JITHU K JOSE

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EDUCATION

University of Hyderabad — Telangana, India
Research Scholar (PhD), Plant Sciences — August 2023 -
Subject area: Conservation biology

St. Thomas College — Kerala, India
Master of Science (MSc), Botany, CGPA: **3.41/4.0**; **85%** — June 2018 - May 2020
Specializations: Plant breeding and Biotechnology
Thesis: A study on invasive plants in Kerala

St. Thomas College — Kerala, India
Bachelor of Science (BSc), Botany, CGPA: **9.88/10**; **95%** — June 2015 - May 2018
Thesis: A study on medicinal plants in Palai

St. Mary's HSS, Kuravilangad — Kerala, India
Higher Secondary Education, Percentage: **98.83%** — June 2012 – March 2014
Subject area: Science

Holyghost BHS, Muttuchira — Kerala, India
Matriculation, Grade: **A^+** — March 2012

EXPERIENCE

Kerala Forest Research Institute (KFRI) — Thrissur, Kerala, India
[An autonomous research institute under Kerala Chief Minister] — July 2021 – August 2023

- **Project Staff** for a research project titled: "Ecological studies on the post-restoration success of threatened plants in situ.''
- Involved in **conservation, restoration, and post-restoration** ecological analysis of endangered plants in the Western Ghats, a biodiversity hotspot in India.

SKILLS

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

AWARDS and GRANTS

- **CSIR-UGC JRF fellowship** in life sciences conducted by NTA (All India rank 124). — June2022
- **GATE Ecology & Evolution** exam (All India rank 179) conducted by IIT Kanpur — 2022
- **GATE life sciences** exam (All India rank 354) conducted by IIT Kharagpur — 2021
- **Kerala Government Higher Education Scholarship** — 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

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India's Forest Conservation Amendment Act raises important questions

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Front Ecol Environ 2024; 22(4): e2741, doi: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 "unclassed" (FAO 2005). Reserved and protected forests "by definition are owned by [the] government [and by the] 'Public' at large"; as for unclassed 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.

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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.

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

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.

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Biodiversity

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tbid20

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

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

Published online: 11 Dec 2023.

BIODIVERSITY
https://doi.org/10.1080/14888386.2023.2289459

BIODIVERSITY NEWS

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

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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

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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.

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Journal of Threatened Taxa

10.11609/jott.2023.15.10.23931-24150
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
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www.wild.zooreach.org

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

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 October 2023 | 15(10): 24148–24150
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.8646.15.10.24148-24150
#8646 | Received 04 July 2023 | Final received 09 September 2023 | Finally accepted 04 October 2023
OPEN ACCESS
NOTE

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

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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 1/3rd 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 bourdilloni* 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 Peermede 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 Peermede plateau. The population studies showed that *H. bourdillonii* has an area of occupancy of less than 0.06 km^2 and an area of occurrence is approximately 2 km^2. 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

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 19th 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.

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NAAS rating (India) 5.64

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Journal of Threatened Taxa

www.threatenedtaxa.org

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

Publisher & Host

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