

## JITHU K JOSE

Phone: +91-9562300621 | Email: jithukjose1@gmail.com | Twitter - @JITHUKJOSE96

### EDUCATION

University of Hyderabad Research Scholar (PhD), Plant Sciences Subject area: Conservation biology	Telangana, India August 2023 -
St. Thomas College Master of Science (MSc), Botany, CGPA: <b>3.41/4.0; 85%</b> Specializations: Plant breeding and Biotechnology Thesis: A study on invasive plants in Kerala	Kerala, India June 2018 - May 2020
St. Thomas College Bachelor of Science (BSc), Botany, CGPA: <b>9.88/10; 95%</b> Thesis: A study on medicinal plants in Palai	Kerala, India June 2015 - May 2018
St. Mary's HSS, Kuravilangad Higher Secondary Education, Percentage: <b>98.83%</b> Subject area: Science	Kerala, India June 2012 – March 2014
Holyghost BHS, Muttuchira Matriculation, Grade: <b>A<sup>+</sup></b>	Kerala, India March 2012

### EXPERIENCE

<b>Kerala Forest Research Institute (KFRI)</b> [An autonomous research institute under Kerala Chief Minister]	Thrissur, Kerala, India July 2021 – August 2023
<ul style="list-style-type: none"><li>• <b>Project Staff</b> for a research project titled: “Ecological studies on the post-restoration success of threatened plants in situ.”</li><li>• Involved in <b>conservation, restoration, and post-restoration</b> ecological analysis of endangered plants in the Western Ghats, a biodiversity hotspot in India.</li></ul>	

### SKILLS

- **Teaching:** Chegg Online tutor
- **Research:** Two years in a forest research institute in the conservation and restoration of endangered plants.

### AWARDS and GRANTS

- |  |           |
|--|-----------|
| • <b>CSIR-UGC JRF fellowship</b> in life sciences conducted by NTA (All India rank 124). | June 2022 |
| • <b>GATE Ecology &amp; Evolution</b> exam (All India rank 179) conducted by IIT Kanpur  | 2022      |
| • <b>GATE life sciences</b> exam (All India rank 354) conducted by IIT Kharagpur         | 2021      |
| • <b>Kerala Government Higher Education Scholarship</b>                                  | 2015      |

## PUBLICATIONS

---

- Jose, J. K. (2024). India's Forest Conservation Amendment Act raises important questions. *Frontiers in Ecology and the Environment*, 22(4), e2741. <https://doi.org/10.1002/fee.2741>
- Jose, J., Anuraj, K., & Gokul, K. (2023). Conservation of *Diospyros crumenata* (Ebenaceae), an Endangered tree endemic to the Western Ghats, India. *Oryx*, 57(4), 424-424. doi:10.1017/S0030605323000388
- Jose, J.K. & K. Anuraj (2023). Threats faced by *Humboldtia bourdillonii* Prain (Magnoliopsida: Fabales: Fabaceae), an endangered tree endemic to the southern Western Ghats, India. *Journal of Threatened Taxa* 15(10): 24148–24150. <https://doi.org/10.11609/jott.8646.15.10.24148-24150>
- Jithu K. Jose & Anuraj K (2023) Conservation of *Gymnacranthera canarica* (Myristicaceae), a threatened tree species endemic to *Myristica* swamps of Western Ghats, India, *Biodiversity*, DOI: 10.1080/14888386.2023.2289459
- JOSE, J. K., & Anuraj, K. (2024). Ecology and Conservation of *Diospyros crumenata* (Ebenaceae), a Critically Endangered Tree of the Western Ghats biodiversity hotspot. doi.org/10.32942/X24P5N

## CONFERENCES

---

- Participated and presented a poster at the international conference on sustainable development organised by the University of Hyderabad, Telangana, in January 2024.
- Participated and presented a poster at the international conference of phytochemistry organized by the biochemistry department, St. Thomas College, Palai.
- Participated in the Safety & Ethics Essentials for the Research Beginners (SEERB 2024) workshop organized by the University of Hyderabad, Telangana.
- Participated in the International Symposium on Plant Biology and Functional Genomics organized by the department of plant sciences, University of Hyderabad during March 13-15, 2024.

## MEMBERSHIPS

---

- Botanic Gardens Conservation International (BGCI)
- Association for Tropical Biology & Conservation (ATBC)
- Global Conservation Consortium (GCC), Ebenaceae
- International Society for Seed Science (ISSS)

## LANGUAGES AND INTERESTS

---

- Languages: Malayalam (native), English
- Interests: Wildlife and Landscape Photography, Traveling

## REFERENCES

---

Dr. Siddharthan S  
Assistant Professor  
University of Hyderabad, Central University  
Mobile: 8825846188  
Email: sid@uohyd.ac.in



# India's Forest Conservation Amendment Act raises important questions

Jithu K Jose

Plant Sciences Department, School of Life Sciences, University of Hyderabad, Hyderabad, India ([23lpph03@uohyd.ac.in](mailto:23lpph03@uohyd.ac.in))

*Front Ecol Environ* 2024; 22(4): e2741, doi:[10.1002/fee.2741](https://doi.org/10.1002/fee.2741)

Of the planet's terrestrial area, nearly 33% and 7% are covered by forests and tropical forests, respectively (Lee and Jarvis 1996). Forests in general provide ecological, economic, social, and aesthetic benefits to people, and tropical forests specifically hold more than 50% of the planet's biodiversity (Singh and Sharma 2009). Worldwide, 15.8 million hectares of tropical forests are lost annually (Weisse and Goldman 2018). Nearly all tropical forests occur within the Global South, which includes some of the most densely populated and economically impoverished nations. The growing need for forest resources in developing countries places tremendous strain on forests therein. India is one example of a country that exerts such pressure on its forests (Figure 1). In India, total (tropical and subtropical) forest and tree cover spans 80.9 million hectares, which is equivalent to nearly 25% of the country's areal extent (Sharma *et al.* 2023). Between 2015 and 2020, India lost 668,400 hectares of forest, placing it second to Brazil in terms of global losses (Ritchie 2021). Various laws, acts, and policies have been formulated and adopted in India to incorporate

forests within legal and policy frameworks—these range from the colonial-era Indian Forest Act of 1865 to the more recent Forest Conservation Amendment Act of 2023 (hereafter, the Act), which modified the existing Forest Conservation Act of 1980. Since its inception, the Act has prompted many conservation-related questions across the world. More discussions and greater transparency on the Act are desperately needed.

In India, government land records generally refer to forests as belonging to one of three legal classifications: “reserved”, “protected”, or “unclassified” (FAO 2005). Reserved and protected forests “by definition are owned by [the] government [and by the] ‘Public’ at large”; as for unclassified forests, “the status of their ownership and control varies among various States in India” (FAO 2005). Many Indian forests are further categorized as “deemed” forests: that is, those that fall under the “dictionary meaning” of a forest (a subjective description) but do not merit official recognition in any government record. The Act rescinds protection completely for deemed forests, limiting protection

only to “notified” forests (that is, reserved and protected forests for which there is “a legal notification in a government gazette under [the] Indian Forest Act [of 1927 that] creates or defines [their] boundaries” [FAO 2005]) and those documented in official records as of or after 25 October 1980. The Act encourages commercial activity in any area not officially acknowledged as a “forest”. As a consequence, up to 25% of the country's forests are now vulnerable to mining, urbanization, infrastructure development, and other destructive land-use changes due to the passage of the Act, which eliminates former protections granted to deemed forests by the Supreme Court's Godavarman judgement of 1996 (Tatpati and Pathak-Broome 2015). About 25% of India's forests are located in the isolated, mountainous parts of northeastern India, which make up only 8% of the country's total area (Forest Report 2021). These forested areas are rich in floral and faunal biodiversity and endemism. However, almost half of these forests are



**Figure 1.** Forested area in Nilgiris District, southern India. Image credit: L Shyamal/Wikimedia Commons (CC BY-SA 3.0).

neither officially classified nor recorded as forests. Most of the forests in these areas occur on privately or communally owned lands managed by traditional institutions, such as village councils. Consequently, according to the Act, the government offers no protection to these forested areas, which are now subject to activities that could result in their degradation and destruction.

