

Building evidence for conservation globally

# Journal of Threatened Taxa

10.11609/jott.2025.17.2.26443-26570

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

26 February 2025 (Online & Print)

17(2): 26443-26570

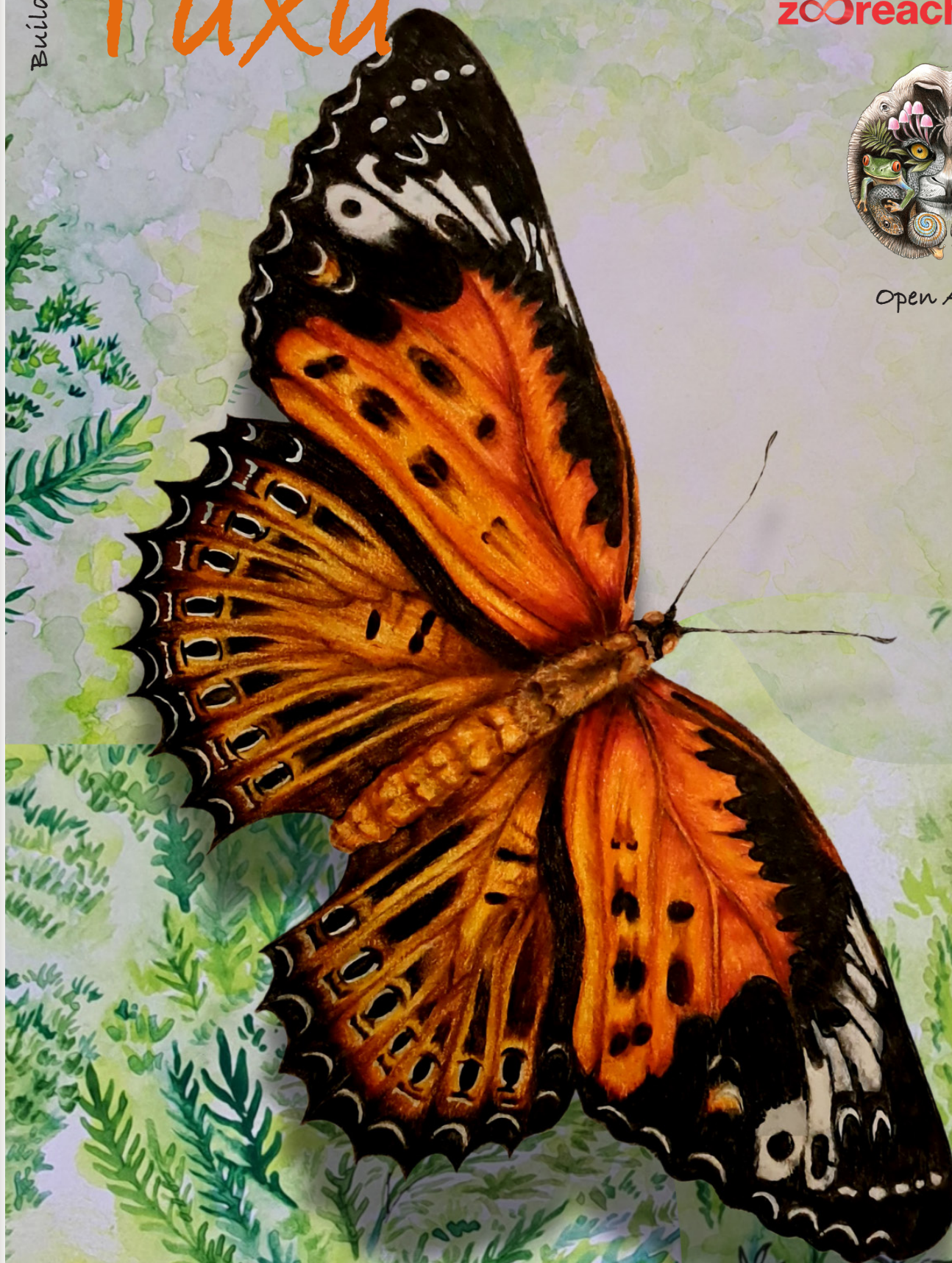
ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)

zooreach@40



Open Access







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

Publisher

**Wildlife Information Liaison Development Society**

[www.wild.zooreach.org](http://www.wild.zooreach.org)

Host

**Zoo Outreach Organization**

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

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

Email: [sanjay@threatenedtaxa.org](mailto:sanjay@threatenedtaxa.org)

#### EDITORS

##### Founder & Chief Editor

**Dr. Sanjay Molur**

Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO), 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, Mavinahalla 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. Karthikeyan, Botanical Survey of India, India

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

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

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

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

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

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

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

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

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

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

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

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

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

##### Invertebrates

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

Dr. D.B. Bastawade, Maharashtra, India

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

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

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

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

Dr. Brian Fisher, California Academy of Sciences, USA

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

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

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

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

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

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

continued on the back inside cover

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



## A report on Conidae (Gastropoda) from the Karnataka coast – distribution and shell morphometry

B.S. Chandan<sup>1</sup> , R. Shyama Prasad Rao<sup>2</sup> & Mohammed S. Mustak<sup>3</sup>

<sup>1,3</sup>Molecular and Genetics Lab, Department of Applied Zoology, Mangalore University, Mangalagangothri, Mangaluru, Karnataka 574199, India.

<sup>2</sup>Center for Bioinformatics, NITTE deemed to be University, Mangaluru, Karnataka 575018, India.

<sup>1</sup>chandugowda.sinu@gmail.com, <sup>2</sup>drsprao@gmail.com, <sup>3</sup>msmustak@gmail.com (corresponding author)

**Abstract:** Conidae are a diverse group of predatory marine gastropods known for their highly potent venom, which may hold potential for biomedical applications. This study presents findings from a survey of Conidae species inhabiting the coastal shorelines of Karnataka. Shell measurements and morphometric analyses were conducted on four species: *Conus biliosus*, *C. inscriptus*, *C. milneedwardsi*, and *Conasprella dictator*. Molecular phylogenetic analysis of *C. biliosus* was performed using the partial mitochondrial cytochrome oxidase subunit I (COI) gene sequence.

**Keywords:** Cone snails, *Conasprella*, *Conus*, Cytochrome oxidase subunit I (COI), marine biodiversity, shell morphometrics, venomous molluscs.

**Kannada:** ಕೊನೊಡೆ ಎಂಬುದು ಪರಭಕ್ಷಕ ಸಮುದ್ರದ ಗೋಪಾಟಕೋಪಾಡಗಳ ವೈವಿಧ್ಯಮಯ ಗುಂಪಾಗಿದ್ದು, ಅವುಗಳ ಅತ್ಯಂತ ಪರಿಣಾಮಕಾರಿ ವಾಷಕ ಹೆಸರುವಾಸಿಯಾಗಿದೆ, ಇದು ಜೈವಿಕ ವೈದ್ಯಕೀಯ ಅನ್ವಯಗಳಿಗೆ ಸಂಭಾವ್ಯತೆಯನ್ನು ಹೊಂದಿರಬಹುದು. ಈ ಅಧ್ಯಯನವು ಕರಾವಳಿ ಕರಾವಳಿ ತೀರಗಳಲ್ಲಿ ವಾಸಿಸುವ ಕೊನೊಡೆ ಪ್ರಭೇದಗಳ ಸಮೀಕ್ಷೆಯ ಫಲಿತಾಂಶಗಳನ್ನು ಪ್ರಸ್ತುತಪಡಿಸುತ್ತದೆ. ಶಂಖದ ಮಾಪನ ಮತ್ತು ಮಾರ್ಫೊಮೆಟ್ರಿಕ್ ವಾಶಲೇಷಣೆಗಳನ್ನು ನಾಲ್ಕು ಪ್ರಭೇದಗಳ ಕೊನಸ್ ಬಿಲಿಯೋಸಸ್, ಕೊನಸ್ ಇನ್‌ಸ್ಕ್ರಿಪ್ಟಸ್, ಕೊನಸ್ ಮಿಲ್‌ನೆಡ್‌ವರ್ಡ್ಸ್ ಮತ್ತು ಕೊನಾಸ್ಪ್ರೆಲ್ಲಾ ಡಿಕ್ಟೇಟರ್ ಮೇಲೆ ನಡೆಸಲಾಯಿತು. ಭಾಗಶಃ ಮೈಟೋಕಾಂಡ್ರಿಯಲ್ ಸೈಟೋಕ್ಸೈಡೇಸ್ ಆಕ್ಸಿಡೇಸ್ ಸಬ್‌ಯುನಿಟ್ I (COI) ಅನುವಂಶಿಕ ಧಾತು ಅನುಕ್ರಮವನ್ನು ಬಳಸಿಕೊಂಡು ಸ್. ಬಿಲಿಯೋಸಸ್‌ನ ಆಣವಿಕ ವೈಲೋಜಿನೆಟಿಕ್ ವಾಶಲೇಷಣೆಯನ್ನು ನಡೆಸಲಾಯಿತು.

