

Building evidence for conservation globally

Journal of Threatened Taxa

10.11609/jott.2023.15.8.23631-23826

www.threatenedtaxa.org

26 August 2023 (Online & Print)

15(8): 23631-23826

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)



Open Access





43/2 Varadarajulu Nagar, 5th 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
Email: sanjay@threatenedtaxa.org

EDITORS**Founder & Chief Editor****Dr. Sanjay Molur**Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO),
43/2 Varadarajulu Nagar, 5th 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, Mavinahalli 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. Ilangovan**, 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, Kuvenpu University, Shimoga, Karnataka, India**Dr. K.R. Sridhar**, Mangalore University, Mangalagangotri, Mangalore, Karnataka, India**Dr. Gunjan Biswas**, Vidyasagar University, Midnapore, West Bengal, India**Dr. Kiran Ramchandra Ranadive**, Anna Sahab 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. Ferdinand 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, Anantapur, 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 Ranjan Housing Society, Pune, Maharashtra, India**Prof. A.J. Solomon Raju**, Andhra University, Visakhapatnam, India**Dr. Mander 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. Lakshminarasiham**, 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. Siru**, 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. Warrier**, 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**, Ilandudno, North Wales, LL30 1UP**Dr. Hemant V. Ghate**, Modern College, Pune, India**Dr. M. Monwar Hossain**, Jahangirnagar University, Dhaka, BangladeshFor Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scopeFor 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: Coromandal Sacred Langur *Semnopithecus priam* - made with acrylic paint. © P. Kritika.



Description of a new species of the genus *Anthaxia* (*Haplanthaxia* Reitter, 1911) from India with molecular barcoding and phylogenetic analysis

S. Seena¹ , P.P. Anand²  & Y. Shibu Vardhanan³ 

^{1,2,3} Biochemistry & Toxicology Division, Department of Zoology, University of Calicut, Kozhikode, Kerala 673635, India.

¹seena.s1984@gmail.com, ²anandpp633@gmail.com (corresponding author), ³svardhanan@gmail.com (corresponding author)

^{1,2}These authors contributed equally to this work.

Abstract: This paper deals with the description of a new *Anthaxia* (subgenus *Haplanthaxia* Reitter, 1911) species from southern India, which belongs to the *Anthaxia (H.) winkleri* Obenberger, 1914 species-group: *Anthaxia (H.) keralensis* sp. nov. In addition to a morphological description, we also generated mt. COI DNA sequences and discuss the results of a phylogenetic analysis of the new species with previously deposited COI DNA sequences of *Anthaxia* spp. In a maximum-likelihood phylogenetic analysis, the new species shared the same hypothetical ancestor node with *A. melancholica* Gory, 1841 and similar molecular characteristics (~48% similarity) with *A. tenella* Kiesenwetter, 1858 and *A. corinthia* Reiche & Saulcy, 1856. More systematic studies are required to understand the species diversity, distribution, biology, and evolutionary significance of the *Anthaxia* (H.) species groups.

Keywords: Beetle, Buprestidae, CO1 gene, Coleoptera, molecular phylogeny, oriental region, southern India, Western Ghats.

ZooBank: urn:lsid:zoobank.org:pub:493B80E1-320B-4AB6-BE97-0D9BB178D043

Editor: Mark G. Volkovitsh, Zoological Institute of the Russian Academy of Sciences St.Petersburg, Russia. **Date of publication:** 26 August 2023 (online & print)

Citation: Seena, S., P.P. Anand & Y.S. Vardhanan (2023). Description of a new species of the genus *Anthaxia* (*Haplanthaxia* Reitter, 1911) from India with molecular barcoding and phylogenetic analysis. *Journal of Threatened Taxa* 15(8): 23771-23777. <https://doi.org/10.11609/jott.8178.15.8.23771-23777>

Copyright: © Seena al. 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: The present study was financially supported by UGC-SAP, Government of India (F.3-6/212 (DAP-II) dated 10.10.2012).

Competing interests: The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

Author details: DR. SEENA, S. completed her PhD from University of Calicut and the thesis dealt with the morphology, molecular, morphometric study of Jewel beetles of Kerala, South India with special emphasis on antennal sensilla structure and light reflection mechanisms of Buprestid. P. P. ANAND doing Ph. D research (University of Calicut) on molecular aspects of mussel foot proteins. DR. Y. SHIBU VARDHANAN working as associate professor in Zoology, University of Calicut. His lab focused diverse aspects such as geometric morphometrics, toxicology, Biochemistry, molecular biology, biomaterial characterization and waste management.

Author contributions: Field level collection: SS; Description: SS and PPA; molecular analysis: SS and PPA; Supervision: YSV.

Acknowledgements: The authors are thankful to the authorities at Department of Zoology, University of Calicut for providing facilities. The authors also thankful to Dr. P.M. Sureshan, officer-in-charge and Dr. P. Girish Kumar, Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, India for the constant support and encouragement throughout this work.