The Act also opens all forested areas within 100 km of India's international borders to development from "strategic projects of national importance and concerning national security". As a result, numerous Indigenous populations and other communities residing in forested regions within this zone will likely face major challenges in exercising their rights as outlined in the Forest Rights Act of 2006 (FRA). Although the FRA acknowledges the rights to forest resources for tribal communities living in the forest and for other traditional forest inhabitants, the new Act ignores Indigenous people and their rights.

According to India's constitution, the central government and states have equal power over managing the nation's forests. However, the Act contradicts the idea of decentralized forest governance. Under the Act, the states have less power and authority over forests. Currently, selected activities within forests—such as ecotourism, establishment of zoo/safari parks, and research surveys—are allowed without prior permission or authorization from state governments.

In addition, the Act upholds compensatory afforestation and encourages private individuals and organizations, including major corporations, to conduct afforestation or restoration. However, India's compensatory afforestation policy does not adhere to the internationally recognized principles of ecological restoration (IUCN/SSC 2013) considered as best practices. Afforestation and restoration initiatives in India have numerous challenges, such as inadequate community participation, inappropriate site selection, preference for hardy species, low sapling survival, and insufficient monitoring (Tambe *et al.* 2022). The Act prioritizes afforestation and restoration to achieve India's carbon targets, which include sequestering 2.5–3 billion metric tons of carbon by 2030. However, this outcome is impractical because most of the country's restoration projects to date have been considered as failures (Duguma *et al.* 2020; Asher and Bhandari 2021). For instance, in an afforestation effort in the northern state of Himachal Pradesh, substantial money was spent without obtaining substantial benefits (Rana *et al.* 2022). Large-scale tree-planting initiatives are frequently unsuccessful, wasting limited funding and sequestering negligible carbon (Duguma *et al.* 2020). The Government of India's flagship program, the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), aims to reforest and restore landscapes to compensate for the amount of forest cover lost as a result of large-scale infrastructure construction (including hydropower projects) and other industrial endeavors. So far, the CAMPA program has spent billions of dollars without considering social, economic, or biophysical contexts (Asher and Bhandari 2021).

India's remaining forests are valuable, but India's federal laws must provide the most protection because all forests are subject to federal control. Notably, the Peruvian government recently passed a similar act, which loosened the country's deforestation restrictions; thus, this issue is not limited to a single country or continent. According to Article 48A of the Indian constitution, the federal government is responsible for the "protection and improvement of [the] environment and safeguarding of forests and wildlife". As a result, policy makers should act responsibly, making laws and amendments that benefit forest conservation.

## References

- Asher M and Bhandari P. 2021. Mitigation or myth? Impacts of hydro-power development and compensatory afforestation on forest ecosystems in the high Himalayas. *Land Use Policy* **100**: 105041.
- Duguma L, Minang P, Aynekulu BE, *et al.* 2020. From tree planting to tree growing: rethinking ecosystem restoration through trees. ICRAF Working Paper No 304. Nairobi, Kenya: World Agroforestry.
- FAO (Food and Agriculture Organization of the United Nations). 2005. Global Forest Resources Assessment – country reports: India. FAO, Forestry Department. Rome, Italy: FAO. <https://www.fao.org/3/ai865E/ai865E00.pdf>.
- Forest Report (India State of the Forest Report). 2021. Forest survey of India. <https://fsi.nic.in>.
- IUCN/SSC (International Union for Conservation of Nature/Species Survival Commission). 2013. Guidelines for reintroductions and other conservation translocations. Version 1.0. Gland, Switzerland: IUCN SSC.
- Lee HS and Jarvis PG. 1996. Effects of tree maturity on some responses to elevated CO<sub>2</sub> in Sitka spruce (*Picea sitchensis* Bong Carr). In: Koch GW and Mooney HA (Eds). Carbon dioxide and terrestrial ecosystems. San Diego, CA: Academic Press.
- Rana P, Fleischman F, Ramprasad V, and Lee K. 2022. Predicting wasteful spending in tree planting programs in Indian Himalaya. *World Dev* **154**: 105864.
- Ritchie H. 2021. Deforestation and forest loss. Published online at [OurWorldInData.org](https://ourworldindata.org/deforestation). Retrieved from: <https://ourworldindata.org/deforestation>.
- Sharma S, Kumari K, Behera J, *et al.* 2023. Forest resources of Bihar: bio-ecological and socio-economic perspectives. *Forest* **2266**: 29–97.
- Singh SP and Sharma CM. 2009. Tropical ecology: an overview. *Trop Ecol* **50**: 7.
- Tambe S, Rawat GS, Krishen P, *et al.* 2022. Compensatory afforestation policy in India: an analysis using an ecorestoration lens. *Int Forest Rev* **24**: 607–18.
- Tatpati M and Pathak-Broome N. 2015. Asserting community forest rights on forest land in India: emerging paradigms under the Forest Rights Act. In: Bhagat-Ganguly V (Ed). Land rights in India. London, UK: Routledge India.
- Weisse M and Goldman ED. 2018. 2017 was the second-worst year on record for tropical tree cover loss. <https://www.wri.org/insights/2017-was-second-worst-year-record-tropical-tree-cover-loss>.



we successfully recorded the daily movements and home ranges of the five males. The collars dropped off by the end of March 2023, and were successfully recovered.

Although the inseminations were unsuccessful, we have demonstrated that male and female pampas deer can be handled without any resulting health issues or injuries. We are now revising the protocols for optimizing the oestrous cycle synchronization so that we can reattempt insemination in the next reproductive season.

SUSANA GONZALEZ\* ([orcid.org/0000-0001-6470-6182](https://orcid.org/0000-0001-6470-6182), [sgonzalez@iibce.edu.uy](mailto:sgonzalez@iibce.edu.uy)) and VERONICA GUTIERREZ ([orcid.org/0000-0002-6627-0519](https://orcid.org/0000-0002-6627-0519)) Instituto de Investigaciones Biológicas Clemente Estable, Montevideo, Uruguay. HUGO ARELLANO and MATIAS LOUREIRO Estación de Cria de Fauna Autóctona “Uruguay Tabaré González”, Piriapolis, Uruguay. NADIA BOU Instituto de Investigaciones Biológicas Clemente Estable, Montevideo, Uruguay. LUCIANA DINIZ ROLA ([orcid.org/0000-0003-3652-1011](https://orcid.org/0000-0003-3652-1011)) Universidade Federal da Paraíba, Areia, Paraíba, Brazil. DAVID GALINDO ([orcid.org/0000-0003-1112-268X](https://orcid.org/0000-0003-1112-268X)) Facultad de Medicina Veterinaria, Universidad Nacional Mayor de San Marcos, San Borja, Lima, Peru. JOSE MAURICIO BARBANTI DUARTE\* ([orcid.org/0000-0002-7805-0265](https://orcid.org/0000-0002-7805-0265)) Núcleo de Pesquisa e Conservação de Cervídeos, Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista, Jaboticabal, São Paulo, Brazil

\*Also at: IUCN Species Survival Commission Deer Specialist Group, Gland, Switzerland

This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/).

### Conservation of *Diospyros crumenata* (Ebenaceae), an Endangered tree endemic to the Western Ghats, India

The Western Ghats of India are recognized as a biodiversity hotspot and are remarkable for their floristic diversity and endemism. *Diospyros crumenata* Thwaites of the family Ebenaceae is an Endangered, dioecious tree endemic to this region. It grows up to 25 m tall in evergreen forests. There is only limited data available for this rare species, so the research team of Kerala Forest Research Institute conducted population surveys from August 2021 to March 2023, locating populations in Poringalkuthu, Vellanipacha and Mannamangalam in the Kerala part of the Western Ghats. We recorded the number of mature individuals, area of occupancy, extent of occurrence, and any natural regeneration or threats.



Characteristics and conservation of *Diospyros crumenata*: (a) habit, (b) & (c) fruit, (d) predated fruits, (e) processed seeds, (f) seed damage by unidentified insects, and (g) planting stock.

We observed that the tree flowers and fruits irregularly. The fruits, locally known as *karimbudan*, are edible. There are eight seeds per fruit, and the seeds are recalcitrant and lose viability within 2 weeks of collection. The fruits are typically consumed before they reach maturity, and fallen fruits are affected by fungal infections. The fruits are consumed in particular by the Endangered lion-tailed macaque *Macaca silenus*, which is endemic to the Western Ghats. The conservation of this tree is therefore important for the conservation of this primate.