**Editor:** J. Benjamin Franklin, Bombay Natural History Society, Mumbai, India.

**Date of publication:** 26 February 2025 (online & print)

**Citation:** Chandan, B.S., R.S.P. Rao & M.S. Mustak (2025). A report on Conidae (Gastropoda) from the Karnataka coast – distribution and shell morphometry. *Journal of Threatened Taxa* 17(2): 26538–26546. <https://doi.org/10.11609/jott.9475.17.2.26538-26546>

**Copyright:** © Chandan et al. 2025. 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:** This work did not receive any specific funding.

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

**Statement of ethics:** The work is in compliance with ethical standards. No animal ethics and bio-safety clearances were necessary.

**Data availability:** The data used in this work are available publicly as given in the tables and supplemental.

**Author details:** B.S. CHANDAN, holds a master degree in Zoology and currently pursuing PhD in Department of Applied Zoology, Mangalore University. Passionate about wildlife ecology and conservation. DR.R. SHYAMA PRASAD RAO, faculty at Center for Bioinformatics, NITTE University, Mangaluru, Karnataka. His area of interest are bioinformatics, computational biology, data analysis. DR.MOHAMMED S. MUSTAK, professor, Department of Applied Zoology, Mangalore University, Mangalagangothri, Karnataka. He is interested in the biodiversity of the cone snail (Mollusca: Conidae) and Lepidoptera diversity in Western Ghats and Lakshadweep archipelago.

**Author contributions:** BSC and MSM planned the work. BSC collected the data. BSC and RSPR analysed the data. BSC drafted the paper and RSPR revised the paper. All authors contributed intellectually, and edited/reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

**Acknowledgements:** Authors thank the Karnataka Forest Department for the permission to visit the study area and collect the samples. BSC thanks Mr. Akshay Jeere, Mr. A. Bharat Kumar, and the Department of Marine Biology, Karnataka University Post Graduate Centre, Karwar for support during the field survey. Authors thank UGC-SAP II Department of Applied Zoology, Mangalore University for the facilities.



## INTRODUCTION

The family Conidae Fleming, 1822 (Dutertre & Lewis 2023) is a widely-distributed species-rich group of marine gastropod molluscs (Rockel et al. 1995). Cone shells are found in all tropical and subtropical oceans, with the Indo-West-Pacific region having the greatest species diversity (Filmer 2001). Studies on the taxonomy and distribution of Conidae in India date back to the latter half of the 19<sup>th</sup> century (Kohn 1978), and recently 76 of the 93 species known from India were reported from the collections of the Zoological Survey of India (Venkitesan et al. 2019). A total of 77 species of Conidae were documented from Indian waters (Kohn 1978). Regionally, 60 species were documented from Tamil Nadu (Franklin et al. 2009), 84 from the Gulf of Mannar and Lakshadweep Islands (Edward et al. 2022), and 46 from the Kerala coast (Ravinesh et al. 2022).

More than 50 species of cone shells have been identified by various researchers from the Andaman & Nicobar Islands (Rao 2003; Venkataraman et al. 2004; Franklin et al. 2013; Franklin & Apte 2021). A total of 78 cone snail species have been documented from the Lakshadweep archipelago (Smith 1894; Hornell 1921; Nagabhushanam & Rao 1972; Appukuttan et al. 1989; Rao & Rao 1991; Ravinesh & Kumar 2015; Edward et al. 2022). More recently, Ravinesh et al. (2018) recorded 49 species from Lakshadweep, including four newly reported species, three of which had not been previously recorded in India.

Until now, there have been no specific reports of *Conus* from the coast of Karnataka, India. This study presents the findings of a Conidae survey conducted in the year 2022–23 across several coastal regions of Karnataka. Field observations documented the regional distribution of four Conidae species, and shell morphometric analyses were carried out. Only one species was observed alive, and its molecular phylogenetic analysis was performed using the partial mitochondrial cytochrome oxidase subunit I (COI) gene sequence.

## MATERIALS AND METHODS

### Sample collection

Field surveys were conducted on accessible beaches across three coastal districts of Karnataka: Dakshina Kannada, Udupi, and Uttara Kannada (Image 1A). Transect and trawl net surveys were carried out along the shorelines in various types of coastal marine

habitats, including intertidal and subtidal sandy bottoms, shallow sandy areas, rocky shorelines, and algae-covered rocks. The frequency of each species in these habitats was recorded (Image 1B). The specimens were collected using the handpicking method. Live specimens of *Conus biliosus* (n = 2) were observed and collected exclusively from rocky shorelines and algae-covered rocks in Karwar, Uttara Kannada District. The identification of collected specimens was based on the shell morphology descriptions (Rocket et al. 1995). Foot tissue from the live specimen was preserved in 90% ethanol for molecular analysis.

### Morphometric analysis

The collected shells were covered with algae, so for easier identification and measurement, they were cleaned using a mixture of commercial liquid bleach ("Rin"), containing nonylphenol ethoxylate, EDTA and sodium xylene sulfonate in water. To preserve the specimens, the surface of the shell was polished with mineral oil. Shell measurements were taken using Vernier Callipers (Kohn & Riggs 1975). The following variables were recorded: weight (W, in grams), shell length (SL), maximum diameter (MD), height of maximum diameter (HMD), aperture height (AH), aperture length (AL), aperture width (AW), height of penultimate whorl (HPW), and spire height (SH) (Fig. S1). All linear measurements were recorded in millimetres (mm).

### DNA extraction and PCR amplification

The foot tissue of *C. biliosus* was used as the source of genetic material and DNA was isolated from 40 mg of tissue using the CTAB method (Doyle & Doyle 1987) yielding approximately 500 ng/μl in a total volume of 60 μl. The mitochondrial cytochrome oxidase subunit I (COI) gene was amplified using universal primers dgLCO: GGTCAACAAATCATAAAGAYATYGG and dgHCO: TAAACTTCAGGGTGACCAARAAYCA (Folmer et al. 1994). Additionally, 12S1: GGCTTGGCGGTGTTTATAGAC and 12S3: GTGCACGTTTCAGAGCCCTA (Simon et al. 1991), and 16Sar: CGCCTGTTTACCAAAAACAT and 16Sbr: CCGGTCTGAATCAGATCACGT (Palumbi 1996) primers were used to amplify 12S rRNA and 16S rRNA genes. PCR reactions were conducted in a total volume of 30 μl, containing 3 μl DNA, 1.5 μl of each primer, 13.5 μl of Takara master mix, 1.5 μl MgCl<sub>2</sub>, and 9 μl of PCR gradient water. The protocol began with initial amplification reaction that denatured at 94°C for 4 minutes, followed by 35 cycle denaturation for 40 seconds, annealing at 51°C for 40 seconds and extension at 72°C for 1 minute. A final extension step at 72°C for 5 minutes was

