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SHORT COMMUNICATION

AN UPDATE ON THE DISTRIBUTION PATTERN AND ENDEMICITY OF THREE LESSER-KNOWN TREE SPECIES IN THE WESTERN GHATS, INDIA

K. Sankara Rao, N.V. Page, A.N. Sringswara, R. Arun Singh & Imran Baig

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AN UPDATE ON THE DISTRIBUTION PATTERN AND ENDEMICITY OF THREE LESSER-KNOWN TREE SPECIES IN THE WESTERN GHATS, INDIA

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Abstract: The present communication reports an update on the distribution of three endemic tree species of the Western Ghats-Sri Lanka biodiversity hotspot, namely, *Atuna indica* (Bedd.) Kosterm., *Paracroton integrifolius* (Airy Shaw) N.P.Balacr. & Chakrab. and *Phaeanthus malabaricus* Bedd. The discovery of these taxa in the Makutta Ghat of Kodagu District results in the extension of their northern range limits and further enriches the flora of Karnataka state by three more tree species. Within the Western Ghats, these taxa were previously recorded only from the states of Kerala and Tamil Nadu, while *Paracroton integrifolius* (Airy Shaw) N.P.Balacr. & Chakrab. has also been recorded from Sri Lanka. Nomenclature updates, detailed descriptions, conservation status and relevant notes on the habitat, phenology and distribution localization are supplied. Additionally, field photographs and scanned herbarium specimens are provided to facilitate easy identification of these taxa in the field.

Keywords: Endemic, Karnataka, Kodagu District, new records, range extension, Western Ghats.

During our routine floristic exploration trips to Kodagu forests intended to strengthen and update the 'flora Karnataka' online database (Digital Flora of Karnataka 2014), the evergreen woody species, *Atuna indica* (Bedd.) Kosterm., *Paracroton integrifolius* (Airy Shaw) N.P. Balacr. & Chakrab. and *Phaeanthus malabaricus* Bedd. were discovered from the evergreen forest of Makutta Ghat along with other endemic

species including *Orophea malabarica* Sasidh. & Sivar. and *Orophea sivarajanii* Sasidh. (Sankararao et al. 2015).

The genus *Atuna* Raf. (Chrysobalanaceae) comprises nine species of the Indo-Malayan origin (Mabberley 2008; The Plant List 2014) of which two species *A. indica* (Bedd.) Kosterm. & *A. travancorica* (Bedd.) Kosterm. are endemic to the Western Ghats in Kerala and Tamil Nadu in India (Nayar et al. 2006). The genus *Paracroton* Miq. (Euphorbiaceae) comprises five species (The Plant List 2014) of which two species *P. integrifolius* (Airy Shaw) N.P.Balacr. & Chakrab. and *P. pendulus* subsp. *zeylanicus* (Thwaites) N.P.Balacr. & Chakrab. are endemic to Kerala and Tamil Nadu in India and Sri Lanka (Nayar et al. 2006; Balakrishnan et al. 2012), and the genus *Phaeanthus* Hook.f. & Thomson (Annonaceae) comprises 16 species distributed throughout the world (The Plant List 2014), one species of which, namely, *P. malabaricus* Bedd. is endemic to the Western Ghats in Kerala and Tamil Nadu.

The present study establishes the extension in distribution range of these species from the earlier mentioned locations to newer sites in the Western Ghats in Karnataka. These findings result in the addition of three tree species to the floral diversity in the state

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Conflict of Interest: The authors declare no competing interests.