We determined that the main threats to *D. crumenata* are (1) the low number of reproductively active trees, (2) poor recruitment of seedlings, (3) irregular flowering and fruiting, (4) low seed viability, and (5) consumption of the fruits by tribal people and by wild animals. As there appear to be constraints to the reproduction of this species in the wild, ex situ conservation may be required. We have grown 2,000 seedlings of *D. crumenata* in the Kerala Forest Research Institute nursery and are planning to plant them in the species' natural habitat.

We thank Thankappan, a forest tracker in Vazhachal, who helped in the forest.

JITHU K. JOSE ([orcid.org/0000-0003-2693-818X](https://orcid.org/0000-0003-2693-818X), [jithukjose1@gmail.com](mailto:jithukjose1@gmail.com)), K. ANURAJ ([orcid.org/0009-0005-1051-3859](https://orcid.org/0009-0005-1051-3859)) and K.G. GOKUL ([orcid.org/0009-0002-8765-3516](https://orcid.org/0009-0002-8765-3516)) Kerala Forest Research Institute, Peechi, Kerala, India

This is an Open Access article, distributed under the terms of the Creative Commons Attribution-ShareAlike licence [CC BY SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/).

# Conservation of *Gymnacranthera canarica* (Myristicaceae), a threatened tree species endemic to *Myristica* swamps of Western Ghats, India

Jithu K. Jose & Anuraj K

To cite this article: Jithu K. Jose & Anuraj K (11 Dec 2023): Conservation of *Gymnacranthera canarica* (Myristicaceae), a threatened tree species endemic to *Myristica* swamps of Western Ghats, India, Biodiversity, DOI: [10.1080/14888386.2023.2289459](https://doi.org/10.1080/14888386.2023.2289459)

To link to this article: <https://doi.org/10.1080/14888386.2023.2289459>



Published online: 11 Dec 2023.



Submit your article to this journal [↗](#)



View related articles [↗](#)



View Crossmark data [↗](#)

---

## Conservation of *Gymnacranthera canarica* (Myristicaceae), a threatened tree species endemic to *Myristica* swamps of Western Ghats, India

Jithu K. Jose <sup>a</sup> and Anuraj K <sup>b</sup>

<sup>a</sup>University of Hyderabad; <sup>b</sup>Kerala Forest Research Institute

**ARTICLE HISTORY** Received 16 November 2023; Accepted 27 November 2023

*Gymnacranthera canarica* (King) Warb. (Myristicaceae) is listed as a vulnerable species by the International Union for Conservation of Nature (IUCN) and is in danger of further habitat loss due to anthropogenic activities. There is concern that this species may be headed for extinction not just because of habitat loss; the fruit of this tree (seeds) are highly utilized by humans and other mammals and there is a severe lack of knowledge around how to germinate the seeds for restoration work. Extinction is considered the biggest threat to biodiversity and humans have accelerated extinction rates by 100 to 1000 times the natural rate (Ricketts et al. 2005; Thuiller 2007). When plant extinctions occur, they endanger other organisms and ecosystems, and human well-being (Humphreys et al. 2019). As forests are large reservoirs of plants, the conservation of forests worldwide could help to remove about 226 gigatons of carbon from the atmosphere, which is equivalent to roughly 20 years of emissions from burning fossil fuels and other sources at current rates (Lidong et al. 2023).

Forests make up nearly one-third of the planet's surface (J. Jose and Anuraj 2023), with around 60,000 different types of trees (BGCI 2022). Since trees are home to at least half of all known terrestrial plant and animal species worldwide, trees are essential to the dynamics of the global biosphere (FAO and UNEP 2020). According to the first global tree assessment report, 30% of trees are threatened with extinction (BGCI 2022). Interestingly, 58% of all tree species are endemic to a single country (Beech et al. 2017). Most tree extinctions occur in high-diversity regions within a tropical or Mediterranean climate (Humphreys et al. 2019).

The Western Ghats, India, is a biodiversity hotspot (Myers et al. 2000) and a world heritage site with high floristic diversity and endemism (J. Jose and Anuraj 2023). The region supports 27% of the flowering plants of the Indian subcontinent (Sasidharan 2017). *Myristica*

swamps are valuable remnants of ancient forests, serving as living museums in India's Western Ghats region. This ecosystem is Critically Endangered and can only be found in small patches. Krishnamoorthy (1960) first described the *Myristica* wetland habitat in the Kulathupuzha region of Kerala's Western Ghats.

*Gymnacranthera canarica* is a rare tree species found exclusively in *Myristica* swamps and has a limited distribution (IUCN 1998). It is locally known as Undappayin and is the only species in its genus found in India (Figure 1). This tree is a dioecious evergreen that can reach a height of up to 30 m. It belongs to the Myristicaceae family (nutmegs), famous for its mace and seeds. The seed aril of this species is highly sought after for its many medicinal and commercial applications, leading to over-exploitation. Additionally, the seeds are utilized in the production of candles and soaps (Gamble 1935). These trees possess a modified root system: knee roots with prominent lenticels on the surface for respiration to survive in the swamp. This particular species has a strong preference for certain habitats and struggles to germinate naturally. A study conducted using ecological niche modelling tools has revealed that *G. canarica* may lose up to 7% of its suitable habitat due to future climate change scenarios (Priti et al. 2016).

The blooming and bearing of *G. canarica* occurs during March and April; however, noticeable inconsistencies have been observed at different locations. The indigenous people collect many fruits and seeds for their livelihood and medicinal purposes. However, this unscientific and massive collection can negatively impact the natural regeneration of the species. Fruits are also consumed and spoiled by the Malabar giant squirrel (*Ratufa indica*), which is also an IUCN red-listed species endemic to the Western Ghats. Seeds are recalcitrant, meaning they have a short viability period; they lose their viability within two weeks after collection. Additionally, they are not suitable for clonal reproduction. The seeds are also very sensitive to





**Figure 1.** (a) Mature *Gymnacranthera canarica* trees in the *Myristica* swamps; (b) site sign; (c) flowers; (d) collected seeds; (e) seedlings for ex situ conservation and restoration.

desiccation. Furthermore, the seeds contain a large quantity of fat, which is believed to be an adaptation to survive in marshy environments. It has been noted that *G. canarica* seeds contain inhibitory compounds released

through the continuous flow of water in their natural swampy habitat (Tambat et al. 2006). This may explain why there is low seedling recruitment in non-swampy conditions.



The main reasons for the endangerment of *G. canarica* are (1) high habitat specificity to swamps, (2) unscientific harvesting of fruits and seeds by tribal communities, (3) low seedling recruitment in natural conditions, (4) climate change and irregularities in flowering and fruiting, (5) habitat degradation and fragmentation and (6) anthropogenic activities. Immediate action must be taken to safeguard this species and prevent its extinction. As per Reveal (1981), the concept of plant rarity is linked to both a species' ecology and its biology. In order to assess the reasons for rarity, it is important to understand the biological and ecological limitations inhibiting the species' spread. In the case of *G. canarica*, there are both ecological and man-made reasons for its endangerment.

To deal with catastrophic environmental changes and extinctions, there is a need to integrate conservation biology and restoration ecology (Dobson, Bradshaw, and Baker 1997). Restoration helps conservation to meet its goals (Wiens and Hobbs 2015). The Kerala Forest Research Institute (KFRI) started a restoration programme for the conservation of this species; around 2500 seedlings were raised and planted in Plavuchal and Darbapana *Myristica* swamps at Second Mile, Kulathupuzha (P. A. Jose and Pillai 2016). Many of the conservation-oriented restoration efforts for endemic and threatened plants were found to be failures and they did not perform well due to insufficient consideration of the effect of microsite conditions on seedling survival. There is a need for species-specific protocols to restore each species, including *G. canarica*. This news article is a reminder to all that effective conservation activities require a detailed analysis of the species in question and the biotic and abiotic components of its habitat. We hope this news article will serve as a call for research into *Gymnacranthera canarica* so that this tree species can be saved.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

## Notes on contributors

**Jithu K. Jose** is currently a research scholar at the University of Hyderabad, and worked as a project fellow in the Kerala

Forest Research Institute for two years. Jose is involved in the conservation and restoration of endangered plants in the Western Ghats, India.

