



40 **zoo**reach
Zoo Outreach Organisation
Years

Open Access

Building evidence for conservation globally
**Journal of
Threatened
Taxa**

10.11609/jott.2026.18.2.28262-28454
www.threatenedtaxa.org

26 February 2026 (Online & Print)
18(2): 28262-28454
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)



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

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

EDITORS

Founder & Chief Editor

Dr. Sanjay Molur

Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO),
Coimbatore, Tamil Nadu 641006, India

Assistant Editor

Dr. Chaithra Shree J., WILD/ZOO, Coimbatore, Tamil Nadu 641006, 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

Board of Editors

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, Mavinhalla PO, Nilgiris, Tamil Nadu 643223, India

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

Copy Editors

Ms. Usha Madgunaki, Zooreach, Coimbatore, India

Ms. Trisa Bhattacharjee, Zooreach, Coimbatore, India

Ms. Paloma Noronha, Daman & Diu, India

Web Development

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

Typesetting

Mrs. Radhika, Zooreach, Coimbatore, India

Mrs. Geetha, Zooreach, Coimbatore, India

Fundraising/Communications

Mrs. Payal B. Molur, Coimbatore, India

Subject Editors 2021–2023

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. Karthigeyan, 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

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

continued on the back inside cover

Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.



Assessing the tree diversity along the Dudhganga River in Kolhapur District of Maharashtra, India

Sachin Chavan¹ & Rajaram Gurav²

^{1,2}Department of Botany, Shivaji University, Vidyanagar, Kolhapur, Maharashtra 416004, India.

¹botanysachin10@gmail.com, ²rvg_botany@unishivaji.ac.in (corresponding author)

Abstract: Riparian vegetation is the buffer zone between the aquatic ecosystem of a river and the terrestrial ecosystem. Trees are a typical feature of many ecosystems. Understanding the diversity and geographic distribution of trees holds significant theoretical and practical value. This study highlights the rich diversity of tree species along the river Dudhganga with 80 species from 30 families identified through an extensive field survey from October 2021 to June 2024. The species-rich families are Fabaceae with 10 native species, contributing 18% of the total native tree diversity, Moraceae with eight species, and Malvaceae & Lamiaceae each with four species. Species-rich and diverse genus *Ficus* dominated with seven species. *Ficus racemosa* exhibits a widespread distribution across riparian habitats, which is the most evenly distributed species, while *Pongamia pinnata* stands out as the most dominant species among riparian tree taxa. Among the 80 tree species, two species are endemic to India, 55 are native and 25 are invasive. The altitudinal gradient exerts a substantial influence, as evidenced by research indicating that the diversity and density of riparian trees escalate with ascending altitudes. This study reveals a relatively diverse tree flora in riparian areas and aims to serve as a tool for managing the tree species diversity of the riparian land.

Keywords: Altitudinal gradient, conservation planning, dominance pattern, endemic tree species, family-level diversity, floristic composition, full census approach, riverine ecosystem, riparian ecology, species richness.

सारांश: नदीकाठवरील वनस्पती नदीच्या जलीय परिसंस्था आणि स्थल परिसंस्था यांमधील एक महत्त्वपूर्ण संरक्षक पट्टा म्हणून कार्य करतात. या पट्ट्यातील वृक्ष समुदाय परिसंस्थेच्या रचना, कार्य आणि स्थैर्यासाठी अत्यावश्यक घटक आहे. वृक्षांची प्रजाती विविधता, भौगोलिक प्रसार आणि वर्चस्व संरचना समजून घेणे हे सैद्धांतिक तसेच व्यावहारिक दृष्टिकोनातून महत्त्वाचे आहे. प्रस्तुत संशोधनामध्ये महाराष्ट्राच्या कोल्हापूर जिल्ह्यातील दूधगंगा नदीकाठवरील वृक्ष विविधतेचे सविस्तर मूल्यांकन करण्यात आले आहे. जानेवारी २०२१ ते जून २०२४ या कालावधीत केलेल्या विस्तृत क्षेत्रीय सर्वेक्षणातून नदीकाठवरील पट्ट्यात आढळणाऱ्या वृक्ष प्रजातींची नोंद करण्यात आली. कुठ-स्तारावर फॅबेसी हे सर्वाधिक प्रजातीसमृद्ध कुळ आढळले, त्याखालोखाल मोरेसी, माल्वेसी आणि लॅमियासी ही कुळे महत्त्वाची ठरली. वंश-स्तारावर फायकस हा सर्वाधिक वैविध्यपूर्ण वंश आढळून त्याचे लक्षणीय वर्चस्व दिसून आले. उंबर (*फायकस रॅसिमोसा*) ही प्रजाती नदीकाठवरील अधिवासांमध्ये व्यापक व समसमान रीतीने प्रसार झालेली आढळली, तर करंज (*पोंगामिया पिन्नाटा*) ही प्रजाती संख्यात्मक दृष्ट्या सर्वाधिक आढळून आली. नोंदविलेल्या वृक्ष प्रजातींपैकी काही प्रदेशनिष्ठ (एन्डेमिक) असून बहुसंख्य प्रजाती स्वदेशी आहेत; तथापि, काही परकीय व आक्रमक प्रजातींची उपस्थितीही आढळून आली आहे. समुद्र सपाटीपासून उंचीनुसार बदलणाऱ्या पर्यावरणीय उताराचा वृक्ष विविधता व भौगोलिक प्रसारावर लक्षणीय प्रभाव दिसून आला असून, अधिक उंचीच्या भागात तुलनेने अधिक प्रजाती समृद्धता आणि घनता आढळली. हा अभ्यास दूधगंगा नदीच्या नदीकाठवरील वृक्ष जैवविविधतेचे महत्त्व अधोरेखित करतो आणि या परिसंस्थेच्या शाश्वत व्यवस्थापन व संवर्धन नियोजनासाठी मूलभूत माहिती प्रदान करतो.

Editor: S. Jeevith, Siddharth Foundation, Coimbatore, India.

Date of publication: 26 February 2026 (online & print)

Citation: Chavan, S. & R. Gurav (2026). Assessing the tree diversity along the Dudhganga River in Kolhapur District of Maharashtra, India. *Journal of Threatened Taxa* 18(2): 28275–28286. <https://doi.org/10.11609/jott.9455.18.2.28275-28286>

Copyright: © Chavan & Gurav 2026. 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: We sincerely thank the University Grants Commission (UGC), New Delhi, for providing financial support for this research. This study forms part of the PhD work of the first author submitted to Shivaji University, Kolhapur, Maharashtra, India.

Competing interests: The authors declare no competing interests.

Author details: SACHIN CHAVAN, senior research scholar, Department of Botany, Shivaji University, Kolhapur, Maharashtra, India. His research focuses on riparian vegetation ecology, biodiversity assessment, carbon sequestration studies, spatial mapping using GIS, and quantitative ecological analysis of riverine ecosystems in the Western Ghats. DR. R.V. GURAV, professor, Department of Botany, Shivaji University, Kolhapur, Maharashtra, India. Specialises in plant taxonomy and biodiversity conservation, with extensive contributions to floristic documentation, vegetation analysis, and conservation of threatened plant taxa. He has supervised several doctoral scholars and contributed to research in plant systematics, conservation biology, and sustainable plant resource management.

Author contributions: SC—lead in conceptualisation, field surveys, data collection, data analysis, GIS mapping, manuscript drafting, and visualisation; contributed equally to manuscript review and editing. RVG—lead supervision, research design refinement, methodological guidance, taxonomic validation, and manuscript review and editing.

Acknowledgements: We sincerely thank the Department of Botany, Shivaji University, Kolhapur, for providing laboratory and academic support. We also acknowledge the assistance of local communities and field assistants who supported vegetation surveys along the river stretches.



