

# Journal of Threatened Taxa

*Building evidence for conservation globally*



*Open Access*

10.11609/jott.2021.13.12.19675-19886

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

26 October 2021 (Online & Print)

Vol. 13 | No. 12 | Pages: 19675-19886

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)



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

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

Host  
**Zoo Outreach Organization**  
www.zooreach.org

No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road, Saravanampatti,  
Coimbatore, Tamil Nadu 641035, 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),  
12 Thiruvannamalai Nagar, Saravanampatti, Coimbatore, Tamil Nadu 641035, India

##### Deputy Chief Editor

**Dr. Neelesh Dahanukar**

Noida, Uttar Pradesh, India

##### Managing Editor

**Mr. B. Ravichandran**, WILD/ZOO, Coimbatore, 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 641035, India

**Dr. B.A. Daniel**, ZOO/WILD, Coimbatore, Tamil Nadu 641035, 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, Mavinhalla PO, Nilgiris, Tamil Nadu 643223, India

**Dr. Martin Fisher**

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

**Dr. John Fellowes**

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

**Prof. Dr. Mirco Solé**

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

**Dr. Rajeev Raghavan**

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

##### English Editors

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

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

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

##### Web Maintenance

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

##### Typesetting

**Mr. Arul Jagadish**, ZOO, Coimbatore, India

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

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

#### Fundraising/Communications

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

**Subject Editors 2018–2020**

#### 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

#### 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, Kadoorie Farm and Botanic Garden Corporation, Hong Kong S.A.R., China

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

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

Dr. Vijayasankar Raman, University of Mississippi, USA

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

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

Dr. Aparna Watve, Pune, Maharashtra, India

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Caption: Stripe-backed Weasel *Mustela strigidorsa*. Medium—digital, Software—procreate, Device—iPad + Apple pencil © Dhanush Shetty.



## New record of *Myrmarachne melanocephala* MacLeay, 1839 (Araneae: Salticidae) from Jharkhand, India and biogeographical implications of the co-occurrence of its ant model *Tetraoponera rufonigra* Jerdon, 1851

Rahul Kumar<sup>1</sup> , Mirtunjay Sharma<sup>2</sup> & Ajay Kumar Sharma<sup>3</sup>

<sup>1,3</sup>University Department of Zoology, Vinoba Bhave University, Hazaribagh, Jharkhand 825301, India.

<sup>1</sup>Department of Zoology, Sheodeni Sao College, Kaler, Arwal, Bihar 824127, India.

<sup>2</sup>Forest Department Office, Hazaribagh, Jharkhand 825301, India.

<sup>1</sup>rahuldayanand33@gmail.com (corresponding author), <sup>2</sup>sharmamirtunjay@gmail.com, <sup>3</sup>ajaysharmavbu@gmail.com

**Abstract:** We report the occurrence of the ant-mimicking jumping spider *Myrmarachne melanocephala* MacLeay, 1839 for the first time from Hazaribagh Wildlife Sanctuary, Jharkhand, India. Digital illustrations and descriptions of the spider, the female's exuviae, and video records of a live male are also presented. The distribution pattern of *M. melanocephala* has not been studied in detail across India whereas its ant model, *Tetraoponera rufonigra* Jerdon, 1851 is known to have a wide distribution. Co-occurrence of the mimic and the model implies a wider range of biogeographical distribution of these species in India.

**Keywords:** Distribution, eastern India, exuviae, Hazaribagh Wildlife Sanctuary, jumping spider, mimicry, myrmecomorphy.

**Abbreviations:** ALE—anterior lateral eye | AME—anterior median eye | md—mid-dorsal | pd—pro-dorsal | PLE—posterior lateral eye | PME—posterior median eye | pv—proventral | rv—retroventral.

**Editor:** John T.D. Caleb, ERI, Loyola College, Chennai, India.

**Date of publication:** 26 October 2021 (online & print)

**Citation:** Kumar, R., M. Sharma & A.K. Sharma (2021). New record of *Myrmarachne melanocephala* MacLeay, 1839 (Araneae: Salticidae) from Jharkhand, India and biogeographical implications of the co-occurrence of its ant model *Tetraoponera rufonigra* Jerdon, 1851. *Journal of Threatened Taxa* 13(12): 19753–19761. <https://doi.org/10.11609/jott.7500.13.12.19753-19761>

**Copyright:** © Kumar et al. 2021. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use, reproduction, and distribution of this article in any medium by providing adequate credit to the author(s) and the source of publication.

**Funding:** None.

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

**Author details:** RAHUL KUMAR is working as an Assistant Professor at Department of Zoology, Sheodeni Sao College (Magadh University), Kaler, Arwal, Bihar. His doctoral research is going on from University Department of Zoology, Vinoba Bhave University, under Dr. Ajay Kumar Sharma. His doctoral work concerns with mimicry among terrestrial arthropods and new approaches to explore integrative taxonomy. He has research experience in molecular biology and functional genomics from School of Life Sciences, JNU, New Delhi as UGC-JRF; in nanotechnology and biotechnology from Department of Anatomy, AIIMS, New Delhi as DST-Nanomission JRF; and in biosystematics and integrative taxonomy from Division of Entomology, ICAR-IARI, New Delhi as DST-SERB JRF. MIRTUNJAY SHARMA is a forest department employee, a Limca Book of World Record holder hobbyist entomologist-arachnologist and a famous nature photographer from Hazaribagh, Jharkhand. He is author of the book "Spiders of Jharkhand" published by Jharkhand Biodiversity Board. DR. AJAY KUMAR SHARMA is working as Associate Professor at University Department of Zoology, Vinoba Bhave University, Hazaribagh, Jharkhand and is also assigned with the positions of University Dean of Science and course coordinator of the Department of Physiotherapy in the same university. He has more than 40 years of research and teaching experience. His thrust areas of research are molecular biology, entomology and ecology.

**Author contributions:** Conceptualization of the research and manuscript writing was done by RK. Site visits, data collections and analyses were done by RK, MS and AKS. Manuscript was reviewed and finalized by AKS before communication. Correspondence to the journal and subsequent revisions were done by RK.

**Acknowledgements:** We acknowledge Dr. John Caleb from the Zoological Survey of India, Kolkata, and Miss Stuti Rai and Mr. Anand Harshana from Division of Entomology, Indian Agricultural Research Institute (IARI), Pusa, New Delhi, for sharing their valuable taxonomic insights. We also acknowledge Dr. Shashank P.R., Division of Entomology, IARI, for allowing us to use the microscopy facility of National Pusa Collection, Division of Entomology, IARI, for our studies. Two anonymous reviewers are thanked for their suggestions and critical comments which helped us to improve our manuscript.



## INTRODUCTION

Ant-mimicry (myrmecomorphy) is not very uncommon among arthropods. Most myrmecomorphs display Batesian mimicry where non-ant species mimic unpalatable and aggressive ants in order to avoid predatory attacks which is the result of adaptive evolution (Cushing 1997). Myrmecomorphy has achieved a distinct level of perfection among salticids (jumping spiders). The genus *Myrmarachne* MacLeay, 1839 is one of the largest salticid genera consisting of 186 accepted species globally out of which 23 are found in India but only six of them are well characterized and all of these species exhibit Batesian mimicry displaying profound morphological as well as behavioural resemblances towards ants (Caleb 2016; Prószyński 2016; Wanless 1978; World Spider Catalog 2021; Yamasaki & Ahmad 2013; Yamasaki & Edwards 2013; Caleb & Benjamin 2017; Caleb & Sankaran 2021).