INTRODUCTION

Buprestidae is one of the world's largest coleopteran families, with nearly 15,000 extant species in 522 genera (Bellamy 2008). The genus *Anthaxia* Eschscholtz, 1829, is a diversified taxon with a wide distribution; this genus includes 697 species worldwide (Bellamy 2008; Kubáň 2016). The genus *Anthaxia* comprises eight subgenera (Bílý 2019), of which *Haplanthaxia* Reitter, 1911 is the largest, comprising 70% of species of the genus. There are currently 20 defined species-groups in the subgenus *Haplanthaxia* and many more awaiting definitions (Bílý 2017, 2019). Due to its worldwide distribution and the extreme morphological similarity of some species, it is considered as the taxonomically most challenging group in Buprestidae (Bílý 2019). *Anthaxiini* from the Oriental region, particularly from the Indian subcontinent, have received little attention. Southern Indian *Anthaxia* (H.) has not yet been studied; in this work, we discuss the new species from *Anthaxia* species group.

In addition to the morphological description, we discuss the molecular phylogenetic position of our new species among relative species. Due to limited sampling, the Buprestidae group's molecular identification, classification, and phylogenetic analysis are not yet well developed. At present, species identification and classification are primarily based on morphological characteristics. Compared to other buprestid genera, *Agrius* Curtis, 1825, which has received the most attention in molecular barcoding and phylogenetic analysis. Kelnarova et al. (2018) investigated and developed the first DNA reference library for ~ 100 *Agrius* species from the Northern Hemisphere using three mitochondrial markers: *cox1-5'* (DNA barcode fragments), *cox1-3'*, and *rmL*. Rapid detection and taxonomic identification of buprestid species is the first step, especially if the species is economically significant. Recently, mitochondrial DNA-based species identification methods have become increasingly important as a practical alternative to classical morphology-based identification (Herbert et al. 2003; Riedel et al. 2013a, b; Ashfaq & Herbert 2016). Here, we present the first molecular mt. CO1 barcoding sequence of the genus *Anthaxia* from India, with the first mt. CO1 phylogeny analysis of all known *Anthaxia* species available in NCBI and BOLD databases.

MATERIALS AND METHODS

Specimens studied here were collected with yellow pan traps from the Aralam wildlife sanctuary (11.9505°N

75.8231°E, 238 m) in Kannur district, southern Western Ghats, Kerala, India. Images were taken with a Carl Zeiss SteREO Discovery.V20 microscope with a 6MP CCD sensor camera 506 attached and processed with Adobe Photoshop CS8 to standardize background and remove artifacts formed during stacking. In addition, measurements of body parts of holotype specimen were taken with Carl Zeiss SteREO Discovery V20 inbuild software. The holotype and paratype are deposited in the Department of Zoology, University of Calicut (DZUC) and will be transferred to the National Collections of Zoological Survey of India, Western Ghats Regional Centre, Kozhikode, Kerala (ZSIK).

The body length was measured in the middle of the body following the elytral suture (the same for the pronotal and elytral length); width of the body was measured at the maximum body width (usually the maximum span between lateral pronotal margins or span between the outer margin of humeral callosities) (Bílý 2020). The terminology used to describe surface sculpture is based on Harris (1979).

DNA extraction, amplification, sequencing, and phylogenetic analysis

Genomic DNA was extracted from the thoracic leg using Nucleospin® Tissue Kit (Macherey-Nagel) following the manufacturer's instructions. The extracted DNA was subjected to PCR amplification. PCR was performed in a reaction mixture containing 6.25 µL master mix (PCR master mix: Phire Hot Start II PCR Master Mix, ThermoFisher, Cat. No: F125S), 1.25 µL forward and reverse primer, 1 µL extracted DNA sample and 3.25 µL water. The total volume of the reaction mixture is 13 µL. For performing PCR mitochondrial cytochrome c oxidase subunit 1 (CO1) amplification, we used Lep primer (LepF1 5' ATTCAACCAATCATAAAGATATTGG 3' and LepR1 5' TAAACTCTGGATGTCCAAAAATCA 3') (Herbert et al. 2004; Wilson 2012). The thermal profiles of CO1 amplification were 5 min at 95°C, 40 cycles of 10 sec at 94°C, 1 min at 52°C, and 45 sec at 72°C, followed by a final extension of 10 min at 72°C. The purified PCR products were sequenced at Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram, Kerala, India, using the dideoxy chain termination method (Sanger & Coulson 1975). The forward and reverse strands were aligned using Clustal W in MEGA X to ensure the sequences were clear without any mismatches, frameshift regions, premature stop codons, etc.

The sequences were checked in the NCBI BLAST tool to find similar sequences in the NCBI database. All mt. CO1 DNA sequences of *Anthaxia* species were retrieved from NCBI and BOLD database and aligned in MEGA X,

MUSCLE alignment method (Kumar et al. 2018), and the aligned sequences were used for phylogeny construction analysis. To find out the best model for phylogeny analysis, we performed maximum likelihood fits of 24 different nucleotide substitution models. Models with the lowest BIC scores (Bayesian information criterion) are considered to describe the substitution pattern the best. For each model, AICc value (Alkaline information criterion, corrected), Maximum likelihood value (InL), and the number of parameters (including branch lengths) are also validated (Nei & Kumar 2000). A total of 30 nucleotide sequences (including new species CO1) were used for phylogenetic analysis. GTR+G+I (General Time Reversible model + Gamma Distributed with Invariants Sites) model is the best model for the phylogeny construction analysis of the genus *Anthaxia* (Parameters = 67; BIC = 10045.924; AICc = 9554.572; InL = -4709.885).