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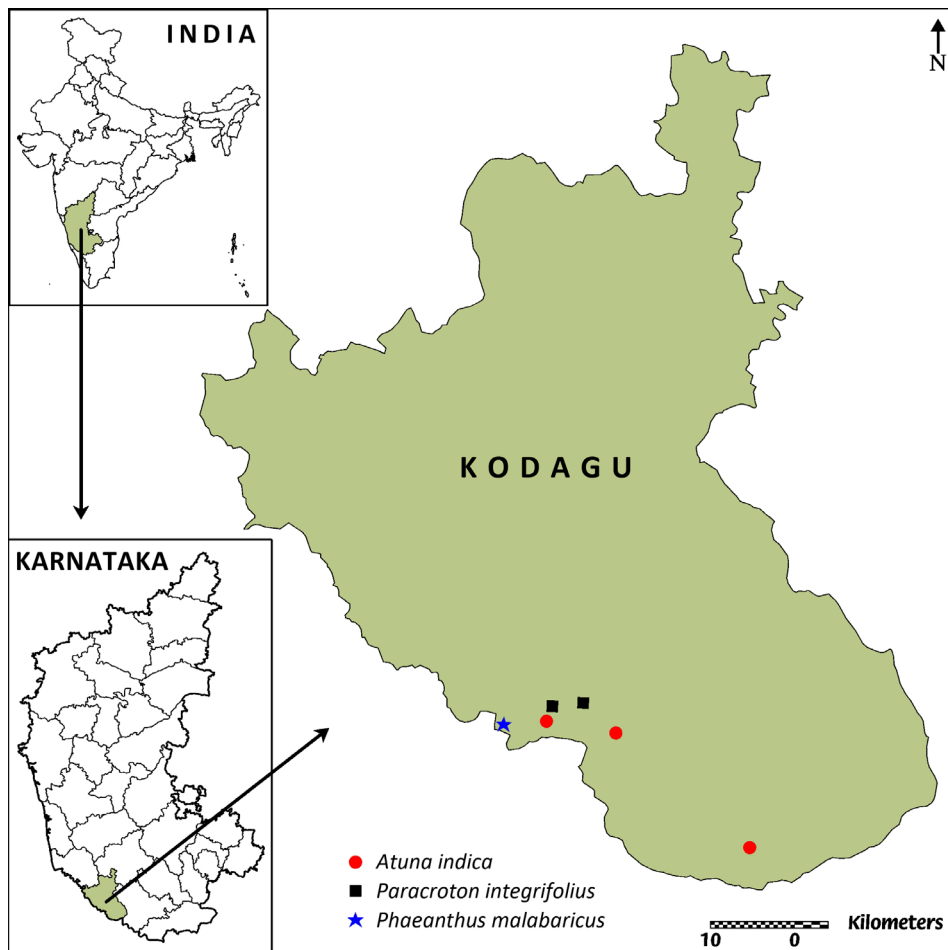


Figure 1. Map of Kodagu District, Karnataka showing specimen collection locations.

and also warrant an extension of the endemicity of these taxa.

STUDY AREA

Kodagu (Coorg), a hilly district of Karnataka State, lies geographically between $12.423333^{\circ}\text{N}$ and 75.7375°E and extends over an area of $4,102\text{km}^2$ in the Western Ghats (Census 2011). This region is bordered by other districts, i.e., Hassan to the north, Mysore to the east, Dakshina Kannada to the northwest and districts of Kerala state to the south including Kasaragod, Kannur and Wayanad districts. Kodagu has three wildlife sanctuaries, viz., the Brahmagiri, Pushpagiri and Talacauvery and one national park, namely, Nagarhole (=Rajiv Gandhi National Park), which is a major bio-reserve of this district. Makutta Ghat, is one of the species rich regions of Kodagu and harbours a number of endemic species of the Western Ghats.

Atuna indica was first located in Makutta Ghat during a visit in February 2014. Subsequently, in the month of March, in the same year *Phaeanthus malabaricus* in

flowering and *Paracroton integrifolius* in fruiting stages were located from other locations of Makutta Ghat (Fig. 1).

MATERIAL AND METHODS

The taxa in their mentioned stages were photographed and their specimens collected. Relevant taxonomic notes and geographical coordinates (using hand held Garmin GPS) were also recorded. Herbarium specimens were prepared using standard protocols and were accessed into Herbarium JCB at the Centre for Ecological Sciences, Indian Institute of Science (IISc), Bengaluru and the Herbarium UASB at the University of Agricultural Sciences, GKVK Campus, Bengaluru. The specimens were carefully examined for identification and the determinations validated by further referring to the available taxonomic literature (Nair & Henry 1983; Nayar et al. 2006; Mabberley 2008; Karthikeyan et al. 2009; Balakrishnan et al. 2012) and online digital herbaria, HIFP (French Institute of Pondicherry), KFRI (Kerala Forest Research Institute, Peechi), K (Royal

Botanic Gardens, Kew) and MO (Missouri Botanical Garden, St. Louis, Missouri). Digitization of specimens was carried out using in-house herbarium scanning equipment.