The genus *Myrmarachne* forms part of a phylogenetic group of the subfamily Salticinae Blackwall, 1841 (Maddison 2015). *Myrmarachne melanocephala* MacLeay, 1839 is the type species of the genus *Myrmarachne* which was originally described from Bengal (which corresponds to present day West Bengal in India and Bangladesh combined) (Edwards & Benjamin 2009; World Spider Catalog 2021). *M. melanocephala* mimics the worker of *Tetraponera rufonigra* Jerdon, 1851, an arboreal ant with conspicuous eyes and long slender body (Pocock 1909). This species was originally described from the Carnatic-Malabar region (which corresponds to present day Indian states: Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh) (Ward 2001). The genus *Tetraponera* Smith, 1852 belongs to subfamily Pseudomyrmecinae of Formicidae which is represented by 95 extant species globally, of which 10 are found in India (Bharti & Akbar 2014; Bolton 2021).

This paper is concerned with the discovery of *M. melanocephala* from Hazaribagh Wildlife Sanctuary, Hazaribagh, Jharkhand with detailed morphological descriptions and observation on its ant model *T. rufonigra*. For the first time, in addition an undamaged whole body exuviae of a freshly moulted female *M. melanocephala* has been used here as material for morphological descriptions of this spider. Both taxonomic as well as behavioural (mimicry related) aspects have been noted. The biogeographical implications of the co-occurrence of the mimic and the model together in the same habitat has also been discussed in the Indian context.

## MATERIALS AND METHODS

Sampling and collection were performed at Hazaribagh Wildlife Sanctuary, Hazaribagh, Jharkhand, India (Image 1). The spiders and ants were observed on and around Sal *Shorea robusta* trees. One male and two female spider specimens were spotted on a Sal tree trunk. The male specimen was captured alive and one freshly moulted female specimen and its undamaged whole body exuviae were manually collected and preserved in 70% ethanol for further investigations. The live male spider and ant specimens were photographed and videoed using a cellphone camera (Samsung M42). Measurements of the live male spider specimen were taken in millimeters (mm) using ocular micrometer placed within the eyepiece of a stereoscopic microscope by keeping the material on a cavity slide with a drop of water. A coverslip was temporarily placed over the cavity of the cavity slide in order to keep the material static for quick measurements. The water drop was added to create surface tension in order to keep the cover slip in firm position without killing the spider. The specimen was kept alive for behavioural studies. Note: one leg of the male spider got detached while trying to measure it alive. The ventral and dorsal sides of the palp and dentition of the live male spider were studied using hand-held magnifying glasses and stereoscopic microscope. The ethanol preserved specimen of the female spider was dissected for its epigyne, palp, and head containing chelicerae and fangs using a fine surgical scalpel. Epigyne was cleared by boiling it in 10% potassium hydroxide (KOH) solution for a minute. After boiling, the epigyne was rinsed thoroughly in water to remove excess KOH and was temporarily mounted in a drop of glycerol using coverslip on a glass slide for microscopic observations. The ethanol preserved female spider (before dissection), its undamaged whole body exuviae, and dissected epigyne, palp & head with chelicerae & fangs were photographed using Leica DFC 425C digital camera mounted over Leica M205FA stereozoom automontage microscope at National Pusa Collection, Division of Entomology, Indian Agricultural Research Institute, Pusa, New Delhi 110012. Measurements were taken in millimeters (mm) using inbuilt settings of the automontage. The format of the description follows Yamasaki (2010), Caleb (2016), and Ward (2001). The studied ethanol preserved specimen of the female spider and its exuviae were deposited in the museum collections of University Department of Zoology, Vinoba Bhave University, Hazaribagh.

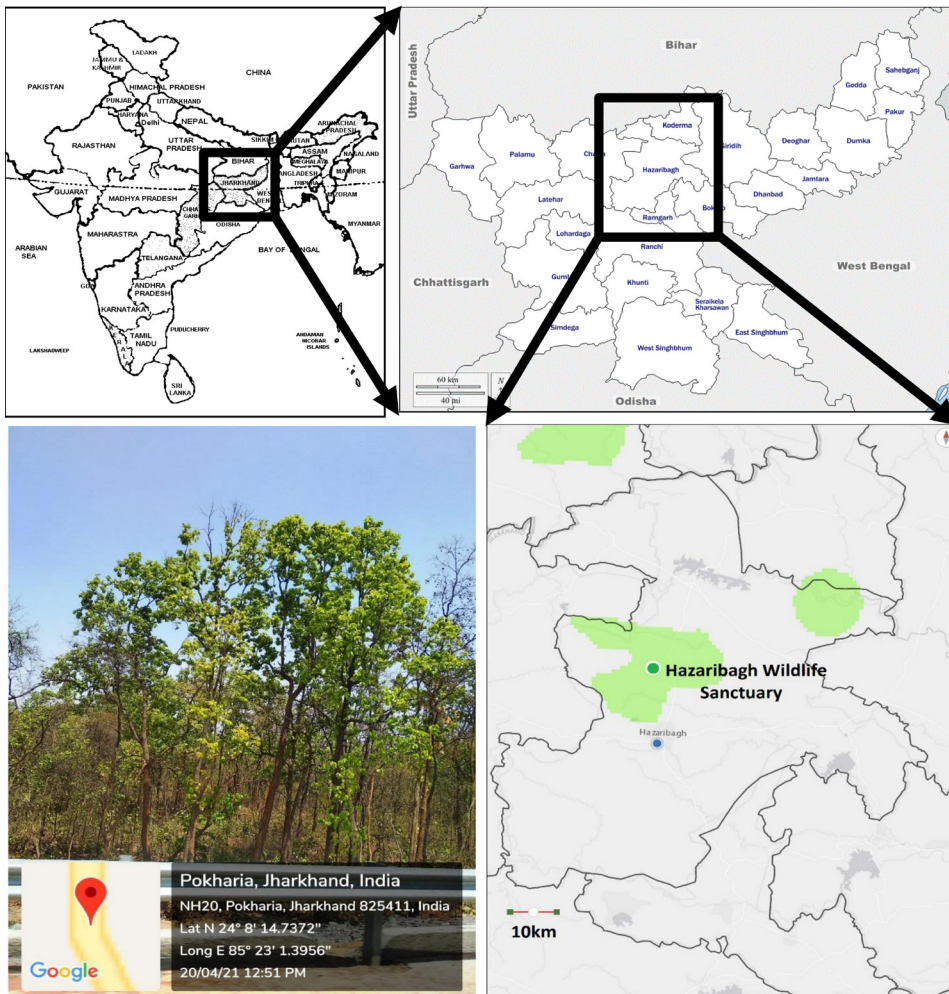


Image 1. Geographical location of Hazaribagh Wildlife Sanctuary, Hazaribagh, Jharkhand, India. The longitudes and latitudes are indicated in the lower left geo-tagged photograph, which also shows Sal trees, the dominant trees of Hazaribagh Wildlife Sanctuary.