Phylogenetic relationship of taxa was analysed by using maximum likelihood and neighbour-joining method. The evolutionary history was inferred using the maximum likelihood method and the General Time Reversible model (Nei & Kumar 2000). The bootstrap consensus tree inferred from 1,000 replicates (Felsenstein 1985) is taken to represent the evolutionary history of the taxa analysed (Felsenstein 1985). Branches corresponding to partitions reproduced in less than 50% of bootstrap replicates are collapsed. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1,000 replicates) are shown next to the branches (Felsenstein 1985). Initial tree(s) for the heuristic search were automatically obtained by applying neighbour-join and BioNJ algorithms to a matrix of pairwise distances estimates using the maximum composite likelihood (MCL) approach, then selecting the topology with superior log likelihood value. A discrete Gama distribution was used to model evolutionary rate differences among sites (5 categories (+G, parameter = 0.2661)). The rate variation model allowed some sites to be evolutionarily invariable ([+I], 18.07% sites). This analysis involved 30 nucleotide sequences (including new species CO1). Codon positions included were 1st+2nd+3rd+Noncoding. All positions with less than 95% site coverage were eliminated, i.e., fewer than 5% alignment gaps, missing data, and ambiguous bases were allowed at any position (partial deletion option). There was a total of 384 positions in the final dataset. Evolutionary analyses were conducted in MEGA X (Kumar et al. 2018).

RESULTS

Anthaxia (Haplanthaxia) winkleri Obenberger, 1914 species group

Small to medium-sized species (4.0–6.0 mm). The head is wide, the forehead is flat, wide, the eyes projecting beyond head contour; upper lobe of eye more obtuse. On the broad vertex, the inner rims of the eyes are far apart, diverging towards vertex. Frons rather variable, from flat, slightly grooved in the middle, to widely depressed; frontal pubescence thicker, more sparse, rather reclined; clypeus almost flat. The forehead is always dark copper or green in colour, as is the rest of the body, only rarely a little lighter. The pronotum is almost twice as wide as long, fairly flat, depressed, the posterior angles not protruding backwards at all. It is widest in the anterior third, from there to the base and to the anterior margin finely and weakly, equally narrowed. Anterior margin deeply bisinuate, with pronounced central lobe. The posterior angles are rectangular. The structure of the pronotum is regular; it consists of low cells similar to those of the head; these are half extinct, very fine, only the central granules protrude somewhat more clearly, the walls of the cells are almost distinct. Scutellum slightly wider than long. The elytra are flat, without depressions, finely granulated, margins deep & wider, not shagreened, dark coppery, slightly wider in the shoulders than pronotum, individually tapered, and rounded at the apex. Metatibiae proportionally shorter, stronger, inner edge usually more strongly sinuate, incised, acutely serrate, with stronger, more acute apical spur. Aedeagus narrower, less sinuate; apex median lobe subparallel, more angulate, acutely pointed.

TAXONOMY

Anthaxia (Haplanthaxia) keralensis sp. nov.

(Image 1,2; Figure 1)

urn:lsid:zoobank.org:act:AF553762-19DC-438D-8BBA-8EE282C7130D

Material examined

Holotype: DZUC BLAK001, male, 10.vi.2019, Aralam Wildlife Sanctuary, Kerala, India, (11.9505°N, 75.8231°E, 238 m), coll: S. Seena”.

Paratype: DZUC BLAK002, male, same as holotype.

Measurement (Holotype): total length 5.71 mm, the width of head 1.65 mm, length of pronotum 1.08 mm, the width of pronotum 1.89 mm, length of elytra 3.87 mm, and width of elytra 1.92 mm.

Diagnosis: Medium-sized (5.7 mm) (Image 2A), robust;

frons, vertex and pronotum bright green metallic with bronze lusters; elytra bronze with bright green lusters; ventral surface, antennae and legs bronze-green metallic, metepimera and abdominal ventrites green with bronze lusters; pronotum with distinct deep posterolateral depressions; lateral sides of 1st abdominal segment with tomentose spot; metatibiae straight, with dense hispid bristles externally; entire body covered with setose, golden yellow, small erect pubescence (Image 2).

Description of the holotype

Head slightly wider than anterior pronotal margin; frons convex, vertex weakly depressed, 0.5 times as wide as width of eye; frontoclypeus anteriorly slightly convex; eyes large, narrowly reniform, slightly projecting beyond the outline of the head; inner ocular margins parallel, feebly converging toward vertex; sculpture of head consisting of very small, dense, polygonal cells with central grains; short erect yellow pubescence uniformly distributed; clypeus roughly micro-sculptured (Image 2D); antennae long, almost reaching posterior pronotal angles when laid alongside; scape claviform, about 4 times as long as wide, pedicel suboval, about 1.5 times as long as wide; third antennomere triangular, about twice as long as wide, antennomeres 4–10 trapezoidal, slightly longer than wide, terminal antennomere rhomboid, twice as long as wide.

Pronotum weakly convex, 1.8 times as wide as long, with wide, distinct deep postero-lateral depressions; anterior margin bisinuate, posterior margin almost

straight; lateral margins widely, regularly rounded, posterior angles obtuse-angled, maximum pronotal width at midlength; pronotal sculpture consisting of a simple, fine, network of subpolygonal cells with weakly raised borders, slightly denser on latero-posterior areas; cell bottom strongly micro-sculptured, with distinct central grain; bearing short, erect, golden yellow pronotal pubescence. Scutellum small, finely micro sculptured, pentagonal, as wide as long (Image 1A).