INTRODUCTION

Riparian zones form transitional interfaces between aquatic and terrestrial ecosystems, encompassing stream channels and adjacent landscapes influenced by hydrological processes such as flooding, elevated water tables, and soil moisture regimes (Naiman & Décamps 1997). Vegetation within these zones comprises plant communities adapted to dynamic environmental conditions and provides critical ecosystem services, including provisioning, regulating, supporting, and cultural functions (Mohan & Joseph 2024). Acting as ecological buffers and ecotones, riparian ecosystems enhance watershed stability by regulating nutrient flow, sediment retention, and energy exchange between land and water (Sumarmi et al. 2022).

Globally, riparian ecosystems are among the most threatened landscapes due to river regulation, land-use change, invasive species, and increasing anthropogenic pressures. While vegetation structure along free-flowing rivers is relatively stable, regulated rivers often show altered species composition and spatial patterns owing to modified flow regimes (Nilsson et al. 1997). Biological invasions and shifts in species dominance further disrupt ecosystem structure and function (Richardson et al. 2007). Despite their ecological importance, riparian landscapes are inherently rare, occupying only a small fraction of the Earth's surface (Hynes 1970).

Riparian vegetation zones are recognised as highly species-rich and productive systems, playing a key role in maintaining water quality by acting as natural filters for sediments and pollutants (Naiman et al. 2005; Liunima et al. 2022). However, most vegetation studies have focused on forest ecosystems, with comparatively fewer investigations addressing riparian tree diversity and structure (Gregory et al. 1991; Nilsson et al. 1997). In India, studies from the Western Ghats report high riparian diversity (Korse & Krishnakumar 2006), but in Maharashtra, systematic information on riparian tree diversity remains limited, with only a few studies such as that along the Panchganga River (Mohite & Mane 2020).

The Western Ghats serve as a major watershed for peninsular rivers and are recognised globally as a biodiversity hotspot (Myers et al. 2000). The Dudhganga River, a tributary of the Krishna River, originates in the Western Ghats and flows through the Radhanagari forest, a UNESCO World Heritage Site (UNESCO 2012). Despite its ecological and socioeconomic importance, comprehensive data on riparian tree species diversity, distribution, and altitudinal variation along the Dudhganga River are lacking.

Information on riparian tree diversity, dominance, and spatial distribution along the Dudhganga River across different altitudinal zones is currently insufficient, limiting effective conservation and management planning. Riparian tree species diversity and composition along the Dudhganga River vary significantly with altitude, with higher elevations supporting greater species richness and structural diversity.

The present study aims to document the tree species composition of riparian vegetation along the Dudhganga River, assess species richness, dominance, and family-level patterns of riparian trees, analyse spatial variation in riparian tree diversity across upstream, midstream, and downstream sections of the river, and generate baseline data to support conservation and sustainable management of riparian ecosystems in the Dudhganga River basin.

STUDY AREA AND METHODS

The Dudhganga River originates in the Western Ghats and flows eastward, joining the Krishna River at Danwad. Based on the composition of the recorded species, the riparian zone of the Dudhganga River occupies a transitional ecotone, with southern moist mixed deciduous forests predominating, and a gradual shift toward southern tropical semi-evergreen forests in the upper catchment. This vegetation pattern corresponds well with the established classifications for the northern Western Ghats (Singh & Karthikeyan 2000; Gunaga et al. 2013). The study area spans 131 km of riparian vegetation on both sides of the river (Image 1), extending from Kalamawadi Dam (16.353° N, 74.010° E) to Sangam Math at Danwad (16.514° N, 74.635° E), forming an integral part of the Krishna River basin.

The Western Ghats biodiversity is influenced by altitudinal changes, which contribute to the variation in tree diversity along the river's course. The field survey has been carried out on upstream, midstream, and downstream riparian vegetation of the river Dudhganga based on elevation gradient, vegetation composition, and distance from the starting point, ensuring a systematic division reflecting slope, species distribution, and flow characteristics.

The upstream (higher elevation) area starts from Panori (16.367° N, 74.032° E) to Sulambi (16.414° N, 74.066° E), the midstream (middle altitude) area comprises area from the Bidri (16.434° N, 74.137° E) to Belawale Budruk (16.506° N, 74.156° E), while the downstream (lower elevation) area starts from Dattawad

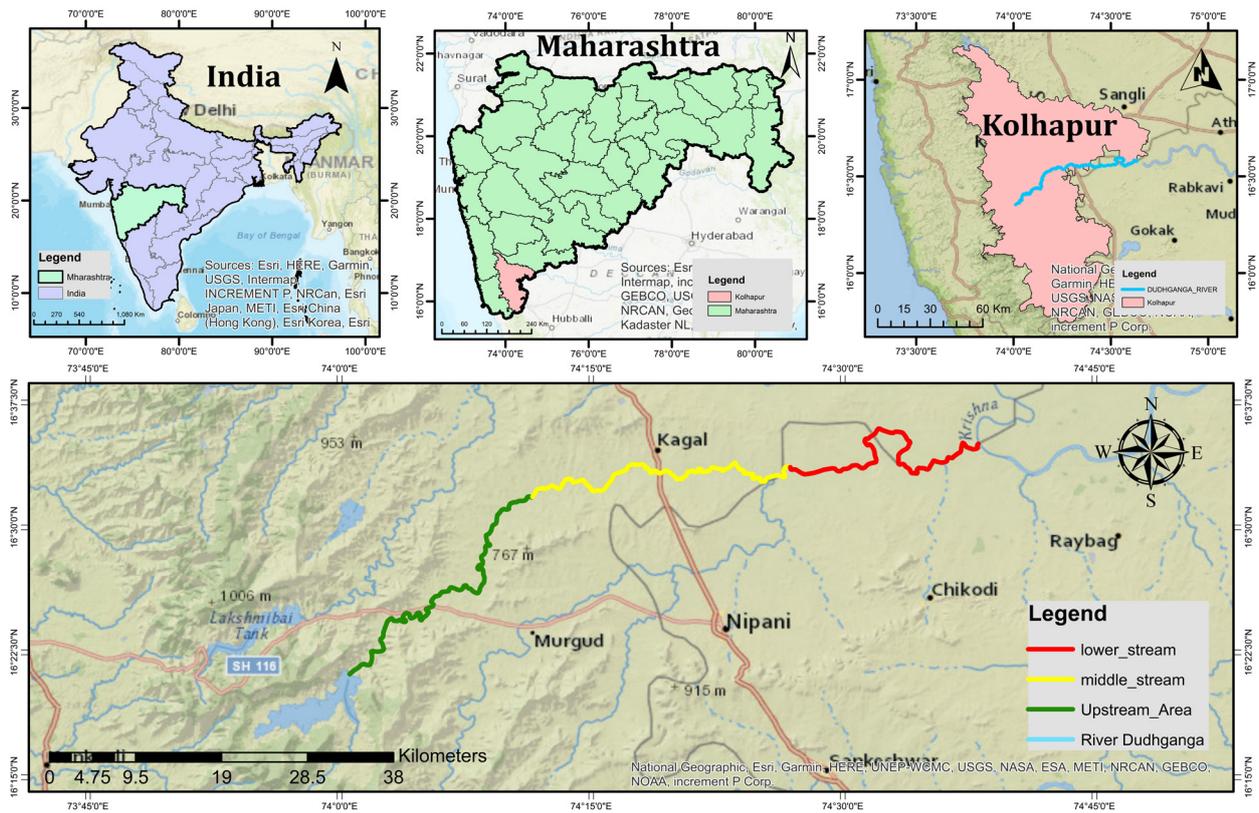


Figure 1. Map of the study area along the river Dudhganga in Maharashtra, India.

