

The identity of *Ophiorrhiza barnesii* (Rubiaceae) – a critically endangered and endemic species of the southern Western Ghats, India

Nair A.S.V.¹, Gangaprasad A.^{1,2*}, Rameshkumar K.B.³ & E.S.S. Kumar³

¹Department of Botany, University of Kerala, Kariavattom, Thiruvananthapuram, Kerala – 695 581, India

²Centre for Biodiversity Conservation, University of Kerala, Kariavattom, Thiruvananthapuram, Kerala – 695 581, India

³Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Karimancode P.O., Thiruvananthapuram, Kerala – 695 562, India

*E-mail: agangaprasad@yahoo.com

Abstract: The identity and rediscovery of *Ophiorrhiza barnesii* C.E.C.Fisch. (Rubiaceae), a critically endangered species from the Western Ghats is discussed here. Detailed species descriptions are accompanied by stereomicroscope images, SEM images of pollen grains, data on ecology and conservation status.

Keywords: Kerala, *Ophiorrhiza caudata*, Ophiorrhizeae, Rubioideae.

Introduction

The genus *Ophiorrhiza* L. (Rubiaceae: Rubioideae: Ophiorrhizeae), represented by 382 species, is distributed mainly in wet tropical and subtropical forests of Southeast Asia (Nair *et al.*, 2022a; POWO, 2023). The Western Ghats and the Northeast India are the two major centres of diversity having the highest concentration of species in India. Out of the 52 species recorded for India, 21 species and seven varieties are found in the Western Ghats, of which 17 species and two varieties are endemic to the region (Nayar *et al.*, 2014; Nair *et al.*, 2021, 2022b).

Field explorations in the Western Ghats as a part of the systematic investigation of *Ophiorrhiza* yielded a collection from the Kallar Valley of Idukki district in Kerala. A perusal of literature (Hooker, 1882; Gamble, 1921; Fischer, 1939; Deb & Mondal, 1997) and types confirmed it as *O. barnesii* C.E.C.Fisch. This species was described by Fischer (1939) based on two collections made by Prof. Edward Barnes (Barnes, 1753, 1754) from the Kallar Valley of Idukki district in 1937. Kumar *et al.* (2013) already published

a paper on the rediscovery of *O. barnesii* from the type locality, after a lapse of 75 years. On critical examination, the specimen collected by Kumar *et al.* (E.S. Santhosh Kumar & P.E. Roy 70440 [TBGT]) revealed to be *O. caudata* C.E.C.Fisch., and not *O. barnesii*. *Ophiorrhiza barnesii* can be distinguished from *O. caudata* by its ovate-lanceolate leaves (*vs.* elliptic-lanceolate in *O. caudata*), corymbose cymes (*vs.* capitate cymes), linear bracts and bracteoles without a distinct midrib (*vs.* lanceolate to ovate with a distinct midrib) and infundibuliform corolla (*vs.* campanulate corolla). A detailed description and colour plates, along with data on the distribution and conservation status are provided here to facilitate easy identification of these taxa.

Taxonomic Treatment

Ophiorrhiza barnesii C.E.C.Fisch., Bull. Misc. Inform. Kew 1939: 248. 1939; Deb & Mondal, Bull. Bot. Surv. India 39: 28. 1997. *Type:* INDIA, Kerala, Travancore High Range, Kalaar valley ['Kallar Valley'], September 1937, Barnes 1754 (holo K [K000031231 digital image!]). **Fig. 1**

Herbs, 20–50 cm tall. Stem erect, somewhat woody at base, terete, glabrous below, slightly puberulous above. Leaves ovate-lanceolate, 8.5–14.6 × 2.8–3.9 cm, acuminate at apex, acute at base, entire at margins, glabrous; lateral nerves 8–12 pairs with eucamptodromous venation; petioles 0.7–2.5 cm long, glabrous; stipules 1–1.5 × c. 0.2 mm, triangular with pointed tip, entire, glabrous. Cymes terminal or axillary, corymbose, 1–2 cm across; branches short, glabrous; peduncles 2.4–2.8 cm long, slender, glabrous. Flowers heterostylous, 8–9 mm long; bracts linear, without a distinct midrib, 4.1–4.2 ×

