower
Apex of the leaflets	Obtuse to round	Acute to acuminate
Length of rachis of inflorescence	0.2–0.35 cm	1–2 cm
Length of the pedicels	0.3–0.5 cm	0.7–1.3 cm
Style	Bent, glabrous, not in line with the dorsal side of the ovary	Straight, in line with the dorsal part of the ovary, a few hairs up to halfway
Ovary	Densely hairy	Slightly hairy
Mature fruits	Rugose with prominent lateral beak	Rugose with sub-terminal beak, beak not prominent as in <i>C. iripa</i>

tip, base cuneate, 2–6.5 × 1–3 cm, lower pair often smaller; petioles 0.1–0.4 mm long, minutely pubescent; petiolules c. 0.2 cm long. Inflorescence: axillary, capitate, 3–7 flowered; bracteoles 1 or 2 towards pedicel base, filiform, 0.15–0.3 cm long, sparsely hairy, caduceus, rachis 0.2–0.35 cm long. Mature flower buds: globular, covered by bract; pedicels 0.3–0.5 cm long, hairy. Calyx: 4-lobed, c. 0.5 cm long, lanceolate or oblong-ovate, becoming reflexed and often incurved at apex, white or very pale pink reflexed. Corolla: 5, creamy white, lanceolate, 0.5–0.8 cm long, glabrous, caduceus, reflexed. Stamens: 10, filaments slender, 0.5–0.7 cm long; anthers small with apiculate apex. Ovary: hairy outside and inside, inserted eccentrically on a short stalk; style slender, glabrous, bent not in line with the dorsal side of the ovary, c. 0.5 cm long, stigma capitate. Mature fruit: 1-seeded, woody, wrinkled with distinct lateral beak, green turning brown on maturity, 2–3.5 × 1.5–2.5 cm.

Phenology. Flowering August to December; fruiting January to April.

Habitat. Often occurs in landward margin of mangrove in association with *Aegiceras corniculatum* (L.) Blanco, *Phoenix paludosa* Roxb., and *Heritiera littoralis* Aiton.

Distribution. Reported only from Andaman Islands in Andaman Nicobar Islands.

Specimens examined. India, Andaman and Nicobar Islands: South Andaman, Chediyatapu, 29-May-1974, Thothathri & N.G. Nair 1086; South Andaman, Chidiyatapu, 28-Feb-1975, N. Bhargava & N.G. Nair 2263; Smith Island, 25-Nov-1976, N.G. Nair 4912; South Andaman, Chidiyatapu, 05-Dec-1978, P. Basu 7081; South Andaman, Chidiyatapu, 16-Mar-1980 Rao & Chakraborty 7647; Mayabunder, Parangada, 20-Jan-1988, G.S. Lakra & M. Tigga 16985; Baratang, 29-Jan-1994, Maral Tigga 16632; Diglipur, 25-Sep-1996, G.S. Lakra 15084; Rutland, 12-Apr-2002, K. Karthigeyan 19209; Tarmugli, 30-Nov-2002, K. Karthigeyan 19242; Great Nicobar Island, Dongi Nallah, 19-Jan-2004, J. Jayanthi 19991; South Andaman, Shoalbay Creek (11°47'58.4" N, 092°43'03.2" E), 24-Mar-2014, P. Ragavan 30939, 30940 (PBL).

Conservation Status. Categorized as Near Threatened by the IUCN and its population declining throughout its range due to coastal development (Duke et al. 2010).