Elytra regularly convex and tapering posteriorly, 2.9 times as long as wide; basal, transverse depressions shallow, not reaching scutellum, humeral callosities small, only weakly projecting beyond elytral outline; elytral epipleura rather wide, parallel-sided, almost reaching elytral apex; lateral preapical serrations very fine, the apex of each elytron broadly rounded; elytral sculpture almost homogeneous, consisting of fine, dense, simple punctures with small erect golden pubescence; apex of elytra weakly dentate (Image 2A, 2C).

Ventral surface lustrous with finely ocellate sculpture, cell borders weakly raised; abdominal ventrites almost glabrous; prosternal process wide, subparallel, with well-developed and acute lateral angles; anal ventrite weakly truncate apically, slightly angulate and rather strongly serrate laterally (Image 2B). Legs long and slender, protibiae weakly curved, meso- and metatibiae straight, with dense hispid bristles externally (Image 2E); tarsal claws delicate, hook-shaped, not enlarged at base.

Aedeagus long, slender, weakly spindle-shaped, dorso-ventrally flattened, and the median lobe sharply

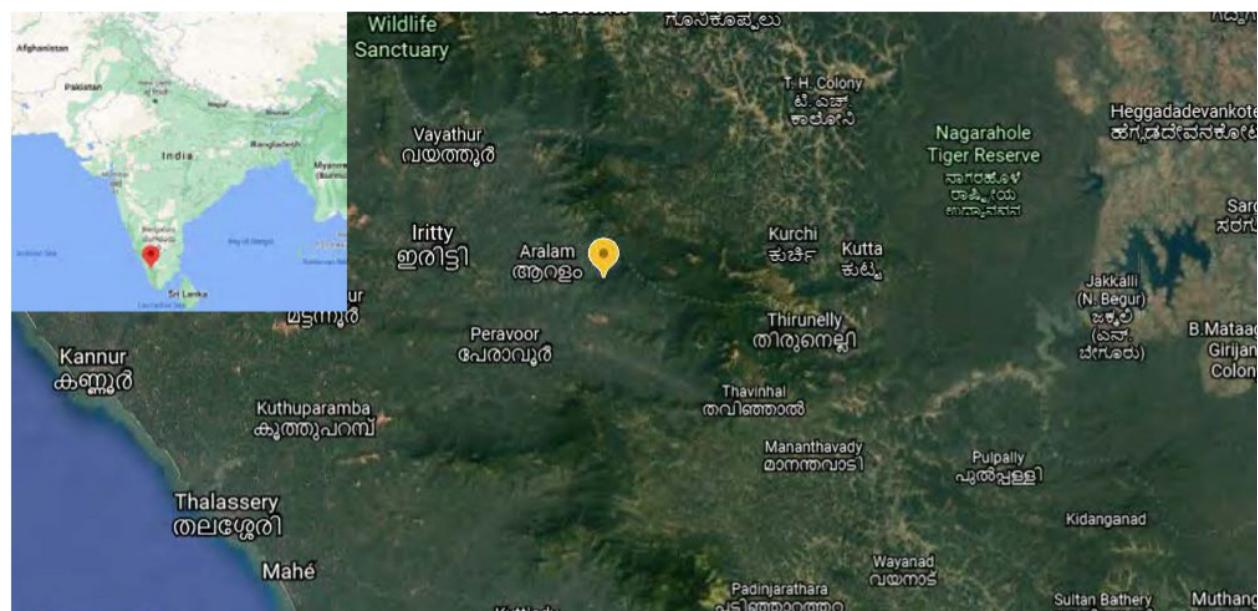


Image 1. Aralam Wildlife Sanctuary with Holotype collection locality (yellow mark).