Atuna indica

(Bedd.) Kosterm., Reinwardtia 7: 423. 1969; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 344. 2009; Sasidh. & Sujjanpal, Rheedeia 21: 81. 2011. *Parinari indica* (Bedd.) Bedd., Icon. Pl. Ind. Or. 22, t. 109. 1870 (as '*Parinarium indicum*'); Fl. Syl. S. India t. 191. 1872; Hook. f., Fl. Brit. India 2:311.1878; Gamble, Fl. Pres. Madras 437 (310). 1919. *Entosiphon indicus* Bedd., Madras J. Lit. Sci. Ser. III, 1: 45, t. 8. 1864 (as '*indicum*') (Image 2 A,B & C).

Tall evergreen trees with thin, smooth, brown bark and reddish-blaze. Leaves simple, alternate, lamina 17–21 x 6–8 cm, elliptic-oblong, base acute, apex acuminate, margin entire, glabrous, chartaceous with 12–18 prominent lateral nerves; petioles 6–12 mm long, swollen at base; stipules free, lateral and lanceolate. Flowers bisexual in terminal or axillary corymbose racemes; bracts brown and hairy. Sepals united, tube funnel-shaped, 5-lobed; petals 5, white; stamens numerous; filaments basally connate; ovary 2-celled, ovules 2 in each cell; style filiform, basal; stigma truncate. Fruit a drupe, ca. 4x3 cm, ovoid, smooth with 1–2 large stony seeds.

Habitat: Understory of the wet evergreen forests, up to 800m altitude.

Specimens examined: HJCB-N 130, 02.ii.2014, India, Karnataka, Kodagu District, Makutta Ghat (12°10'03.00"N & 75°76'09.00"E), coll. Arun Singh R, Navendu Page & Imran Baig, deposited at the Herbarium JCB, IISc, Bangalore (Image 1A).

Flowers and Fruits: September–January.

Distribution: Endemic to the Western Ghats of India. This species is restricted to the northwestern range of Nilgiris of Tamil Nadu (Ahmedullah & Nayar 1987; Nair & Henry 1983) and northern Kerala in Malappuram and Wayanad District (Sasidharan 2011; Nayar et al. 2006). Now as a new record from Makutta Ghat in Kodagu District of Karnataka.

Paracroton integrifolius

(Airy Shaw) N.P.Balacr. & Chakrab., Kew Bull. 48: 718. 1993; Sivar. & Mathew, Fl. Nilambur 632. 1997; Sasidh., Fl. Parambikulam WS 296. 2002; N.P.Balacr. & Chakrab., Fam. Euphorbiaceae India 218. 2007; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 747. 2009; N.P. Balacr. et al., Euphorbiaceae in Fl. India 23: 245. 2012. *Ostodes integrifolius* Airy Shaw, Kew Bull. 16: 362.

1963. *Ostodes zeylanicus* var. *minor* sensu Gamble, Fl. Pres. Madras 1336(935). 1925, non (Thw.) Hook.f. 1887. *Fahrenheitia integrifolia* (Airy Shaw) Airy Shaw, Kew Bull. 20: 410. 1966; Ramach. & V.J. Nair, Fl. Cannanore Dist. 417. 1988. (Image 3).

Moderate-sized evergreen trees; bark thick, smooth, exfoliating with brownish-orange blaze. Young shoots sparsely-pubescent. Leaves simple, alternate with caducous, lateral stipules. Petioles 10–25 mm long, bi-glandular at the apex on either side; lamina 10–16 x 4–7 cm, elliptic-obovate, base cuneate, apex acuminate, margin entire or serrate, lateral nerves 10–13 pairs, pinnate and prominent. Flowers unisexual, white, in terminal and axillary racemes. Tepals lobed, free, 10 in 2 whorls, outer 5 unequal, inner 5 petaloid; stamens 10–20; ovary superior, glabrous, 3-celled, ovule single in each cell; styles 3, short, bifid, glandular. Fruit capsule, ca. 2cm across, subglobose, ribbed, tomentose, breaking into three, 2-valved cocci; Seeds ovoid or angled and mottled.

Habitat: In wet evergreen forests, often in valleys and along streams banks.