**Anuraj K** was a researcher at the Kerala Forest Research Institute (KFRI), Peechi, Thrissur, India.

## ORCID

Jithu K. Jose  <http://orcid.org/0000-0003-2693-818X>

Anuraj K  <http://orcid.org/0009-0005-1051-3859>

## References

- Beech, E., M. Rivers, S. Oldfield, and P. P. Smith. 2017. "Globaltresearch: The First Complete Global Database of Tree Species and Country Distributions." *Journal of Sustainable Forestry* 36 (5): 454–489. <https://doi.org/10.1080/10549811.2017.13100>.
- BGCI. 2022. "Globaltresearch Online Database. Botanic Gardens Conservation International." Accessed February 28, 2022. [https://tools.bgci.org/global\\_tree\\_search.php](https://tools.bgci.org/global_tree_search.php).
- Dobson, A. P., A. D. Bradshaw, and A. J. Baker. 1997. "Hopes for the Future: Restoration Ecology and Conservation Biology." *Science* 277 (5325): 515–522. <https://doi.org/10.1126/science.277.5325.515>.
- FAO and UNEP. 2020. *The State of the World's Forests 2020. Forests, Biodiversity and People*. Rome: FAO. <https://doi.org/10.4060/ca8642en>.
- Gamble, J. S. 1935. *Flora of the Presidency of Madras*, Vol. II. London: Adlard and Son, Limited. 1212.
- Humphreys, A. M., R. Govaerts, S. Z. Ficinski, E. Nic Lughadha, and M. S. Vorontsova. 2019. "Global Dataset Shows Geography and Life Form Predict Modern Plant Extinction and Rediscovery." *Nature Ecology & Evolution* 3 (7): 1043–1047. <https://doi.org/10.1038/s41559-019-0906-2>.
- Jose, J. K., and K. Anuraj. 2023. "Threats Faced by *Humboldtia Bourdillonii* Prain (Magnoliopsida: Fabales: Fabaceae), an Endangered Tree Endemic to the Southern Western Ghats, India." *Journal of Threatened Taxa* 15 (10): 24148–24150. <https://doi.org/10.11609/jott.8646.15.10.24148-24150>.
- Jose, P. A., and P. C. Pillai. 2016. Conservation through Restoration of Wild Nutmeg Tree Populations of the Western Ghats of Kerala.
- Lidong, Mo, Constantin M. Zohner, Peter B. Reich, Jingjing Liang, Sergio De Miguel, Gert-Jan Nabuurs, Susanne S. Renner, et al. 2023. "Integrated Global Assessment of the Natural Forest Carbon Potential." *Nature* 624:1–10.
- Moorthy, K. K. 1960. "Myristica Swamps in the Evergreen Forests of Travancore." *Indian Forester* 86 (5): 314–5.
- Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. Da Fonseca, and J. Kent. 2000. "Biodiversity Hotspots for Conservation Priorities." *Nature* 403 (6772): 853–858. <https://doi.org/10.1038/35002501>.
- Priti, H, N. A Aravind, R. Uma Shaanker, and G Ravikanth. 2016. "Modelling Impacts of Future Climate on the Distribution of Myristicaceae Species in the Western Ghats, India." *Ecological Engineering* 89: 14–23. <https://doi.org/10.1016/j.ecoleng.2016.01.006>.

- Reveal, J. L. 1981. "The Concept of Rarity and Population Threats in Plants Communities." In *Rare Plant Conservation: Geographical Data Organization*, edited by E. Larry Morse and Mary Sue Henifin, 41–47. New York: Botanical Garden.
- Ricketts, T. H., E. Dinerstein, T. Boucher, T. M. Brooks, Stuart H. M. Butchart, M. Hoffmann, J. F. Lamoreux, et al. 2005. "Pinpointing and Preventing Imminent Extinctions". *Proceedings of the National Academy of Sciences* 102 (51): 18497–18501. <https://doi.org/10.1073/pnas.0509060102>.
- Sasidharan, N. 2017. "A Handbook on the Red Listed Species and Their Conservaton Status in Kerala." Final Technical Report. Peechi: Kerala Forest Research Institute.
- Tambat, B., K. Vishwanath, G. N. Chaithra, and T. S. Hareesh. 2006. "Improved Germination of *Gymnacranthera Canarica* Warb. an Endangered, Endemic Tree Species of Myristica Swamps, Western Ghats, India." *Seed Science and Technology* 34 (3): 603–608. <https://doi.org/10.15258/sst.2006.34.3.07>.
- Thuiller, W. 2007. "Biodiversity: Climate Change and the Ecologist." *Nature* 448 (7153): 550–552. <https://doi.org/10.1038/448550a>.
- Wiens, J. A., and R. J. Hobbs. 2015. "Integrating Conservation and Restoration in a Changing World." *Bioscience* 65 (3): 302–312. <https://doi.org/10.1093/biosci/biu235>.
- World Conservation Monitoring Centre. 1998. "*Gymnacranthera Canarica*." *The IUCN Red List of Threatened Species* 1998: e.T32505A9710690. <https://doi.org/10.2305/IUCN.UK.1998.RLTS.T32505A9710690.en>.



Building evidence for conservation globally

# Journal of Threatened Taxa

10.11609/jott.2023.15.10.23931-24150

[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

26 October 2023 (Online & Print)

15(10): 23931-24150

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)



Open Access







ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher  
**Wildlife Information Liaison Development Society**  
[www.wild.zooreach.org](http://www.wild.zooreach.org)

Host  
**Zoo Outreach Organization**  
[www.zooreach.org](http://www.zooreach.org)

43/2 Varadarajulu Nagar, 5<sup>th</sup> Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India  
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India  
Ph: +91 9385339863 | [www.threatenedtaxa.org](http://www.threatenedtaxa.org)  
Email: [sanjay@threatenedtaxa.org](mailto:sanjay@threatenedtaxa.org)

#### EDITORS

##### Founder & Chief Editor

**Dr. Sanjay Molur**

Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO),  
43/2 Varadarajulu Nagar, 5<sup>th</sup> Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India

##### Deputy Chief Editor

**Dr. Neelesh Dahanukar**

Noida, Uttar Pradesh, India

##### Managing Editor

**Mr. B. Ravichandran**, WILD/ZOO, Coimbatore, Tamil Nadu 641006, India

##### Associate Editors

**Dr. Mandar Paingankar**, Government Science College Gadchiroli, Maharashtra 442605, India

**Dr. Ulrike Streicher**, Wildlife Veterinarian, Eugene, Oregon, USA

**Ms. Priyanka Iyer**, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India

**Dr. B.A. Daniel**, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India

##### Editorial Board

**Dr. Russel Mittermeier**

Executive Vice Chair, Conservation International, Arlington, Virginia 22202, USA

**Prof. Mewa Singh Ph.D., FASc, FNA, FNAsc, FNAPsy**

Ramanna Fellow and Life-Long Distinguished Professor, Biopsychology Laboratory, and  
Institute of Excellence, University of Mysore, Mysuru, Karnataka 570006, India; Honorary  
Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore; and Adjunct  
Professor, National Institute of Advanced Studies, Bangalore

**Stephen D. Nash**

Scientific Illustrator, Conservation International, Dept. of Anatomical Sciences, Health Sciences  
Center, T-8, Room 045, Stony Brook University, Stony Brook, NY 11794-8081, USA

**Dr. Fred Pluthero**

Toronto, Canada

**Dr. Priya Davidar**

Sigur Nature Trust, Chadapatti, Mavinahalla PO, Nilgiris, Tamil Nadu 643223, India

**Dr. Martin Fisher**

Senior Associate Professor, Battcock Centre for Experimental Astrophysics, Cavendish  
Laboratory, JJ Thomson Avenue, Cambridge CB3 0HE, UK

**Dr. John Fellowes**

Honorary Assistant Professor, The Kadoorie Institute, 8/F, T.T. Tsui Building, The University of  
Hong Kong, Pokfulam Road, Hong Kong

**Prof. Dr. Mirco Solé**

Universidade Estadual de Santa Cruz, Departamento de Ciências Biológicas, Vice-coordenador  
do Programa de Pós-Graduação em Zoologia, Rodovia Ilhéus/Itabuna, Km 16 (45662-000)  
Salobrinho, Ilhéus - Bahia - Brasil