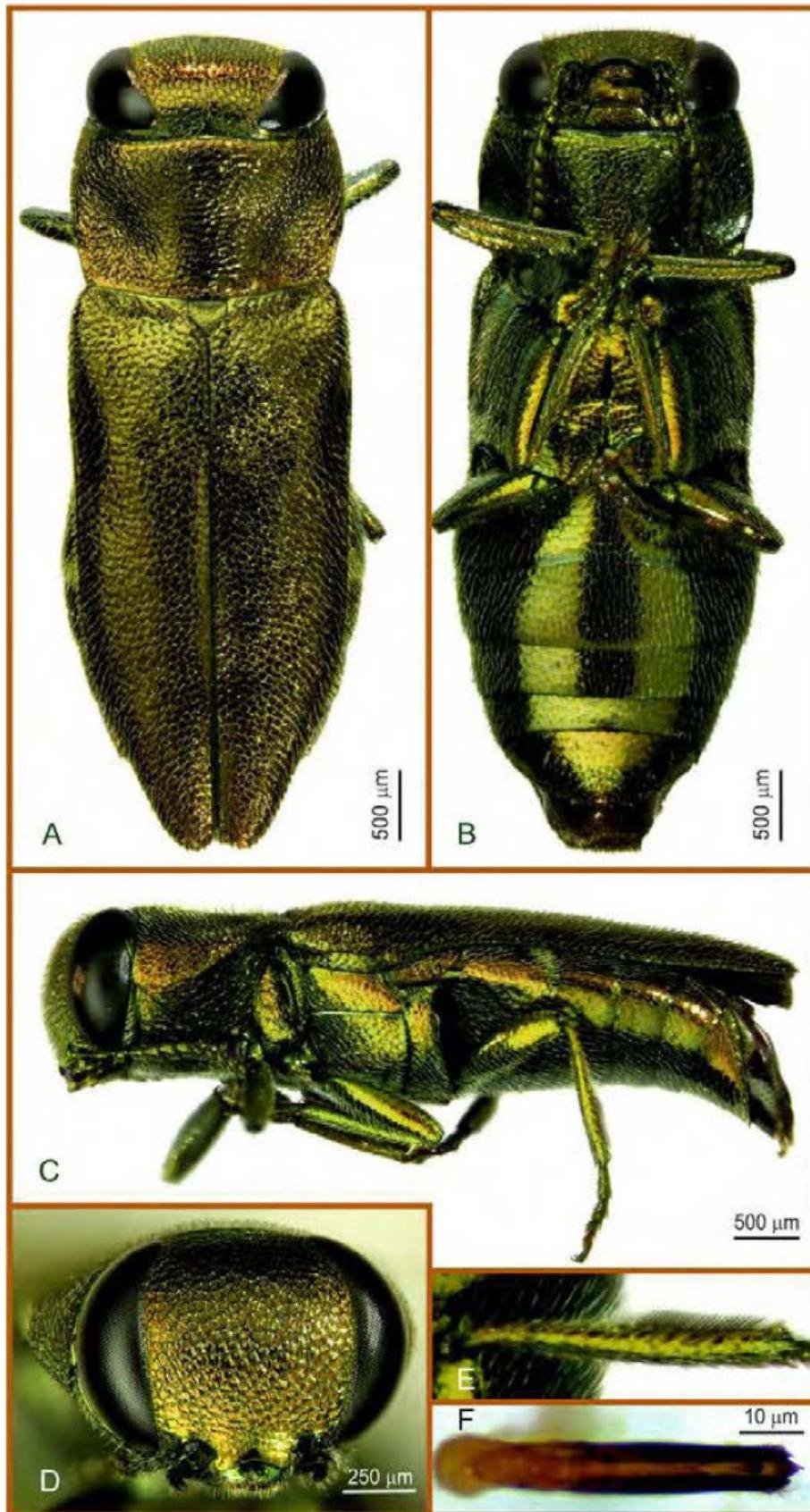


Image 2. *Anthaxia (Haplanthaxia) keralensis* sp. nov. holotype DZUC BLAK001 (male): A—dorsal aspect | B—ventral aspect | C—lateral view | D—frontal aspect of head | E—Metatibia | F—Aedeagus. © Y. Shibu Vardhanan.