## TAXONOMIC NOTES ON THE MYRMECOMORPH

### *Myrmarachne melanocephala* MacLeay, 1839 (Images 2A–D, 3 & 4A–E; supplementary video 1)

*Myrmarachne melanocephala* MacLeay, 1839: 11, pl. 1, fig. 4; Galiano, 1969: 146; Edwards & Benjamin, 2009: 5, figs. 1A–H, 2A–D, 3A–D, 4A–E, 5A–D; Yamasaki & Edwards, 2013: 15, figs. 46–58; Yamasaki & Ahmad, 2013: 541, figs. 32A–G, 33A–H, 34A–C; Benjamin, 2015: 17, figs. 17A–D, 18A–D, 19A–D; Caleb, 2016: 409, figs 20–30.

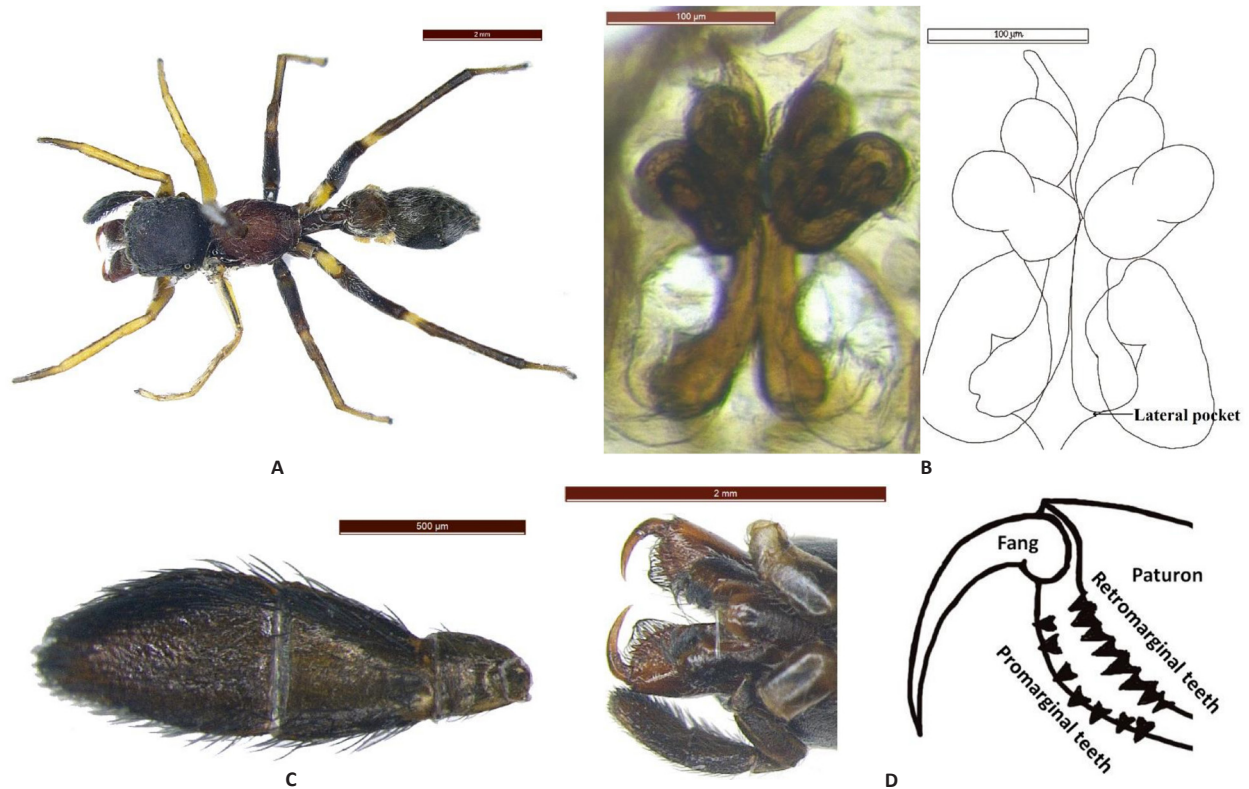
Further references may be read in World Spider Catalog (2021).

**Materials examined (n=3).** 1 preserved freshly moulted female specimen, 1 preserved complete whole-body exuviae of female, and 1 live male. Hazaribagh Wildlife Sanctuary (24° 8' 14.7372'' N, 85° 23' 1.3956''

E), Hazaribagh, Jharkhand, India, 20.iv.2021, R. Kumar & M. Sharma.

**Diagnosis** (following Yamasaki & Edwards 2013). Pedicel in both sexes as long as ALE-PLE. Males are further distinguished from other congeners by the shape and dentition of chelicerae. Females can be distinguished by abdominal markings and structure of epigyne (Yamasaki & Edwards 2013). For a complete diagnosis and description see Edwards & Benjamin (2009) and Benjamin (2015).

**Female.** Body length 7.8; carapace length 2.25, width 1.5; abdomen length 3.4, width 1.66. Width of eye row I 1.11; II 1.1; III 1.2. Eye sizes and interdistances: AME 0.3, ALE 0.2, PME 0.05, PLE 0.2; ALE-PLE 0.8; ALE-PME 0.39. Leg spination: tibia I pv 4, rv 5; metatarsus I pv 2, rv 2; tibia II pv 3, rv 3; metatarsus II pv 2, rv 2. Pedicel 0.6 long. Cephalic region rugulose and dark brown to black, covered with white hairs; thoracic region reddish



**Image 2.** *Myrmarachne melanocephala* MacLeay, 1839 (female): A—Habitus of preserved specimen, dorsal view | B—Epigyne, ventral view | C—Left palp, ventral view | D—Chelicerae and fangs, ventral view. Scale bars: A—2 mm | B—100 µm | C—500 µm | D—2 mm.

brown, sparsely covered with white hairs. Cephalic region slightly higher than thoracic region. Sternum brown. Chelicerae dark brown, geniculate with seven teeth on promargin and 8 teeth on retromargin (Image 2D). Legs I and II light yellow, coxae I brown, tarsi I light brown which gets darker near the tip, legs III, IV brown, trochanter and patella of leg IV yellowish, patella of leg III lighter in colour. Leg IV longest. Palp paddle shaped and fringed with preening setae (Image 2C). Abdomen elongate, and slightly constricted in the anterior third, covered with white hairs, almost oval (Image 2A). Epigyne with laterally oriented large oval copulatory atria; copulatory ducts twist to form butterfly shaped structure just before reaching ovoid spermatheca; lateral pockets present between artia just at the bases of copulatory ducts (Image 2B).

**Exuviae of female:** The undamaged whole body exuviae revealed morphological features of the female spider (Image 3). Exuviae contains imprints of the outer surface of spider's body. Abdominal markings (dark and lightly pigmented areas) are sharply revealed in the exuviae which is otherwise not clearly visible on the spider body. The inflated abdominal region displays the site of exit of the spider after moulting from its own



**Image 3.** *Myrmarachne melanocephala* MacLeay, 1839: female exuviae (whole mount). Scale bar: 2 mm.

exuviae. Locations of four pairs of limbs, limb markings, geniculate chelicerae, fangs, and paddle shaped pedipals are clearly visible.

