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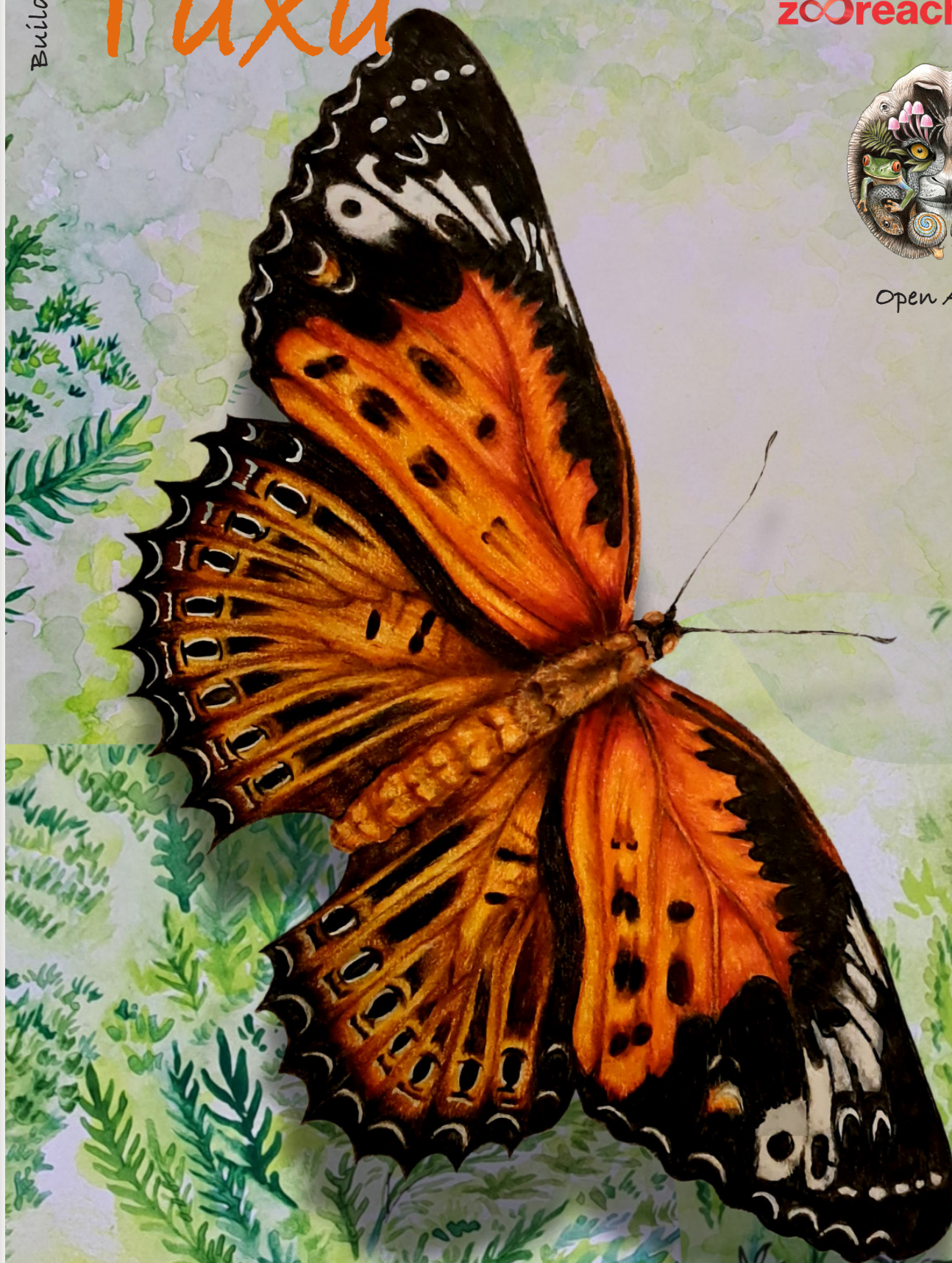
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Cover: Tamil Lacewing *Cethosia nietneri* with colour pencils and watercolours for the background; detailing with fine liners by Elakshi Mahika Molur.