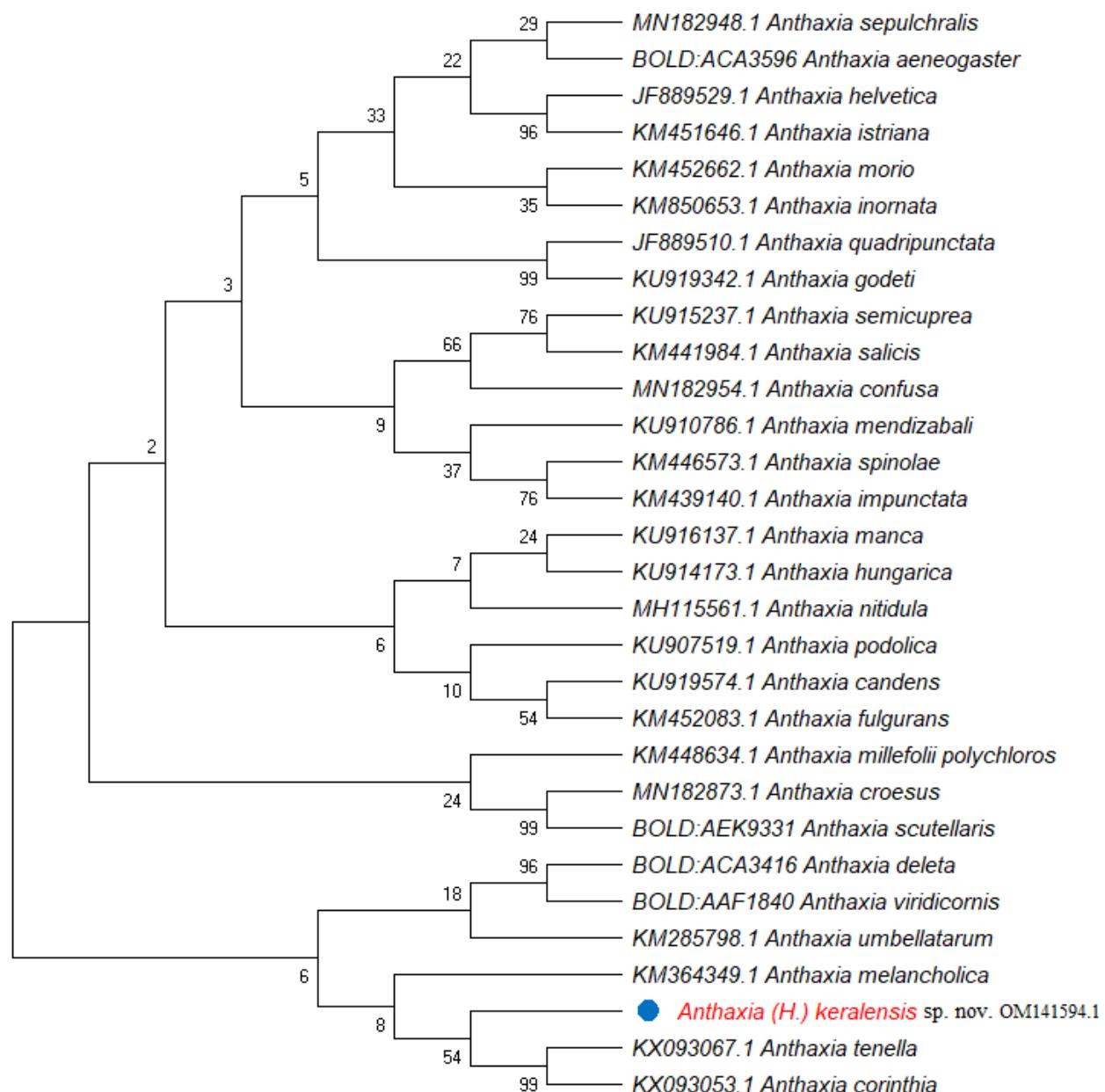


Figure 1. Maximum-likelihood phylogeny analysis. Red color indicated new species *Anthaxia (Haplanthaxia) keralensis* sp. nov. MUSCLE alignment, 1,000 bootstrap, developed in MEGA X.

pointed apically (Image 2F).

Female: unknown.

Etymology: The new species is named after the Indian state Kerala where the holotype was collected.

Distribution: India, Kerala State, known only from the type locality.

Differential diagnosis: This species is similar to *A. marshalli* Stebbing, 1914 and *A. (H.) tanjorensis* Obenberger, 1938 by size and general habitus but it distinguishes by its setose body, uniformly distributed golden yellow short erect pubescence, tomentum on

the lateral side of 1st ventrite (Image 2C), and aedeagus shape (Image 2F). *A. (H.) keralensis* sp. nov. is easily distinguished from *A. (H.) tanjorensis* Obenberger, 1938 by its pronotal sculpture, since *A. (H.) keralensis* sp. nov. has a pronotal sculpture usually regularly polygonal on the whole pronotal surface, but in longitudinally stretched on discal area as in *A. (H.) tanjorensis*.

Molecular phylogeny analysis

A total of 29 mt.CO1 barcoding sequences of the genus *Anthaxia* available in NCBI and BOLD database.

In the ML phylogenetic analysis (Figure 1), the tree divides into two major clades, one clade containing seven species and the other clade containing 23 species. *Anthaxia (H.) keralensis* sp. nov. (OM141594.1) is positioned in a distinct clade. *A. (H.) keralensis* sp. nov. and *A. melancholica* diverged from the same hypothetical ancestor node. *A. (H.) keralensis* sp. nov. showed a molecular relationship (~48% of similarity) with *A. melancholica*, *A. tenella*, and *A. corinthia*. The resulted molecular phylogeny of *Anthaxia* has a strongly preliminary character because all main clades and subclades have very low nodal support. Basal clade which includes new species, is formed by representatives of the subgenera *Haplanthaxia* (*A. deleta* [= *A. caseyi*] - *A. melancholica*) and *Melanthaxia* (*A. tenella* and *A. corinthia*). In the same time all other species of subgenus *Melanthaxia* form a monophyletic most distant subclade (*A. sepulchralis* - *A. godeti*). Intermediate subclades are also mainly polyphyletic and include representatives of subgenera *Anthaxia* s. str., *Haplanthaxia* and *Cratomerus*. Only basal subclade of the second clade comprises species of *Haplanthaxia*. It's important to remember that one of the factors contributing to the preliminary uncorrelated relationship of some *Anthaxia* spp. was a lack of data in genebanks. For the purpose of studying the molecular phylogenetic link among the *Anthaxia*, multilocus-based gene barcoding and the development of phylogenies with extremely comparable taxa will be helpful. More molecular and morphological systematic studies are required to understand the phylogenetic relationship among the *Anthaxia* spp.

CONCLUSION

The lack of proper revision of species from the Indian subcontinent and the high degree of morphological variability in the *A. winkleri* species group are significant impediments in assigning and describing a new species from India. The lack of appropriate molecular barcode sequences in GenBank databases makes mt. CO1 barcoding ineffective for species identification at the moment. Nevertheless, we can use the barcode for molecular phylogeny and genetic similarity analysis. *A. (H.) keralensis* sp. nov. showed no close similarity with previously studied *Anthaxia* spp. A multiple gene sequencing studies are required to confirm the species group belonging of newly described species and to build the molecular phylogeny and their evolutionary origin of the genus *Anthaxia*.

REFERENCES

Ashfaq, M. & P.D.N. Herbert (2016). DNA barcodes for bio-surveillance: regulated and economically important arthropod plant pests. *Genome* 59: 933–945. <https://doi.org/10.1139/gen-2016-0024>

Bellamy, C.L (2008). A world catalogue and bibliography of the jewel beetles (Coleoptera: Buprestoidea). Vol. 3. *Buprestinae: Pterobothrini through Agrilinae: Rhaeboscelina*. Pensoft series Faunistica No. 78. Sofia-Moscow: Penssoft Publisheres, 1338–1495 pp.