**Male:** Body length 7.5; carapace length 3, width 1.2; abdomen length 2.9, width 1.5; chelicerae 2. Pedicel 0.5 long. Legs I and II light brown but not yellow as in female, coxae and trochanters of legs I, II and III white, and tarsi I brown which gets darker near the tip, legs III

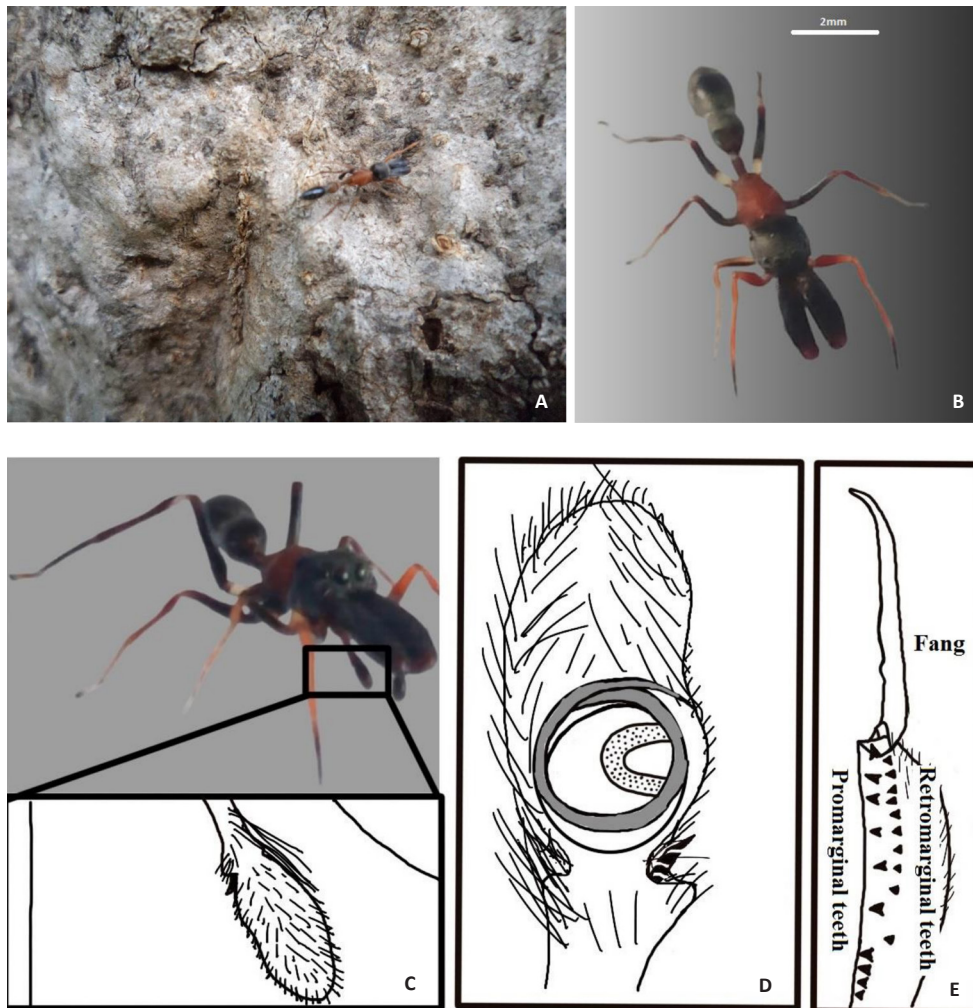


Image 4. *Myrmarachne melanocephala* MacLeay, 1839 (male): A—Spider on a tree trunk | B—Habitus of a live spider, dorsal view | C—Right palp, dorsal view | D—Left palp, ventral view | E—Chelicera and fang, ventral view.

and IV brown in colour, trochanter and patellae of leg IV white. Cephalic region rugulose and black; thoracic region reddish brown. Cephalic region slightly higher than thoracic region. Chelicerae black throughout except the region from where fangs arise which is reddish brown. Chelicerae porrect with 10 teeth each on prolateral and retrolateral margin (Images 4B, E; [supplementary video 1](#)). Sternum light brown. Abdomen elongate-oval, constricted in the anterior third. Palp with oval cymbium, round tegulum with distal-retrolateral C-shaped sperm duct, embolus with two coils, spiralled helix like retrolateral tibial apophysis with prominent flange (Images 4C, D).

**Remarks:** Exuviae has been used as a material for species description by some workers, and some have used it even as a holotype (Kranzfelder et al. 2017; Lin et al. 2017). We have used it here as additional material for morphological studies. We suggest that exuviae can

also provide such useful information while describing a species which may not be clearly recognizable in the type or non-type material.

**Biology:** The spider specimens were spotted on a tree trunk at the Sal forest. Refer ecological notes on mimic-model coexistence in a subsequent section for other important details.

**Distribution:** Pakistan to Indonesia (Edwards & Benjamin 2009; World Spider Catalog 2021), the records from India include states of Tamil Nadu, West Bengal, Assam, Uttarakhand (Caleb 2016) and Jharkhand (present study) (Images 1 & 6).

**TAXONOMIC NOTES ON THE ANT MODEL**

***Tetraponera rufonigra* Jerdon, 1851  
(Image 5A–D; supplementary video 2)**

*Tetraponera rufonigra* Jerdon, 1851: 111; Smith, 1877: 68; Bingham, 1903: 108; Wheeler, 1922: 1015; Ward, 1990: 489; Ward, 2001: 649.

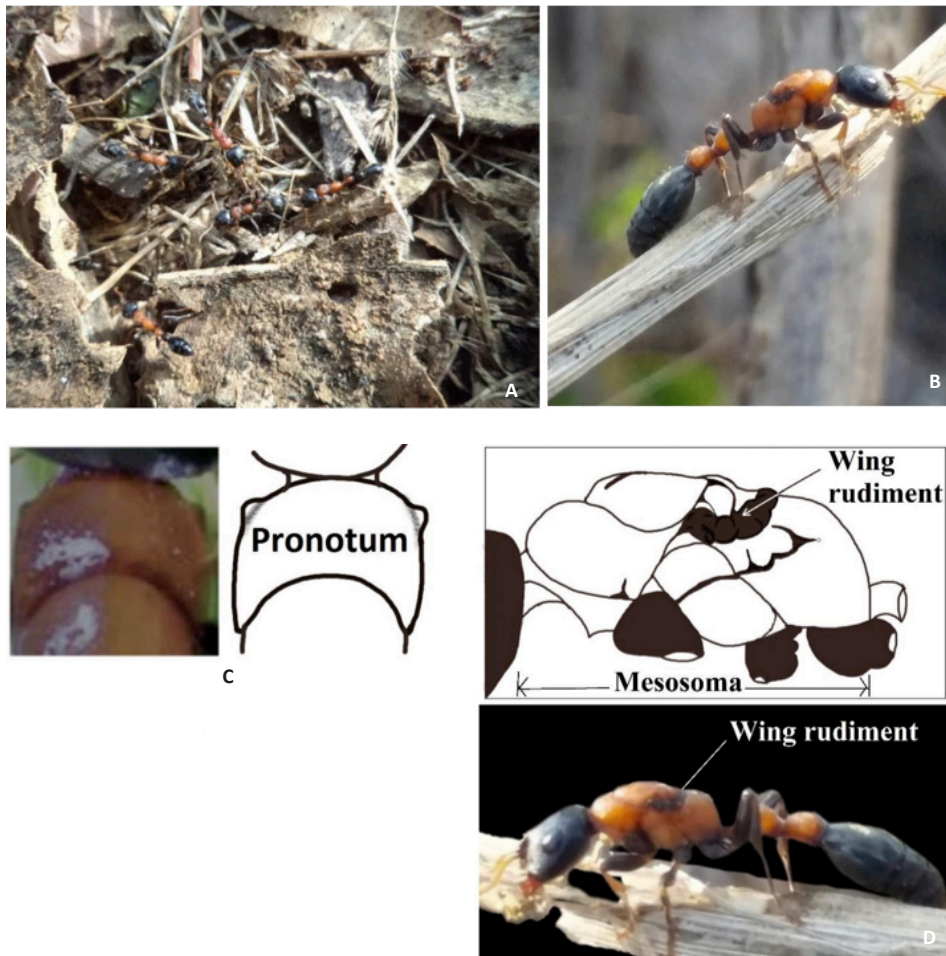
Further references may be read in Bolton (2021).