INTRODUCTION

The *Cordia* plant genus is part of the Boraginaceae family often referred to as the forget me-not family and includes herbs and trees, among its 2,700 species spread across almost 125 genera historically categorized into five subfamilies named Boraginoideae, Cordioideae, Ehretioideae, Heliotropioideae, and Wellstedioideae (De Candolle in 1845; Bentham & Hooker in 1876; Engler in 1898; Pilger & Krause in 1915). However, according to evolutionary studies, physical traits, and consistent naming conventions, these have now been expanded to 11 separate and related plant families. These include Boraginaceae sensu stricto, Codonaceae, the established Coldeniaceae family, Cordiaceae, Ehretiaceae, Heliotropaceae, Hoplestigmataceae, Hydrophylaceae, Lennoaceae, Namaceae, and Wellstediaceae as detailed by Luebert et al. (2016). The genus name *Cordia* pays tribute to the botanist and pharmacist Valerius Cordus as referenced by Quattrocchi (2012).

Henry et al. (1978) reported *Cordia diffusa* K.C.Jacob, a shrub commonly known as Kovai Manjack or Sirunaruvilli, is a rare and threatened flowering plant of southern India. While it is believed to be endemic to this region (Arumugam et al. 2019), reports suggest its presence in other areas like the Gulf of Mannar (Daniel & Umamaheshwari 2001) and Chengalpattu District (Ramamurthy 1987; Nayar 1996; Singh et al. 2015). In the region of Kurumbapalayam, in Sarkarsamakulam, within Coimbatore *C. diffusa* has been recently discovered. Highlighted by its traits the identification of plant species has been a common practice. Spotting endangered plants that resemble species based on their vegetative features poses a challenge. A solution to this dilemma could lie in DNA barcoding, introduced by Hebert et al. (2003) for the purpose of species identification or discovery. The ideal DNA barcode should be a consistent short DNA sequence (400–800 bp) that can be produced and characterized efficiently for all living species (Savolainen et al. 2005). CBOL Plant Working Group (2009) evaluated the performance of psbK-psbI, atpF-atpH, and trnH-psbA spacers, and matK, rbcL, rpoB, and rpoC1 and among the seven plastid barcode loci, recommends that rbcL and matK as standard barcoding region, ITS and trnH-psbA as supplementary barcode loci (China plant BOL group et al. 2011; Pang et al. 2012) these four loci were widely accepted as plant DNA barcodes (Yu et al. 2011; Li et al. 2012; Parveen et al. 2012; Aubriot et al. 2013; Saarela et al. 2013; Yan et al. 2015). Plastome sequences have also been used widely to study the phylogenetic connections of numerous plant taxa (Lv et

al. 2022; Su et al. 2022; Xu et al. 2022; Hu et al. 2023).

It should be remembered that DNA barcoding is not a substitute for taxonomy, but rather an important tool that generates information on undiscovered species (Ebach et al. 2005). Rapid economic development and its impact on the flora and fauna of numerous nations, particularly in the tropical and subtropical regions, molecular identification can speed up identification and improve the accuracy of species separation in complex species and tree plants and estimate the biodiversity of these regions to preserve the rare endemic and endangered species. In the present study, DNA barcoding of the endangered species *Cordia diffusa*, which has not been done so far, is done, and its phylogenetic relationship with other species was determined based on BLAST results.

MATERIALS AND METHODS

Plant collection

Plant materials were collected in 2022 in Kurumbapalayam, Coimbatore (Figure 1, Image 1). The collected specimens were authenticated, and a herbarium voucher was submitted to the Botanical Survey of India, Southern Circle, Coimbatore, Tamil Nadu.

DNA isolation, PCR amplification and DNA sequencing

DNA from *C. diffusa* leaf was obtained using the Macherey Nagel Nucleospin Plant II mini spin DNA extraction kit from 100 mg of tissue. The amount of DNA extracted was measured using a Thermo Scientific Nanodrop 2000 spectrophotometer. To barcode the DNA samples, for identification purposes the specific genes matK, rbcL and trnH-psbA were used for PCR amplification using a thermal cycler (Bio-Rad, USA). PCR reactions were performed with a total volume of 30 µl reaction mixture containing 2 µl (100 ng) of DNA, 15 µl of EmeraldAmp GT PCR mix (TaKaRa, Bio USA, Inc.), 0.5 µl (10 pM) of each forward and reverse primer, and 12 µl of nuclease-free water. PCR cycling conditions were: one cycle of 5 min at 95°C, followed by 30 cycles at 95°C for 1 min. Annealing at different temperatures for different genes: 58°C for the matK gene, 55°C for the rbcL gene, and 57°C for the trnH psba gene for 30 seconds and extension at 72°C for a minute and the final extension step at 72°C for 10 minutes. The reaction mixture consists of 2 µl (100 ng) of DNA, 15 µl of EmeraldAmp GT PCR mix (TaKaRa, Bio USA, Inc.), 0.5 µl (10 pM) of each forward and reverses primer, and 12 µl of nuclease-free