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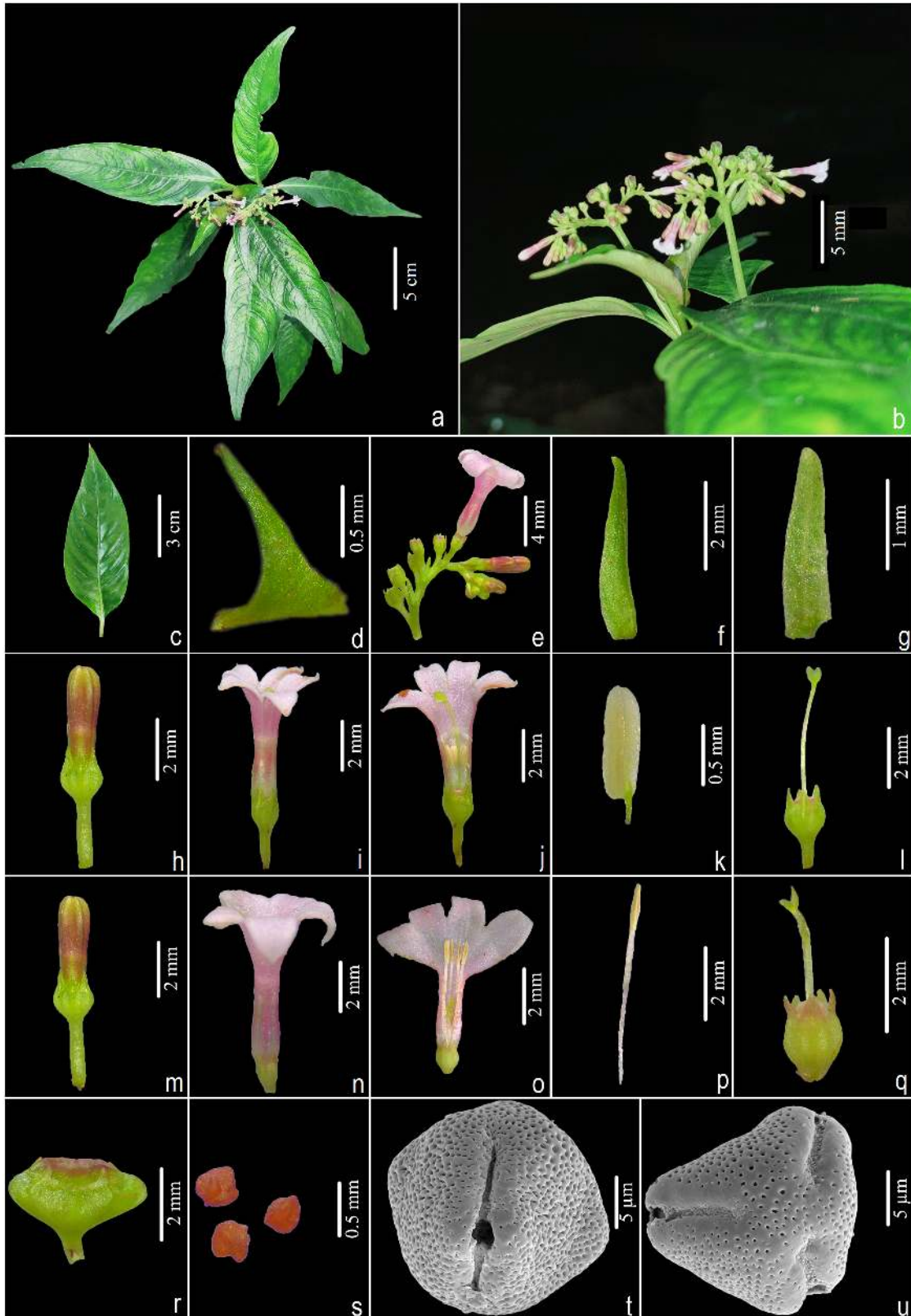


Fig. 1. *Ophiorrhiza barnesii* C.E.C.Fisch.: a. Habit; b. Inflorescence; c. Leaf; d. Stipule; e. A branch of inflorescence; f. Bract; g. Bracteole; h-l. long styled flower; h. bud; i. flower; m-q. Carpel of short-styled flower; r. Fruit; s. Seeds; t. Pollen grain—equatorial view; u. Pollen grain—polar view (from Akhilesh S.V. Nair, Gangaprasad A. & K.B. Rameshkumar 10234; photos by S.V.N. Akhilesh).