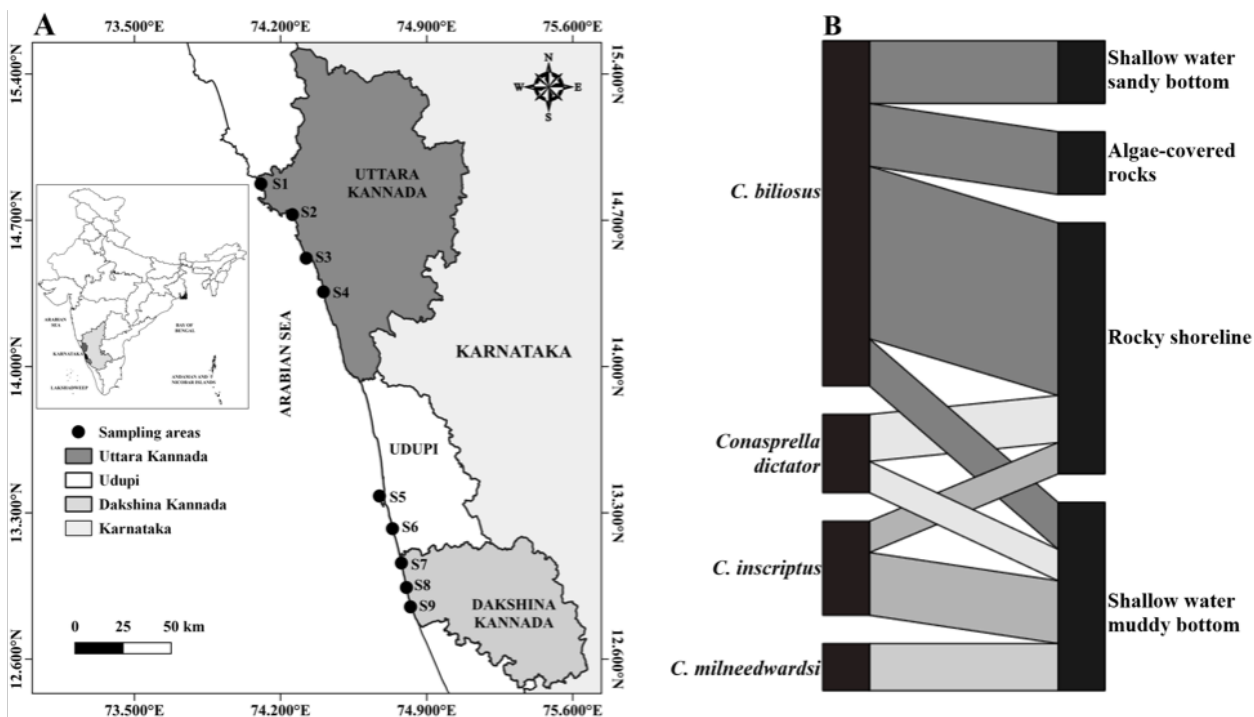


Image 1. Sampling sites (S1–S9) of Conidae in the Karnataka coast. (B) Natural habitat of cone snails collected.

included (Laxmilatha et al. 2021). The genomic DNA concentration and yield of PCR products were quantified using a Nano Drop spectrophotometer (Thermo Fisher Scientific Pvt. Ltd.) and assessed qualitatively using 0.8% agarose gel electrophoresis for DNA and 2% acrylamide gel electrophoresis for PCR products.

### Phylogenetic analysis

The amplified PCR products were sequenced using the Sanger sequencing method (Barcode Biosciences). The resulting sequences were compared against the NCBI nr database using BLAST, and the top hits corresponding to *C. biliosus* were downloaded. Additionally, sequences of closely related species (*C. shikamai*) and other COI sequences were retrieved for use as an outgroup. Multiple sequence alignment was performed using MUSCLE, and a phylogenetic tree was constructed using the maximum likelihood (ML) method with the Kimura 2-parameter (K2P) model in MEGA7 software (Kumar et al. 2016). Bootstrap analysis was conducted with 1,000 replicates to assess the tree's robustness.

### Data/Statistical analysis:

The morphometric measurements were recorded in a Microsoft Excel spreadsheet and summarized as mean ( $\pm$ standard deviation) along with minimum-maximum values. A Spearman's rank correlation coefficient matrix

of the morphometric variables was generated using the R *corrplot* package (Wei & Simko 2021), and scatter plots of morphometric variables (Raup 1961; Kohn & Riggs 1975) were created in Microsoft Excel. Principal component analysis (PCA) was then performed using the R *ggplot2* package (Wickham 2016).

## RESULTS

### Distribution

Four species were recorded: *Conus biliosus*, *C. inscriptus*, *C. milneedwardsi*, and *Conasprella dictator*; only *C. biliosus* was sampled alive. Altogether, 27 shells, including two live specimens were collected. *Conus milneedwardsi* is listed under Schedule I of the Indian Wildlife (Protection) Act, 1972, Part G: Mollusca (Ravinesh et al. 2019; Samuel et al. 2021).

Based on the sampling data (Image 2A–D), *Conus biliosus*, *C. inscriptus*, and *Conasprella dictator* were observed in the Uttara Kannada and Dakshina Kannada districts, while *C. milneedwardsi* was recorded only in the Udupi District. Sampling of cone shells included several marine habitats. *Conus biliosus* was found in shallow water sandy bottoms and rocky habitats (Image 1B, 2N–Q) with live specimens collected from algae-covered rocks. *Conasprella dictator* and *Conus inscriptus* shells

were found in rocky shoreline areas and shallow muddy bottoms (Image 1B). In contrast, *C. milneedwardsi* shells were collected by trawling in shallow muddy bottoms.

#### Family: Conidae Fleming, 1822

#### Genus: *Conus* Linnaeus, 1758

##### *Conus biliosus* (Röding, 1798)

Method of collection: Handpicking.

Condition: Live specimens (n = 2) and shells (n = 11).

Habitat: Rocky shore and algae-covered rocks.

Description (Image 2A, 2E–M): Shell length approximately ranges from 20 mm to 40 mm, the body is covered with low, wavy spiral ridges that run from shell base to shoulder and spiral growth ridges are frequently visible, but in some shells they are smooth. We observed this species with different shades (Image 2E–M) of orange, brown, brown-black, and pale brown (juvenile).

##### *Conus inscriptus* Reeve, 1843

Method of collection: Trawl bycatch.

Condition: Shells (n = 6).

Habitat: Shallow to subtidal sandy bottom.

Description (Image 2B): Shell length approximately ranges 40–55 mm. Shells are solid with a monotonous finish in a pale brown colour. Anteriorly, spiral grooves present – grooves are wide and contain spiral threads. In the sub-shoulder, bands are usually less noticeable than anterior bands.

##### *Conus milneedwardsi* Jousseaume, 1894

Method of collection: Trawl bycatch.

Condition: Shells (n = 3).

Habitat: Subtidal sandy bottoms.

Description (Image 2C): Shell length approximately ranges 86–136 mm. Shells are reddish-white or brownish-white with prominent reticulated patches and spiral bands.

#### Genus: *Conasprella* Thiele, 1929

##### *Conasprella dictator* (Melvill, 1898)

Method of collection: Handpicking and trawl bycatch.

Condition: Shells (n = 5).

Habitat: Shallow sandy bottoms.

Description (Image 2D): Shell length approximately ranges 25–35 mm. Shell is brownish-cream color, surrounded by distinct, dark-brown to reddish-brown bands, which are particularly prominent on the body whorl.

#### Morphometric analysis

The morphometric data for *C. biliosus* (n = 13), *Conasprella dictator* (n = 5), *C. inscriptus* (n = 6), and *C. milneedwardsi* (n = 3) is given in Table 1.

The Spearman's rank correlation coefficient matrix of the morphometric variables indicated that all variables were positively correlated (Figure 1A), with correlation coefficients ranging from  $\rho = 0.38$  to  $\rho = 0.99$ . The scatter plots of morphometric variables against shell length are shown in Figure 1B–I. The variables such as HMD ( $R^2=0.994$ ) and AL ( $R^2 = 0.987$ ) exhibited excellent predictability in relation to shell length. Some variables, such as AW and HPW appeared to be more species-specific as *C. milneedwardsi* samples deviated from the general trend. HPW demonstrated the lowest predictability with respect to shell length among and within species.

A PCA (Figure 2) biplot of morphometric measurements explained 75.6% of the variance in PC1 and 15.5% in PC2. The samples from all four species formed distinct clusters, though the *Conasprella dictator* cluster overlapped with that of *C. biliosus*. As indicated by the lower variability of morphometric measurements (Table 1), *Conasprella dictator* was less spread compared to the other species in the PCA biplot. The variables projected onto the biplot revealed that SL, MD, and

**Table 1. The morphometric measurements of the collected cone shells.**

Variables	<i>C. biliosus</i> (n = 13) Mean (±SD) Min–Max	<i>Conasprella</i> <i>dictator</i> (n = 5) Mean (±SD) Min–Max	<i>C. inscriptus</i> (n = 6) Mean (±SD) Min–Max	<i>C. milneedwardsi</i> (n = 3) Mean (±SD) Min–Max
W	4.2 (2.3) 1.3–8.4	2.1 (0.7) 1.4–3.3	10.7 (3.6) 6.8–15.3	41.1 (21.8) 17.7–60.8
SL	28.2 (7.2) 19.1–41.2	29.1 (4.2) 25–35.5	48.8 (5.5) 41.9–54.6	114.7 (25.8) 86–136
MD	17.2 (3.7) 11.2–22.6	13.6 (1.9) 12.1–16.9	24.2 (3.4) 20.3–27.8	38.0 (12.5) 24–48
HMD	19.8 (6.0) 12.7–32.3	20.1 (2.8) 17.8–24.7	36.3 (4.9) 29.2–41.2	72.4 (16.0) 54.1–84
AH	25.5 (6.4) 16.7–35.5	23.1 (2.5) 21–27	39.3 (4.8) 34.8–45.8	76.7 (14.4) 60.1–86
AL	23.0 (6.3) 14.1–32	21.8 (2.6) 19.7–26	39.4 (5.6) 33–45.3	74.7 (16.3) 55.9–85.2
AW	3.2 (1.0) 1.8–4.9	3.0 (1.1) 1.9–4.4	5.0 (0.7) 4.1–5.8	4.2 (0.4) 3.8–4.5
HPW	1.4 (0.4) 0.7–2.3	1.3 (0.4) 0.6–1.9	3.7 (1.4) 2.2–6.0	2.2 (0.2) 2.0–2.3
SH	3.5 (1.1) 2.5–6.1	13.8 (6.3) 6.7–20.0	8.7 (1.0) 7.2–9.9	31.7 (4.1) 27.2–35

Abbreviations: W—Weight | SL—Shell length | MD—Maximum diameter | HMD—Height of maximum diameter | AH—Aperture height | AL—Aperture length | AW—Aperture width | HPW—Height of penultimate whorl | SH—Spire height. The measurements/values for W are in grams, and all others are in millimeter.