**Materials examined (n= 6):** 1 live solitary dealate gyne and 5 foraging live workers. Hazaribagh Wildlife Sanctuary (24°8'14.7372" N, 85°23'1.3956" E), Hazaribagh, Jharkhand, India, 20.iv.2021, R. Kumar & M. Sharma.

**Diagnosis:** (following Bolton 2021). Larger than other *Tetraponera* species. Bicoloured body. Head and gaster darker than mesosoma. In case of the examined specimen, head and gaster are black in contrast to the orange-brown mesosoma. The species is so distinctive

that its identity has never been a matter of confusion or doubt. For a complete diagnosis and description see Ward (2001).

**Dealate gyne:** Large body (larger than other species of *Tetraponera*) with broad head, with small but conspicuous crystalline glass like compound eyes and three ocelli. Head densely punctate but without clearly visible puncture interspaces. Clypeus with long and narrow median lobe. Bicoloured body, head and gaster dark in colour (dark brown to black) which contrast with the orange-brown mesosoma. Antennae, mandibles, tarsi and protibia light in colouration (light brown to yellowish-brown), matching with the colour of mesosoma to some extent (Image 5B). The studied specimen also shows the presence of a conspicuously wide semicircular band of highly pigmented (dark brown to black) wing rudiment which contrasts with the light orange background of the mesosoma which is characteristic feature of the dealate gyne (Image 5D).



**Image 5.** *Tetraponera rufonigra* Jerdon, 1851 (workers and dealate gyne): A—Workers foraging on the forest floor | B—A dealate gyne cutting a twig on a tree branch | C—Magnified dorsal view of pronotum of a foraging worker | D—Lateral view of mesosoma displaying a wide dorsal semicircular band of highly pigmented (dark brown to black) wing rudiment (characteristic feature of a dealate gyne).



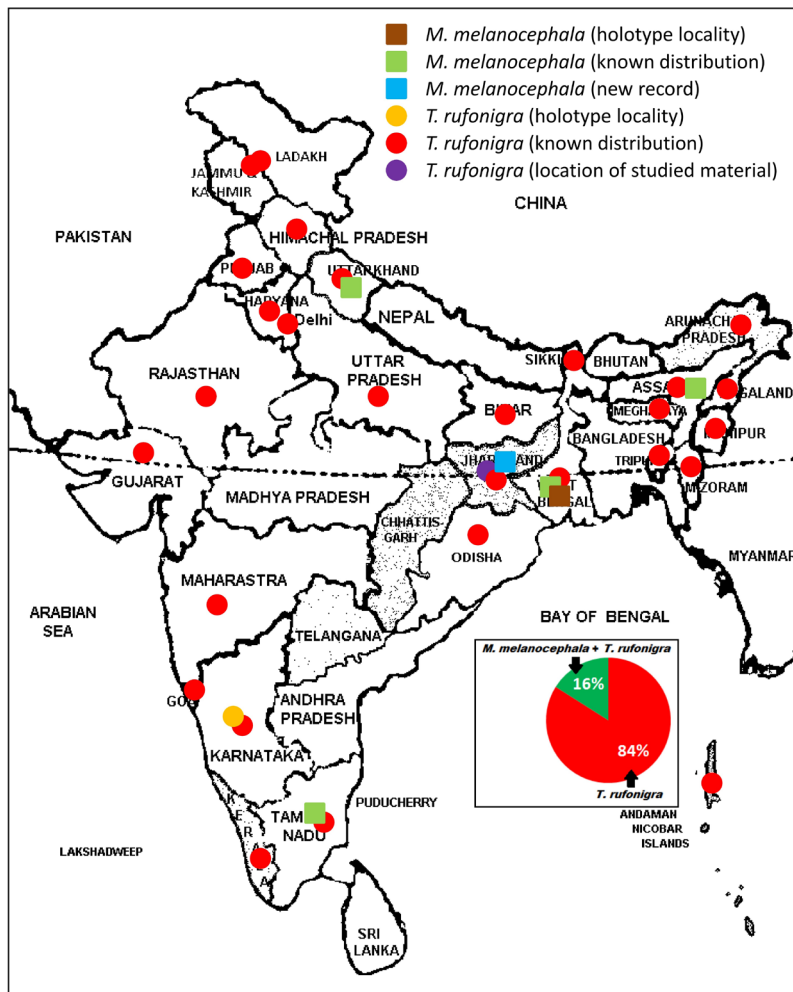


Image 6. State wise distribution of *Myrmarachne melanocephala* MacLeay, 1839 and *Tetraponera rufonigra* Jerdon, 1851 in India. Pie chart represents the percentage of distribution of *M. melanocephala* in India vis-à-vis distribution of *T. rufonigra*.

**Worker:** They display similar morphological features and colouration pattern like the dealate gyne except the wing rudiment which is absent in workers. Pronotum with well developed lateral margin and punctate humeral corners (Image 5C). Workers are smaller than the dealate gyne. Abdomen is more tapering in the workers compared to the more inflated abdomen of the dealate gyne (Image 5A).

**Remarks:** This ant is known to exhibit regional morphological variations. For example, the ants studied from some places in Sri Lanka are uniformly dark (mesosoma approaching colour of head and gaster) in comparison to the typical bicoloured ants like those found in India (head and gaster darker than mesosoma). As already reported by various workers, common morphological variations include variation in integument sculpture, colour of mesosoma, and pilosity (Ward 2001).

**Biology:** The ants were spotted on and around trees of the Sal forest. Refer ecological notes on mimic-model coexistence in a subsequent section for other important details.

**Distribution:** Pakistan to Indonesia including India (Ward 2001). Widely distributed in India; the records from India include Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Ladakh, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, and West Bengal (Bharti et al. 2016) (Image 6).