Bílý, S. (2017). A new species-group of the genus *Anthaxia* (*Haplanthaxia*) from south-eastern Asia, with descriptions of two new species (Coleoptera: Buprestidae: Anthaxiini). *Acta Entomologica Musei Nationalis Pragae* 57(1): 145–152. <https://doi.org/10.1515/aemnp-2017-0063>

Bílý, S. (2019). Subgeneric classification of the genus *Anthaxia* Eschscholtz, 1829 (Coleoptera: Buprestidae: Anthaxiini). *Zootaxa* 4568(2): 261–278. <https://doi.org/10.11646/zootaxa.4568.2.3>

Bílý, S. (2020). A revision of the *Anthaxia* (*Haplanthaxia*) *dispar* Kerremans species-group (Coleoptera: Buprestidae: Anthaxiini). *Zootaxa* 4851 (3): 522–534. <https://doi.org/10.11646/zootaxa.4851.3.4>

Felsenstein, J. (1985). Confidence limits on phylogenies: An approach using the bootstrap. *Evolution*. 39: 783–791.

Harris, R.A. (1979). A glossary of surface sculpturing. *Occasional papers in Entomology. State of California. Department of Food and Agriculture* 28: 1–31.

Herbert, P.D.N., E.H. Penton, J.M. Burns, D.H. Janzen & W. Hallwachs (2004). Ten species in one: DNA barcoding reveals cryptic diversity in the neotropical skipper butterfly *Astraptes fulgerator*. *PNAS* 101: 14812–14817. <https://doi.org/10.1073/pnas.0406166101>

Herbert, P.D.N., S. Ratnasingham & R.R. deWaard (2003). Barcoding animal life: cytochrome c oxidase subunit 1 divergences among closely related species. *Proceeding Royal Society of London B: Biological Sciences* 270: 96–99. <https://doi.org/10.1098/rsbl.2003.0025>

Kelnarova, I., E. Jendek, V.V. Grebennikov & L. Bocak (2018). First molecular phylogeny of *Agrilus* (Coleoptera: Buprestidae), the largest genus on Earth, with DNA barcode database for forestry pest diagnostics. *Bulletin of Entomological Research* 109(2): 1–12. <https://doi.org/10.1017/S0007485318000330>

Kubáň, V. (2016). Catalogue. Buprestidae: Buprestinae: Actenodini, Anthaxiini. In: Löbl, I., Löbl, D., editors. *Catalogue of Palaearctic coleoptera. Vol. 3. Scarabaeoidea – Scirtoidea – Dasilloidea – Buprestoidea – Byrrhoidea*. Leiden, Boston: Brill, 494–5143 pp.

Kumar, S., G. Stevher, M. Li, C. Knyaz & K. Tamura (2018). MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and Evolution* 35: 1547–1549. <https://doi.org/10.1093/molbev/msy096>

Nei, M. & S. Kumar (2000). *Molecular Evolution and Phylogenetics*. Oxford University Press, New York, xiii+329 pp.

Riedel, A., K. Sagata, S. Surbakti, T. Rene & M. Balke (2013a). One hundred and one new species of *Trigonopterus* weevils from New Guinea. *Zookeys* 280: 1–150. <https://doi.org/10.3897/zookeys.280.3906>

Riedel, A., K. Sagata, Y.R. Suhardjono, R. Tänzler & M. Balke (2013b). Integrative taxonomy on the fast track-towards more sustainability in biodiversity research. *Frontiers in Zoology* 10(15). <https://doi.org/10.1186/1742-9994-10-15>

Sanger, F. & A.R. Coulson (1975). A rapid method for determining sequences in DNA by primed synthesis with DNA polymerase. *Journal of Molecular Biology* 94(3): 441–446. [https://doi.org/10.1016/0022-2836\(75\)90213-2](https://doi.org/10.1016/0022-2836(75)90213-2)

Wilson, J.J (2012). DNA barcodes for insects. *Methods in Molecular Biology* 858: 17–46. https://doi.org/10.1007/978-1-61779-591-6_3



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. Karen 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 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 Sondi, 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. Lional 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. Karen 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. Priyadarshan 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. Priyadarshan 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 Dhabi, UAE.

Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey

Prof. Chandrashekher U. Rironker, 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, Zootaxa, and Biological 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, 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 Sundev, Professor of Ornithology, Ulaanbaatar, Mongolia

Prof. Reuven Yosef, International Birding & Research Centre, Eilat, Israel

Dr. Taej Munduk, Wetlands International, Wageningen, The Netherlands

Dr. Carol Inskip, Bishop Auckland Co., Durham, UK

Dr. Tim Inskip, 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. Kumar, 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, 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. Manda 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 Hellenn 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 paucity 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, 5th 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. All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](#) 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.

www.threatenedtaxa.org

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

August 2023 | Vol. 15 | No. 8 | Pages: 23631–23826

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

DOI: 10.11609/jott.2023.15.8.23631-23836

Articles

Group densities of endangered small apes (Hylobatidae) in two adjacent forest reserves in Merapoh, Pahang, Malaysia

– Adilah Suhailin Kamaruzaman, Nurul Iza Adriana Mohd Rameli, Susan Lappan, Thad Quincy Bartlett, Nik Rosely Nik Fadzly, Mohd Sah Shahru Anuar & Nadine Ruppert, Pp. 23631–23640

Population demography of the Blackbuck *Antilope cervicapra* (Cetartiodactyla: Bovidae) at Point Calimere Wildlife Sanctuary, India