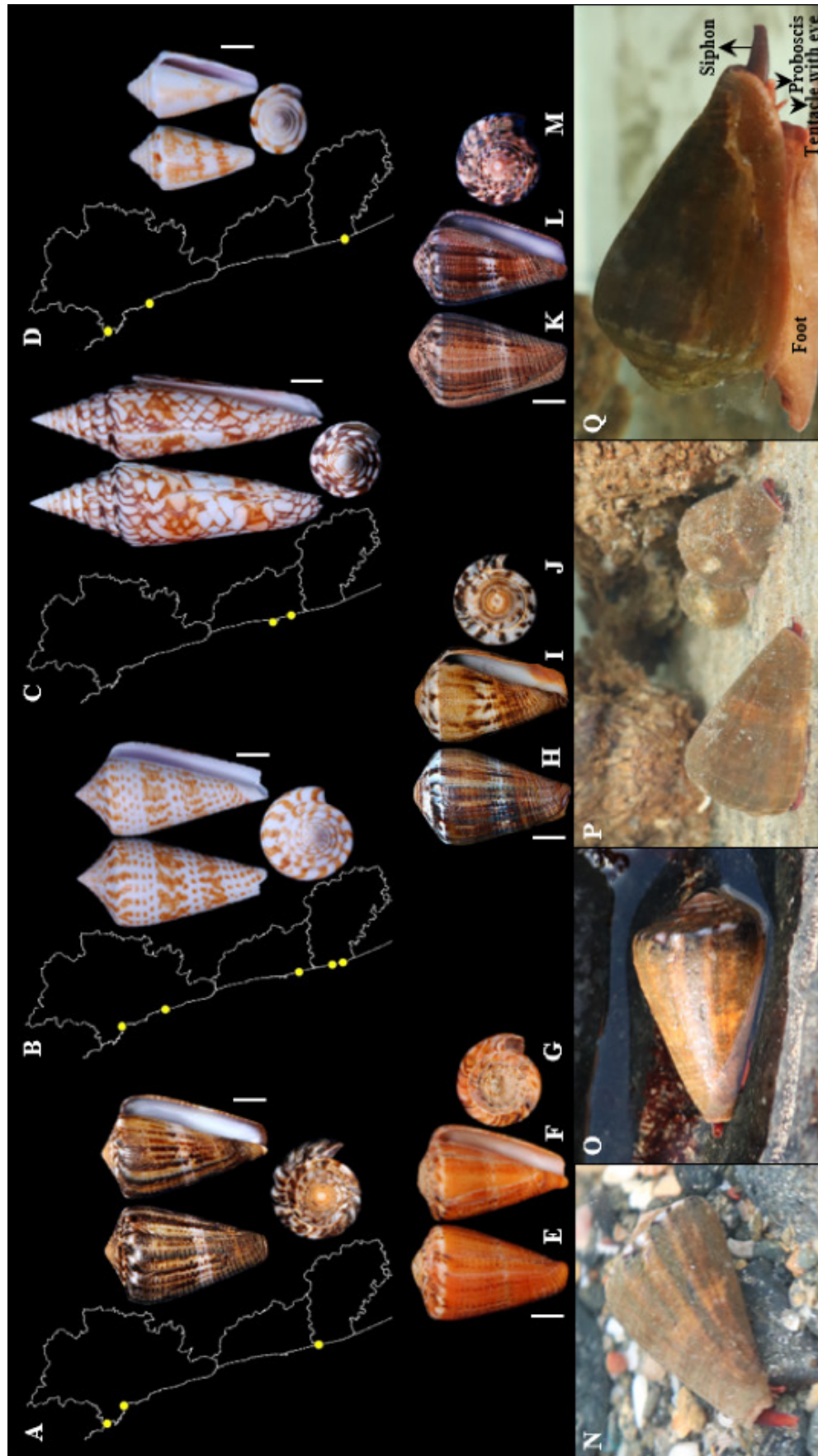


Image 2. Distribution (locality data) of Conidae in the Karnataka coast. (A) *C. biliosus*, (B) *C. inscriptus*, (C) *C. milneedwardsi*, and (D) *Conasprella dictator*. (E-M) Colour morphs in *C. biliosus*. (A-M) Dorsal, ventral, and top views of cone snail species. Scale bar is 1 cm. (N-O) *C. biliosus* in the natural habitat. (P-Q) *C. biliosus* in aquarium. © B S Chandan.

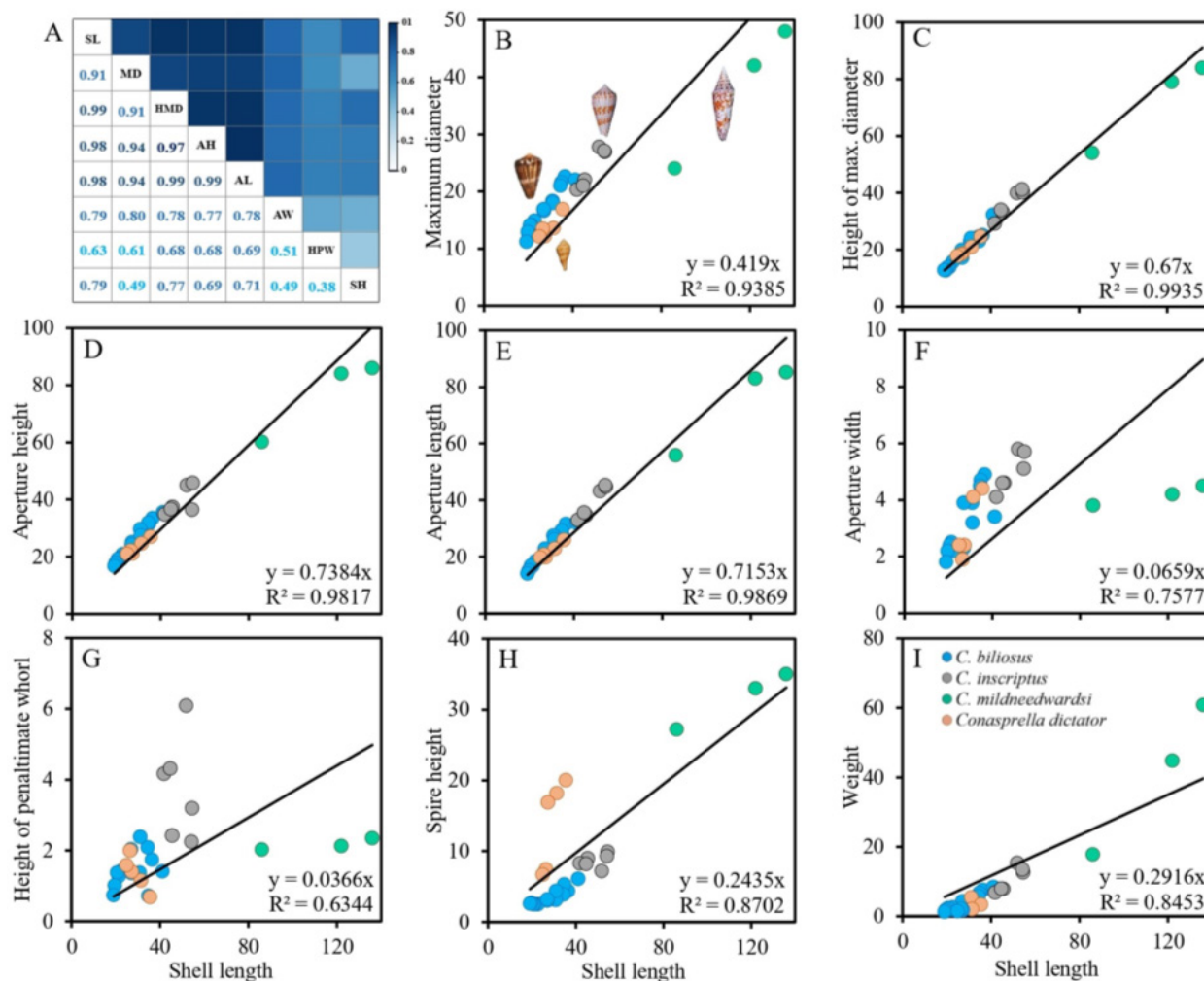


Figure 1. (A) The Spearman's rank correlation coefficient matrix of morphometric variables. (B-I) Scatter plots of various shell measurements (all in mm, except weight which is in g) against the shell length (in mm). Abbreviations: AH - aperture height, SL - shell length, MD - maximum diameter, HMD - height of maximum diameter, AL - aperture length, AW - aperture width, APW - height of penultimate whorl, and SH - spire height.