## DISCUSSION

### Ecological notes on mimic-model co-existence

As an ideal myrmecomorph, *M. melanocephala* shares many morphological features with its ant model *T. rufonigra*. The most striking feature is its ant like bicolored body and size. Both share similar body colour pattern, body size and appearance. The female spider mimics the ant more efficiently than the male spider due to the absence of long chelicerae found in the male spider. The long pedicel of the spider mimics the whole petiolar and post-petiolar structure of ants due to its comparable length. The inflated elongate ovate abdomen of the spider and ant also appears similar in appearance. The limbs of the spider also display a lighter colouration pattern like that of the ant (Images 2A, 4A, B, 5A, B). Along with morphological resemblances, *Myrmarachne melanocephala* MacLeay, 1839 also exhibits some behavioural similarities to its ant model. In this regard, the first two pairs of legs are lighter in colour (yellowish in female) than the third and fourth pairs, and bear no stripes or markings in the spider (Image 2A). The spider waves its first pair of limbs in the air to mimic the long antennae (which is also yellowish) of the ant model occasionally. The spider also displays a zig-zag movement like the ant along with occasional salutatory movement typical of the jumping spiders (Supplementary video 1 & Supplementary video 2). Therefore, *M. melanocephala* perfectly imitates the gait and gestures of its ant model *T. rufonigra*.

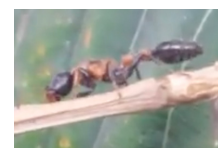
### Biogeographical implications of mimic-model co-discovery

Most myrmecomorphic spiders have been found to occupy spaces in close vicinity to their ant models (Pekar & Jarab 2011a). Such associations provide a space devoid of potential enemies as ants are mostly avoided by frequent predators who prey upon birds, wasps and spiders (Edmunds 1974). Association of myrmecomorphs with a particular ant species could be the result of either preference to ant dominated habitat or ant's prey preference (Pekár 2014). A large number of myrmecomorphic species go with the former strategy where they prefer to occupy ant dominated habitats and they capture prey other than ants. *M. melanocephala* fall under the same category (Edmunds 1978; Oliviera 1988; Pekár 2014; Pekár & Jarab 2011b). Apparent from their global distribution pattern, both *M. melanocephala* and *T. rufonigra* are adaptable to multiple climatic regions. The association between *M. melanocephala*

and *T. rufonigra* was first observed by Pocock (1909). Global natural distribution of the ant model *T. rufonigra* completely overlaps with the reported distribution of its mimic *M. melanocephala* which means they follow a parallel biogeographical distribution pattern (Ward 2001; Yamasaki 2010). But if we look at India (which has the largest land area among the countries falling under the habitat range of the spider and the ant), we find that the myrmecomorph is confined to only five states (including the present study) as per available reports, whereas the ant model is widely distributed across Indian Territory (24 states including Jammu & Kashmir along with Ladakh and three other union territories) (Bharti & Akbar 2014; Caleb 2016) (Image 6). Therefore, in India *T. rufonigra* shows a continuous distribution pattern whereas *M. melanocephala* shows a highly discontinuous distribution pattern. This big difference in the distribution pattern may be attributed to the gap in studies pertaining to this spider in India. This is also true for many other spider species in India. The spider fauna of India has never been studied in entirety as noted by Keswani et al. (2012). This gap in study in turn may be attributed to a very small number of arachnologists in India. It can also be observed that all the states from which *M. melanocephala* has been reported also have reports of *T. rufonigra*. In the present study also, the spider mimic has been reported from the state where the ant model is already known to exist. Local extinction of *M. melanocephala* in other states where it coexisted with *T. rufonigra* in past or range expansion of *T. rufonigra* outside the states from where *M. melanocephala* have been reported may be speculated as a reason of such a sharp difference in their distribution pattern but it cannot be inferred with certainty because of the huge study gap and also due to high adaptive capabilities of these animals to multiple climatic regions, there is no apparent plausible reason to presume such extreme events in their natural history. Therefore, we suggest that *M. melanocephala* could also be present in other states from which the ant model has already been reported. *M. melanocephala* could have a wider distribution across different states of India vis-à-vis the distribution of the ant model *T. rufonigra*.



Supplementary Video 1. *Myrmarachne melanocephala* MacLeay, 1839. Live male.



Supplementary Video 2. *Tetraponera rufonigra* Jerdon, 1851. Live dealate gyne.