(16.584° N, 74.568° E) to Examba (16.564° N, 74.599° E) (Image 2 & 3).

Data Collection

The tree specimens were surveyed between October 2021 and June 2024. To ensure accurate estimation of tree diversity along the river Dudhganga, data was collected using the mobile GPS application, namely GPSWAYPOINT. Following the census approach described by Condit (1998), we conducted a systematic walk-through survey of the entire accessible riparian stretch and recorded all detectable individual trees. This approach represents the first application of a near-complete tree census method for riparian vegetation in this region and was adopted to minimise sampling bias commonly associated with plot-based methods. Although the survey was designed to maximise spatial coverage, complete access to all microhabitats was not always possible due to dense vegetation, steep slopes, and seasonally waterlogged sections typical of dynamic riparian environments. Consequently, a small proportion of individuals occurring in physically inaccessible or periodically inundated microhabitats may have been underrepresented. However, repeated surveys across

multiple post-monsoon seasons and continuous riverbank coverage ensured robust documentation of dominant, common, and ecologically significant riparian tree species across the Dudhganga River. This approach allowed for capturing the true distribution of species across the landscape and reduced the chances of missing rare or scattered species, which is a common limitation of fixed-area sampling methods such as quadrats or transects (Chazdon et al. 1998; Gotelli & Colwell 2001). By mapping every tree systematically, a comprehensive dataset was obtained, capturing the true representation of riparian vegetation across different altitude zones.

The riparian trees within the study area were identified and recorded. All individual trees with a girth at breast height (GBH) greater than 20 cm were measured. The collected specimens were identified with the help of Flora of Bombay (Cooke 1903) and Kolhapur Flora (Yadav & Sardesai 2002). The dry method was used to prepare the herbarium specimens and deposited at the herbarium of the Department of Botany, Shivaji University, Kolhapur (SUK), following the protocol of Jain & Rao (1977). The nomenclature and classification followed the Angiosperm Phylogeny Group IV System (Stevens 2001). Nomenclature and



Image 1. Riparian habitat of river Dudhganga at upstream (higher altitude) showing dense vegetation area dominated by the native species of *Salix tetrasperma* & *Pandanus furcatus* and the invasive *Acacia auriculiformis*. © Sachin Chavan.



Image 2. Habitat of midstream (middle altitude) showing moderate vegetation area dominated by *Ficus racemosa*, *Pongamia pinnata*, *Bambusa bambos*, and *Crateva magna*. © Sachin Chavan.



Image 3. Showing downstream with sparse vegetation of *Bambusa bambos* and *Syzygium salicifolium*. © Sachin Chavan.

distribution information was verified using Plants of the World Online (POWO 2024) and India Flora Online (Rao & Kumar 2024). Vernacular names were referred from Flowers of India (2024).

RESULTS AND DISCUSSION

Tree diversity and distribution along the riparian continuum

A total of 80 angiosperm tree species, belonging to 66 genera and 30 families, were recorded from the riparian vegetation of the Dudhganga River (Table

1). Tree diversity was unevenly distributed along the longitudinal gradient of the river, with species richness and community composition varying distinctly across the upstream, midstream, and downstream sections. Overall, 55 species (68.8%) were native, while the remaining species were classified as non-native / invasive, indicating a predominance of indigenous flora with increasing invasion pressure downstream. Notably, 21 tree species were common to all three zones, reflecting their broad ecological tolerance and adaptability to varying riparian conditions.

Upstream zone

The upstream section supported the highest tree species richness (62 species), comprising 47 native and 15 non-native / invasive species. This zone is characterized by higher elevation, steeper gradients, well-drained rocky to sandy soils, and higher water flow velocity. Dominant species such as *Salix tetrasperma*, *Syzygium salicifolium*, *Vitex leucoxylon*, *Terminalia arjuna*, and *Syzygium cumini* were well adapted to seasonal water fluctuations, moderate water stress, and occasional flooding. The strong dominance of native species reflects relatively intact riparian habitats, greater connectivity with adjoining natural vegetation, and lower levels of anthropogenic disturbance, favoring the persistence and regeneration of indigenous tree taxa.

Midstream zone

The midstream section recorded 50 tree species, including 29 native and 21 non-native / invasive species, representing a transitional phase in both species composition and disturbance intensity. This zone is characterized by moderate water flow, wider floodplains, and nutrient-rich alluvial soils. Species such as *Ficus hispida*, *Pongamia pinnata*, *Ficus racemosa*, and *Mitragyna parvifolia* were prevalent, benefiting from periodic inundation and higher soil moisture availability. Compared to the upstream zone, the midstream section exhibited a noticeable increase in invasive species, suggesting moderate anthropogenic influence from agriculture, settlements, and riverbank modifications, which create favorable conditions for invasion.

Downstream zone

The downstream section exhibited the lowest species richness (30 species), comprising 17 native and 13 non-native / invasive species. This zone is characterized by lower elevation, reduced flow velocity, prolonged inundation, and greater accumulation of fine sediments and organic matter. Flood-tolerant and disturbance-

adapted species such as *Neltuma juliflora*, *Bambusa bambos*, *Vachellia nilotica*, and *Syzygium salicifolium* were common. The relatively high proportion of invasive species in this zone reflects intensified human pressure, habitat fragmentation, and altered hydrological regimes, which collectively weaken native species dominance and facilitate invasive plant establishment.

Overall pattern

Across the riparian continuum, a clear longitudinal trend was observed, marked by a gradual decline in total tree species richness and native species dominance from upstream to downstream, accompanied by a proportional increase in invasive species. This zonation underscores the combined influence of hydrology, soil characteristics, elevation, flood frequency, and anthropogenic disturbance in structuring riparian tree communities along the river ecosystem.

Dominant families of the riparian region

Fabaceae was the most dominant family, contributing 10 species (18.2%) to the native riparian tree diversity of the Dudhganga River, followed by Moraceae with eight species (14.5%). Lamiaceae and Malvaceae were represented by four species each (7.3% each), while Rubiaceae contributed three species (5.5%). The remaining 20 families collectively accounted for 26 species (47.3%), indicating a broad but uneven distribution of native tree diversity across families (Figure 2).

Range-restricted taxa

A significant portion of the tree species was found to be restricted to specific sections of the riparian area. The upstream region has 28 unique species, representing 35.90% of the total restricted species. The midstream region had 19 restricted species, accounting for 24.34% of the total. Despite having a lower overall species richness, the downstream regions still contained three species exclusive to this area, comprising 11.11% of the restricted species. These findings emphasize the importance of conserving all three sections of the riparian ecosystem to maintain the overall biodiversity and protect unique genetic resources.

At-risk taxa

Out of the 80 tree species recorded in the riparian zone of the river Dudhganga, 20 species have a limited presence, with only a few individuals found in a single locality. Currently, two species, *Santalum album* and *Dalbergia latifolia*, are classified as 'Vulnerable'

Table 1. Checklist of tree species recorded in the riparian vegetation of the Dudhganga River.

