Rediscovery of *Bunium nothum* (C.B. Clarke) P.K. Mukh. (Apiaceae), an endemic and critically endangered umbellifer after 137 years from the Nilgiris, Tamil Nadu, India

Linnaeus (1753) established the genera *Carum* and *Bunium*. However, most of the *Bunium* species were treated under the genus *Carum*. Subsequent critical studies were made on both genera by several researchers[1–4]. They established the delimitation of these two genera very well. One of the most important diagnostic characters between these two genera is the presence (*Bunium*) or absence (*Carum*) of a tuber. Other important characters to differentiate these two genera include leaves being pinnate or compound and calyx absent or obsolete in *Carum*, whereas in *Bunium* leaves are radical, ternately or pinnately decompound and calyx lobes are prominent and well developed.

According to Kljuykov[4], the genus *Bunium* is represented by 48 species, chiefly distributed from Central Asia to Turkey. The species have been grouped under six sections and 15 subsections. Among them, *Bunium nothum* belongs to the section Austrobunium Kljuykov. The most important and obvious diagnostic character for this section is the presence of well-developed calyx teeth[4]. However, according to Plants of the World Online (POWO) database, there are 32 accepted species mainly distributed in Europe, the Mediterranean region and Central Asia[5]. In India, this genus is represented by two species – *Bunium persicum* (Boiss.) B. Fedtsch. distributed in the Himalaya and North East India, and *Bunium nothum* a stenoendemic species, found restricted only in the upper Nilgiri hills of Tamil Nadu. This species was initially described as *Carum nothum* by Clarke[6]. However, Mukherjee[7] transferred this species to the genus *Bunium* because of the presence of tuberous roots.

While indexing representative specimens of the members of Apiaceae collected from the Nilgiris by the earlier workers housed at Madras Herbarium (MH) and various virtual herbaria, in connection with an ongoing project on the Flora of Nilgiri Biosphere Reserve, the present authors came across a digital image of an interesting species, i.e. *Bunium nothum* preserved at K (K000685686 holo!) without any field details. A critical scrutiny of the relevant literature revealed that this species has not been collected after Gamble's collection from the Sispara Ghats of the Nilgiris in 1883. Also, there is no authentic information on the taxonomy and distribution of this species. Even Mukherjee[7] reported its distribution in Peninsular India and doubtful occurrence in Sri Lanka?

In view of the above-mentioned facts, intensive botanical explorations have been conducted in the Nilgiri Biosphere Reserve during October 2019 to Bangitappal, Mukurthi National Park of the Nilgiris, an adjoining area of type locality to relocate *B. nothum* in its natural habitat and also to assess its current status. As a result, a few live plants of this species were recorded from Bangitappal on 30 October 2019.

Clarke[6] described *C. nothum* based on a specimen deposited at K (K000685686, holo!) without any field details, name of the collector, date of collection and collection number, except the place of collection as 'Ceylon'. Trimen[8] included this species in his handbook on the flora of Ceylon on the basis of Clarke (l.c.). However he was doubtful about its occurrence in Ceylon and thus mentioned 'an error is possible on its occurrence in Ceylon'. Later, Joseph and Theobald[9] while revising the family Umbelliferae in Ceylon did not include this species in the revised handbook. Hence, it is clearly evident that this species is not distributed in Sri Lanka. Clarke[6] also mentioned Lobb's (Thomas Lobb (1820–94), an English plant collector, who had collected plants, seeds and botanical specimens in India and Southeast Asia) collection from Mysore (possibly from the Nilgiris, a part of Mysore Province until the 19th century). However, this species was included in the *Flora of Karnataka* by Saldanha[10] and the *Flora of Peninsular India* by Rao *et al.*[11] based on Lobb's collection from Mysore (i.e. the Nilgiris). While searching for information on the plant collections of Lobb, we found that he had collected some specimens from the Nilgiris during 1845–47, and unfortunately some of his specimens were lost in a shipwreck (https://plants.jstor.org/stale/10.5555/al.ap.person.bm0-00152427). Lobb's collections are deposited in many of the major herbaria in Europe, especially in British Museum (BM) and Kew (K). However, we could not trace any of his *B. nothum* collections in both herbaria. The occurrence of this species was also not reported later by Rao and Razi[12], and Sharma *et al.*[13].