other factors primarily contributed to PC1, as evident by the spread of long-shelled *C. milneedwardsi* along PC1. The variables HPW, AW and SH primarily contributed to PC2.

### Phylogeny of *C. biliosus*

The mitochondrial COI sequences from two *C. biliosus* samples were obtained and submitted to NCBI (supplemental information). The phylogenetic tree based on these COI sequences revealed that *C. biliosus* samples (PQ390234 and PQ392002) from Karnataka were distinct, but clustered within the same clade of other *C. biliosus* (KJ549870.1 and KJ550138.1) from Indo-West-Pacific region (Puillandre et al. 2014) (Figure 3). The *C. shikamai* and other species formed a clear outgroup. Since COI sequences were found and used

widely for cone snail databases, 12S rRNA and 16S rRNA sequences were not included in the analysis.

### DISCUSSION

This study documents four species of cone snails: *C. biliosus*, *C. inscriptus*, *C. milneedwardsi*, and *Conasprella dictator* from the Karnataka coast. While Conidae species generally share a similar shell shape (Rockel et al. 1995), morphometric measurements are widely used as distinguishing features between species. The ranges of values observed in this study are consistent with previous records of morphometric measurements for cone shells of the corresponding species from the Indo-Pacific region (Rockel et al. 1995), Lakshadweep



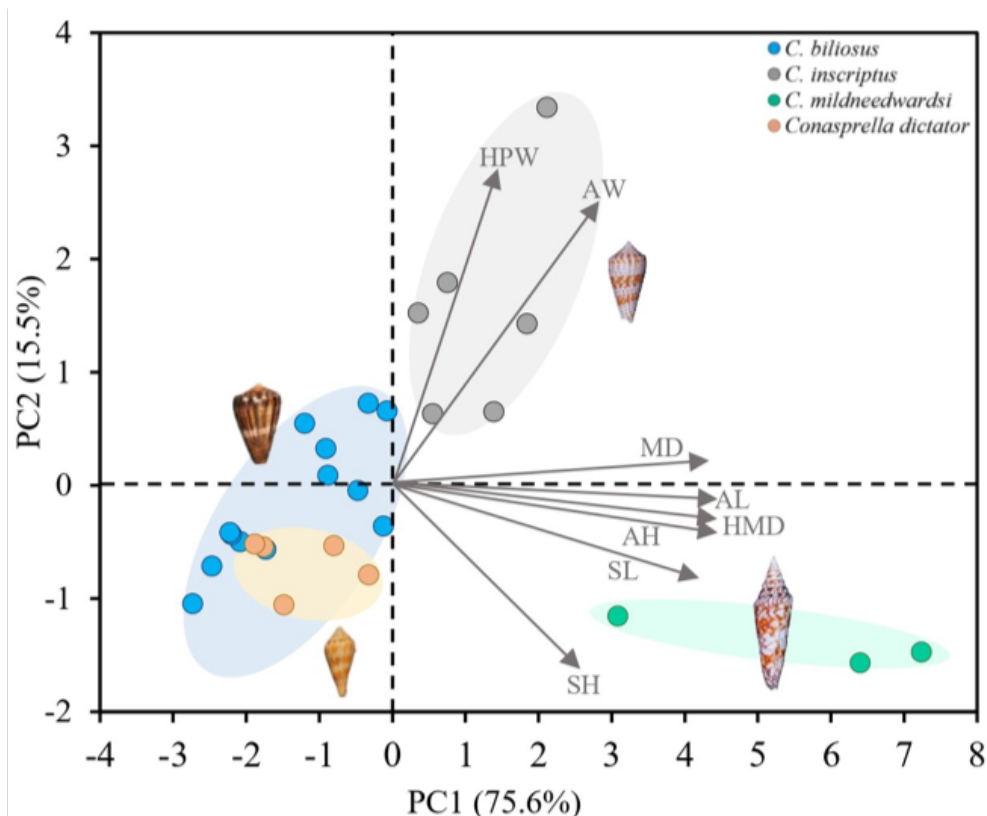


Figure 2. PCA biplot of Conidae species based on morphometric variables. Groups based on species. The arrows indicate the relationships of the variables with species group.

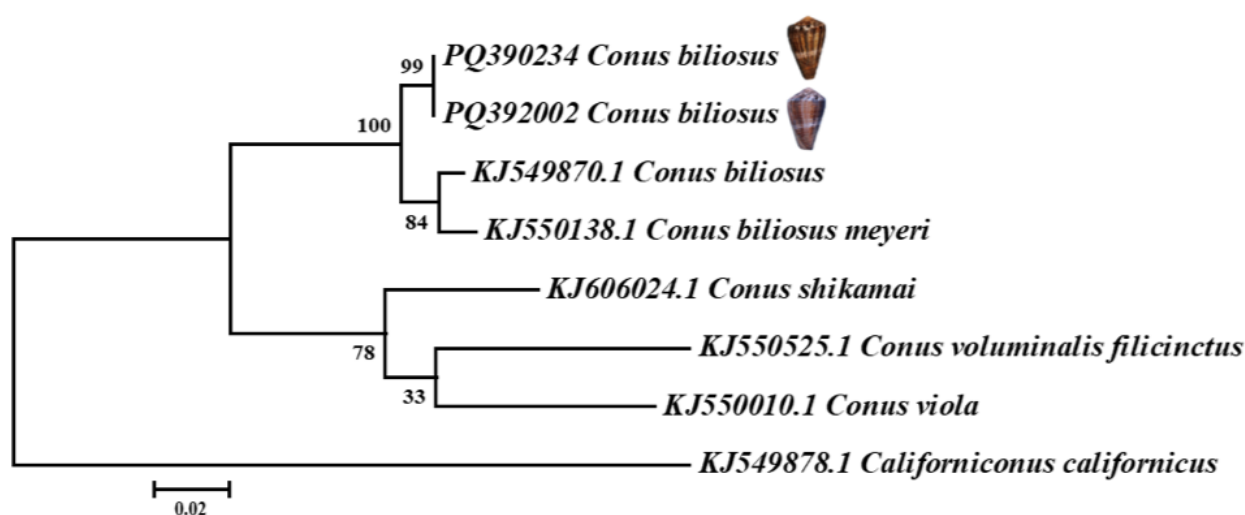


Figure 3. Maximum likelihood (ML) based phylogenetic tree of *C. biliosus* using partial mitochondrial COI gene sequences. The *C. shikamai* and others were used as the out group. Numbers next to nodes indicate percentage bootstrap values based on 1000 iterations. Scale bar indicates the number of substitutions per site.

(Ravinesh et al. 2018), Tamil Nadu (Venkitesan et al. 2019), and Kerala (Ravinesh et al. 2022).

The phylogenetic analysis based on mitochondrial COI sequences of live *C. biliosus* specimens collected in

this study placed them in a monophyletic group with *C. biliosus meyeri*, a southern subspecies found in Indian marine habitats (Puillandre et al. 2014).

This pilot study on the previously unexplored

Karnataka coast may inspire researchers to conduct more intensive surveys and acquire accurate data on habitat and distribution of cone snails of the Karnataka coast.