– Subhasish Arandhara, Selvaraj Sathishkumar, Sourav Gupta & Nagarajan Baskaran, Pp. 23641–23652

Communications

Camera trap surveys reveal a wildlife haven: mammal communities in a tropical forest adjacent to a coal mining landscape in India

– Nimaan Charan Palei, Bhakta Padarbinda Rath, Himanshu Shekhar Palei & Arun Kumar Mishra, Pp. 23653–23661

Observations of Gray Fox *Urocyon cinereoargenteus* (Schreber, 1775) (Mammalia: Carnivora: Canidae) denning behavior in New Hampshire, USA

– Maximilian L. Allen & Jacob P. Kritzer, Pp. 23662–23668

Historical and contemporary perpetuation of assumed occurrence reports of two species of bats in Rajasthan, India

– Dharmendra Khandal, Ishan Dhar & Shyamkant S. Talmale, Pp. 23669–23674

Preference of *Helopsaltes pleskei* (Taczanowski, 1890) (Aves: Passeriformes: Locustellidae) on uninhabited islets (Chengdo, Jikgudo, and Heukgeomdo) in South Korea as breeding sites

– Young-Hun Jeong, Sung-Hwan Choi, Seon-Mi Park, Jun-Won Lee & Hong-Shik Oh, Pp. 23675–23680

Avifaunal diversity of Tsirang District with a new country record for Bhutan

– Gyeltshen, Sangay Chhophel, Karma Wangda, Kinley, Tshering Penjor & Karma Dorji, Pp. 23681–23695

Importance of conserving a critical wintering ground for shorebirds in the Valinokkam Lagoon—a first study of the avifaunal distribution of the southeastern coast of India

– H. Byju, N. Raveendran, S. Ravichandran & R. Kishore, Pp. 23696–23709

Diversity and conservation status of avifauna in the Surguja region, Chhattisgarh, India

– A.M.K. Bharos, Anurag Vishwakarma, Akhilesh Bharos & Ravi Naidu, Pp. 23710–23728

Seasonal variation and habitat role in distribution and activity patterns of Red-wattled Lapwing *Vanellus indicus* (Boddaert, 1783) (Aves: Charadriiformes: Charadriidae) in Udaipur, Rajasthan, India

– Sahil Gupta & Kanan Saxena, Pp. 23729–23741

Notes on nesting behavior of Yellow-footed Green Pigeon *Treron phoenicopterus* (Latham, 1790) in Aligarh Muslim University campus and its surroundings, Uttar Pradesh, India

– Ayesha Mohammad Maslehuddin & Satish Kumar, Pp. 23742–23749

Observations on cooperative fishing, use of bait for hunting, propensity for marigold flowers and sentient behaviour in Mugger Crocodiles *Crocodylus palustris* (Lesson, 1831) of river Savitri at Mahad, Maharashtra, India
– Utkarsha M. Chavan & Manoj R. Borkar, Pp. 23750–23762

Communal egg-laying by the Frontier Bow-fingered Gecko *Altiphylax stoliczkai* (Steindachner, 1867) in Ladakh, India
– Dimpi A. Patel, Chinnasamy Ramesh, Sunetro Ghosal & Pankaj Raina, Pp. 23763–23770

Description of a new species of the genus *Anthaxia* (Haplanthaxia Reitter, 1911) from India with molecular barcoding and phylogenetic analysis
– S. Seena, P.P. Anand & Y. Shibu Vardhanan, Pp. 23771–23777

Odonata diversity in the Egra and its adjoining blocks of Purba Medinipur District, West Bengal, India
– Tarak Samanta, Asim Giri, Lina Chatterjee & Arjan Basu Roy, Pp. 23778–23785

Morpho-anatomy and habitat characteristics of *Xanthostemon verdugonianus* Náves ex Fern.-Vill. (Myrtaceae), a threatened and endemic species in the Philippines
– Jess H. Jumawan, Arlyn Jane M. Sinogbuhan, Angie A. Abucayon & Princess Ansie T. Taperla, Pp. 23786–23798

The epiphytic pteridophyte flora of Cooch Behar District of West Bengal, India, and its ethnomedicinal value
– Aninda Mandal, Pp. 23799–23804

Seed germination and storage conditions of *Ilex embeloides* Hook.f. (Magnoliopsida: Aquifoliaceae), a threatened northeastern Indian species
– Leoris Malngiang, Krishna Upadhyaya & Hiranjit Choudhury, Pp. 23805–23811

Short Communications

Mantispa indica Westwood, 1852 (Neuroptera: Mantispidae), a rare species with some morphological notes from Assam, India
– Kushal Choudhury, Pp. 23812–23816

Notes

Auto-fellatio behaviour observed in the Indian Palm Squirrel *Funambulus palmarum* (Linnaeus, 1766)
– Anbazhagan Abinesh, C.S. Vishnu & Chinnasamy Ramesh, Pp. 23817–23818

A novel anti-predatory mechanism in *Indrella ampulla* (Gastropoda: Ariophantidae)
– Karunakar Majhi, Maitreya Sil & Aniruddha Datta-Roy, Pp. 23819–23821

Hedychium coccineum Buch.-Ham. ex Sm. (Zingiberaceae): an addition to the flora of Andhra Pradesh, India
– P. Janaki Rao, J. Prakasa Rao & S.B. Padal, Pp. 23822–23826

Publisher & Host