## REFERENCES

- Benjamin, S.P. (2015). Model mimics: antlike jumping spiders of the genus *Myrmarachne* from Sri Lanka. *Journal of Natural History* 49(43–44): 2609–2666. <https://doi.org/10.1080/00222933.2015.1034209>
- Bharti, H. & S.A. Akbar (2014). *Tetraoponera periyarensis*, a new pseudomyrmecine ant species (Hymenoptera: Formicidae) from India. *Asian Myrmecology* 6: 43–48.
- Bharti, H., B. Guénard, M. Bharti & E.P. Economo (2016). An updated checklist of the ants of India with their specific distributions in Indian states (Hymenoptera, Formicidae). *ZooKeys* 2016(551): 1–83. <https://doi.org/10.3897/zookeys.551.6767>
- Bingham, C.T. (1903). *The fauna of British India, including Ceylon and Burma. Hymenoptera, Vol. II. Ants and Cuckoo-wasps*. Taylor and Francis Ltd., London, U.K., 506pp.
- Blackwall, J. (1841). The difference in the number of eyes with which spiders are provided proposed as the basis of their distribution into tribes; with descriptions of newly discovered species and the characters of a new family and three new genera of spiders. *Transactions of the Linnean Society of London* 18: 601–670.
- Bolton, B. (2021). *An Online Catalog of the Ants of the World*. <https://antcat.org> Accessed on 16 August 2021.
- Caleb, J.T.D. (2016). Taxonomic notes on some ant-mimicking jumping spiders (Araneae: Salticidae) from India. *Arthropoda Selecta* 25(4): 403–420. <https://doi.org/10.15298/arthsel.25.4.09>
- Caleb, J.T.D. & S.P. Benjamin (2017). On the type of *Myrmarachne uniseriata* Narayan, 1915 (Araneae: Salticidae), with notes on its synonymy. *Arachnology* 17(6): 294–296. <https://doi.org/10.13156/ARAC.2017.17.6.294>
- Caleb, J.T.D. & P.M. Sankaran (2021). *Araneae of India. Version 2021*. <http://www.indianspiders.in> Accessed on 21 August 2021
- Cushing, P.E. (1997). Myrmecomorphy and myrmecophily in spiders: A review. *Florida Entomologist* 80(2): 165–193. <https://doi.org/10.2307/3495552>
- Edmunds, M. (1974). *Defence in animals: a survey of anti-predator defences*. Burnt Mill (Angleterre): Longman, 381pp.
- Edmunds, M. (1978). On the association between *Myrmarachne* spp. (Salticidae) and ants. *Bulletin of the British Arachnological Society* 4(4): 149–160.
- Edwards, G.B. & S.P. Benjamin (2009). A first look at the phylogeny of the Myrmarachninae, with rediscovery and redescription of the type species of *Myrmarachne* (Araneae: Salticidae). *Zootaxa* 2309: 1–29. <https://doi.org/10.11646/zootaxa.2309.1.1>
- Galiano, M.E. (1969). Salticidae (Araneae) formiciformes. VII. El género *Myrmarachne* Mac Leay, 1839, en America. *Revista Del Museo Argentino Ciencias Naturales Bernardino Rivadavia (Entomologia)* 3: 107–148.
- Jerdon, T.C. (1851). A catalogue of the species of ants found in Southern India. *Madras Journal of Literature and Science* 17: 103–127.
- Keswani, S., P. Hadole & A. Rajoria (2012). Checklist of spiders (Arachnida: Araneae) from India. *Indian Journal of Arachnology* 1(1): 1–129
- Kranzfelder, P., T. Ekrem & E. Stur (2017). DNA barcoding for species identification of insect skins: A test on chironomidae (Diptera) pupal exuviae. *Journal of Insect Science* 17(6)(111): 1–7. <https://doi.org/10.1093/jisesa/iex075>
- Lin, X. L., E. Stur & T. Ekrem (2017). DNA barcodes and morphology reveal unrecognized species in chironomidae (Diptera). *Insect Systematics and Evolution* 49(4): 329–398. <https://doi.org/10.1163/1876312X-00002172>
- MacLeay, W.S. (1839). On some new forms of Arachnida. *Annals of Natural History* 2(7): 1–14. <https://doi.org/10.1080/00222933809496646>
- Maddison, W.P. (2015). A phylogenetic classification of jumping spiders (Araneae: Salticidae). *Journal of Arachnology* 43(3): 231–292.
- Oliviera, P.S. (1988). Ant-mimicry in some Brazilian salticid and clubionid spiders (Araneae: Salticidae, Clubionidae). *Biological Journal of the Linnean Society* 33(1): 1–15. <https://doi.org/10.1111/j.1095-8312.1988.tb00443.x>
- Peckham, G.W. & E.G. Peckham (1885). Genera of the family Attidae: with a partial synonymy. *Transactions of the Wisconsin Academy of Sciences, Arts and Letters* 6: 255–342.
- Pekár, S. (2014). Is inaccurate mimicry ancestral to accurate in myrmecomorphic spiders (Araneae)? *Biological Journal of the Linnean Society* 113(1): 97–111. <https://doi.org/10.1111/bij.12287>
- Pekar, S. & M. Jarab (2011a). Life-history constraints in inaccurate Batesian myrmecomorphic spiders (Araneae: Corinnidae, Gnaphosidae). *European Journal of Entomology* 108(2): 255–260. <https://doi.org/10.14411/eje.2011.034>
- Pekár, S. & M. Jarab (2011b). Assessment of color and behavioral resemblance to models by inaccurate myrmecomorphic spiders (Araneae). *Invertebrate Biology* 130(1): 83–90. <https://doi.org/10.1111/j.1744-7410.2010.00217.x>
- Pocock, R.I. (1909). Mimicry in spiders. *Journal of the Linnean Society of London, Zoology* 30(199): 256–270. <https://doi.org/10.1111/j.1096-3642.1909.tb02405.x>
- Prószyński, J. (2016). Delimitation and description of 19 new genera, a subgenus and a species of Salticidae (Araneae) of the world. *Ecologica Montenegrina* 7: 4–32.
- Smith, F. (1852). Descriptions of some hymenopterous insects captured in India, with notes on their economy, by Ezra T. Downes, Esq., who presented them to the Honourable the East India Company. *Annals and Magazine of Natural History* 2(9): 44–50.
- Smith, F. (1877). Descriptions of new species of the genera *Pseudomyrma* and *Tetraoponera*, belonging to the family Myrmecidae. *Transactions of the Entomological Society of London* 1877: 57–72.
- Wanless, F.R. (1978). A revision of the spider genera *Belippo* and *Myrmarachne* (Araneae: Salticidae) in the Ethiopian region. *Bulletin of the British Museum of Natural History (Zoology)* 33(1): 1–139.
- Ward, P.S. (1990). The ant subfamily Pseudomyrmecinae (Hymenoptera: Formicidae): generic revision and relationship to other formicids. *Systematic Entomology* 15: 449–489.
- Ward, P.S. (2001). Taxonomy, phylogeny and biogeography of the ant genus *Tetraoponera* (Hymenoptera: Formicidae) in the Oriental and Australian regions. *Invertebrate Systematics* 15(5): 589–665. <https://doi.org/10.1071/it01001>
- Wheeler, W.M. (1922). Ants of the American Museum Congo expedition. *Bulletin of the American Museum of Natural History, New York*, 1139pp.
- World Spider Catalog (2021). *World Spider Catalog. Version 22.0*. *Natural History Museum Bern*. <https://wsc.nmbe.ch/> Accessed on 16 August 2021.
- Yamasaki, T. & G.B. Edwards (2013). The genus *Myrmarachne* (Araneae, Salticidae) in Flores, Indonesia. *ZooKeys* 299: 1–20. <https://doi.org/10.3897/zookeys.299.4970>
- Yamasaki, T. (2010). Redescription of two Bornean species of the genus *Myrmarachne* (Araneae: Salticidae). *Acta Arachnologica* 59(2): 63–66. <https://doi.org/10.2476/asjaa.59.63>
- Yamasaki, T. & A.H. Ahmad (2013). Taxonomic study of the genus *Myrmarachne* of Borneo (Araneae: Salticidae). *Zootaxa* 3710(6): 501–556. <https://doi.org/10.11646/zootaxa.3710.6.1>





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 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 Sondhi, TITLI TRUST, Kalpvriksh, 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. Niyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India  
Dr. John T.D. Caleb, Zoological Survey of India, Kolkata, West Bengal, India  
Dr. Priyadarsanan Dharma Rajan, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Bangalore, Karnataka, India

#### Fishes

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

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

#### Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy  
Dr. Anwaruddin Chowdhury, Guwahati, India  
Dr. David Mallon, Zoological Society of London, UK  
Dr. Shomita Mukherjee, SACON, Coimbatore, Tamil Nadu, India  
Dr. Angie Appel, Wild Cat Network, Germany  
Dr. P.O. Nameer, Kerala Agricultural University, Thrissur, Kerala, India  
Dr. Ian Redmond, UNEP Convention on Migratory Species, Lansdown, UK  
Dr. Heidi S. Riddle, Riddle's Elephant and Wildlife Sanctuary, Arkansas, USA  
Dr. Karin Schwartz, George Mason University, Fairfax, Virginia.  
Dr. Lala A.K. Singh, Bhubaneswar, Orissa, India  
Dr. Mewa Singh, Mysore University, Mysore, India  
Dr. Paul Racey, University of Exeter, Devon, UK  
Dr. Honnavalli N. Kumara, SACON, Anaikatty P.O., Coimbatore, Tamil Nadu, India  
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India  
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy  
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India  
Dr. H. Raghuram, 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 Challenger, 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 2018–2020

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.