## REFERENCES

- Appukkuttan, K.K., A. Chellam & A.K. Ramdoss (1989). Molluscan resources. In: Suseelan, C. (Ed.), *Marine living resources of the union territory of Lakshadweep: An indicative survey with suggestions for development*. CMFRI Bulletin 43: 77–92.
- Doyle, J.J. & J.L. Doyle (1987). A rapid DNA isolation procedure for small quantities of fresh leaf tissue. *Phytochemical Bulletin* 19: 11–15.
- Dutertre, S. & R.J. Lewis (2013). Cone snail biology, bioprospecting and conservation, fhal-02306901f, pp. 1–15. In: Hämäläinen, E.M. & Sofia Järvinen (eds.). *Snails: Biology, Ecology, and Conservation*. Nova Science Publishers, New York.
- Edward, J.K.P., R. Ravinesh & A.B. Kumar (2022). The molluscs of Gulf of Mannar, India and adjacent waters: A fully illustrated guide. Suganthi Devadason Marine Research Institute (SDMRI) & Department of Aquatic Biology & Fisheries, Thiruvananthapuram, Kerala, India.
- Filmer, R.M. (2001). A catalogue of nomenclature and taxonomy in the living Conidae. Backhuys Publishers, Leiden, 388 pp.
- Folmer, O., M. Black, W.R. Hoeh, R. Lutz & R.C. Vrijenhoek (1994). DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3: 294–299. [https://doi.org/10.1016/1050-1738\(94\)90029-9](https://doi.org/10.1016/1050-1738(94)90029-9)
- Franklin, J.B., K.A. Subramanian, S.A. Fernando & K.S. Krishnan (2009). Diversity and distribution of Conidae from the Tamil Nadu coast of India (Mollusca: Caenogastropoda: Conidae). *Zootaxa* 2250: 1–63. <https://doi.org/10.11646/zootaxa.2250.1.1>
- Franklin, J.B., P. Venkateshwaran, N.V. Vinithkumar & R. Kirubakaran (2013). Four new records of Conidae (Mollusca: Caenogastropoda) from the Andaman Islands, India. *Zootaxa* 3635: 81–86. <https://doi.org/10.11646/zootaxa.3635.1.8>
- Franklin, J.B. & D.A. Apte (2021). Three new distribution records of Conidae (Gastropoda: Neogastropoda: Conoidea) from the Andaman Islands, India. *Journal of Threatened Taxa* 13: 18378–18384. <https://doi.org/10.11609/jott.6891.13.5.18378-18384>
- Hornell, J. (1921). Common molluscs of South India; Appendix molluscan fauna of the Laccadive islands. *Madras Fisheries Bulletin* 14: 213–215.
- Kohn, A.J. & A.C. Riggs (1975). Morphometry of the *Conus* shell. *Systematic Zoology* 24: 346–359. <https://doi.org/10.1093/sysbio/24.3.346>
- Kohn, A.J. (1978). The Conidae (Mollusca: Gastropoda) of India. *Journal of Natural History* 12: 295–335. <https://doi.org/10.1080/00222937800770171>
- Kumar, S., G. Stecher & K. Tamura (2016). MEGA7: Molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution* 33: 1870–1874. <https://doi.org/10.1093/molbev/msw054>
- Laxmilatha, P., S. Ameri, K.A. Labeeb, K.V. Chaitanya & V.N. Varma (2021). A new species of cone snail, *Conus laccadivensis* sp. nov.: (Gastropoda: Conidae) from the Islands of Lakshadweep Archipelago. *Regional Studies in Marine Science* 44: 101783. <https://doi.org/10.1016/j.rsma.2021.101783>
- Nagabhushanam, A.K. & G.C. Rao (1972). An ecological survey of the marine fauna of Minicoy Atoll (Laccadive Archipelago, Arabian Sea). *Mitteilungen Aus Dem Museum Für Naturkunde in Berlin. Zoologisches Museum Und Institut Für Spezielle Zoologie (Berlin)* 48: 265–324. <https://doi.org/10.1002/mmzn.19720480203>
- Palumbi, S.R. (1996). The polymerase chain reaction, pp. 205–247. In: Hillis, D.M., C. Moritz & B.K. Mable (eds.). *Molecular Systematics*, 2nd edition. Sinauer, Sunderland, Massachusetts.
- Puillandre, N., P. Bouchet, Jr. T.F. Duda, Y.I. Kantor, A.V. Sysoev & C. Meyer (2014). Molecular phylogeny and evolution of the cone snails (Gastropoda, Conoidea). *Molecular Phylogenetics and Evolution* 78: 290–303. <https://doi.org/10.1016/j.ympev.2014.05.023>
- Rao, K.V. & N.V. Rao (1991). Mollusca, pp. 273–362. In: Ghosh, A.K. & A. Kumar (eds.). *State fauna series 2. Fauna of Lakshadweep*. Zoological Survey of India.
- Rao, N.V.S. (2003). *Indian Sea Shells (Part 1). Polyplacophora and Gastropoda*. Records of the Zoological Survey of India, Kolkata, 416 pp.
- Raup, D.M. (1961). The geometry of coiling in gastropods. *Proceedings of the National Academy of Sciences* 47: 602–609. <https://doi.org/10.1073/pnas.47.4.602>
- Ravinesh, R. & A.B. Kumar (2015). A checklist of the marine molluscs of Lakshadweep, India. *Journal of Aquatic Biology & Fisheries* 3: 15–55.
- Ravinesh, R., A.B. Kumar & A.J. Kohn (2018). Conidae (Mollusca, Gastropoda) of Lakshadweep, India. *Zootaxa* 4441: 467–494. <https://doi.org/10.11646/zootaxa.4441.3.3>
- Ravinesh, R., A.B. Kumar & V.D. Samuel (2019). Status of marine molluscs in illegal wildlife trade in India. *TRAFFIC Post* 30: 33–39.
- Ravinesh, R., A.B. Kumar & P. Karnaver (2022). Diversity of Conidae (Caenogastropoda: Conoidea) from the Kerala Coast, India. *Molluscan Research* 42: 73–89. <https://doi.org/10.1080/13235818.2022.2034080>
- Rockel, D., W. Korn & A.J. Kohn (1995). Manual of the living Conidae. Indo-Pacific region. Verlag Christa Hemmen, Wiesbaden 517 pp.
- Samuel, D.V., R. Ravinesh, A.B. Kumar, K.P. Raghuram, R.K. Sundar & R.K. Thakur (2021). Protected molluscs (seashells) of India. *TRAFFIC Identification Poster* 11–12.
- Simon, C., A. Franke & A. Martin (1991). The polymerase chain reaction: DNA extraction and amplification, pp. 329–355. In: Hewitt, G.M. (ed.). *Molecular Techniques in Taxonomy*. Springer, Berlin, Germany. [https://doi.org/10.1007/978-3-642-83962-7\\_22](https://doi.org/10.1007/978-3-642-83962-7_22)
- Smith, E.A. (1894). XLIV-Natural history notes from HM Indian marine survey steamer ‘Investigator,’ Commander CF Oldham, RN-Series II., No. 10. Report upon some Mollusca dredged in the Bay of Bengal and the Arabian Sea. *Journal of Natural History* 14: 157–174. <https://doi.org/10.1080/00222939408677814>
- Venkataraman, K., R. Jeyabaskaran, K.P. Raghuram & J.R.B. Alfred (2004). Bibliography and checklist of corals and coral reef associated organisms of India. *Records of the Zoological Survey of India* 226: 1–468.
- Venkitesan, R., S. Barua & M. Hafiz (2019). Contribution to the knowledge on Indian marine molluscs: Family Conidae. *Records of the Zoological Survey of India* 119: 165–184.
- Wei, T. & V. Simko (2021). R package “Corrplot”: Visualization of a Correlation Matrix. *The Comprehensive R Archive Network* 26 pp. [https://doi.org/10.1007/978-3-030-50889-1\\_45](https://doi.org/10.1007/978-3-030-50889-1_45)
- Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. Springer, New York, 260 pp. <https://doi.org/10.1007/978-3-319-24227-4>

## Supplemental information

## Notes:

Partial gene sequences of 12S rRNA, 16S rRNA, and COI from two specimens of *C. biliosus*. The sequences have been submitted to NCBI and the accession numbers are given.