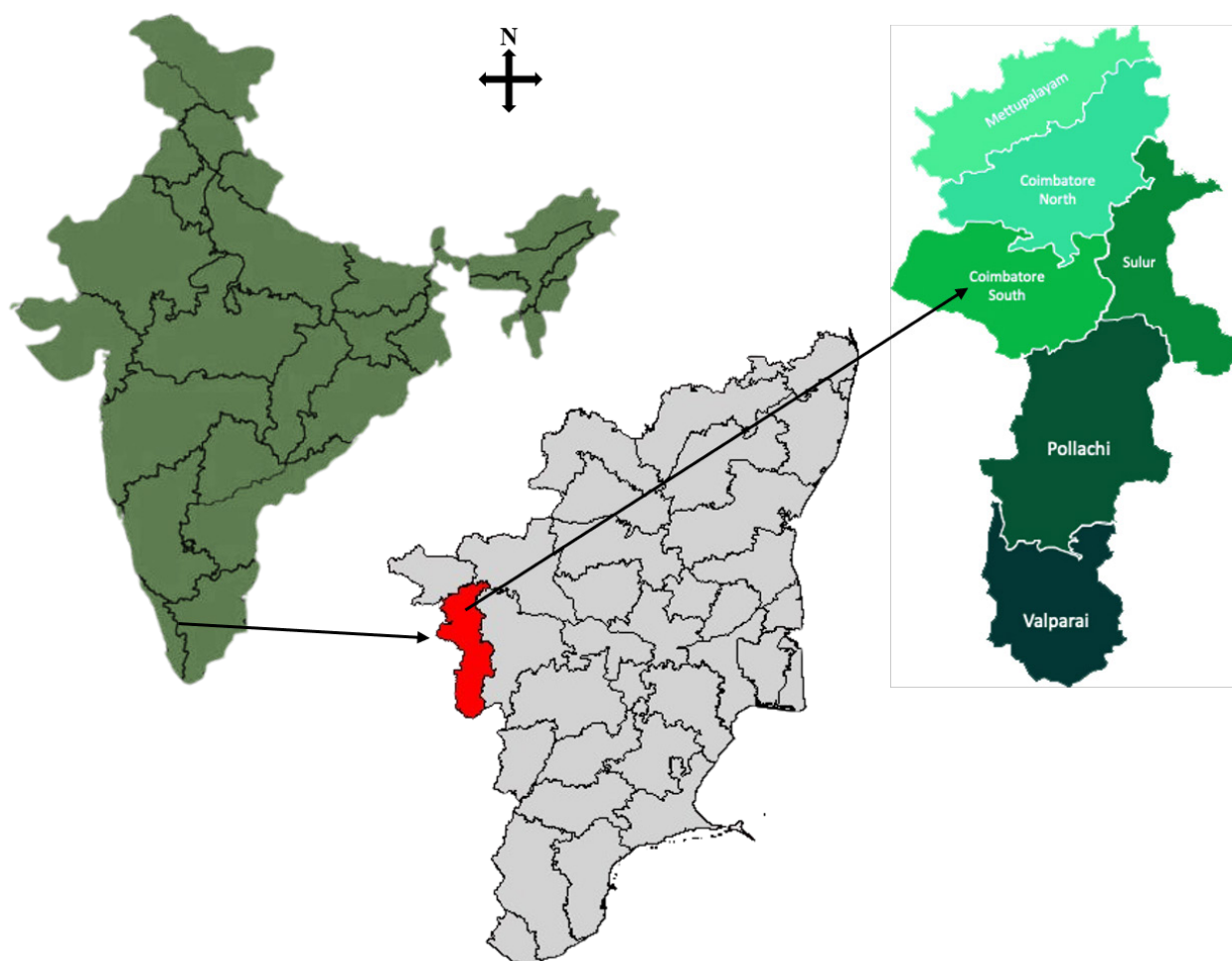


Figure 1. Study area of the plant *Cordia diffusa*.

water made up to 30 μ l. The primer set descriptions are given in Table 1. The amplified PCR products were loaded in a 1% TAE agarose gel and observed using a UV-Transilluminator. The amplified DNA was sequenced at Biokart (Karnataka, India). Sequencing was performed in both primers to obtain the full length of the targeted region.