**Dr. Rajeev Raghavan**

Professor of Taxonomy, Kerala University of Fisheries & Ocean Studies, Kochi, Kerala, India

##### English Editors

**Mrs. Mira Bhojwani**, Pune, India

**Dr. Fred Pluthero**, Toronto, Canada

**Mr. P. Ilangoan**, Chennai, India

**Ms. Sindhura Stothra Bhashyam**, Hyderabad, India

##### Web Development

**Mrs. Latha G. Ravikumar**, ZOO/WILD, Coimbatore, India

##### Typesetting

**Mrs. Radhika**, ZOO, Coimbatore, India

**Mrs. Geetha**, ZOO, Coimbatore India

#### Fundraising/Communications

**Mrs. Payal B. Molur**, Coimbatore, India

#### Subject Editors 2020–2022

##### Fungi

Dr. B. Shivaraju, Bengaluru, Karnataka, India

Dr. R.K. Verma, Tropical Forest Research Institute, Jabalpur, India

Dr. Vatsavaya S. Raju, Kakatiya University, Warangal, Andhra Pradesh, India

Dr. M. Krishnappa, Jnana Sahyadri, Kuvempu University, Shimoga, Karnataka, India

Dr. K.R. Sridhar, Mangalore University, Mangalagangothri, Mangalore, Karnataka, India

Dr. Gunjan Biswas, Vidyasagar University, Midnapore, West Bengal, India

Dr. Kiran Ramchandra Ranadive, Annasaheb Magar Mahavidyalaya, Maharashtra, India

##### Plants

Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India

Dr. N.P. Balakrishnan, Ret. Joint Director, BSI, Coimbatore, India

Dr. Shonil Bhagwat, Open University and University of Oxford, UK

Prof. D.J. Bhat, Retd. Professor, Goa University, Goa, India

Dr. Ferdinando Boero, Università del Salento, Lecce, Italy

Dr. Dale R. Calder, Royal Ontario Museum, Toronto, Ontario, Canada

Dr. Cleofas Cervancia, Univ. of Philippines Los Baños College Laguna, Philippines

Dr. F.B. Vincent Florens, University of Mauritius, Mauritius

Dr. Merlin Franco, Curtin University, Malaysia

Dr. V. Irudayaraj, St. Xavier's College, Palayamkottai, Tamil Nadu, India

Dr. B.S. Kholia, Botanical Survey of India, Gangtok, Sikkim, India

Dr. Pankaj Kumar, Department of Plant and Soil Science, Texas Tech University, Lubbock, Texas, USA.

Dr. V. Sampath Kumar, Botanical Survey of India, Howrah, West Bengal, India

Dr. A.J. Solomon Raju, Andhra University, Visakhapatnam, India

Dr. Vijayasankar Raman, University of Mississippi, USA

Dr. B. Ravi Prasad Rao, Sri Krishnadevaraya University, Anantpur, India

Dr. K. Ravikumar, FRLHT, Bengaluru, Karnataka, India

Dr. Aparna Watve, Pune, Maharashtra, India

Dr. Qiang Liu, Xishuangbanna Tropical Botanical Garden, Yunnan, China

Dr. Noor Azhar Mohamed Shazili, Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia

Dr. M.K. Vasudeva Rao, Shiv Ranjani Housing Society, Pune, Maharashtra, India

Prof. A.J. Solomon Raju, Andhra University, Visakhapatnam, India

Dr. Mandar Datar, Agharkar Research Institute, Pune, Maharashtra, India

Dr. M.K. Janarthanam, Goa University, Goa, India

Dr. K. Karthikeyan, Botanical Survey of India, India

Dr. Errol Vela, University of Montpellier, Montpellier, France

Dr. P. Lakshminarasimhan, Botanical Survey of India, Howrah, India

Dr. Larry R. Noblick, Montgomery Botanical Center, Miami, USA

Dr. K. Haridasan, Pallavur, Palakkad District, Kerala, India

Dr. Analinda Manila-Fajard, University of the Philippines Los Baños, Laguna, Philippines

Dr. P.A. Sinu, Central University of Kerala, Kasaragod, Kerala, India

Dr. Afroz Alam, Banasthali Vidyapith (accredited A grade by NAAC), Rajasthan, India

Dr. K.P. Rajesh, Zamorin's Guruvayurappan College, GA College PO, Kozhikode, Kerala, India

Dr. David E. Boufford, Harvard University Herbaria, Cambridge, MA 02138-2020, USA

Dr. Ritesh Kumar Choudhary, Agharkar Research Institute, Pune, Maharashtra, India

Dr. A.G. Pandurangan, Thiruvananthapuram, Kerala, India

Dr. Navendu Page, Wildlife Institute of India, Chandrabani, Dehradun, Uttarakhand, India

Dr. Kannan C.S. Warriar, Institute of Forest Genetics and Tree Breeding, Tamil Nadu, India

##### Invertebrates

Dr. R.K. Avasthi, Rohtak University, Haryana, India

Dr. D.B. Bastawade, Maharashtra, India

Dr. Partha Pratim Bhattacharjee, Tripura University, Suryamaninagar, India

Dr. Kailash Chandra, Zoological Survey of India, Jabalpur, Madhya Pradesh, India

Dr. Ansie Dippenaar-Schoeman, University of Pretoria, Queenswood, South Africa

Dr. Rory Dow, National Museum of Natural History Naturalis, The Netherlands

Dr. Brian Fisher, California Academy of Sciences, USA

Dr. Richard Gallon, Llandudno, North Wales, LL30 1UP

Dr. Hemant V. Ghate, Modern College, Pune, India

Dr. M. Monwar Hossain, Jahangirnagar University, Dhaka, Bangladesh

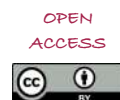
For Focus, Scope, Aims, and Policies, visit [https://threatenedtaxa.org/index.php/JoTT/aims\\_scope](https://threatenedtaxa.org/index.php/JoTT/aims_scope)

For Article Submission Guidelines, visit <https://threatenedtaxa.org/index.php/JoTT/about/submissions>

For Policies against Scientific Misconduct, visit [https://threatenedtaxa.org/index.php/JoTT/policies\\_various](https://threatenedtaxa.org/index.php/JoTT/policies_various)

continued on the back inside cover

Cover: Orange Oakleaf *Kallima inachus* with colour pencils and watercolor wash by Elakshi Mahika Molur adapted from a workshop by Lenin Raj.



## Threats faced by *Humboldtia bourdillonii* Prain (Magnoliopsida: Fabales: Fabaceae), an endangered tree endemic to the southern Western Ghats, India

Jithu K. Jose<sup>1</sup> & K. Anuraj<sup>2</sup>

<sup>1</sup>Karakkadayil House, Nazareth Hill P.O, Kottayam, Kerala 686633, India.

<sup>2</sup>Karakkath Veedu, Anamangad, Aliparamba P.O., Malappuram, Kerala 679357, India.

<sup>1</sup>jithukjose1@gmail.com (corresponding author), <sup>2</sup>kanuraj684@gmail.com

Forests cover nearly a third of the world's surface (Lee & Jarvis 1996), containing almost 60,000 tree species (BGCI 2022). According to the first Global Tree Assessment Report in 2021, almost 1/3<sup>rd</sup> of these tree species are threatened with extinction, of which 142 have already recorded as 'Extinct' (BGCI 2021). Of all the tree species 58% are single-country endemics (Beech et al. 2017). The report says that there are 2,603 tree species in India, of which 650 are endemic and 469 are under the threat of extinction (BGCI 2021). Western Ghats is one of the biodiversity hotspots in India with high floristic diversity and endemism (Jose et al. 2023).

The genus *Humboldtia* comprises nine species (Kumar et al. 2022), all of which are endemic to the Western Ghats, except *H. laurifolia* which is endemic to Sri Lanka. *Humboldtia bourdillonii* Prain is an Endangered species (World Conservation Monitoring Centre 1998) endemic to the southern Western Ghats, India. It is locally known as 'Adimundan' and belongs to the family Leguminosae and subfamily Caesalpinioideae. It is a medium-sized tree that grows up to 20 m in evergreen forests in the altitudinal range of 200–1,250 m. The species was first described by David Prain, based on the collections of T.F. Bourdillon from Peermade Ghats in 1894, then for the next 108 years there was no report or data about this species. In 2002, the Kerala Forest Research Institute

(KFRI) research team rediscovered this species from the Periyar Tiger Reserve. Now this species is facing serious ecological and man-made threats in its natural habitat.