***Cynometra ramiflora* L. Sp. Pl. 1: 382–383. 1753.**
Figures 13–22

C. ramiflora L., Baker in Hook, f., Fl. Brit. India 2: 267. 1878; Brandis, Ind. Trees 255. 1906. *C. ramiflora* ssp. *genuina* Prain, *J. Asiat. Soc. Bengal* 66(2): 198. 1897. *C. bijuga* Span. ex Miq., Fl. Ind. Bat. 1(1): 78. 1855; Kurz, *J. Asiat. Soc. Beng.* 45(2): 129 & 289. 1876. *C. ramiflora* ssp. *bijuga* Prain, *J. Asiat. Soc. Bengal* 66(1): 198 & 66(2): 478. 1897. *C. ramiflora* var. *heterophylla* Thwaites, Enum. Ceyl. Pl. 97. 1859; Baker in Hook, f., Fl. Brit. India 2: 267. 1878; Parkinson, For. Fl. Andaman Islands 325. 1923. *C. ramiflora* ssp. *bijuga* var. *heterophylla* Prain, *J. Asiat. Soc. Bengal* 66(2): 198 & 66(2): 478. 1897.

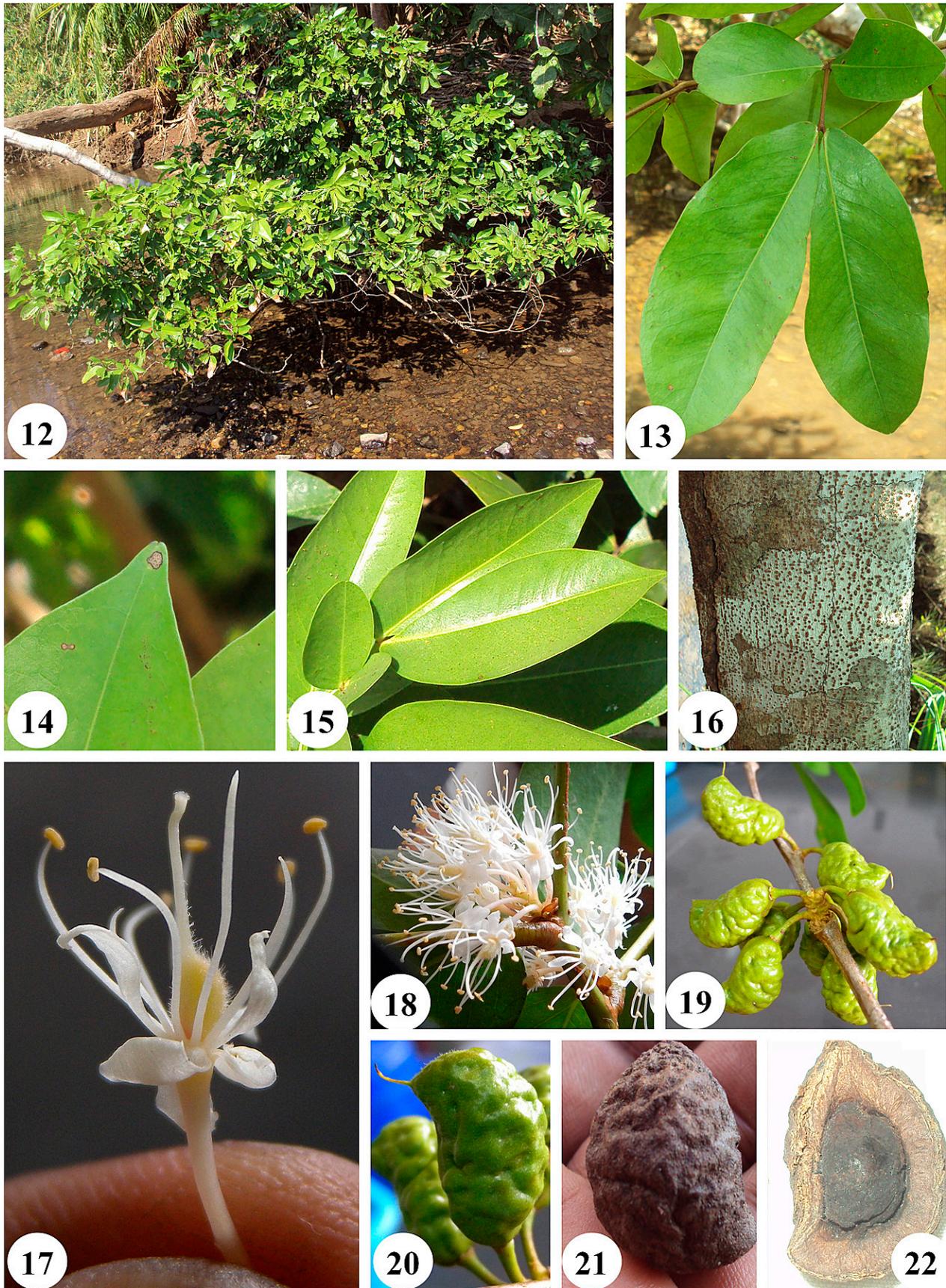
Tree: evergreen, spreading, 3–10 m high. Bark: smooth, brown-grey, patchy with numerous lenticels. Leaves: 1 or 2jugate, alternate; leaflets green, coriaceous, glabrous, margin entire, mid vein off centered, elliptic, apex acute with notched leaf tip, base cuneate or attenuate, 3.5–15 × 2–5.5 cm, lower pair often smaller, terminal leaflets much larger; petiole 0.5–1.5 cm long, minutely pubescent; petiolules c. 0.2 cm long. Inflorescence: axillary, capitate, 3–10 flowered; bracteoles near pedicel bases boat-shaped and keeled, 0.2–0.3 × c. 0.15 mm, ciliate at apex, caduceus; rachis 1–2 cm long; Mature flower buds: globular, covered by bract; pedicels 0.7–1.3 cm long, glabrous. Calyx: 4-lobed, white, c. 0.5 cm long, apex acute, margin entire, glabrous, reflexed. Corolla: 5, creamy white, lanceolate, 0.6–1 cm long, caducous, glabrous, apex acute or mucronate, margin entire, not reflexed as in *C. iripa*. Stamens: 10; filaments slender, 0.7–1 cm long; anthers small with slightly apiculate apex. Ovary: curly hairy outside, glabrous inside, inserted eccentrically on a short stalk; style slender, straight, hairy at base, 0.5–0.8 cm long; stigma capitate. Mature fruits: 1-seeded, woody, wrinkled with sub-terminal beak, green turning brown on maturity, 2–2.5 × 1–1.5 cm.