0.6–0.8 mm, glabrous, persistent; bracteoles linear, without a distinct midrib, $2.9\text{--}3.2 \times 0.4\text{--}0.43$ mm, glabrous, persistent; pedicels $1.6\text{--}1.7$ mm long, glabrous. Hypanthium obovoid, $1.1\text{--}1.3 \times 0.9\text{--}1$ mm, glabrous. Calyx lobes ovate-lanceolate, $0.5\text{--}0.7 \times 0.5\text{--}0.6$ mm, acute, glabrous. Corolla infundibuliform; tube $3.8\text{--}4.2$ mm long, glabrous outside with a villous ring of hairs at the middle of corolla tube within; lobes ovate, $1.6\text{--}2.3 \times 1.1\text{--}1.4$ mm, acute, glabrous. Stamens attached slightly below the middle of corolla tube in long-styled flower and to base of corolla tube and exerted in short-styled flower; filaments $0.1\text{--}0.2$ mm long in long-styled flower and $3.6\text{--}4$ mm long in short-styled flower, glabrous; anthers $0.9\text{--}1.3 \times 0.1\text{--}0.4$ mm, oblong or narrowly oblong in long-styled flower and $1.2\text{--}1.35 \times 0.15\text{--}0.2$ mm and narrowly oblong in short-styled flower. Pollen grains oblate spheroidal, small, isopolar, monad, angular in polar outline, polar axis (P) $\times$ equatorial axis (E) = $c. 22.25 \times 22.87$ μm , tricolporate; colpi $c. 17.66 \times 2.60$ μm , elongated colpi with acute end; ora circular, $c. 2.59$ μm in diam.; microreticulate; surface lumen $c. 0.29$ μm diam. Ovary obovoid, $0.7\text{--}0.75 \times 0.55\text{--}0.6$ mm; styles $3.9\text{--}4.1$ mm long in long-styled flower and $1.7\text{--}1.8$ mm long in short-styled flower, glabrous; stigma bilobed, $0.65\text{--}0.75 \times 0.45\text{--}0.5$ mm and ovate in long-styled flower, $0.4\text{--}0.5 \times 0.15\text{--}0.25$ mm and lanceolate in short-styled flower, glabrous. Capsules obcordate, $2.6\text{--}3 \times 5.10\text{--}5.15$ mm, glabrous, bilocular. Seeds $0.40\text{--}0.55 \times 0.40\text{--}0.50$ mm, irregularly angled, glabrous, brown.

Flowering & fruiting: Flowering from August to October and fruiting from September to December.

Specimen examined: INDIA, Kerala, Idukki district, Kallar Valley, 700–800 m, N $10^{\circ}03'39.5''$, E $76^{\circ}57'27.3''$, 12.01.2021, Akhilesh S.V. Nair 10234 (KUBH).

Distribution: Endemic to Western Ghats of Kerala.

Habitat: Grows in moist, shady places of evergreen forests and also along the banks of streams or rivulets, at an altitude of 700–800 m. The associated species are *Ophiorrhiza barberi* Gamble, *O. caudata*, *Argostemma courtallense* Arn. (all Rubiaceae) and *Sonerila wallichii* Benn. (Melastomataceae).

Conservation status: *Ophiorrhiza barnesii* is only reported from Kallar Valley in Idukki district of Kerala. During our field trip in 2021, we could

observe only a single population of *O. barnesii* with less than 20 mature individuals along the roadsides rock cuttings. The species grows in moist and cool shady environment along the rock cuttings near streams. Since the locality is outside a protected area, it is facing serious threat due to anthropogenic activities and roadside cleaning activities, etc. With a view to the location and small size of the population, a further decline is likely. According to the IUCN Red List Criteria (IUCN, 2012, 2022), it is assessed here as Critically Endangered (CR), B2a,b(iii,v), D.