Sequence submission and data analysis

The DNA sequences were assembled and edited using codon code Aligner V 2.06 (Codon Code Co, USA) to remove unclear base calls, and both sequences were assembled. The sequences were modified according to the NCBI criteria (<https://www.ncbi.nlm.nih.gov/>) and compared to the global sequence in the GenBank database (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>) using the nucleotide BLAST algorithm. Both BLASTn and BLASTx were performed sequentially. The sequences were submitted to NCBI through the Bankit submission channel (<https://www.ncbi.nlm.nih.gov/WebSub/>). To

determine the percentage of sequence similarity, the FASTA format of *Cordia diffusa* DNA sequences was compared with the NCBI database using BLAST + 2.14.).

RESULTS

A detailed literature survey on the occurrence of *C. diffusa* was done, and the species previously reported in Vaalankulam, Ramanathapuram (Chandrabose 1968), and IFGTB (Prabu et al. 2019) were identified in Kurumbapalayam, Coimbatore. The herbarium of the plant was submitted to the Botanical Survey of India, Coimbatore, with Voucher number MH178154 (Image 2).

PCR Results and DNA Barcode Sequence Analysis

Partial DNA sequencing was performed using matK, rbcL, and trnH-psbA gene regions. The accession number of the GenBank submitted sequences with their



Image 1. The habit of *Cordia diffusa*. © Haritha, M. & D. Leena Lavanya.

Table 1. List of primers used for DNA amplification.

Primer name	Sequence
F	CTTCCGATATGAGGAATTCTTC
R	CTTCCGATATGAGGAATTCTTC
F	ATGTCACCACAAACAGAGACTAAAGC
R	TCGCATGTACCTGCAGTAGC
F	CGCGCATGGTGGATTACAATCC
R	GTTATGCATGAACGTAATGCTC

respective base lengths and nucleotide composition percentages are summarized in Table 2. Among the genes used for the study, the highest G+C content (42%) was observed in the *rbcl* gene compared to *matK* and *trnH-psbA*.

DISCUSSION

Cordia diffusa, a rare, endemic shrub species geographically restricted to Tamil Nadu and Sri Lanka, was first identified by Dr. K. Cherian Jacob in 1938 and later described in 1944. Henry et al. (1978) listed *C. diffusa* as a rare and threatened plant of southern India. Later, Chandrabose & Nair (1988) expressed concerns over its potential extinction, classifying it as indeterminate on the IUCN Red List of Threatened Plants (Rao et al. 2003). Although *C. diffusa* has been reported at several locations in Coimbatore, recent observations by Prabhu et al. (2019) indicated the removal of the species from the IFGTB region where it had previously been found.



Image 2. Herbarium of *Cordia diffusa* (MH178154).

This study adds new findings by documenting the presence of *C. diffusa* in Kurumbapalayam, Coimbatore.

Plant species identification primarily relies on sequencing variation from reference sequences and reconstructing phylogenetic relationships (Altschul et al.

Table 2. Average AT and GC nucleotide composition of *Cordia diffusa* species in three primers.

Primers	Accession number	Total base pairs obtained after sequencing	A (%)	T (%)	G (%)	C (%)	AT (%)	GC (%)
matK	OQ852800.1	727 bp	36	32	17	15	68	32
rbcl	OR096230.1	548 bp	28	30	21	21	58	42
trnH-psbA	OR096231.1	315 bp	28	45	17	10	73	27

1997). But as Smith et al. (2008) pointed out, in order to comprehend the detected species, it is crucial to combine plant DNA data with other traits, including morphology, ecology, and development. Because the chloroplast genomes of angiosperms are so well conserved, the chloroplast regions matK, rbcl, and trnH-psbA were used in this study to barcode *C. diffusa* (Chevenet et al. 2006; Amiryousefi et al. 2018; Mehmood et al. 2020). Reliable molecular markers for species identification are provided by these conserved areas.