We conducted extensive forest surveys in the southern Western Ghats region from June 2021 to March 2023 to study the population and ecology of *H. bourdillonii* in its natural habitat (Image 1). The information from floristic literature and herbariums helped us to plan the field surveys. The major population sites located were Kulamavu, Vagamon, and Arjunankotta-Poonkavanam forests in the Periyar Tiger Reserve of the Peermade plateau. The population studies showed that *H. bourdillonii* has an area of occupancy of less than 0.06 km<sup>2</sup> and an area of occurrence is approximately 2 km<sup>2</sup>. The number of mature trees is less than 200.

There are irregularities observed in the flowering and fruiting of *H. bourdillonii* mainly owing to climate change. Generally, the flowers are produced in November–January, and fruiting is observed in January–May (Balan et al. 2019). The flowers are pollinated by wind, ants, and honey bees *Apis indica*. However, the intensity of pollinators has recently decreased. Young fruits are largely consumed by the Malabar Giant Squirrel *Ratufa indica*, which is also endemic to the Western Ghats. Insect infestation heavily affects the reproductive biology of *H. bourdillonii*. Jumping thrips

**Editor:** Aparna Watve, Biome Conservation Foundation, Pune, India.

**Date of publication:** 26 October 2023 (online & print)

**Citation:** Jose, J.K. & K. Anuraj (2023). Threats faced by *Humboldtia bourdillonii* Prain (Magnoliopsida: Fabales: Fabaceae), an endangered tree endemic to the southern Western Ghats, India. *Journal of Threatened Taxa* 15(10): 24148–24150. <https://doi.org/10.11609/jott.8646.15.10.24148-24150>

**Copyright:** © Jose & Anuraj 2023. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use, reproduction, and distribution of this article in any medium by providing adequate credit to the author(s) and the source of publication.

**Funding:** None.

**Competing interests:** The authors declare no competing interests.





Image 1. *Humboldtia bourdillonii*: A—mature tree | B—steep slippery terrain habitat with streams | C—view of flowers | D & E—damaged pods | F—reduction in seeds | G—processed seeds for seedling production. © Jithu K. Jose & Anuraj K.

multiply and colonize the young inflorescence and suck the sap of young fruits. Sixty percent of seeds are lost due to the damage caused by the weevils. Weevils penetrate the fruit wall and lay eggs in the cotyledons of the young embryo. The larvae grow at the expense of the cotyledons and the adults emerge out as the seeds get dispersed. The entire metamorphosis of the insect occurs within the fruit. The attack of weevils is more prominent during the months of April and May. The seed dispersal is carried out by dehiscing pods, the blasted seeds are scattered around the mother tree indicating

the short-distance gene flow within the population. This short-distance gene flow has affected the genetic diversity of this species (Rathmacher et al. 2010). The pre-monsoon rainfall is beneficial to seed establishment but recent abnormal monsoon flooding (started in 2018) wipes the seeds and hinders the soil seed bank of the species. The recalcitrant nature of the seed is also a cue factor affecting the regeneration of the species.

The conversion of forest areas in Vagamon and Peermede Ghats into tea and cardamom plantations has heavily affected the populations of *H. bourdillonii*.



This conversion was started during the 19<sup>th</sup> century British rule. Vagamon is a major tourist spot in Kerala, so tourism development has also negatively affected this species. The impact of recent abnormal flooding in Kerala triggered a number of landslides that affected the Vagamon Hill population of the species. Both locations (Vagamon and Peermede) of this species are identified as landslide-prone areas by the Kerala State Disaster Management Authority (KSDMA; Balan et al. 2019). In Kulamavu forest areas, commissioning the Idukki Dam reservoir may submerge the populations of the target species. So, the conservation of this endangered, endemic species is the need of the hour.

## References

- Balan, A.P., A.J. Robi & S.V. Predeep (2019). Notes on the extended distribution of *Humboldtia bourdillonii* (Fabales: Fabaceae), an Endangered tree legume in the Western Ghats, India. *Journal of Threatened Taxa* 11(14): 14886–14890. <https://doi.org/10.11609/jott.5424.11.14.14886-14890>
- Beech, E., M. Rivers, S. Oldfield & P.P. Smith (2017). GlobalTreeSearch: The first complete global database of tree species and country distributions. *Journal of Sustainable Forestry* 36(5): 454–489. <https://doi.org/10.1080/10549811.2017.13100>
- BGCI (2021). State of the World's Trees. Botanic Gardens Conservation International. Richmond, UK. <https://www.bgci.org/resources/bgci-tools-and-resources/state-of-the-worlds-trees/> (Accessed 16/05/2023).
- BGCI (2022). GlobalTreeSearch online database. Botanic Gardens Conservation International. Available at [https://tools.bgci.org/global\\_tree\\_search.php](https://tools.bgci.org/global_tree_search.php) (Accessed on 28 February 2022).
- FAO & UNEP (2020). *The State of the World's forests 2020. Forests, Biodiversity, and People*. FAO and UNEP, Rome, 214 pp. <https://doi.org/10.4060/ca8642en>
- Jose, J., K. Anuraj & K. Gokul (2023). Conservation of *Diospyros crumenata* (Ebenaceae), an Endangered tree endemic to the Western Ghats, India. *Oryx* 57(4): 424–424. <https://doi.org/10.1017/S0030605323000388>
- Kumar, E.S.S., S.M. Shareef & R.R. Vikraman (2022). *Humboldtia ponmudiensis* (Fabaceae-Detarioideae), a new species from Kerala, India. *Phytotaxa* 552(1): 115–121. <https://doi.org/10.11646/phytotaxa.552.1.11>
- Lee, H.S. & P.G. Jarvis (1996). Effects of tree maturity on some responses to elevated CO<sub>2</sub> in Sitka Spruce (*Picea sitchensis* Bong. Carr.), pp. 53–70. In: Koch, G.W. & H.A. Mooney (eds.). *Carbon Dioxide and Terrestrial Ecosystems*. Academic Press, San Diego, CA.
- Rathmacher, G., M. Niggemann, M. Köhnen, B. Ziegenhagen & R. Bialozyt (2010). Short-distance gene flow in *Populus nigra* L. accounts for small-scale spatial genetic structures: implications for in situ conservation measures. *Conservation Genetics* 11: 1327–1338.
- World Conservation Monitoring Centre (1998). *Humboldtia bourdillonii*. The IUCN Red List of Threatened Species 1998: e.T31187A9606349. Accessed on 05 October 2023. Accessed on 21 October 2023. <https://doi.org/10.2305/IUCN.UK.1998.RLTS.T31187A9606349.en>