Ophiorrhiza caudata C.E.C.Fisch., Bull. Misc. Inform. Kew 1938: 125. 1938; Deb & Mondal, Bull. Bot. Surv. India 39: 34. 1997. *Type:* INDIA, Kerala, Travancore High Range, Kallar ['Kallar'], May 1937, *E. Barnes* 1560 (holo K [K0000174141 digital image!]).

Fig. 2

Herbs, 40–80 cm tall; stem erect, branching, terete at base, glabrous. Leaves elliptic-lanceolate, $9.5\text{--}13 \times 2.5\text{--}3.5$ cm, caudate-acuminate at apex, acuminate at base, glabrous; lateral nerve pairs 8–10; petioles $0.7\text{--}2.5$ cm long, glabrous; stipules persistent, linear to lanceolate, $2.79\text{--}4.2 \times 1.6\text{--}2.6$ mm, margins entire, glabrous. Cymes terminal, capitate, 1–2 cm across, glabrous; peduncles $4\text{--}5.5$ cm long, slender, glabrous. Flowers heterostylous, 11–11.5 mm long; bracts ovate to lanceolate, with a distinct midrib, $8.3\text{--}8.42 \times 2\text{--}2.2$ mm, glabrous; bracteoles ovate to lanceolate, with a distinct midrib, $6.8\text{--}7 \times 2\text{--}2.1$ mm, glabrous; pedicels $0.9\text{--}1.1$ mm long, glabrous. Hypanthium obovoid, $0.9\text{--}1.3 \times 0.9\text{--}1.6$ mm, glabrous. Calyx lobes ovate-lanceolate, $0.75\text{--}1.1 \times 0.7\text{--}0.75$ mm, acute, glabrous. Corolla campanulate; tube $7.5\text{--}8.6$ mm long, glabrous outside with a villous ring at middle of tube inside; lobes ovate, $2.4\text{--}3.2 \times 2.14\text{--}2.29$ mm, acute. Stamens adnate to middle of corolla tube, inserted; filaments $0.3\text{--}0.35$ mm long in long-styled flower and $3.3\text{--}3.4$ mm long in short-styled flower, glabrous; anther oblong, $1.2\text{--}1.3 \times 0.4\text{--}0.46$ mm in long-styled flowers, $1.43\text{--}1.55 \times 0.42\text{--}0.44$ mm in short-styled flowers, oblong. Pollen grains sub-oblate, small, isopolar, monad, angular in polar outline, polar axis (P) $\times$ equatorial axis (E) = $19\text{--}20 \times 23.5\text{--}24$ μm , tricolporate; colpi $15\text{--}16 \times 4\text{--}5$ μm , elongated colpi with acute end; ora circular, $4.5\text{--}4.7$ μm in diam.; microreticulate; surface lumen $0.6\text{--}1.1$ μm diam. Ovary obovoid, $0.86\text{--}1 \times 0.85\text{--}0.9$ mm; styles $5.1\text{--}5.3$ mm long in