Across the plant taxa, rbcl is highly conserved, enabling the development of universal primers for PCR amplification. However, the variation within the rbcl region allows for species identification and phylogenetic studies (Kress & Erickson 2007; Hollingsworth et al. 2009). *C. diffusa* (OR096230.1) has a base pair length of 548. The main purpose of DNA barcoding is to tell species apart effectively due to its significant variability, which helps in identifying plant species, especially when dealing with diverse groups where other markers might struggle with distinguishing closely related taxa as mentioned by Kress et al. (2005) and Shaw et al. (2007).

CONCLUSION

The study serves a significant part in documenting the molecular identification of *Cordia diffusa*, an endangered and steno-endemic plant species. In addition to enriching molecular databases, DNA sequences submitted to GenBank are a useful resource for upcoming studies in conservation biology and plant taxonomy. The new occurrence of the plant in Kurumbapalayam, Coimbatore, extends its known distribution and shows the need for continuous research and observation of regional plants. Further studies will concentrate on creating plans for the plant's conservation and sustainable management.

REFERENCES

Arumugam, S., K.S. Kumar, B. Karthik & V. Ravichandran (2019). *Cordia diffusa* K.C. Jacob, the Kovai Manjack (Boraginaceae): a highly threatened steno-endemic species from Coimbatore City,

Tamil Nadu, India. *Journal of Threatened Taxa* 11(14): 14870–14875. <https://doi.org/10.11609/jott.5292.11.14.14870-14875>

Mehmood, F., I. Shahzadi, S. Waseem, B. Mirza, I. Ahmed & M.T. Waheed (2020). Chloroplast genome of *Hibiscus rosa-sinensis* (Malvaceae): Comparative analyses and identification of mutational hotspots. *Genomics* 112(1): 581–591. <https://doi.org/10.1016/j.ygeno.2019.04.010>

Altschul, S., T.L. Madden, A.A. Schäffer, J. Zhang, Z. Zhang, W. Miller & D.J. Lipman (1997). Gapped BLAST and PSI-BLAST: A new generation of protein database search programs. *Nucleic Acids Research* 25(17): 3389–3402. <https://doi.org/10.1093/nar/25.17.3389>

Amiryousefi, A., J. Hyvonen & P. Pocai (2018). The chloroplast genome sequence of bittersweet (*Solanum dulcamara*): Plastid genome structure evolution in Solanaceae. *PLoS One* 13(4): e0196069. <https://doi.org/10.1371/journal.pone.0196069>

Aubriot, X., P.P. Lowry, C. Cruaud, A. Couloux & T. Haevermans (2013). DNA barcoding in a biodiversity hot spot: potential value for the identification of Malagasy Euphorbia L. listed in CITES Appendices I and II. *Molecular Ecology Resources* 13(1): 57–65. <https://doi.org/10.1111/1755-0998.12028> PMID: 23095939

Bentham, G. & J.D. Hooker (1876). *Genera Plantarum*, Vol. 1. Reeve, London, 57–102.

CBOL Plant Working Group, P.M. Hollingsworth, L.L. Forrest, J.L. Spouge, M. Hajibabaei, S. Ratnasingham, M. Van der Bank, M. Chase, W. Cowan, R.S. Erickson, D.L. Fazekas, A.J. Graham, S.W. James, K.E. Kim, K.J. Kress, W.J. Schneider, H. van AlphenStahl, J. Barrett, S.C.H. van den Berg & C. Little (2009). A DNA barcode for land plants. *Proceeding of the National Academy of Science* 106(31): 12794–12797. <https://doi.org/10.1073/pnas.0905845106>

Chandrabose, M. (1968). A New Species of *Polygala* from South India. *Bulletin of the Botanical Survey of India* 9(1–4): 288–290.

Chandrabose, M. & N.C. Nair (1988). *Flora of Coimbatore*. Bishen Singh Mahendra Pal Singh, Dehra Dun, 398 pp.

Chevenet, F., C. Brun, A.L. Bañuls, B. Jacq & R. Christen (2006). TreeDyn: Towards dynamic graphics and annotations for analyses of trees. *BMC Bioinformatics* 7: 439. <https://doi.org/10.1186/1471-2105-7-439>

China Plant BOL Group; D.Z. Li, L.M. Gao, H.T. Li, H. Wang, X.J. Ge, J.Q. Liu, Z.D. Chen, S.L. Zhou, S.L. Chen, J.B. Yang, C.X. Fu, C.X. Zeng, H.F. Yan, Y.J. Zhu, Y.S. Sun, S.Y. Chen, L. Zhao, K. Wang, T. Yang & G.W. Duan (2011). Comparative analysis of a large dataset indicates that internal transcribed spacer (ITS) should be incorporated into the core barcode for seed plants. *Proceeding of the National Academy of Science* 108(49): 19641–19646. <https://doi.org/10.1073/pnas.1104551108> PMID: 2210073

Daniel, P. & P. Umamaheshwari (2001). *Flora of Gulf of Mannar Southern India*. Botanical Survey of India, Calcutta, 688 pp.