Mr. Jatishwor Singh Irungbam, Biology Centre CAS, Branišovská, Czech Republic.  
Dr. Ian J. Kitching, Natural History Museum, Cromwell Road, UK  
Dr. George Mathew, Kerala Forest Research Institute, Peechi, India  
Dr. John Noyes, Natural History Museum, London, UK  
Dr. Albert G. Orr, Griffith University, Nathan, Australia  
Dr. Sameer Padhye, Katholieke Universiteit Leuven, Belgium  
Dr. Nancy van der Poorten, Toronto, Canada  
Dr. Kareen Schnabel, NIWA, Wellington, New Zealand  
Dr. R.M. Sharma, (Retd.) Scientist, Zoological Survey of India, Pune, India  
Dr. Manju Siliwal, WILD, Coimbatore, Tamil Nadu, India  
Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India  
Dr. K.A. Subramanian, Zoological Survey of India, New Alipore, Kolkata, India  
Dr. P.M. Sureshan, Zoological Survey of India, Kozhikode, Kerala, India  
Dr. R. Varatharajan, Manipur University, Imphal, Manipur, India  
Dr. Eduard Vives, Museu de Ciències Naturals de Barcelona, Terrassa, Spain  
Dr. James Young, Hong Kong Lepidopterists' Society, Hong Kong  
Dr. R. Sundararaj, Institute of Wood Science & Technology, Bengaluru, India  
Dr. M. Nithyanandan, Environmental Department, La Ala Al Kuwait Real Estate. Co. K.S.C., Kuwait  
Dr. Himender Bharti, Punjabi University, Punjab, India  
Mr. Purnendu Roy, London, UK  
Dr. Saito Motoki, The Butterfly Society of Japan, Tokyo, Japan  
Dr. Sanjay Sondhi, TITLI TRUST, Kalpavriksh, Dehradun, India  
Dr. Nguyen Thi Phuong Lien, Vietnam Academy of Science and Technology, Hanoi, Vietnam  
Dr. Nitin Kulkarni, Tropical Research Institute, Jabalpur, India  
Dr. Robin Wen Jiang Ngiam, National Parks Board, Singapore  
Dr. Lionel Monod, Natural History Museum of Geneva, Genève, Switzerland.  
Dr. Asheesh Shivam, Nehru Gram Bharti University, Allahabad, India  
Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná, Curitiba, Brasil  
Dr. Kurt R. Arnold, North Dakota State University, Saxony, Germany  
Dr. James M. Carpenter, American Museum of Natural History, New York, USA  
Dr. David M. Claborn, Missouri State University, Springfield, USA  
Dr. Kareen Schnabel, Marine Biologist, Wellington, New Zealand  
Dr. Amazonas Chagas Júnior, Universidade Federal de Mato Grosso, Cuiabá, Brasil  
Mr. Monsoon Jyoti Gogoi, Assam University, Silchar, Assam, India  
Dr. Heo Chong Chin, Universiti Teknologi MARA (UiTM), Selangor, Malaysia  
Dr. R.J. Shiel, University of Adelaide, SA 5005, Australia  
Dr. Siddharth Kulkarni, The George Washington University, Washington, USA  
Dr. Priyadarsanan Dharma Rajan, ATREE, Bengaluru, India  
Dr. Phil Alderslade, CSIRO Marine And Atmospheric Research, Hobart, Australia  
Dr. John E.N. Veron, Coral Reef Research, Townsville, Australia  
Dr. Daniel Whitmore, State Museum of Natural History Stuttgart, Rosenstein, Germany.  
Dr. Yu-Feng Hsu, National Taiwan Normal University, Taipei City, Taiwan  
Dr. Keith V. Wolfe, Antioch, California, USA  
Dr. Siddharth Kulkarni, The Hormiga Lab, The George Washington University, Washington, D.C., USA  
Dr. Tomas Ditrich, Faculty of Education, University of South Bohemia in Ceske Budejovice, Czech Republic  
Dr. Mihaly Foldvari, Natural History Museum, University of Oslo, Norway  
Dr. V.P. Uniyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India  
Dr. John T.D. Caleb, Zoological Survey of India, Kolkata, West Bengal, India  
Dr. Priyadarsanan Dharma Rajan, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Bangalore, Karnataka, India

Fishes

Dr. Neelesh Dahanukar, IISER, Pune, Maharashtra, India  
Dr. Topiltzin Contreras MacBeath, Universidad Autónoma del estado de Morelos, México  
Dr. Heok Hee Ng, National University of Singapore, Science Drive, Singapore  
Dr. Rajeev Raghavan, St. Albert's College, Kochi, Kerala, India  
Dr. Robert D. Sluka, Chiltern Gateway Project, A Rocha UK, Southall, Middlesex, UK  
Dr. E. Vivekanandan, Central Marine Fisheries Research Institute, Chennai, India  
Dr. Davor Zanella, University of Zagreb, Zagreb, Croatia  
Dr. A. Biju Kumar, University of Kerala, Thiruvananthapuram, Kerala, India  
Dr. Akhilesh K.V., ICAR-Central Marine Fisheries Research Institute, Mumbai Research Centre, Mumbai, Maharashtra, India  
Dr. J.A. Johnson, Wildlife Institute of India, Dehradun, Uttarakhand, India  
Dr. R. Ravinesh, Gujarat Institute of Desert Ecology, Gujarat, India

Amphibians

Dr. Sushil K. Dutta, Indian Institute of Science, Bengaluru, Karnataka, India  
Dr. Annemarie Ohler, Muséum national d'Histoire naturelle, Paris, France

Reptiles

Dr. Gernot Vogel, Heidelberg, Germany  
Dr. Raju Vyas, Vadodara, Gujarat, India  
Dr. Pritpal S. Soorae, Environment Agency, Abu Dubai, UAE.  
Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey  
Prof. Chandrashekher U. Rivonker, Goa University, Taleigao Plateau, Goa. India  
Dr. S.R. Ganesh, Chennai Snake Park, Chennai, Tamil Nadu, India  
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

**Journal of Threatened Taxa** is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Birds

Dr. Hem Sagar Baral, Charles Sturt University, NSW Australia  
Mr. H. Byju, Coimbatore, Tamil Nadu, India  
Dr. Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK  
Dr. Priya Davidar, Pondicherry University, Kalapet, Puducherry, India  
Dr. J.W. Duckworth, IUCN SSC, Bath, UK  
Dr. Rajah Jayapal, SACION, Coimbatore, Tamil Nadu, India  
Dr. Rajiv S. Kalsi, M.L.N. College, Yamuna Nagar, Haryana, India  
Dr. V. Santharam, Rishi Valley Education Centre, Chittoor Dt., Andhra Pradesh, India  
Dr. S. Balachandran, Bombay Natural History Society, Mumbai, India  
Mr. J. Praveen, Bengaluru, India  
Dr. C. Srinivasulu, Osmania University, Hyderabad, India  
Dr. K.S. Gopi Sundar, International Crane Foundation, Baraboo, USA  
Dr. Gombobaatar Sunde, Professor of Ornithology, Ulaanbaatar, Mongolia  
Prof. Reuven Yosef, International Birding & Research Centre, Eilat, Israel  
Dr. Taej Mundkur, Wetlands International, Wageningen, The Netherlands  
Dr. Carol Inskipp, Bishop Auckland Co., Durham, UK  
Dr. Tim Inskipp, Bishop Auckland Co., Durham, UK  
Dr. V. Gokula, National College, Tiruchirappalli, Tamil Nadu, India  
Dr. Arkady Lelej, Russian Academy of Sciences, Vladivostok, Russia  
Dr. Simon Dowell, Science Director, Chester Zoo, UK  
Dr. Mário Gabriel Santiago dos Santos, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Vila Real, Portugal  
Dr. Grant Connette, Smithsonian Institution, Royal, VA, USA  
Dr. P.A. Azeez, Coimbatore, Tamil Nadu, India

Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy  
Dr. Anwaruddin Chowdhury, Guwahati, India  
Dr. David Mallon, Zoological Society of London, UK  
Dr. Shomita Mukherjee, SACION, Coimbatore, Tamil Nadu, India  
Dr. Angie Appel, Wild Cat Network, Germany  
Dr. P.O. Nameer, Kerala Agricultural University, Thrissur, Kerala, India  
Dr. Ian Redmond, UNEP Convention on Migratory Species, Lansdown, UK  
Dr. Heidi S. Riddle, Riddle's Elephant and Wildlife Sanctuary, Arkansas, USA  
Dr. Karin Schwartz, George Mason University, Fairfax, Virginia.  
Dr. Lala A.K. Singh, Bhubaneswar, Orissa, India  
Dr. Mewa Singh, Mysore University, Mysore, India  
Dr. Paul Racey, University of Exeter, Devon, UK  
Dr. Honnavalli N. Kumara, SACION, Anaikatty P.O., Coimbatore, Tamil Nadu, India  
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India  
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy  
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India  
Dr. H. Raghuram, The American College, Madurai, Tamil Nadu, India  
Dr. Paul Bates, Harison Institute, Kent, UK  
Dr. Jim Sanderson, Small Wild Cat Conservation Foundation, Hartford, USA  
Dr. Dan Challender, University of Kent, Canterbury, UK  
Dr. David Mallon, Manchester Metropolitan University, Derbyshire, UK  
Dr. Brian L. Cypher, California State University-Stanislaus, Bakersfield, CA  
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India  
Prof. Karan Bahadur Shah, Budhanilakantha Municipality, Kathmandu, Nepal  
Dr. Susan Cheyne, Borneo Nature Foundation International, Palangkaraja, Indonesia  
Dr. Hemanta Kafley, Wildlife Sciences, Tarleton State University, Texas, USA