	Riparian tree species	Family	Vernacular name	IUCN Red List status	Biogeographic status	Regional distribution
1	<i>Acacia auriculiformis</i> A.Cunn. ex Benth.	Fabaceae	Australian Babul	--	I	U, M, D
2	<i>Albizia lebbek</i> (L.) Benth.	Fabaceae	Siris Tree	LC	N	M, D
3	<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	Pandhra Shirish	LC	N	U
4	<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae	Saptarni, Satvin	LC	N	M
5	<i>Annona reticulata</i> L.	Annonaceae	Ram-Phal	--	I	M
6	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Phans	NA	N	U, M
7	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Kadu Limb	--	I	D
8	<i>Bambusa bambos</i> (L.) Voss	Poaceae	Kashti	NA	N	U, M, D
9	<i>Bambusa multiplex</i> (Lour.) Raeusch. ex Schult.f.	Poaceae	Bet	NA	N	U, M
10	<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl.	Poaceae	Bet	--	I	U
11	<i>Bauhinia purpurea</i> L.	Fabaceae	Rakta Kanchan	LC	N	U
12	<i>Bergera koenigii</i> L.	Rutaceae	Kadipatta	NA	N	U
13	<i>Bombax ceiba</i> L.	Malvaceae	Kate-Saver	LC	N	U, M
14	<i>Caryota urens</i> L.	Arecaceae	Fish-Tail Palm	LC	N	U
15	<i>Cassia fistula</i> L.	Fabaceae	Bahava	LC	N	U
16	<i>Ceiba pentandra</i> (L.) Gaertn.	Malvaceae	Safed Simal	--	I	U
17	<i>Citrus × limon</i> (L.) Osbeck	Rutaceae	Limbu	--	I	U, M
18	<i>Cocos nucifera</i> L.	Arecaceae	Narel	--	I	U, M,
19	<i>Cordia dichotoma</i> G.Forst.	Boraginaceae	Bhokar	LC	N	U, M, D
20	<i>Crateva magna</i> (Lour.) DC.	Capparaceae	Katarlingad	NA	N	U, M, D
21	<i>Dalbergia latifolia</i> Roxb.	Fabaceae	Biti, Sissu	VU	N	U, M
22	<i>Diospyros montana</i> Roxb.	Ebenaceae	Lohari	NA	N	U
23	<i>Erythrina variegata</i> L.	Fabaceae	Pangira	LC	N	U
24	<i>Eucalyptus rudis</i> Endl.	Myrtaceae	Nilgir	--	I	U, M, D
25	<i>Eucalyptus tereticornis</i> Sm.	Myrtaceae	Nilgir	--	I	U, M
26	<i>Ficus benghalensis</i> L.	Moraceae	Wad	NA	N	U, M
27	<i>Ficus hispida</i> L.f.	Moraceae	Bokeda, Kala-Umber	LC	N	U, M,
28	<i>Ficus microcarpa</i> L.f.	Moraceae	Kamarup	LC	N	M
29	<i>Ficus racemosa</i> L.	Moraceae	Umber	LC	N	U, M, D
30	<i>Ficus religiosa</i> L.	Moraceae	Pimpal	LC	N	U, M
31	<i>Ficus tinctoria</i> G.Forst.	Moraceae	Datir	LC	N	U
32	<i>Ficus virens</i> Aiton	Moraceae	Bassari, Gandhaumbara	LC	N	M
33	<i>Gliricidia sepium</i> (Jacq.) Kunth	Fabaceae	Undirmari	--	I	M
34	<i>Glochidion ellipticum</i> Wight	Phyllanthaceae	Bhoma	NA	N	U
35	<i>Gmelina arborea</i> Roxb. ex Sm.	Lamiaceae	Sivan	NA	N	U
36	<i>Grewia serrulata</i> DC.	Malvaceae	Kawri	NA	N	U
37	<i>Grewia tiliifolia</i> Vahl	Malvaceae	Dhaman	NA	N	U
38	<i>Holarrhena pubescens</i> Wall. ex G.Don	Apocynaceae	Indrajav	LC	N	U
39	<i>Jatropha integerrima</i> Jacq.	Euphorbiaceae	Jangli Erand	--	I	M, D
40	<i>Kydia calycina</i> Roxb.	Malvaceae	Warang	NA	N	U
41	<i>Lasiosiphon glaucus</i> Fresen.	Thymelaeaceae	Datpadi, Rametha	--	I	U
42	<i>Leucaena leucocephala</i> (Lam.) de Wit	Fabaceae	Subabul	--	I	U, M, D
43	<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Euphorbiaceae	Chandwar	NA	N	U

	Riparian tree species	Family	Vernacular name	IUCN Red List status	Biogeographic status	Regional distribution
44	<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Euphorbiaceae	Shendri	NA	N	U, M, D
45	<i>Mappia nimmoniana</i> (J.Graham) Byng & Stull	Icacinaceae	Amrita	NA	N	U
46	<i>Memecylon umbellatum</i> Burm.f.	Melastomataceae	Anjani	LC	N	U
47	<i>Mangifera indica</i> L.	Anacardiaceae	Amba	DD	N	U, M, D
48	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae	Kalam	NA	N	U, M
49	<i>Monoon longifolium</i> (Spreng.) Kosterm.	Annonaceae	Devdar	NA	N	M, D
50	<i>Moringa oleifera</i> Lam.	Moringaceae	Shevga	NA	N	U
51	<i>Morus alba</i> L.	Moraceae	Tuti	--	I	M
52	<i>Musa × paradisiaca</i> L.	Musaceae	Kel	--	I	U, M
53	<i>Neltuma juliflora</i> (Sw.) Raf.	Fabaceae	Vilayati Babul	--	I	D
54	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae	Kadamba	NA	N	U
55	<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	Broken Bones Tree	NA	N	U
56	<i>Pandanus furcatus</i> Roxb.	Pandanaceae	Bongi	NA	N	U
57	<i>Peltophorum pterocarpum</i> (DC.) Backer ex K.Heyne	Fabaceae	Peela Gulmohar	--	I	M
58	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Fabaceae	Vilayatichinch	--	I	U, M, D
59	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	Karanj	LC	N	U, M, D
60	<i>Psidium guajava</i> L.	Myrtaceae	Peru	--	I	U, M, D
61	<i>Ricinus communis</i> L.	Euphorbiaceae	Yerand	--	I	U, M, D
62	<i>Salix tetrasperma</i> Roxb.	Salicaceae	Walunj	NA	N	U, M, D
63	<i>Samanea saman</i> (Jacq.) Merr.	Fabaceae	Gulabi Siris	--	I	U, M, D
64	<i>Santalum album</i> L.	Santalaceae	Chandan	--	I	M
65	<i>Senegalia rugata</i> (Lam.) Britton & Rose	Fabaceae	Shikakai	NA	N	U
66	<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	Fabaceae	Kassod	--	I	U, M, D
67	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	shewarie	LC	N	M, D
68	<i>Swietenia macrophylla</i> King	Meliaceae	Mahogany	--	I	M
69	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Jambhul	NA	N	U, M, D
70	<i>Syzygium salicifolium</i> J.Graham	Myrtaceae	Pan Jambhul	NA	N	U, M, D
71	<i>Tamarindus indica</i> L.	Fabaceae	Chinch	--	I	M, D
72	<i>Tamarix ericoides</i> Rottler & Willd.	Tamaricaceae	Kadsherni	NA	N	D
73	<i>Tectona grandis</i> L.f.	Lamiaceae	Sagwan	NA	N	U, M
74	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjun	NA	N	U, M, D
75	<i>Terminalia paniculata</i> B.Heyne ex Roth	Combretaceae	Kinjāl	NA	N	U
76	<i>Vachellia nilotica</i> (L.) P.J.H.Hurter & Mabb.	Fabaceae	Babhal	NA	N	U, M, D
77	<i>Vitex leucoxydon</i> L.f.	Lamiaceae	Sheras Songarbi	NA	N	U, M
78	<i>Vitex negundo</i> L.	Lamiaceae	Nirgundi	NA	N	U, M, D
79	<i>Wendlandia heynei</i> (Schult.) Santapau & Merchant	Rubiaceae	Til	NA	N	U
80	<i>Woodfordia fruticosa</i> (L.) Kurz	Lythraceae	Dhayati, Dowari	LC	N	U

DD—Data Deficient | EN—Endangered | NA—Not Assessed | LC—Least Concern | NT—Near Threatened | VU—Vulnerable | U—Upstream | M—Midstream | D—Downstream | I—Invasive | N—Native.