Specimens examined: HJCB-N 131 A & B, 05.iii.2014, India, Karnataka, Kodagu, Makutta Ghat (12°11'66.70"N & 75°76'66.67"E; 12°12'16.70"N & 75°80'00.00"E), coll. Arun Singh R, Imran Baig & Sringswara, deposited at the Herbarium JCB, Centre for Ecological Sciences, Indian Institute of Science, Bengaluru (Image 1C,D)

Flowers and Fruits: August–March

Distribution: This species is distributed in the Western Ghats in Kerala (Nayar et al. 2006; Sasidharan 2011) and from the Nilgiris of Tamil Nadu (Henry et al. 1987); also recorded from Sri Lanka (Sasidharan 2011), and now as a new record from Makutta Ghat in Kodagu District of Karnataka.

Phaeanthus malabaricus

Bedd., Icon. Pl. Ind. Or. 16. t. 76. 1869; Hook. f., Fl. Brit. India 1: 72. 1872; Gamble, Fl. Pres. Madras 17(12). 1915; Ramach. et al., J. Econ. Taxon. Bot. 1: 96. 1980; Mohanan et al., J. Econ. Taxon. Bot. 5: 399. 1984; Ramach. & V.J. Nair, Fl. Cannanore Dist. 41. 1988; Debika Mitra in B. D. Sharma et al., Fl. India 1: 230. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur For. 32. 1996; Sasidh., Fl. Shenduruny WS 17. 1997; Sasidh., Fl. Periyar Tiger Reserve 9. 1998; Mohanan & Sivad., Fl. Agasthyamala 59. 2002; Anil Kumar et al., Fl. Pathanamthitta 45. 2005; M. Mohanan in P. Daniel, Fl. Kerala 1: 161. 2005; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 100. 2009. *Polyalthia malabarica* (Bedd.) I.M. Turner, Nordic J. Bot.33(3): 284. 2015 (Image 2 D, E & F)