De Candolle, A.P. (1845). *Prodromus Systematis Naturalis Regni Vegetabilis*, Vol. 9. Paris, 573 pp. <https://doi.org/10.5962/bhl.title.286>

Ebach, M.C. & C. Holrege (2005). DNA barcoding is no substitute for taxonomy. *Nature* 434(7034): 697–697. <https://doi.org/10.1038/434697b>

Engler, A. (1898). *Syllabus der Pflanzenfamilien*, second edition. Berlin: Gebrüder Borntraeger. <https://archive.org/details/syllabusderpfla00eng>

Hebert, P.D., S. Ratnasingham & J.R. De Waard (2003). Barcoding animal life: cytochrome c oxidase subunit 1 divergences among

- closely related species. Proceedings of the Royal Society of London. Series B: *Biological Sciences* 270: S96–S99. <https://doi.org/10.1098/rsbl.2003.0025>
- Henry, A.N., K. Vivekananthan & N.C. Nair (1978). Rare and threatened flowering plants of South India. *Journal of the Bombay Natural History Society* 75(3): 684–697.
- Hollingsworth, M.L., A. Clark, L.L. Forrest, J. Richardson, R.T. Pennington, D.G. Long & P.M. Hollingsworth (2009). Selecting barcoding loci for plants: evaluation of seven candidate loci with species-level sampling in three divergent groups of land plants. *Molecular Ecology Resources* 9(2): 439–457. <https://doi.org/10.1111/j.1755-0998.2008.02439.x>
- Hu, H.S., J.Y. Mao, X. Wang, Y. Liang, B. Jiang & D.Q. Zhang (2023). Plastid phylogenomics and species discrimination in the “Chinese” clade of *Roscoea* (Zingiberaceae). *Plant Diversity* 45: 523–534. <https://doi.org/10.1016/j.pld.2023.03.012>
- Kress, W.J. & D.L. Erickson (2007). A two-locus global DNA barcode for land plants: the coding *rbcl* gene complements the non-coding *trnH-psbA* spacer region. *PLOS one* 2(6): e508. <https://doi.org/10.1371/journal.pone.0000508>
- Kress, W.J., K.J. Wurdack, E.A. Zimmer, L.A. Weigt & D.H. Janzen (2005). Use of DNA barcodes to identify flowering plants. *Proceedings of the National Academy of Sciences* 102(23): 8369–8374. <https://doi.org/10.1073/pnas.0503123102>
- Li, H.Q., J.Y. Chen, S. Wang & S.Z. Xiong (2012). Evaluation of six candidate DNA barcoding loci in *Ficus* (Moraceae) of China. *Molecular Ecology Resources* 12(5): 783–790. <https://doi.org/10.1111/j.1755-0998.2012.03147.x>
- Luebert, F., L. Cecchi, M.W. Frohlich, M. Gottschling, C.M. Williams, K.E. Hasenstab-Lehman, H.H. Hilger, J.S. Miller, M. Mittelbach, M. Nazeir, M. Nepi, D. Nocentini, D. Ober, R.G. Olmstead, F. Selvi, M.G. Simpson, K. Sutory, B. Valdes, G.K. Walden & M. Weigend (2016). Familial classification of the Boraginales. *Taxon* 65(3): 502–522. <https://doi.org/10.12705/653.5>
- Lv, S.Y., X.Y. Ye, Z.H. Li, P.F. Ma & D.Z. Li (2022). Testing complete plastomes and nuclear ribosomal DNA sequences for species identification in a taxonomically difficult bamboo genus. *Fargesia*. *Plant Diversity* 45: 147–155. <https://doi.org/10.1016/j.pld.2022.04.002>
- Nayar, M.P. (1996). *Hotspots of Endemic Plants of India, Nepal, and Bhutan*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, 254 pp.
- Pang, X., C. Liu, L. Shi, R. Liu, D. Liang, H. Li, S.S. Cherny & S. Chen (2012). Utility of the *trnH-psbA* intergenic spacer region and its combinations as plant DNA barcodes: a meta-analysis. *PLOS One* 7(11): e48833. <https://doi.org/10.1371/journal.pone.0048833>