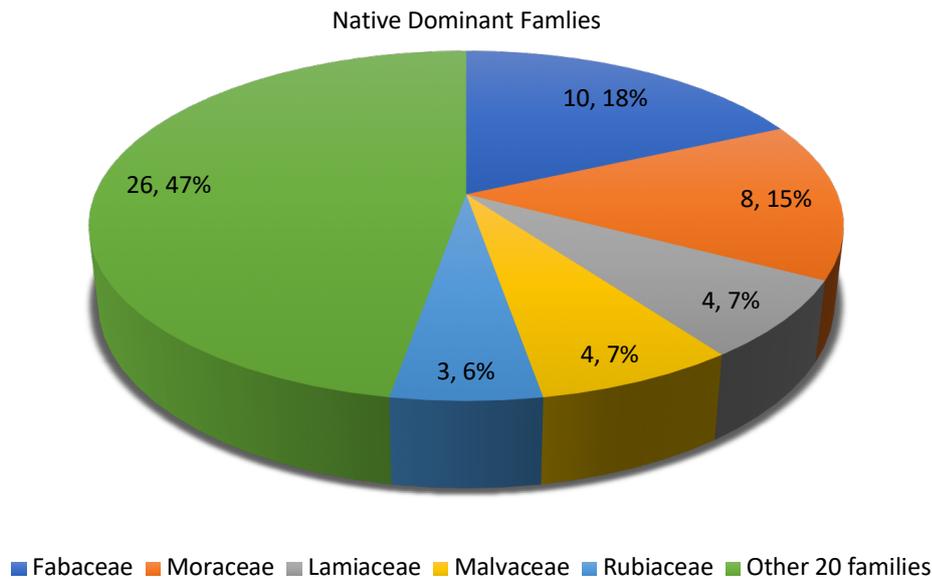


Figure 2. Native species per family in the tree flora.

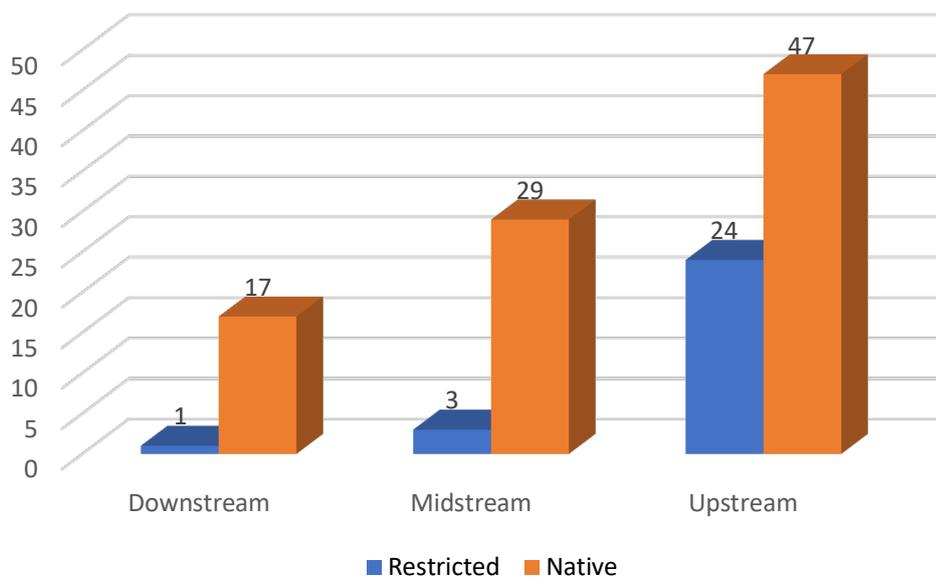


Figure 3. Zonal distribution of restricted tree species.

(IUCN 2024), while *Swietenia macrophylla* is listed as 'Endangered' according to IUCN conservation status (IUCN 2024). Twenty-four species are categorized as 'Least Concern', and *Mangifera indica* L. is classified as 'Data Deficient' (Table 1). The flagship species of the Western Ghats, *Memecylon umbellatum*, is also present in the study area and found to be restricted to the upstream area. The zonation of riparian vegetation along the river belt was evident, with distinct species distributions observed across all three sections.

Non-native trees

Non-native species such as *Eucalyptus rudis*, *Neltuma juliflora*, *Pithecellobium dulce*, and *Senna siamea* are prevalent in the riparian vegetation of the river Dudhganga. Twenty-five non-native tree species, including several invasive taxa, were recorded along the Dudhganga River. Although riparian zones are typically characterised by rapid successional dynamics, the proliferation of invasive species can disrupt natural regeneration processes by suppressing native species establishment, thereby posing a potential long-term

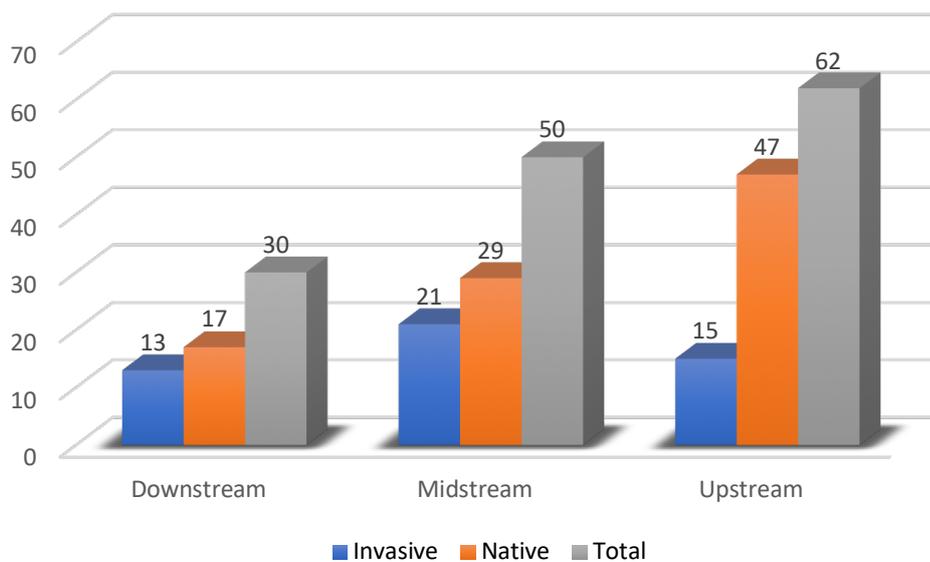


Figure 4. Zonal distribution of native and invasive species.

threat to riparian forest structure and stability. These invasive species can also disrupt watershed hydrology and riparian ecosystems (Richardson et al. 2007). Many researchers have reported that the riparian zone has served as a corridor for the introduction and spread of invasive species, primarily due to long-term human activities (Johansson et al. 1996; Hood & Naiman 2000; Tockner & Stanford 2002). Invasive tree species pose a significant threat to the ecological balance of riparian vegetation, often outcompeting native flora and altering habitat dynamics. Along the river Dudhganga, species such as *Neltuma juliflora*, *Pithecellobium dulce*, *Leucaena leucocephala*, and *Acacia auriculiformis* have established small but dominant micro populations. Among these, *Pithecellobium dulce* and *Neltuma juliflora* exhibit particularly aggressive invasion patterns, forming multiple micro populations that dominate certain localities. Notably, a large patch of *Pithecellobium dulce* is present at the confluence of the river Dudhganga and the river Krishna near Sangam Math, June Danwad. Their rapid spread can impact native biodiversity, water availability, and soil composition, making their management crucial for maintaining the ecological integrity of the riparian ecosystem.