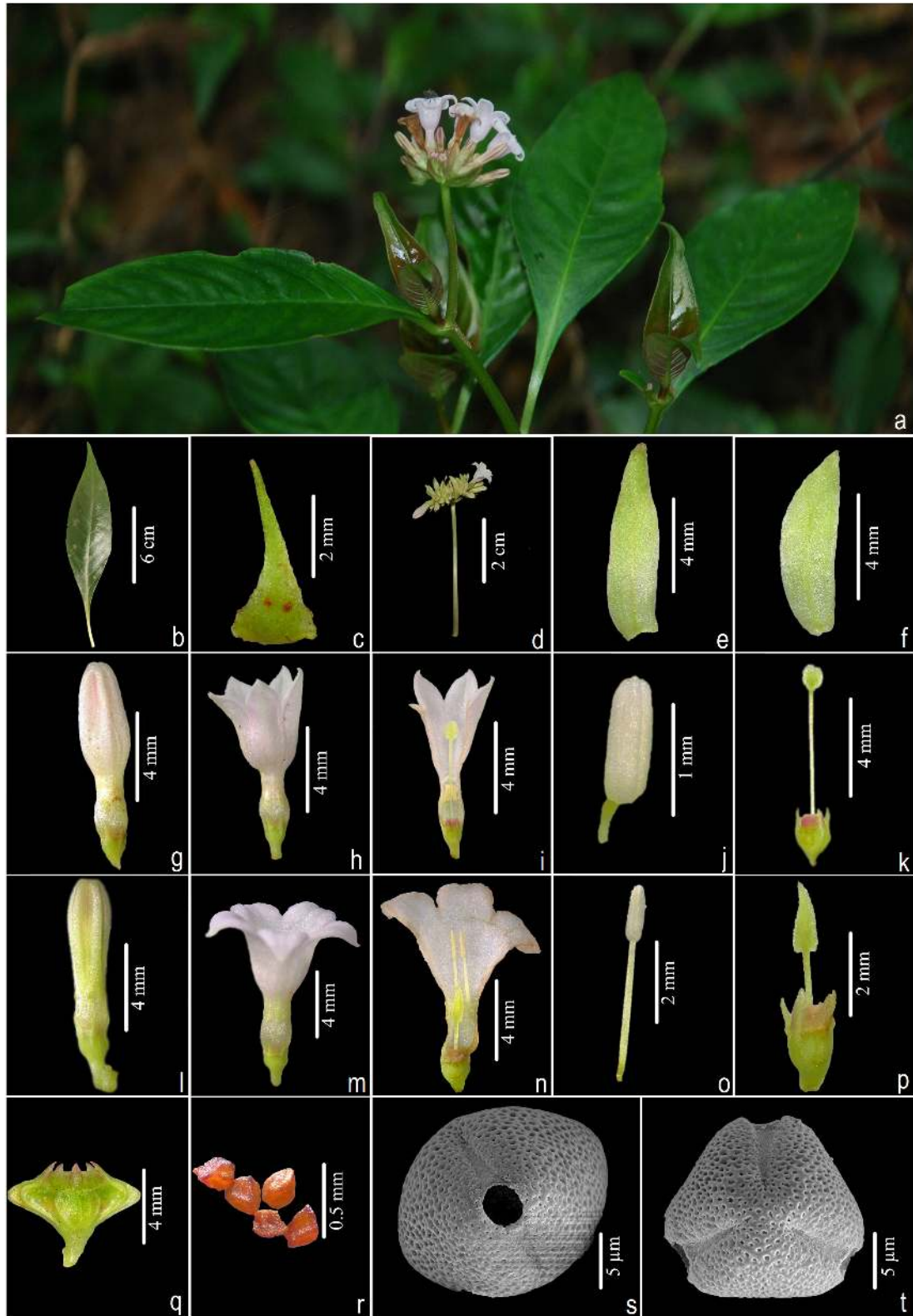


Fig. 2. *Ophiorrhiza caudata* C.E.C.Fisch.: a. Habit; b. Leaf; c. Stipule; d. Inflorescence; e. Bract; f. Bracteole; g. Bud of long-styled flower; h. Long-styled flower; i. Longitudinal section of long-styled flower; j. Stamen of long-styled flower; k. Carpel of long-styled flower; l. Bud of short-styled flower; m. Short-styled flower; n. Longitudinal section of short-styled flower; o. Stamen of short-styled flower; p. Carpel of short-styled flower; q. Fruit; r. Seeds; s. Pollen grain—equatorial view; t. Pollen grain—polar view (from Akhilesh S.V. Nair 10235; photos by S.V.N. Akhilesh).

long-styled flowers and 0.9–1 mm long in short-styled flowers, glabrous; stigma bilobed, $1.12\text{--}1.2 \times 0.86\text{--}0.87$ mm and rounded in long-styled flowers, $1.9\text{--}2.1 \times 0.68\text{--}0.71$ mm and lanceolate in short-styled flowers, glabrous. Capsules obcordate, $3.2\text{--}3.4 \times 6.45\text{--}7.7$ mm, glabrous, bilocular. Seeds $0.43\text{--}0.46 \times 0.3\text{--}0.32$ mm, irregularly angled, glabrous, brown.

Flowering & fruiting: Flowering from May to October and fruiting from June to December.

Specimens examined: INDIA, Kerala, Idukki district, Kallar Valley, 700–800 m, N $10^{\circ}03'39.5''$, E $76^{\circ}57'27.3''$, 12.01.2021, Akhilesh S.V. Nair 10235 (KUBH). Kerala, Idukki district, Kallar valley, 21.02.2012, E.S. Santhosh Kumar & P.E. Roy 70440 (TBGT).