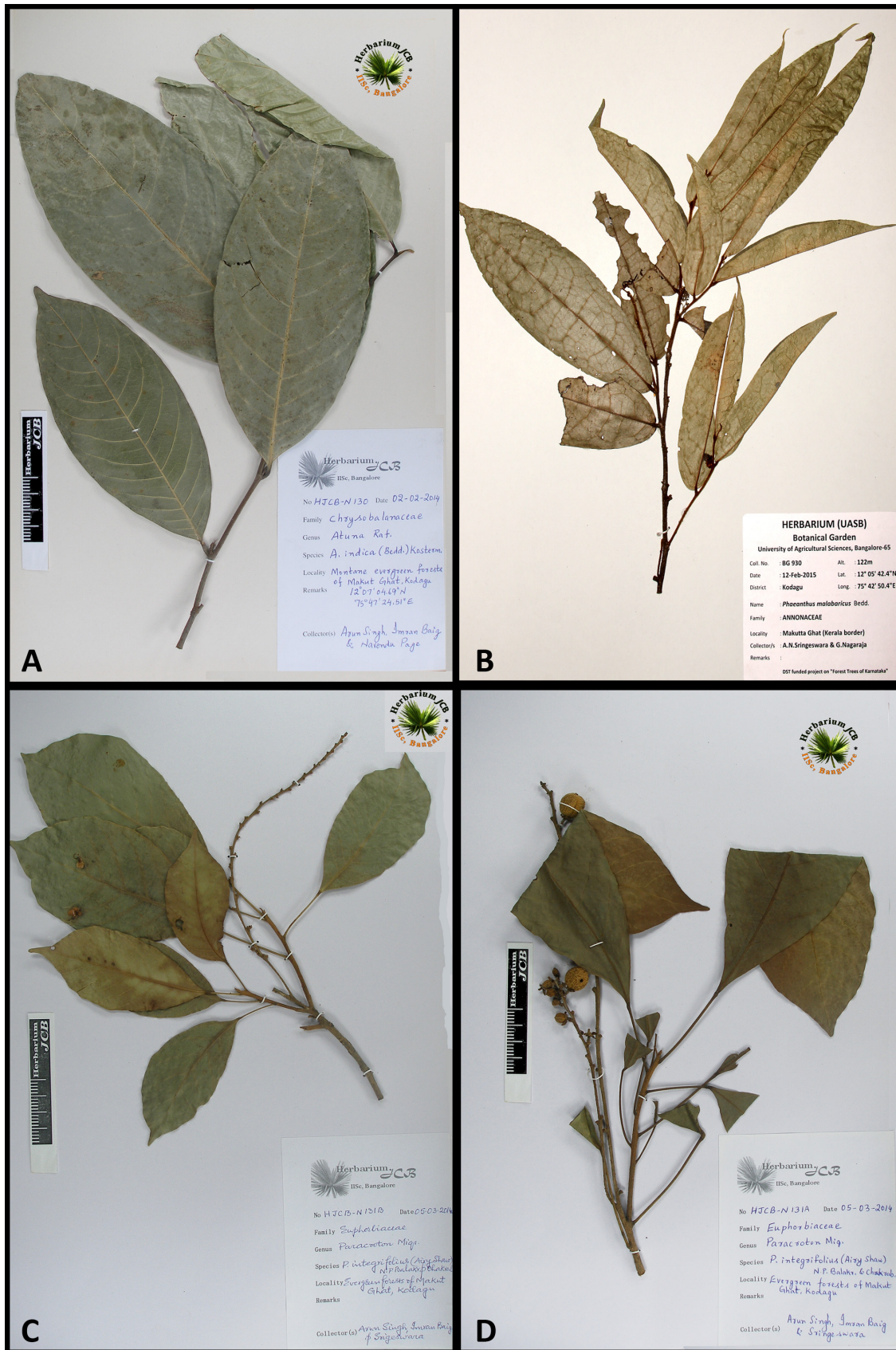


Image 1. Scanned herbarium specimens of A. *Atuna indica* (Bedd.) Kosterm., B. *Phaenanthus malabaricus* Bedd. and C & D. *Paracroton integrifolius* (Airy Shaw) N.P. Balakr. & Chakrab.



Image 2. Field photographs of live specimens. A, B & C - *Atuna indica* (Bedd.) Kosterm. A. Foliar twig, B. Inflorescence, C. Portion of the inflorescence shown enlarged; D, E & F - *Phaeanthus malabaricus* Bedd. D. Twig showing leaves and flowers., E. & F. Flowers shown enlarged; E. side view. F. frontal view.



Image 3. Field photographs of live specimens. G - L. *Paracroton integrifolius* (Airy Shaw) N.P. Balakr. & Chakrab. G. Inflorescence showing female flowers, H. portion of female inflorescence enlarged. I. Inflorescence showing male flowers, J. portion of male inflorescence enlarged. K. Twig showing leaves and fruits. L. Fruits shown enlarged.

Small trees; branchlets sparsely tomentose. Leaves up to 16x4.5 cm, oblong, shortly acuminate at apex, rounded to subcordate at base, glabrous; nerves 6–10 pairs looping below the margin, reticulate. Flowers axillary, solitary or in fascicles; pedicels ca. 1.5cm long, hispid; sepals ca. 3x3 mm, ovate, acute, hispid; petals unequal, outer ca. 9x5 mm, elliptic, acute, inner ca. 12x8 mm, ovate, acute, concave, thick, spreading; stamens many, anthers oblong, connective hooded; ovaries 20, oblong, villous; ovules 1 or 2; stigma globose.

Habitat: Understory of evergreen forests, mostly at low elevations.

Specimens examined: BG 930, 12.ii.2015, India, Karnataka, Kodagu district, Makutta Ghat (12°05'42.40"N & 75°42'50.40"E), coll. A.N. Sringswara & G.Nagaraja, deposited at the Herbarium UASB, University of Agricultural Sciences, Bengaluru (Image 1B).

Flowers and Fruits: Most part of the year.

Distribution: This species is confined to the Western Ghats in Kerala including the southern part of the Palakkad gap and to the Agastyamalai Hills in Tamil Nadu (Nayar et al. 2006; Sasidharan 2011). Now as a new record to Karnataka in Makutta Ghat in Kodagu District.

Conservation Status

The IUCN conservation status for the species reported is as follows:

a. *Atuna indica* (Bedd.) Kosterm. Endangered (EN), B1+2c, ver. 2.3 (World Conservation Monitoring Centre, 1998a)

b. *Paracroton integrifolius* (Airy Shaw) N.P. Balakr. & Chakrab. Not Evaluated (NE)

c. *Phaeanthus malabaricus* Bedd. Lower Risk/Near Threatened (NT), ver. 2.3 (World Conservation Monitoring Centre, 1998b)

Habitat loss, largely due to anthropogenic activity, is one of the major threats to the populations of these species. The destruction of evergreen forests that took place in the recent past for laying of power transmission lines between Mysore to Kozhikode is one such example of forest fragmentation and habitat degradation in Kodagu (Times News Network 2015). The results also indicate that natural forests along Western Ghats, particularly those in Kodagu region, are understudied.

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