Threats

Riparian vegetation is experiencing gradual degradation due to factors such as deforestation, soil erosion, mining and construction activities. Areas with intensive agriculture and other human activities, including water extraction, logging, grazing by cattle,

and recreation are particularly vulnerable to vegetation loss. Studies have demonstrated that the loss of riparian vegetation can have significant ecological consequences, including a reduction in biodiversity. Riparian corridors serve as vital habitats for numerous animal species and breeding grounds for many migratory birds. Anthropogenic disturbances can significantly alter the structure and composition of these plant communities (Mohan & Joseph 2024).

The study identified several anthropogenic and natural threats along the Dudhganga River, varying across the upper, mid, and lower courses.

Upstream—located in the higher altitudes with relatively undisturbed forested areas, the primary threats include deforestation due to agricultural expansion, encroachment, and soil erosion on steep slopes. Occasional illegal logging and grazing pressures also impact vegetation stability.

Midstream—this zone experiences moderate human interference, with threats such as sand and gravel mining, habitat fragmentation due to infrastructure development, and pollution from agricultural runoff. The conversion of riparian land for settlements and farming is gradually altering species composition.

Downstream—the most impacted zone, facing severe threats from industrial pollution, urban expansion, and intensive agricultural activities. Unregulated wastewater discharge, sand dredging, and invasive species proliferation have significantly degraded riparian vegetation, leading to biodiversity loss and altered hydrological patterns.

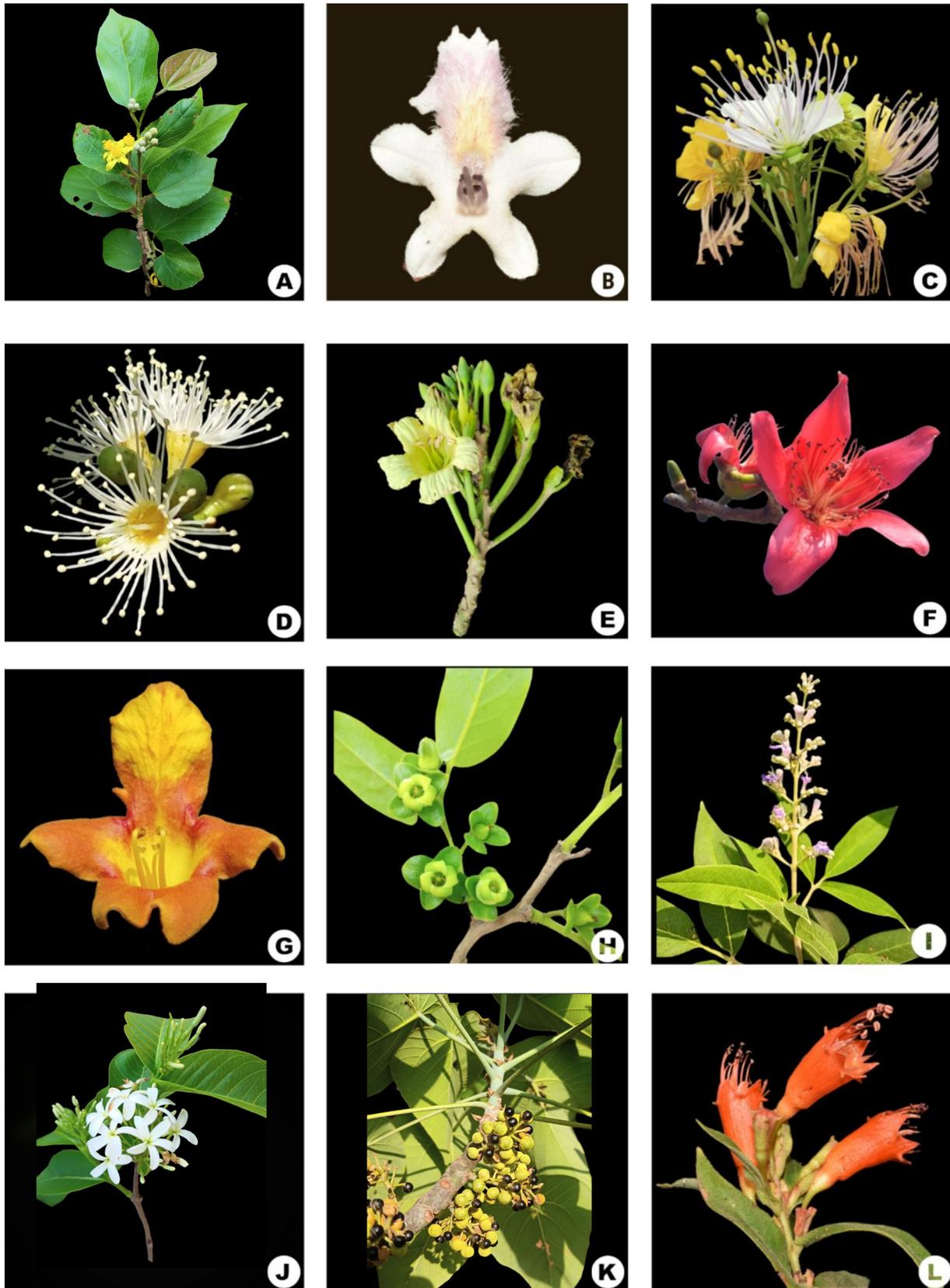


Image 4. Flowering diversity: A—*Grewia tiliifolia* | B—*Vitex leucoxydon* | C—*Crateva magna* | D—*Syzygium salicifolium* | E—*Oroxylum indicum* | F—*Bombax ceiba* | G—*Gmelina arborea* | H—*Diospyros montana* | I—*Vitex negundo* | J—*Holarrhena pubescens* | K—*Macaranga peltata* | L—*Woodfordia fruticosa*. © Sachin Chavan.

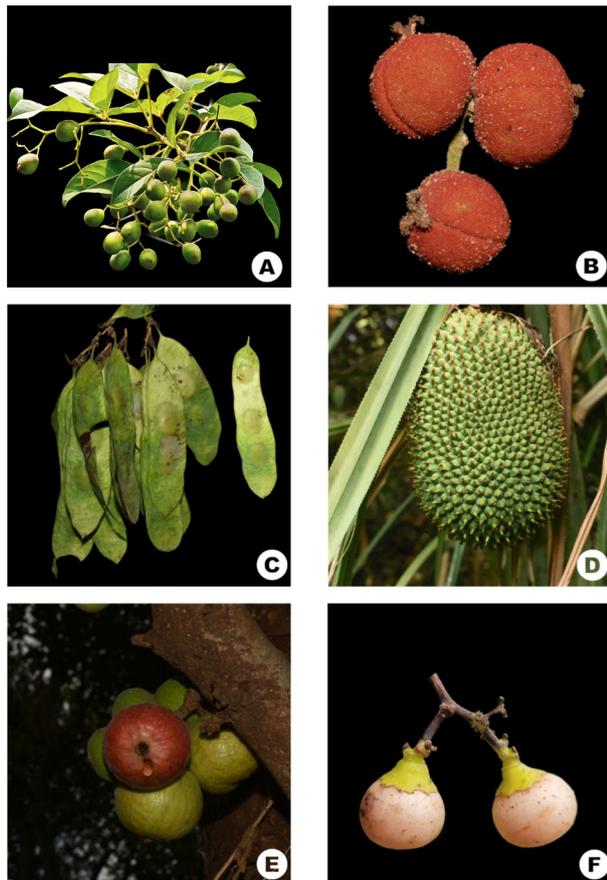


Image 5. Fruit diversity: A—*Vitex leucoxydon* | B—*Mallotus philippensis* | C—*Dalbergia latifolia* | D—*Pandanus furcatus* | E—*Ficus racemosa* | F—*Cordia dichotoma*. © Sachin Chavan.