Mohanan[14] included it in the *Flora of Kerala* on the basis of work by Sasidharan[15] and Nayar *et al.*[16] from Idukki and Palakkad districts respectively. Therefore, the specimens collected from Mangaladevi hills in Idukki district during 2000, housed in Calicut University Herbarium and Kerala Forest Research Institute Herbarium, were carefully studied. It was found that the specimens were erroneously identified as *C. nothum*; they were in fact *Pimpinella heyneana* (DC.) Benth. & Hook.f. Hence it is confirmed that its distribution in Idukki district is also doubtful. Zakharova *et al.*[17] reported that there are two herbarium sheets of Beddome at BM with two consecutive field numbers, one from the Nilgiris (R.H. Beddome 3347) and the other from 'Anamolleys' (Anamalais) (R.H. Beddome 3348). The specimen from Anamalais is doubtful (most probably a wrong labelling), as this species has never been reported from the hills of Anamalais hitherto. We could not trace these herbarium sheets in BM.

Also, while searching the on-line Kew Herbarium Catalogue, a digital image of a specimen of *B. nothum* collected by Gamble (No. 13442) from the Sispara Ghats in 1883 was found; it is the only available evidence of the occurrence of this species in the Nilgiris so far.

Even though several authors have reported the occurrence of this species from different parts of southern Western Ghats, there are no authentic evidences either as herbarium specimens or documented data available on its existence in the above-mentioned areas, except in the Sispara Ghats. According to Mukherjee and Constance[18], the Nilgiris is more likely the type locality of this species. During the present study only one population was observed in Bangitappal with 27 individuals, which covers about 1 km^2 geographical area. Therefore, it has been

provisionally assessed here as a critically endangered (CR) stenoendemic species, known only from the Sispara Ghats of Nilgiris, Tamil Nadu, following the guidelines of the IUCN Red List Categories and Criteria, version 14 (ref. 19).

A perusal of the literature pertaining to family Apiaceae of India[7,18] and careful examination of fresh specimens collected during the present study as well as digital images of specimens revealed that *B. nothum* has never been collected after Gamble's collection in 1883. So far, it is only known by two specimens deposited in K, of which the one with barcode K000685686 is without name of collector, place and year of collection. This specimen was initially studied by Joseph Hooker, who identified it as *Ptychotis*, followed by Bentham, who examined the same specimen and annotated it as *Carum*. Finally, it was described as *C. nothum* by Clarke[6]. Another collection by Gamble (with barcode K000685687 and annotated as *Bunium nilghirense* H. Wolff) from the Sispara Ghats is the only representative specimen (Gamble 13442), available in Indian herbaria (Forest Research Institute Herbarium, Dehra Dun (DD), Central National Herbarium (CAL)). After these collections, this species was neither collected nor reported from anywhere. Therefore, it has been assessed as a 'Possibly Extinct' species by various workers[15,20,21].