Phenology. Flowering December to January; fruiting January to February.

Habitat. Found on landward margins of mangroves on the banks of the freshwater stream in association with *Bruguiera cylindrica* (L.) Blume, and *Heritiera littoralis* Aiton.

Distribution. Rare, found only in Chidiyatapu, South Andaman Island in the present study. However, it has also been known in the past from Nicobar Islands.

Specimens examined: India, Andaman and Nicobar



Figures 12–22. Morphological features of *Cynometra ramiflora*. **12.** Habit. **13.** Leaf with two pairs of leaflets. **14, 15.** Leaflets with pointed emarginate tip. **16.** Bark. **17.** Flower. **18.** Inflorescence. **19.** Fruit cluster. **20.** Fruit with sub-terminal beak. **21.** Mature fruit. **22.** Seed.

Islands: Katchal Island, Aat Kona nallah, 30.03.1979, Vasudeva Rao 7502, 7503; Car Nicobar, Near freshwater streams, 01-Oct-1979, N.G. Nair 7498, 7499; Car Nicobar, 15-Jun-1974, N.G. Nair 7496, 7497; Katchal Island, 14-Jun-1977, Chakraborty 6037; Great Nicobar, 27Oct-1979, D.K. Hore 7722; South Andaman Island, Chidiyatpu (11°29'31.2" N, 092°42'33.6" E), 15-Jun-2014, P. Ragavan 30941, 30942 (PBL).