CONCLUSION

These findings highlight the rich arboreal diversity of the Dudhganga riparian zone, with notable economically valuable species, including *Mappia nimmoniana* and *Pongamia pinnata*, underscoring its ecological significance and the need for continued conservation efforts. Notably, the Fabaceae family emerged as the most predominant, with *Ficus* standing out as the most diverse genus within the study area. Therefore, it is imperative to prioritize conservation efforts to safeguard this rich biodiversity along the river Dudhganga by encouraging local communities to participate in afforestation, especially planting native species, sustainable water management, and riparian conservation efforts including regulating anthropogenic activities.

REFERENCES

- Chazdon, R.L., R.K. Colwell, J.S. Denslow & M.R. Guariguata (1998). Statistical methods for estimating species richness of woody regeneration in primary and secondary rain forests of NE Costa Rica. *Forest Ecology and Management* 112: 1–10.
- Condit, R. (1998). *Tropical Forest Census Plots: Methods and Results from Barro Colorado Island, Panama and a Comparison with Other Plots*. Springer-Verlag, Berlin, 211 pp.
- Cooke, T. (1903). *The Flora of the Presidency of Bombay: Vol. 1*. Taylor and Francis, London, 645 pp. <https://www.biodiversitylibrary.org/item/42327>
- Flowers of India (2024). <http://www.flowersofindia.net>. Downloaded on 23.viii.2024.
- Gotelli, N.J. & R.K. Colwell (2001). Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology Letters* 4: 379–391.
- Gregory, S.V., F.J. Swanson, W.A. McKee & K.W. Cummins (1991). An ecosystem perspective of riparian zones. *BioScience* 41(8): 540–551.
- Gunaga, S., N. Rajeshwari & R. Vasudeva (2013). Tree diversity and disturbance of kaan forests: relics of a community-protected climax vegetation in the Central Western Ghats. *Tropical Ecology* 54(1): 117–131.
- Hood, W.G. & R.J. Naiman (2000). Vulnerability of riparian zones to invasion by exotic vascular plants. *Plant Ecology* 148: 105–114.
- Hynes, H.B.N. (1970). *The Ecology of Running Waters*. University of Toronto Press, Toronto, 555 pp.
- IUCN (2024). The IUCN Red List of Threatened Species (Version 2022-1). <https://www.iucnredlist.org>. Downloaded on 01.viii.2024.
- Jain, S.K. & R.R. Rao (1977). *A Handbook of Field and Herbarium Methods*. Scholarly Publications, New Delhi, 157 pp.
- Johansson, M.E., C. Nilsson & E. Nilsson (1996). Do rivers function as corridors for plant dispersal? *Journal of Vegetation Science* 7(5): 593–598. <https://doi.org/10.2307/3236309>
- Korse, K.H. & G. Krishnakumar (2006). Riparian flora of perennial rivers in the Western Ghats: floristic diversity, ecological uniqueness and conservation strategies. *Proceedings of Lake 2006*. Indian Institute of Science, Bengaluru, 12 pp.
- Lacerda, A.V.D., N. Nordi, F.M. Barbosa & T. Watanabe (2005). Levantamento florístico do componente arbustivo-arbóreo da vegetação ciliar na bacia do rio Taperoá, PB, Brasil. *Acta Botanica Brasiliica* 19(3): 647–656. <https://doi.org/10.1590/S0102-33062005000300027>
- Liunima, V., L. Banilodu & C.G. Semiun (2022). Composition and diversity of riparian vegetation of the Talau river, Belu Regency. *Edubiotik: Jurnal Pendidikan, Biologi dan Terapan* 7(02): 167–176. <https://doi.org/10.33503/ebio.v7i02.1934>
- Mohan, S.N. & S. Joseph (2024). Disturbances on riparian vegetation: a comprehensive review. *International Journal of Research and Review* 11(4): 200–208. <https://doi.org/10.52403/ijrr.20240422>
- Mohite, S. & S.A. Mane (2020). Phytosociological study of riparian trees in the Panchganga River system at Kolhapur District, Maharashtra, India. *Journal of Aquatic Biology & Fisheries* 8 (Special Issue): 62–67.
- Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca & J. Kent (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858. <https://doi.org/10.1038/35002501>
- Naiman, R.J. & H. Décamps (1997). The ecology of interfaces: Riparian zones. *Annual Review of Ecology and Systematics* 28(1): 621–658. <https://doi.org/10.1146/annurev.ecolsys.28.1.621>
- Naiman, R.J., H. Décamps & M. McClain (2005). *Riparia: Ecology, Conservation, and Management of Streamside Communities*. Academic Press, Burlington, MA, 448 pp. <https://doi.org/10.1016/B978-012663315-3/50003-4>
- Nilsson, C., R. Jansson & U. Zinko (1997). Long-term responses of river-margin vegetation to water-level regulation. *Science* 276(5313): 798–800. <https://doi.org/10.1126/science.276.5313.798>
- POWO (2024). Plants of the World Online. Royal Botanic Gardens, Kew. <https://www.plantsoftheworldonline.org>. Downloaded on

- 01.viii.2024.
- Rao, K.S. & D. Kumar (2024).** India Flora Online. <https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=3517&cat=13>. Downloaded on 01.viii.2024.
- Richardson, D.M., P.M. Holmes, K.J. Esler, S.M. Galatowitsch, J.C. Stromberg, S.P. Kirkman, P. Pyšek & R.J. Hobbs (2007).** Riparian vegetation: degradation, alien plant invasions, and restoration prospects. *Diversity and Distributions* 13(1): 126–139. <https://doi.org/10.1111/j.1366-9516.2006.00314.x>
- Singh, N.P. & S. Karthikeyan (eds.) (2000).** *Flora of Maharashtra State: Dicotyledones – Vol. 1*. Botanical Survey of India, Calcutta, 898 pp.
- Stevens, P.F. (2001 onwards).** Angiosperm Phylogeny Website (Version 14, July 2017). <http://www.mobot.org/MOBOT/research/APweb/>.
- Downloaded on 01.viii.2024.
- Sumarmi, S., T.I. Pakarti, L.F.P. Destari, N. Aini & A. Tanjung (2022).** Preservation of vegetation diversity to maintain the riparian ecosystem of the Sampean watershed. *KnE Social Sciences* 7(16): 140–151. <https://doi.org/10.18502/kss.v7i16.12168>
- Tockner, K. & J.A. Stanford (2002).** Riverine flood plains: present state and future trends. *Environmental Conservation* 29: 308–330.
- UNESCO (2012).** Western Ghats (India) (No. 1342rev). UNESCO World Heritage Centre. <https://whc.unesco.org/en/list/1342/> Downloaded on 07.viii.2024.
- Yadav, S.R. & M.M. Sardesai (2002).** *Flora of Kolhapur District*. Shivaji University, Kolhapur, India, 680 pp.

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
Mr. 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. Topiltzin Contreras MacBeath, Universidad Autónoma del estado de Morelos, México
Dr. Heok Hee Ng, National University of Singapore, Science Drive, Singapore
Dr. Rajeesh 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 Vyasa, Vadodara, Gujarat, India
Dr. Pritpal S. Soorae, Environment Agency, Abu Dhabi, UAE.
Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey
Prof. Chandrashekhar U. Rivonker, Goa University, Taleigao Plateau, Goa, India
Dr. S.R. Ganesh, Kalinga Foundation, Agumbe, India.
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

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, SACON, 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, SACON, 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, SACON, 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, Sri S. Ramasamy Naidu Memorial College, Virudhunagar, 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 2021–2023

Due to paucity of space, the list of reviewers for 2021–2023 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.