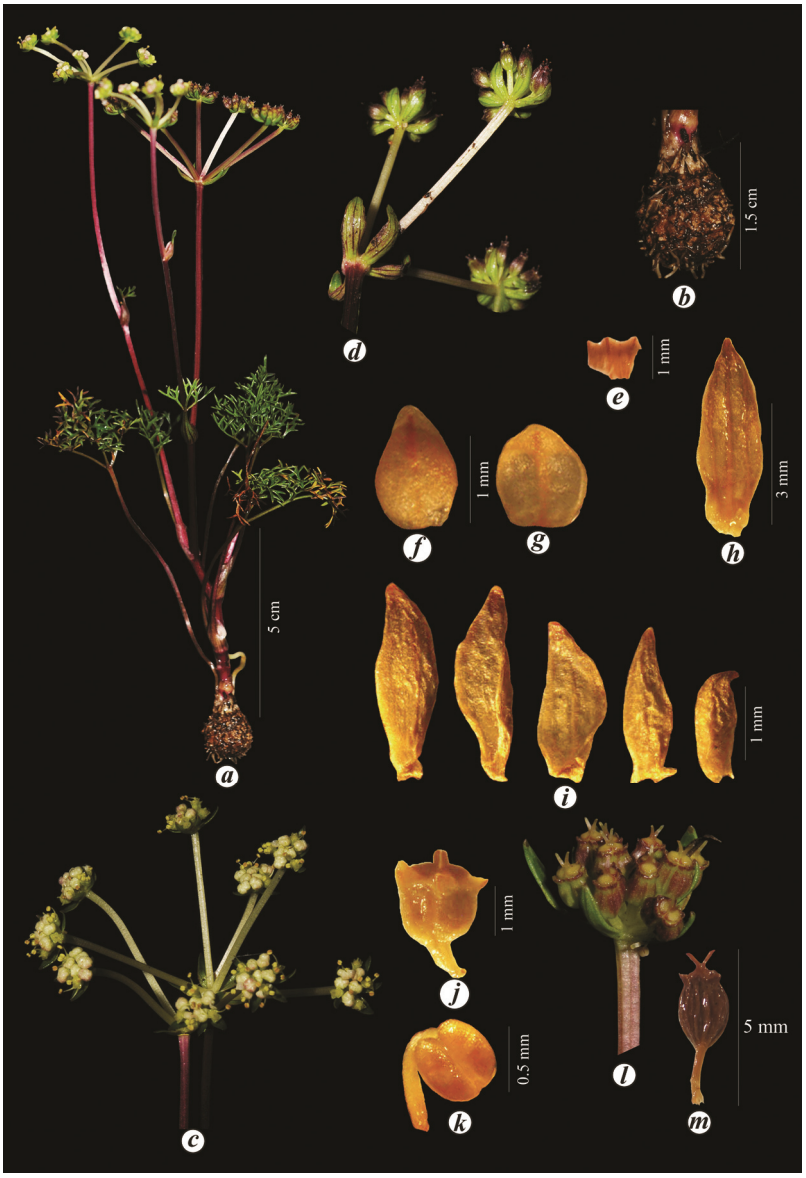

Figure 1. ***a***, Whole plant, ***b***, tuberous root, ***c***, inflorescence, ***d***, young infructescence, ***e***, calyx, ***f***, ***g***, petals (outer and inner), ***h***, bract, ***i***, bracteoles, ***j***, stylopodium, ***k***, anther, ***l***, immature fruits; ***m***, mature fruit.

Taxonomy: *Bunium nothum* (C.B. Clarke) P.K. Mukh. in *Bull. Bot. Surv. India* 24 (1–4): 43. 1983; P.K. Mukh. & Constance, Umbelliferae India: 71. 1993; Karthik. *et al*., Fl. Pl. India 1: 101. 2009; Zakharova *et al*., S. African J. Bot. 94: 126. 2014. *Carum nothum* C.B. Clarke in Hook. f., Fl. Brit. India 2: 681. 1879; H. Wolff in Engl., Pflanzenr. IV, 228(90): 161. 1927; Gamble, Fl. Madras: 394. 1915; Chandrab. in N.C. Nair & A.N. Henry, Fl. Tamil Nadu Ind., Ser. I: Analysis 1: 178. 1983. *Bunium nilghirense* H. Wolff in Feddes Repert. Spec. Nov. Regni Veg. 27: 334. 1930. Type (probable holotype): 'Ceylon?' [Probably Nilgiri Hills, Peninsular India], no other details indicated (K [K000685686, digital image!]).

Perennial herb, erect, branched or unbranched, slender–rigid, glabrous, up to 30 cm high, with tuberous roots; tubers globose, 1–1.7 cm in diameter, brownish or whitish-brown. Stems herbaceous, angular, ribbed, pinkish–purplish. Leaves in rosette at base, alternate on stem, well-developed at base, broadly triangular to rhomboid, cauline leaves reduced towards apex, tri-pinnately decompound, 2–8 × 1.5–3.5 cm, with broad-sheathing leaf base, leaf divisions 0.5–4.5 × 0.5–1.5 mm, entire at margins, acute at apex, midvein prominent, sometimes channelled above, ultimate divisions linear, three-parted or -lobed, 5–10 × 0.5–1 mm; petioles 3–7.5 cm long, greenish or pinkish; sheaths broadly ovate or oblong, whitish or greenish or rarely purplish, 1–1.5 × 0.8–1.2 cm, 3–7-veined, sometimes dilated. Inflorescence of compound or decompound umbel, terminal, ca. 9 cm across; peduncles purplish or greenish or rarely whitish, 1.5–12.5 cm long, slender or rigid, ribbed or angled, erect or curved. Flowers perfect, polygamous or bisexual, pentamerous, pedicellate, 1.5–2.2 × 1.2–1.4 mm; involucral bracts usually five, rarely three or four or six, variable, oblong–lanceolate or linear–lanceolate or oblanceolate, 5–2 × 2.5–5.5 mm, entire at margins, acute or obtuse at apex, usually greenish, rarely purplish or pinkish, prominently three-veined, slightly curved at middle, reflexed, persistent. Rays 4–8, unequal or subequal, spreading–ascending, purplish or greenish or rarely whitish-yellow when young, slender or rigid, terete or