Distribution: Endemic to Western Ghats of Kerala.

Habitat: In moist, shady places of the evergreen forests and also along the banks of streams or rivulets, between 700–800 m altitude, along with *Ophiorrhiza barberi*, *O. barnesii*, *Argostemma courtallense* (all Rubiaceae), *Sonerila wallichii* (Melastomataceae).

Conservation status: During our field trip in 2021 in Kallar Valley in Idukki district of Kerala, we had the opportunity to observe two populations of *O. caudata*, each consisting of fewer than 100 mature individuals. The species occurs in moist and cool shady environment along rock cuttings near streams. Since the locality is outside a protected area, it is facing serious threat due to anthropogenic activities and roadside cleaning activities, etc. Considering the specific location and the small size of the population, it is likely that their numbers will further decline. Based on the IUCN Red List Criteria (IUCN, 2012, 2022), *O. caudata* is assessed here as Critically Endangered (CR), B2a,b (iii,v).

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Literature Cited

- DEB D.B. & D.C. MONDAL 1997. Taxonomic revision of the genus *Ophiorrhiza* L. (Rubiaceae) in Indian subcontinent. *Nelumbo- Bulletin of Botanical Survey of India*. 39: 1–148.
- FISCHER C.E.C. 1938. New or little-known plants from southern India: IX. *Bulletin of the Miscellaneous Information (Royal Botanic Gardens, Kew)*. 1938: 125–126.
- FISCHER C.E.C. 1939. New or little-known plants from southern India: X. *Bulletin of the Miscellaneous Information (Royal Botanic Gardens, Kew)*. 1939: 248–249.
- GAMBLE J.S. 1921. *Flora of the Presidency of Madras*. Volume 2, Adlard & Co., London.
- HOOKE J.D. 1882. *The flora of British India*. Volume 3. L. Reeve & Co. Ltd., London.
- IUCN 2012. *IUCN Red List Categories and Criteria*. Version 3.1. Second edition. IUCN Species Survival Commission, Gland and Cambridge.
- IUCN 2022. *Guidelines for using the IUCN Red List Categories and Criteria*. Version 15.1. Prepared by the Standards and Petitions Committee. Available at: <https://www.iucnredlist.org/documents/RedListGuidelines.pdf> (Accessed on 01.06.2023).
- KUMAR E.S.S., ROY P.E. & S.M. SHAREEF 2013. Rediscovery of *Ophiorrhiza barnesii* C.E.C.Fisch. (Rubiaceae) from the southern Western Ghats, Kerala, India. *Journal of Threatened Taxa* 5(7): 4115–4117. <http://dx.doi.org/10.11609/JOTT.03241.4115-7>
- NAIR A.S.V., GANGAPRASAD A. & K.B. RAMESHKUMAR 2021. Rediscovery and lectotypification of *Ophiorrhiza brunonis* var. *johnsonii* (Rubiaceae) – an endemic variety of the southern Western Ghats, India. *Rheede* 31: 307–310. <https://dx.doi.org/10.22244/rheede.2021.31.04.08>
- NAIR A.S.V., NAIR G.A., BAHULEYAN R.K. & S.K.E. SUKUMARAN 2022a. Taxonomy and lectotypification of *Ophiorrhiza radicans* (Rubiaceae). *Annales Botanici Fennici* 59: 61–65. <https://doi.org/10.5735/085.059.0111>
- NAIR A.S.V., NAIR G.A., BAHULEYAN R.K. & S.K.E. SUKUMARAN 2022b. *Ophiorrhiza sasiharaniana* (Rubiaceae), a new species from the southern Western Ghats, Kerala, India. *Annales Botanici Fennici* 59: 149–152. <https://doi.org/10.5735/085.059.0122>
- NAYAR T.S., A.R. BEEGAM & M. SIBI 2014. *Flowering plants of the Western Ghats, India*. Volume 1. Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram.
- POWO 2023. *Plants of the World Online*. Facilitated by the Royal Botanic Gardens, Kew. Available at: <http://www.plantsoftheworldonline.org/> (Accessed on 01.06.2023).