Discussion

The synonyms of *C. ramiflora* based on the differences in the number and size of leaflets (characters of minor importance) often causing confusion with *C. iripa* (Meeuwen 1970). *Cynometra iripa* is distinguished from *C. ramiflora* by its eccentric bent style, hairy ovary, distally curved calyx lobes, and fruit with prominent lateral beak, whereas in *C. ramiflora* style is straight, ovary curly hairy outside and glabrous inside, calyx lobes erect, and fruits with sub-terminal beak (Meeuwen 1970, Ding Hou et al. 1996, Giesen et al. 2006). Considering the distribution of *C. iripa* and *C. ramiflora*, Prain (1897) noted that *C. ramiflora* subsp. *genuina* (unijugate form of *C. ramiflora*) has never been collected in Indian territory, var. *mimosoides* was noted in Sundarbans, Malabar, Ceylon, Burma, Andamans (very common); distribution of var. *heterophylla* was noted in Ceylon, Andamans; Coco Group, and South Andaman (very rare), Malay Peninsula and Singapore. From these notes, it is clear that *C. iripa* (= var. *mimosoides*) was observed from mainland India and Andaman Islands, whereas *C. ramiflora* (= var. *heterophylla*) was observed only in Andaman Islands and it is very rare.

In the present study *C. iripa* was observed exclusively in mangrove swamps, whereas *C. ramiflora* was observed on banks of the freshwater in back mangrove towards inland side. *Cynometra iripa* was found common in the Andaman Islands, whereas only a few individuals of *C. ramiflora* were recorded from Chidiyatapu, South Andaman. Earlier, Prain (1897) and Parkinson (1923) also noted rare distribution of *C. ramiflora* in the South Andaman Islands. However, Sinha (1999) reported the occurrence of *C. ramiflora* from fringes of Galathea Bay and specimens of *C. ramiflora* and *C. iripa* from Nicobar Islands are also available in BSI, Regional Centre at Port Blair. Of these, specimen deposited by N.G. Nair (Accession no. 7498, 7499, 7496, 7497) from Car Nicobar, Chakraborty (Accession no.6037) and Vasudeva Rao (Accession no.7502, 7503) from Katchal Island and D.K. Hore (Accession no.7722) from Great Nicobar Island are verified here as *C. ramiflora*. J. Jayanthi deposited specimens of *C. iripa* (Accession No. 19991) from Great Nicobar Island in 2004. It has been reported that the geomorphologic changes caused by the 2004 catastrophic event drastically affected the mangroves and other coastal vegetations of Nicobar Islands (Sridhar et al. 2006). Recent floristic study carried out by Nehru and Balasubramanian (2014) also noted the drastic change in

the floral composition in Nicobar Islands. It is suspected, therefore, that permanent submergence might have led to the extinction of these species from the Nicobar Islands, although this needs to be validated by more extensive and thorough surveys for *Cynometra* species in the Nicobar Islands. Furthermore, limited site-specific survey confined to mangroves of Nicobar Islands could also be the possible reason for its absence in the present study.

Both *C. iripa* and *C. ramiflora* are often classified as true mangrove species in India (Naskar 2004, Kathiresan 2008, MoEF 2008, Sanjappa et al. 2011), but only *C. iripa* is the most common representative in mangrove swamps (Meeuwen 1970) and classified often as a true mangrove species globally (Duke 1992, Polidoro et al. 2010), whereas *C. ramiflora* is found commonly in the fringes of the freshwater streams or back mangroves and also found inland. Nevertheless, *C. iripa* does not have any adaptive features (like pneumatophores, stilt root, and vivipary) to consider it as a true mangrove species, thus *C. iripa* is not categorized as “core” mangrove species (Spalding et al. 2010). In other parts of India, *C. iripa* was recorded from Sundarbans, Odisha and Maharashtra (Sanjappa 1992, Bhosale 2002) and *C. ramiflora* was found only in the A & N Islands. Both *C. iripa* and *C. ramiflora* are threatened in India as different parts of these species have considerable medical significance (Bandaranayake 1998). The information provided in this communication will be helpful to take effective conservation measures for the protection and propagation of *C. iripa* and *C. ramiflora*.

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Authors' Contributions

PR, KR, and PMM collected specimens; PR and TSR identified the specimen; and PR, AS, RSC, and KS wrote the paper.

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