sometimes ribbed, 0.5–5.5 cm long, sometimes fruiting rays elongated up to 10 cm long. Umbellules 6–15-flowered; mature pedicels ca. 2.5 mm long. Involucel bracteoles usually 5, sometimes varies from 3 to 10, oblong–lanceolate or oblanceolate, 3–8.5 × 1.5–2.5 mm, similar to involucral bracts. Calyx five-lobed; lobes triangular–ovate, 0.4–1 × 0.3–1 mm, acute or rounded at the apex, persistent, midvein present, pinkish or greenish yellow, attached to the stylopodium. Petals five, elliptic–ovate or broadly ovate, equal, 1.2–2.2 × 1–1.5 mm, entire or sometimes reflexed at margins, obtuse, retuse or rounded or slightly emarginate at apex, white inside, pinkish or whitish pink or white outside, with a prominent midvein; sometimes sterile flowers often with irregular petals. Stamens five, alternate to petals, inserted on disk; filaments inflexed in bud, linear or filiform in open flowers, 1–1.6 mm long, whitish or greenish; anthers ca. 0.9 × 0.7 mm, dorsifixed. Stylopodium conical, depressed, ca. 1.5 × 1 mm, obtuse, sometimes obsolete. Ovary two-celled; ovule one per cell; style bifid, 0.4–1.1 mm long, recurved; stigma capitate. Fruits ovoid–ellipsoid or oblong, ca. 5.2 × 2.5 mm, brown; mericarps elliptic, 2.8–3 × 1.2–1.3 mm, pentagonal, subterete in transection, compressed laterally, prominently five-ribbed, acute; vittae large, solitary in interval, two on commissure; carpophore bifurcate; commissure narrow; commissural face plane; seeds terete, flat or obscurely channelled on the inner face.

Flowering and fruiting: October–November.

Specimens examined: Ceylon (?), s.n. (K [K000685686, digital image!]); India, Tamil Nadu, Nilgiris District, Sispara Ghats,7500 ft, Nov. 1883, J.S. Gamble 13442 (K [K000685687, digital image!]); On the way to Bangitappal Trekking shed, 11°15′58.0″N, 76°31′28″E, 2300 m, 30.10.2019, M. Murugesan *& al.* 147771 (MH).

Distribution: India, Tamil Nadu (Nilgiris district).

Habitat: Rare in open rolling grassy slopes at elevations between 2300 and 2450 m.

Associated species: *Anaphalis* spp., *Arundinella* spp., *Eriocaulon* spp., *Eulalia phaeothrix* (Hack.) Kuntze, *Fimbristylis* spp., *Impatiens* spp., *Ischaemum indicum* (Houtt.) Merr., *I. nilagiricum* Hack., *Pedicularis zeylanica* Benth., *Tripogon* spp., *Valeriana* sp., etc.