- Parveen, I., H.K. Singh, S. Raghuvanshi, U.C. Pradhan & S.B. Babbar (2012). DNA barcoding of endangered Indian *Paphiopedilum* species. *Molecular Ecology Resources* 12(1): 82–90. <https://doi.org/10.1111/j.1755-0998>
- Pilger, R. & K. Krause (1915). *Die Natürlichen Pflanzenfamilien*, Ergänzungsheft 3. Leipzig: W. Engelmann.
- Prabu, K., A. Rajasekaran, D. Bharathi & S. Ramalakshmi (2019). Anti-oxidant activity, phytochemical screening and HPLC profile of rare endemic *Cordia diffusa*. *Journal of King Saud University - Science* 31(4): 724–727. <https://doi.org/10.1016/j.jksus.2018.04.025>
- Quattrocchi, U. (2012). *CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology*. CRC Press. <https://doi.org/10.1201/b16504>
- Ramamurthy, K. (1987). *Boraginaceae. Flora of Tamil Nadu*, India, 97 pp.
- Rao, C.K., B.L. Geetha & S. Geetha (2003). *Red list of threatened vascular plant species in India*. Botanical Survey of India, Kolkata.
- Saarela, J.M., P.C. Sokoloff, L.J. Gillespie, L.L. Consaul & R.D. Bull (2013). DNA barcoding the Canadian Arctic flora: core plastid barcodes (*rbcl* + *matK*) for 490 vascular plant species. *PLOS One* 8(10): e77982. <https://doi.org/10.1371/journal.pone.0077982>
- Savolainen, V., R.S. Cowan, A.P. Vogler, G.K. Roderick & R. Lane (2005). Towards writing the encyclopedia of life: an introduction to DNA barcoding. *Philosophical Transactions of the Royal Society B* 360: 1805–1811. <https://doi.org/10.1098/rstb.2005.1730>
- Shaw, J., E.B. Lickey, E.E. Schilling & R.L. Small (2007). Comparison of whole chloroplast genome sequences to choose noncoding regions for phylogenetic studies in angiosperms: the tortoise and the hare III. *American Journal of Botany* 94(3): 275–288. <https://doi.org/10.3732/ajb.94.3.275>
- Singh, P., K. Karthikeyan, P. Lakshminarasimhan & S.S. Dash (2015). *Endemic Vascular Plants of India*. Botanical Survey of India, Kolkata, 339 pp.
- Smith, M.A., J.J. Rodriguez, J.B. Whitfield, A.R. Deans, D.H. Janzen, W. Hallwachs & P.D. Hebert (2008). Extreme diversity of tropical parasitoid wasps exposed by iterative integration of natural history, DNA barcoding, morphology, and collections. *Proceedings of the National Academy of Sciences* 105(34): 12359–12364. <https://doi.org/10.1073/pnas.0805319105>
- Su, T., Y.F. Geng, C.L. Xiang, F. Zhao, M. Wang, L. Gu & G.X. Hu (2022). Chloroplast genome of *Salvia* sect. *Drymosphaea*: comparative and phylogenetic analysis. *Diversity* 14: 324. <https://doi.org/10.3390/d14050324>
- Xu, Y.L., H.H. Shen, X.Y. Du & L. Lu (2022). Plastome characteristics and species identification of Chinese medicinal wintergreens (*Gaultheria*, *Ericaceae*). *Plant Diversity* 44: 519–529. <https://doi.org/10.1016/j.pld.2022.06.002>
- Yan, H.F., Y.J. Liu, X.F. Xie, C.Y. Zhang, C.M. Hu, G. Hao & X.J. Ge (2015). DNA barcoding evaluation and its taxonomic implications in the species-rich genus *Primula* L. in China. *PLOS One* 10(4): e0122903. <https://doi.org/10.1371/journal.pone.0122903>
- Yu, W.B., P.H. Huang, R.H. Ree, M.L. Liu, D.Z. Li & H. Wang (2011). DNA barcoding of *Pedicularis* L. (Orobanchaceae): evaluating four universal barcode loci in a large and hemiparasitic genus. *Journal of Systematics and Evolution* 49(5): 425–437. <https://doi.org/10.1111/j.1759-6831.2011.00154.x>

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