>PQ393374|12S rRNA (partial) from *C. biliosus* 1

ATTCGACATTCCAGCTTTTCCCGACCTTCTTATTCGAGTTTCAGCCTTGATACCGTTGTCGTCAGGTAATCTTAAACATAGTAGTCTAGCTACGAAAATATTATTAATTAACAGCTCA  
AATCAAGGTGCAGCTAATAAGAGGGAGAGGATGGGTACAATTATATATTATAATCACGAAAAACGCTCTAAATAAGGTGTTGGAAGGAGGACTTGAAAGTAATTTAATTATATAAGAGA  
ATGAATAGGGCTCTAAAAACGTGCACA

>PQ394594|16S rRNA (partial) from *C. biliosus* 1

CGGACCTTGCCAGTGAGTTTTTCAACGGCGCGGTACTACTACCGTGCAAAGGTAGCATAATCATCCTGCCTTATAATTGAAGGCTGGAATGAATGGTTTGACAAGAATACAACGTCTC  
TATATGATTTCTAGAAATTTATTTTGGATGAAAAAGTCCAGATATTATTAAGAGACAAGAAGACCTATCGAGCTTAGAGAAATAGTAGACTTAATAATAATCAATAGAAATAAGAAAA  
AACTACTAAATACACTTTGGTTGGGGCAACCGAGGAGCAAATAAGCCTCTTTAAGTTTAAATCTGCATGTGCTGATCCAAATTTTGATCAAAGGAATTAGTTACCGTAGGGATAACAG  
CATTATCTTTTCAAGAGCCATATCGAAAAAGGTTTGTGACCTCGATGTTGGACCAGAAATATCTAAAGATGCAGAAAGTCTTAAAGGTTGGTCTGTTGACCATTAATCTACGTGAT  
CTGT

>PQ390234|COI (partial) from *C. biliosus* 1

GGGTTGGTGGTACTGCCTTAAGTTTATTGATTCGTGCAGAAATTAGGTGAGCCTGGTGCATTACTCGGAGACGATCAGTTGTATAATGTAATTGTGACAGCACATGCTTTTGTATAATTTTTT  
CTTAGTGATGCCAATAAATTTGGGGATTGGGAATTGATTAGTACCTCTTATTTGGGGGCTCCAGATATGGTTTTCTCGACTAAATAATATAAGTTTTGGCTCTCCGCCTGCGTTATT  
GCTTCTTATCATCGGCAGCGGTAGAAAGGGGTGGTGTACAGGATGAACAGTATATCTCTTTAGCAGGAAATCTAGCTCATGCTGGAGGTTCTGTAGATCTGGCGATTTCTCTCTCCAT  
CTTGCTGGGGTTTCTCTATTTGGGTGCAGTAAATTTATTACCACAATTATTAATATACGATGGCAGGGAATAAATTTGAACGCCTTTCGTGTTGTGTGGTCCGTAATAATCTGCTATT  
TTATTGCTTTTATCTTTACCTGTGTAGCAGGAGCAATTACGATACTCTAACCGATCGAAATTTAATACTGCTTCTTTGACCCAGCAGGAGGTGGGGATCTATTTTATACCAGCATTTGTTT

>PQ393375|12S rRNA (partial) from *C. biliosus* 2

TACAAAAAGAAATCATAAGTGGTAAGTCTATCCAGCTATACCCGACCTCTATAGCAGTTGAGCCTGTATACCGTTGTCGTCAGGTAACCTCTTAAACATAGTAGTCTAGCTGAAAATAT  
TATTAAATTAACAGCTCAAATCAAGGTGCAGCTAATAAGAGGGAGAGGATGGGTACAATTATATATTATAATCACGAAAAACGCTCTAAATAAGGTGTTGGAAGGAGGACTTGAAAGTAAT  
TTAATTATATAAGAGAATGAATAGGGCTCTGAAACGTGCACAAA

>PQ380238|16S rRNA (partial) from *C. biliosus* 2

TTTTAAACGGGCGCGGTACTCTGACCGTGCAAAGGTAGCATAATCATTTGCCTTATAATTGAAGGCTGGAATGAATGGTTTGACAAGAATACAACGTCTCTATATGATTCTAGAAATTTAT  
TTTTGGATGAAAAAGTCCAGATATTATAAAGACAAGAAGACCTATCGAGCTTAGAGAAATAGTAGACTTAATAATAAATCAATAGAAATAAAGAAAACTACTAAATACACTTTGGTT  
GGGGCAACCGAGGAGCAATAAAGCCTCTTAAAGTTTAAATCTGCATGTGCTGATCCAATATTATGATCAAAAGGAATTAGTTACCGTAGGATAACAACGTTATC

>PQ392002|COI (partial) from *C. biliosus* 2

GGGTTGGTGGTACTGCCTTAAGTTTATTGATTCGTGCAGAAATTAGGTGAGCCTGGTGCATTACTCGGAGACGATCAGTTGTATAATGTAATTGTGACAGCACATGCTTTTGTATAATTTTTT  
CTTAGTGATGCCAATAAATTTGGGGATTGGGAATTGATTAGTACCTCTTATTTGGGGGCTCCAGATATGGTTTTCTCGACTAAATAATATAAGTTTTGGCTCTCCGCCTGCGTTATT  
GCTTCTTATCATCGGCAGCGGTAGAAAGGGGTGGTGTACAGGATGAACAGTATATCTCTTTAGCAGGAAATCTAGCTCATGCTGGAGGTTCTGTAGATCTGGCGATTTCTCTCTCCAT  
CTTGCTGGGGTTTCTCTATTTGGGTGCAGTAAATTTATTACCACAATTATTAATATACGATGGCAGGGAATAAATTTGAACGCCTTTCGTGTTGTGTGGTCCGTAAAAATCTGCTATT  
TTATTGCTTTTATCTTTACCTGTGTAGCAGGAGCAATTACGATACTCTAACCGATCGAAATTTAATACTGCTTCTTTGACCCAGCAGGAGGTGGGGATCTATTTTATACCAGCATTTGTTT

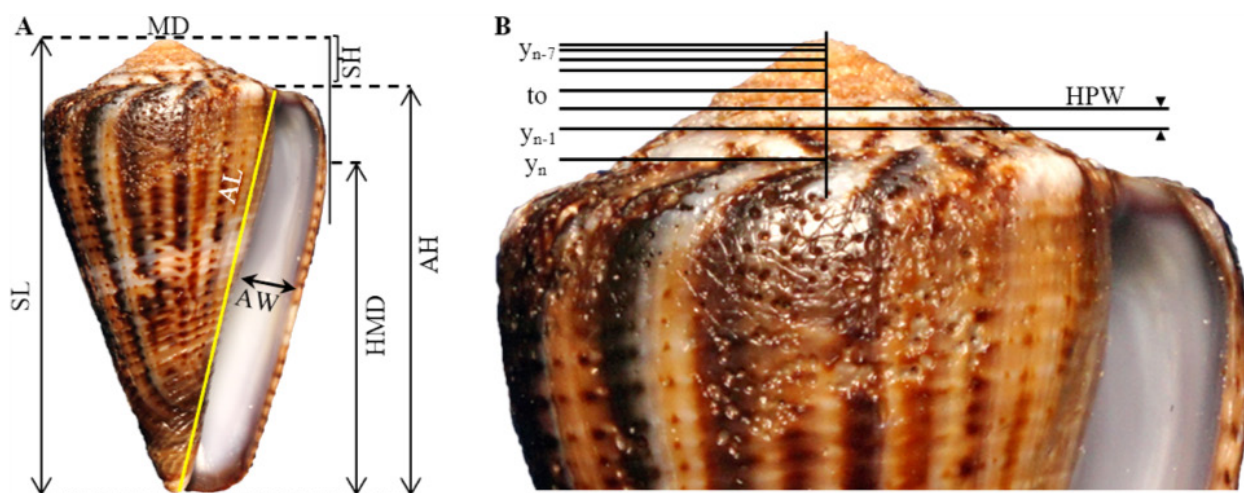


Image S1. Morphometric measurements of the Conidae shell (*C. biliosus*): A—Ventral view | B—Posterior or spire view. Abbreviations: AH—aperture height | AL—aperture length | AW—aperture width | HPW—height of penultimate whorl | HMD—height of maximum diameter | MD—maximum diameter | SH—spire height | SL—shell length. In the spire, the successive whorls are labelled as  $y_n$  to  $y_{n-7}$ . © B S Chandan.