1. Drude, O., In *Die Naturlichen Pflanzenfamilien* (eds Engler, H. G. A. and Prantl, K.), W. Engelmann, Leipzig, 1898, vol. 3(8), pp. 63–250.
2. Korovin, E. P., *Byull. Sredne-Aziatsk. Gosud. Univ.*, 1927, **15**, 117–129.
3. Wolff, H., In *Das Pflanzenreich* (ed. Engler, H. G. A.), W. Engelmann, Leipzig, 1927, IV, 228, Heft 90, pp. 1–398.
4. Kljuykov, E. V., *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol.*, 1988, **93**, 76–89.
5. POWO; http://www.plantsoftheworldonline.org (accessed on 21 December 2020).
6. Clarke, C. B., In *The Flora of British India* (ed. Hooker, J. D.), L. Reeve & Co., London, 1879, vol. 2, pp. 665–720.
7. Mukherjee, P. K., *Bull. Bot. Surv. India*, 1982, **24**(1–4), 42–45.
8. Trimen, H., *A Hand-Book to the Flora of Ceylon*, Dulau & Co., London, 1894, vol. II, pp. 1–392.
9. Joseph, L. K. and Theobald, W. L., In *A Revised Handbook to the Flora of Ceylon* (ed. Dassanayake, M. D.), Oxford & IBH Publishing Co. Pvt Ltd, New Delhi, 1985, vol. 3, pp. 479–499.
10. Saldanha, C. J., *Flora of Karnataka*, Oxford & IBH Publishing Co. Pvt Ltd, New Delhi, 1996, vol. 2, pp. 1–304.
11. Rao, K. S., Swamy, R. K., Kumar, D., Singh A. R. and Bhat, K. G., *Flora of Peninsular India*, 2019; http://flora-peninsula-indica.ces.iisc.ac.in/herbsheet.php?id=725&cat=7 (accessed on 13 January 2021).
12. Rao, R. R. and Razi B. A., *A Synoptic Flora of Mysore District*, Today & Tomorrow's Printers and Publishers, New Delhi, 1981, pp. 1–674.
13. Sharma, B. D., Singh, N. P., Raghavan, R. S. and Deshpande, U. R., *Flora of Karnataka Analysis*, Botanical Survey of India, Calcutta, 1984, pp. 1–395.
14. Mohanan, N., In *The Flora of Kerala* (eds Murthy, G. V. S. and Nair, V. J.), Botanical Survey of India, Kolkata, 2016, vol. 2, pp. 529–554.
15. Sasidharan, N., *Biodiversity documentation for Kerala, Part 6: Flowering Plants*, Kerala Forest Research Institute, Peechi, 2004, pp. 1–702.
16. Nayar, T. S., Beegam R. A., Mohanan, N. and Rajkumar, G., *Flowering Plants of Kerala: A Handbook*, Tropical Botanic Garden and Research Institute, Thiruvananthapuram, 2006, pp. 1–1069.
17. Zakharova, E. A., Degtjareva, G. V., Kljuykov, E. V. and Tilney, P. M., *S. African J. Bot.*, 2014, **94**, 122–128.
18. Mukherjee, P. K. and Constance, L., *Umbelliferae (Apiaceae) of India*, Oxford & IBH Publishing Co. Pvt Ltd, New Delhi, 1993, pp. 1–279.
19. IUCN, *Guidelines for Using the IUCN Red List Categories and Criteria. Version 14*, Prepared by the Standards and Petitions Committee, 2019; http://www.iucnredlist.org/documents/RedListGuidelines.pdf (accessed on 28 October 2020).
20. Nayar, M. P., In *Biodiversity of Tropical Forests Kerala Scenario* (eds Pushpangadan, P. and Nair, K. S. S.), Kerala State Council for Science, Technology and Environment, Trivandrum, 1997, pp. 7–80.
21. Vivekananthan, K., Daniel, P. and Premanath, R. K., In *Plant diversity hotspots in India – An overview* (eds Hajra, P. K. and Mudgal, V.), Botanical Survey of India, Calcutta, 1997, pp. 23–53.

ACKNOWLEDGEMENTS. We thank Dr A. A. Mao, Director, Botanical Survey of India (BSI), Kolkata, for providing the necessary facilities and encouragement, and Dr M. U. Sharief, Head of Office, BSI, Southern Regional Centre (Madras Herbarium, MH), Coimbatore, for help and support. We also thank Dr W. Arisdason (MH) for his valuable comments and inputs on our manuscript, officials of the Tamil Nadu Forest Department for granting permission to explore the forests, and M. Sulaiman and M. Premkumar (MH) for their help during the study.

Received 23 March 2021; revised accepted 31 May 2021

M. MURUGESAN*
R. THARANI
V. RAVICHANDRAN
B. KARTHIK
V. ANUSUBA

Botanical Survey of India,
Southern Regional Centre,
TNAU Campus,
Coimbatore 641 003, India
**For correspondence.*
e-mail: taxonmurugesh@gmail.com