Other Disciplines

Dr. Aniruddha Belsare, Columbia MO 65203, USA (Veterinary)  
Dr. Mandar S. Paingankar, University of Pune, Pune, Maharashtra, India (Molecular)  
Dr. Jack Tordoff, Critical Ecosystem Partnership Fund, Arlington, USA (Communities)  
Dr. Ulrike Streicher, University of Oregon, Eugene, USA (Veterinary)  
Dr. Hari Balasubramanian, EcoAdvisors, Nova Scotia, Canada (Communities)  
Dr. Rayanna Hellem Santos Bezerra, Universidade Federal de Sergipe, São Cristóvão, Brazil  
Dr. Jamie R. Wood, Landcare Research, Canterbury, New Zealand  
Dr. Wendy Collinson-Jonker, Endangered Wildlife Trust, Gauteng, South Africa  
Dr. Rajeshkumar G. Jani, Anand Agricultural University, Anand, Gujarat, India  
Dr. O.N. Tiwari, Senior Scientist, ICAR-Indian Agricultural Research Institute (IARI), New Delhi, India  
Dr. L.D. Singla, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India  
Dr. Rupika S. Rajakaruna, University of Peradeniya, Peradeniya, Sri Lanka  
Dr. Bahar Baviskar, Wild-CER, Nagpur, Maharashtra 440013, India

Reviewers 2020–2022

Due to pausity of space, the list of reviewers for 2018–2020 is available online.

The opinions expressed by the authors do not reflect the views of the Journal of Threatened Taxa, Wildlife Information Liaison Development Society, Zoo Outreach Organization, or any of the partners. The journal, the publisher, the host, and the partners are not responsible for the accuracy of the political boundaries shown in the maps by the authors.

Print copies of the Journal are available at cost. Write to:  
The Managing Editor, JoTT,  
c/o Wildlife Information Liaison Development Society,  
43/2 Varadarajulu Nagar, 5<sup>th</sup> Street West, Ganapathy, Coimbatore,  
Tamil Nadu 641006, India  
ravi@threatenedtaxa.org





OPEN ACCESS



The Journal of Threatened Taxa (JoTT) is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at [www.threatenedtaxa.org](http://www.threatenedtaxa.org). All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use, reproduction, and distribution of articles in any medium by providing adequate credit to the author(s) and the source of publication.

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

October 2023 | Vol. 15 | No. 10 | Pages: 23931–24150

Date of Publication: 26 October 2023 (Online & Print)

DOI: 10.11609/jott.2023.15.10.23931-24150

[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

## Articles

### Echolocation call characterization of insectivorous bats from caves and karst areas in southern Luzon Island, Philippines

– Renz Angelo Duco, Anna Pauline de Guia, Judeline Dimalibot, Phillip Alviola & Juan Carlos Gonzalez, Pp. 23931–23951

### Seasonality, diversity, and forest type associations of macro moths (Insecta: Lepidoptera: Heterocera) in the Shiwalik landscape of northern India and its conservation implications

– Arun Pratap Singh & Lekhendra, Pp. 23952–23976

### Vertebrate assemblages on fruiting figs in the Indian eastern Himalaya's Pakke Wildlife Sanctuary

– Akangkshya Priya Gogoi, Janmejay Sethy, Awadhesh Kumar, Dipika Parbo, Murali Krishna Chatakonda & Ajay Maletha, Pp. 23977–23989

## Communications

### From the Arabian Peninsula to Indian shores: Crab Plover *Dromas ardeola* Paykull, 1805 (Aves: Charadriiformes: Dromadidae) breeding at Point Calimere, India

– H. Byju, N. Raveendran & K.M. Aarif, Pp. 23990–23995

### Assessing avian diversity and conservation status in Dighal Wetlands, Haryana, India

– Parul & Parmesh Kumar, Pp. 23996–24008

### Studies on the response of House Sparrow *Passer domesticus* to artificial nest-boxes in rural Arakkonam and Nemili taluks, Vellore District, Tamil Nadu, India

– M. Pandian, Pp. 24009–24015

### Threat assessment and conservation challenges for the herpetofaunal diversity of Dampa Tiger Reserve, Mizoram, India

– Sushanto Gouda, Ht. Decemson, Zoramkhuma, Fanai Malsawmdawngliana, Lal Biakzuala & Hmar Tlawmte Lalremsanga, Pp. 24016–24031

### Taxonomy and conservation status of swamp eels (Synbranchiformes: Synbranchidae) of West Bengal, India

– Ram Krishna Das, Pp. 24032–24042

### Sacred river of Pune: boon or bane for the diversity of aquatic beetles (Insecta: Coleoptera)

– Rita Deb, Pallavi Takawane & K.A. Subramanian, Pp. 24043–24053

### Fine structure of sensilla on the proboscis of the Indian Honey Bee *Apis cerana indica* Fabricius (Insecta: Hymenoptera: Apidae)

– A.G. Suhas Krishna, Shamprasad Varija Raghu & Rajashekhar K. Patil, Pp. 24054–24062

### A compendium of *Aphelenchoides* (Fischer, 1894) (Nematoda: Tylenchina: Aphelenchoidea) nematodes with the description of a new species from Manipur, India

– Loukrakpam Bina Chanu & Naorem Mohilal, Pp. 24063–24078

### Efficacy of levamisole and oxclozanide treatment on gastrointestinal nematodes of ungulates at the Central Zoo, Nepal

– Pratik Kiju, Amir Sadaula, Parbat Jung Thapa & Chiranjibi Prasad Pokheral, Pp. 24079–24085

### *Ocimum gratissimum* L. ssp. *gratissimum* var. *macrophyllum* Briq. (Lamiaceae: Nepetoideae: Ocimeae) a new record from northeastern India

– Mamita Kalita, Nilakshee Devi & Diganta Narzary, Pp. 24086–24091

### The study of biogeographic patterns of the genus *Parmotrema* in Wayanad District, Kerala with a new record in India

– Bibin Joseph, Edathum Thazhekuni Sinisha, Valiya Thodiyil Jaseela, Harshid Pulpambil & Nediaparambu Sukumaran Pradeep, Pp. 24092–24103

## Review

### Diversity of Calliphoridae and Polleniidae (Diptera) in the Himalaya, India

– Meenakshi Bharti, Pp. 24104–24115

## Short Communications

### First photographic evidence of mangle manifestation in Panna Tiger Reserve, India

– Supratim Dutta & Krishnamurthy Ramesh, Pp. 24116–24119

### New locality record of Forest Spotted Gecko *Cyrtodactylus* (*Geckoella*) cf. *speciosus* (Beddome, 1870) (Reptilia: Squamata: Gekkonidae) from Thanjavur, in the eastern coastal plains of Tamil Nadu, India

– Gopal Murali, Pp. 24120–24124

### Preliminary observations of moth (Lepidoptera) fauna of Purna Wildlife Sanctuary, Gujarat, India

– Preeti Choudhary & Indu Sharma, Pp. 24125–24130

### On the occurrence of *Audouinella chalybea* (Roth) Bory, 1823, a rare freshwater red algae (Florideophyceae: Acrochaetiales: Audouinellaceae) from eastern Himalaya, India

– Jai Prakash Keshri & Jay Mal, Pp. 24131–24134

### Addition of four invasive alien plant species to state flora of Mizoram, India

– Lal Tlanhlu, Margaret Lalhlupui, Sanatombi Devi Yumkham & Sandhyarani Devi Khomdram, Pp. 24135–24139

## Notes

### First sighting record of Western Reef-Heron *Egretta gularis* (Bosc, 1792) (Aves: Pelecaniformes: Ardeidae) from Jammu & Kashmir, India

– Parvaiz Yousuf, Semran Parvaiz, Nisheet Zehbi, Sabia Altaf, Showkat Maqbool, & Mudasir Mehmood Malik, Pp. 24140–24143

### Rare desmid genus *Bourrellyodesmus* Compère (Chlorophyceae: Desmidiaceae) in India with description of a new species (*Bourrellyodesmus indicus* Das & Keshri sp. nov.) from eastern Himalaya, India

– Debjyoti Das & Jai Prakash Keshri, Pp. 24144–24147

### Threats faced by *Humboldtia bourdillonii* Prain (Magnoliopsida: Fabales: Fabaceae), an endangered tree endemic to the southern Western Ghats, India

– Jithu K. Jose & K. Anuraj, Pp. 24148–24150

Publisher & Host