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

Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore,
Tamil Nadu 641006, India
ravi@threatenedtaxa.org & ravi@zooreach.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. 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)

February 2026 | Vol. 18 | No. 2 | Pages: 28262–28454

Date of Publication: 26 February 2026 (Online & Print)

DOI: 10.11609/jott.2026.18.2.28262-28454

www.threatenedtaxa.org

Articles

Floristic composition and conservation significance of vascular plants in Kalatop-Khajjiar Wildlife Sanctuary, Himachal Pradesh, India

– Sumit, Gulshan Kumar, Sumit Singh, Kanwaljeet Singh, Taslima Sheikh, P. Vishal Ahuja & Arvind Kumar, Pp. 28263–28274

Assessing the tree diversity along the Dudhganga River in Kolhapur District of Maharashtra, India

– Sachin Chavan & Rajaram Gurav, Pp. 28275–28286

Flower bud growth, mortality rate, and population structure of *Sapria himalayana* Griffith f. *albavinosa* Banziger & Hansen (Rafflesiaceae) in a subtropical forest, northeastern India

– K. Shamran Maring & Athokpam Pinokiyo, Pp. 28287–28295

Comparing three sampling techniques for surveying and monitoring arthropods in Moroccan agroecosystems

– Hanae El Harche, Pp. 28296–28306

Community structure of Lepidoptera in Nantu-Bolihuto Wildlife Reserve, Sulawesi, Indonesia

– Chairunnisah J. Lamangantjo, Marini Susanti Hamidun, Sasmianti & Dewi Wahyuni K. Baderan, Pp. 28307–28316

Foraging niche segregation among woodpeckers in the oak-pine forest of Kumaon Himalaya, Uttarakhand, India

– Rafat Jahan, Satish Kumar & Kaleem Ahmed, Pp. 28317–28328

Local knowledge, attitudes, and perceptions of ecosystem services and disservices provided by the Painted Stork *Mycteria leucocephala* Pennant, 1769 (Aves: Ciconiidae) in northern India: insights for conservation

– Yashmita-Ulman & Manoj Singh, Pp. 28329–28342

Communications

Analysis revealed minuscule DNA sequence data availability for Indian marine macroalgal diversity

– Digvijay Singh Yadav, Aswin Alichen & Vaibhav A. Mantri, Pp. 28343–28349

Checklist of rust fungi of the Nuratau Nature Reserve, Uzbekistan

– I.M. Mustafae, M.M. Iminova, I.Z. Ortiqov, S.A. Teshaboyeva & N.Q. Iskanov, Pp. 28350–28357

Checklist of moths (Lepidoptera: Heterocera) from the campus of University of North Bengal, Siliguri, India

– Abhirup Saha, Ratnadeep Sarkar, Rujas Yonle, Subhajit Das, Prapti Das & Dhiraj Saha, Pp. 28358–28369

Vulture diversity and long-term trends in the Ranikhet region, Kumaon Himalaya, Uttarakhand, India

– Mirza Altaf Baig, Nazneen Zehra & Jamal Ahmad Khan, Pp. 28370–28377

Nesting dynamics of Red-wattled Lapwing *Vanellus indicus* Boddaert, 1783 in urban and rural regions of Indore, India

– Kratika Patidar & Vipul Keerti Sharma, Pp. 28378–28386

Assessing avian diversity and conservation status in Dhamapur Lake World Heritage Irrigation Structure, Sindhudurg, Maharashtra, India

– Yogesh Koli, Pravin Sawant & Mayuri Chavan, Pp. 28387–28398

Population status and habitat use of Indian Grey Wolf *Canis lupus pallipes* in Pench Tiger Reserve, Madhya Pradesh, India

– Iqra Rabbani & Sharad Kumar, Pp. 28399–28405

Activity budgets of a zoo-housed Mishmi Takin *Budorcas taxicolor taxicolor* (Mammalia: Artiodactyla: Bovidae) herd

– Nabanita Ghosh, Pranita Gupta, Joy Dey & Basavaraj S. Holeyachi, Pp. 28406–28412

Extended distribution of *Nymphoides peltata* (S.G.Gmel.) Kuntze (Menyanthaceae) in Manipur, India

– Aahen Chanu Waikhom & Bimolkumar Singh Sadokpam, Pp. 28413–28418

Short Communications

***Impatiens chamchumroonii* (Balsaminaceae), a new record for the flora of Vietnam**

– Cuong Huu Nguyen, Diep Quang Dinh, Dinh Duc Nguyen & Keoudone Souvannakhommane, Pp. 28419–28423

Occurrence of the wood fern *Arachniodes sledgei* Fraser-Jenk. (Pteridophyta: Dryopteridaceae) in the northern Western Ghats, India

– Sachin Patil & Jagannath Patil, Pp. 28424–28427

Notes

A note on the Petal-less Caper *Maerua apetala* (B. Heyne ex Roth) Jacobs (Capparaceae)

– Shamsudheen Abdul Kader & Bagavathy Parthipan, Pp. 28428–28429

Record of *Euploea mulciber* (Cramer, [1777]) (Lepidoptera: Nymphalidae) in Delhi, India: evidence of range extension in a restored urban ecosystem

– Aisha Sultana, Mohammad Shah Hussain & Balwinder Kaur, Pp. 28430–28432

Hump-nosed Pit Viper *Hypnale hypnale* feeding on an Allapalli Skink *Eutropis allapallensis* in Karwar, India

– Nonita Rana, Karthy Shivapushanam, S.J.D. Frank & Govindan Veeraswami Gopi, Pp. 28433–28435

Sighting of vagrant Red-backed Shrike *Lanius collurio* in the coastal areas of Thoothukudi, Tamil Nadu, India

– Kishore Muthu, Anand Shibu & Santhanakrishnan Babu, Pp. 28436–28437

First record of the Diamond Dove *Geopelia cuneata*, an Australian endemic, in Sikhna Jwhlwao National Park, Assam, India

– Bibhash Sarkar, Bijay Basfore, Leons Mathew Abraham & Anjana Singha Naorem, Pp. 28438–28440

First photographic record of the Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Kuldiha Wildlife Sanctuary, Odisha, India

– Tarun Singh, Harshvardhan Singh Rathore, N. Abhin, Subhalaxmi Muduli, Yash Deshpande, Vivek Sarkar, Diganta Sovan Chand, Samrat Gowda, Prakash C. Gogineni, Manoj V. Nair, Bivash Pandav & Samrat Mondol, Pp. 28441–28443

First photographic evidence of the Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Kapilash Wildlife Sanctuary, Odisha, India

– Alok Kumar Naik, Sumit Kumar Kar, Shyama Bharati, Ashit Chakraborty & Ashis Kumar Das, Pp. 28444–28446

Record of a Tiger *Panthera tigris* (Linnaeus, 1758) (Mammalia: Carnivora: Felidae) in Saptari District of eastern Nepal: implications for conservation and habitat connectivity

– Gobinda Prasad Pokharel, Chiranjibi Prasad Pokharel, Ashish Gurung, Bishnu Singh Thakuri, Ambika Prasad Khatiwada, Aastha Joshi, Birendra Gautam, Mithilesh Mahato, Naresh Subedi & Madhu Chetri, Pp. 28447–28450

Book Review

At the Point of No Return? – Reading Pankaj Sekhsaria's Island on Edge: The Great Nicobar Crisis

– Himangshu Kalita, Pp. 28451–28454

Publisher & Host



Threatened Taxa