Mr. Jatishwor Singh Irungbam, Biology Centre CAS, Branišovská, Czech Republic.  
Dr. Ian J. Kitching, Natural History Museum, Cromwell Road, UK  
Dr. George Mathew, Kerala Forest Research Institute, Peechi, India  
Dr. John Noyes, Natural History Museum, London, UK  
Dr. Albert G. Orr, Griffith University, Nathan, Australia  
Dr. Sameer Padhye, Katholieke Universiteit Leuven, Belgium  
Dr. Nancy van der Poorten, Toronto, Canada  
Dr. Kareen Schnabel, NIWA, Wellington, New Zealand  
Dr. R.M. Sharma, (Retd.) Scientist, Zoological Survey of India, Pune, India  
Dr. Manju Siliwal, WILD, Coimbatore, Tamil Nadu, India  
Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India  
Dr. K.A. Subramanian, Zoological Survey of India, New Alipore, Kolkata, India  
Dr. P.M. Sureshan, Zoological Survey of India, Kozhikode, Kerala, India  
Dr. R. Varatharajan, Manipur University, Imphal, Manipur, India  
Dr. Eduard Vives, Museu de Ciències Naturals de Barcelona, Terrassa, Spain  
Dr. James Young, Hong Kong Lepidopterists' Society, Hong Kong  
Dr. R. Sundararaj, Institute of Wood Science & Technology, Bengaluru, India  
Dr. M. Nithyanandan, Environmental Department, La Ala Al Kuwait Real Estate. Co. K.S.C., Kuwait  
Dr. Himender Bharti, Punjabi University, Punjab, India  
Mr. Purnendu Roy, London, UK  
Dr. Saito Motoki, The Butterfly Society of Japan, Tokyo, Japan  
Dr. Sanjay Sondhi, TITLI TRUST, Kalpavriksh, Dehradun, India  
Dr. Nguyen Thi Phuong Lien, Vietnam Academy of Science and Technology, Hanoi, Vietnam  
Dr. Nitin Kulkarni, Tropical Research Institute, Jabalpur, India  
Dr. Robin Wen Jiang Ngiam, National Parks Board, Singapore  
Dr. Lionel Monod, Natural History Museum of Geneva, Genève, Switzerland.  
Dr. Asheesh Shivam, Nehru Gram Bharti University, Allahabad, India  
Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná, Curitiba, Brasil  
Dr. Kurt R. Arnold, North Dakota State University, Saxony, Germany  
Dr. James M. Carpenter, American Museum of Natural History, New York, USA  
Dr. David M. Claborn, Missouri State University, Springfield, USA  
Dr. Kareen Schnabel, Marine Biologist, Wellington, New Zealand  
Dr. Amazonas Chagas Júnior, Universidade Federal de Mato Grosso, Cuiabá, Brasil  
Mr. Monsoon Jyoti Gogoi, Assam University, Silchar, Assam, India  
Dr. Heo Chong Chin, Universiti Teknologi MARA (UiTM), Selangor, Malaysia  
Dr. R.J. Shiel, University of Adelaide, SA 5005, Australia  
Dr. Siddharth Kulkarni, The George Washington University, Washington, USA  
Dr. Priyadarsanan Dharma Rajan, ATREE, Bengaluru, India  
Dr. Phil Alderslade, CSIRO Marine And Atmospheric Research, Hobart, Australia  
Dr. John E.N. Veron, Coral Reef Research, Townsville, Australia  
Dr. Daniel Whitmore, State Museum of Natural History Stuttgart, Rosenstein, Germany.  
Dr. Yu-Feng Hsu, National Taiwan Normal University, Taipei City, Taiwan  
Dr. Keith V. Wolfe, Antioch, California, USA  
Dr. Siddharth Kulkarni, The Hormiga Lab, The George Washington University, Washington, D.C., USA  
Dr. Tomas Ditrich, Faculty of Education, University of South Bohemia in Ceske Budejovice, Czech Republic  
Dr. Mihaly Foldvari, Natural History Museum, University of Oslo, Norway  
Dr. V.P. Uniyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India  
Dr. John D.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. 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. Rivonker, Goa University, Taleigao Plateau, Goa. India  
Dr. S.R. Ganesh, Chennai Snake Park, Chennai, Tamil Nadu, India  
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

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, SAGON, 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, SAGON, 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, SAGON, Anaikatty P.O., Coimbatore, Tamil Nadu, India  
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India  
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy  
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India  
Dr. H. Raghuram, The American College, Madurai, Tamil Nadu, India  
Dr. Paul Bates, Harison Institute, Kent, UK  
Dr. Jim Sanderson, Small Wild Cat Conservation Foundation, Hartford, USA  
Dr. Dan Challender, University of Kent, Canterbury, UK  
Dr. David Mallon, Manchester Metropolitan University, Derbyshire, UK  
Dr. Brian L. Cypher, California State University-Stanislaus, Bakersfield, CA  
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India  
Prof. Karan Bahadur Shah, Budhanilakantha Municipality, Kathmandu, Nepal  
Dr. Susan Cheyne, Borneo Nature Foundation International, Palangkaraja, Indonesia  
Dr. Hemanta Kafley, Wildlife Sciences, Tarleton State University, Texas, USA

Other Disciplines

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

Reviewers 2021–2023

Due to pausity 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.

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

**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



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

OPEN ACCESS



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

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

February 2025 | Vol. 17 | No. 2 | Pages: 26443–26570

Date of Publication: 26 February 2025 (Online & Print)

DOI: 10.11609/jott.2025.17.2.26443-26570

## Articles

### Culture and provisioning: the case of Human-Long-tailed Macaque *Macaca fascicularis* (Raffles, 1821) interactions in Sumile, Butuan City, Philippines

– Fritche H. Lapore, Debbie S. Aseñas & Sherryl L. Paz, Pp. 26443–26458

### Noteworthy comments on birds for mega-diverse Myanmar

– Swen C. Renner, Saw Moses, Lay Win, Thein Aung, Myint Kyaw, Saw Myat Ohnmar, Thiri Dae We Aung, Kay Thwe Myint, Sai Sein Lin Oo, Paul J.J. Bates & Marcela Suarez-Rubio, Pp. 26459–26467

### Ultra-structure of antenna, eye, mouthparts and sensilla of *Cheilomenes sexmaculata* Fabricius, 1781 (Coccinellidae: Coleoptera)

– Prakash Ghagargunde & Mandar S. Paingankar, Pp. 26468–26478

### Morphological characterization and ecological insights of *Pseudonapaeus* cf. *candelaris* (L. Pfeiffer, 1846) in the Pir Panjal Range of western Himalaya

– Hilal Ahmed, Imtiaz Ahmed & N.A. Aravind, Pp. 26479–26486

## Communications

### Diet and nutrient balance of wild Asian Elephants *Elephas maximus* in Nepal

– Raj Kumar Koirala & Sean C.P. Coogan, Pp. 26487–26493

### Avian diversity in wetlands of southwestern Kerala of India during COVID

– Vijayakumari Sudhakaran Bindu & S. Sajitha, Pp. 26494–26503

### Checklist on the ichthyofaunal resources and conservation status of Dikhu River, Nagaland, India

– Metevinu Kechu & Pranay Punj Pankaj, Pp. 26504–26514

### A study on the diversity of butterflies in selected landscapes of the Indian Institute of Technology, Guwahati campus, Assam, India

– Uma Dutta, Sonali Dey & Deepshikha Moran, Pp. 26515–26529

### *Sphaeroma taborans* sp. nov., a new species of wood-boring isopod (Crustacea: Isopoda: Sphaeromatidae) from Munroe Island, Ashtamudi Estuary, Kerala, India

– M.S. Arya, A. Biju & Dani Benchamin, P. 26530–26537

### A report on Conidae (Gastropoda) from the Karnataka coast – distribution and shell morphometry

– B.S. Chandan, R. Shyama Prasad Rao & Mohammed S. Mustak, Pp. 26538–26546

### New distribution record and DNA barcoding of the steno-endemic plant *Cordia diffusa* (Boraginaceae)

– M. Haritha, D. Leena Lavanya & H. Abinaya, Pp. 26547–26552

## Short Communications

### First record of the sea slug *Lobiger serradifalci* (Calcara, 1840) (Gastropoda: Sacoglossa: Oxynoidae) from the Indian coast

– Dimpal Dodiya & Paresh Poriya, Pp. 26553–26557

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

– Ha Van Dang, Leonid Vladimirovich Averyanov & Cuong Huu Nguyen, Pp. 26558–26561

### Invasive record of Brazilian Petunia *Ruellia elegans* Poir. (Acanthaceae) from northeastern India

– Mamita Kalita, Pp. 26562–26565

## Note

### *Cuphea carthagenensis* (Jacq.) J.F. Macbr. (Lythraceae)

— a new non-native plant record for the Eastern Ghats of India

– Prabhat Kumar Das, Bishal Kumar Majhi, Shashi Sourav Hansda, Samarendra Narayan Mallick, Purnendu Panda & Pratap Chandra Panda, Pp. 26566–26570

Publisher & Host



Threatened Taxa