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

NAAS rating (India) 5.64

Print copies of the Journal are available at cost. Write to:  
The Managing Editor, JoTT,  
c/o Wildlife Information Liaison Development Society,  
No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road,  
Saravanampatti, Coimbatore, Tamil Nadu 641035, India  
ravi@threatenedtaxa.org



OPEN ACCESS



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

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

October 2021 | Vol. 13 | No. 12 | Pages: 19675–19886

Date of Publication: 26 October 2021 (Online & Print)

DOI: 10.11609/jott.2021.13.12.19675-19886

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

#### Articles

**Roosting habits and habitats of the Indian Flying Fox *Pteropus medius* Temminck, 1825 in the northern districts of Tamil Nadu, India**  
– M. Pandian & S. Suresh, Pp. 19675–19688

**Diversity and distribution of avifauna at Warathenna-Hakkinda Environmental Protection Area in Kandy, Sri Lanka**  
– Dinelka Thilakarathne, Tithira Lakkana, Gayan Hirimuthugoda, Chaminda Wijesundara & Shalika Kumburegama, Pp. 19689–19701

**Grass species composition in tropical forest of southern India**  
– M. Ashokkumar, S. Swaminathan & R. Nagarajan, Pp. 19702–19713

#### Communications

**Habitat use and conservation threats to Wild Water Buffalo *Bubalus arnee* (Mammalia: Artiodactyla: Bovidae) in Koshi Tappu Wildlife Reserve, Nepal**  
– Reeta Khulal, Bijaya Neupane, Bijaya Dhami, Siddhartha Regmi, Ganesh Prasad Tiwari & Manita Parajuli, Pp. 19714–19724

**Get my head around owls: people perception and knowledge about owls of Andaman Islands**  
– Shanmugavel Sureshmarimuthu, Santhanakrishnan Babu, Nagaraj Rajeshkumar & Honnavalli Nagaraj Kumara, Pp. 19725–19732

**Abundance and diversity of threatened birds in Nangal Wetland, Punjab, India**  
– Rajwinder Kaur & Onkar Singh Braich, Pp. 19733–19742

**Evaluation of fish diversity and abundance in the Kabul River with comparisons between reaches above and below Kabul City, Afghanistan**  
– Ugyen Kelzang, Ahmad Farid Habibi & Ryan J. Thoni, Pp. 19743–19752

**New record of *Myrmarachne melanocephala* MacLeay, 1839 (Araneae: Salticidae) from Jharkhand, India and biogeographical implications of the co-occurrence of its ant model *Tetraponera rufonigra* Jerdon, 1851**  
– Rahul Kumar, Mirtunjay Sharma & Ajay Kumar Sharma, Pp. 19753–19761

**Diversity of spiders (Arachnida: Araneae) and the impact of pruning in Indian sandalwood plantations from Karnataka, India**  
– S. Padma 1 & R. Sundararaj, Pp. 19762–19772

**New records of cheilostome Bryozoa from the eastern coast of India encrusting on the exoskeleton of live horseshoe crabs of Indian Sundarbans**  
– Swati Das, Maria Susan Sanjay, Basudev Tripathy, C. Venkatraman & K.A. Subramanian, Pp. 19773–19780

**On the pteridophytes of Bherjan-Borajan-Padumoni Wildlife Sanctuary, Assam, India**  
– Pranjal Borah & Jayanta Barukial, Pp. 19781–19790

**Population status of *Heritiera fomes* Buch.-Ham., a threatened species from Mahanadi Mangrove Wetland, India**  
– Sudam Charan Sahu, Manas Ranjan Mohanta & N.H. Ravindranath, Pp. 19791–19798

**Additions to the lichenized and lichenicolous fungi of Jammu & Kashmir from Kishtwar High Altitude National Park**  
– Vishal Kumar, Yash Pal Sharma, Siljo Joseph, Roshinikumar Ngangom & Sanjeeva Nayaka, Pp. 19799–19807

#### Short Communications

**Is release of rehabilitated wildlife with embedded lead ammunition advisable? Plumbism in a Jaguar *Panthera onca* (Mammalia: Carnivora: Felidae), survivor of gunshot wounds**  
– Eduardo A. Díaz, Carolina Sáenz, E. Santiago Jiménez, David A. Egas & Kelly Swing, Pp. 19808–19812

**New record of the Sewing Needle Zipper Loach *Paracanthocobitis linypha* Singer & Page, 2015 (Teleostei: Cypriniformes: Nemacheilidae) from the Chindwin drainage of Manipur, India**  
– Yumnam Rameshori, Yengkhom Chinglemba & Waikhom Vishwanath, Pp. 19813–19817

**Field identification characters to diagnose *Microhyla mukhlesuri* from closely related *M. mymensinghensis* (Amphibia: Microhylidae) and range extension of *M. mukhlesuri* up to West Bengal State, India**  
– Suman Pratihar & Kaushik Deuti, Pp. 19818–19823

**First report of *Scipinia horrida* (Stål) (Heteroptera: Reduviidae) from Assam, with comments on related genus *Irantha* Stål**  
– Anjana Singha Naorem, Santana Saikia, Anandita Buragohain, Rubina Azmeera Begum, Swapnil S. Boyane & Hemant V. Ghate, Pp. 19824–19830

**Flesh fly (Diptera: Sarcophagidae): male terminalia, diversity and expanded geographical distribution from India**  
– Kanholi Sreejith, Shuvra Kanti Sinha, Santanu Mahato & Edamana Pushpalatha, Pp. 19831–19836

**Checklist of moths (Heterocera) of Tadong, Sikkim, India**  
– Prayash Chettri, Yuki Matsui, Hideshi Naka & Archana Tiwari, Pp. 19837–19848

**New distribution records of *Begonia* L., *B. murina* Craib and *B. poilanei* Kiew (Begoniaceae: Cucurbitales) for Laos**  
– Phongphayboun Phonepaseuth, Phetlasy Souladeth, Soulivanh Lanorsavanh, Shuichiro Tagane, Thyraphon Vongthavone & Keoudone Souvannakhoummane Pp. 19849–19854

#### Notes

**A recent sighting of the Stripe-backed Weasel *Mustela strigidorsa* (Mammalia: Carnivora: Mustelidae) in Hkakabo Razi Landscape, Myanmar**  
– Sai Sein Lin Oo, Tun Tun, Kyaw Myo Naing & Paul Jeremy James Bates, Pp. 19855–19859

**Are the uplifted reef beds in North Andaman letting nesting Olive Ridley Sea Turtle *Lepidochelys olivacea* stranded?**  
– Nehru Prabakaran, Anoop Raj Singh & Vedagiri Thirumurugan, Pp. 19860–19863

**First record of the orb-weaving spider *Araneus tubabdominus* Zhu & Zhang, 1993 (Araneae: Araneidae) from India**  
– Souvik Sen, John T.D. Caleb & Shelley Acharya, Pp. 19864–19866

**The genus *Catapiestus* Perty, 1831 (Coleoptera: Tenebrionidae: Cnodalonini) from Arunachal Pradesh with one new record to India**  
– V.D. Hegde & Sarita Yadav, Pp. 19867–19869

**Rediscovery and extended distribution of *Indigofera santapau* Sanjappa (Leguminosae: Papilionoideae) from the states of Maharashtra and Gujarat, India**  
– Kumar Vinod Chhotupuri Gosavi, Sanjay Gajanan Auti, Sharad Suresh Kambale & Munivenkatappa Sanjappa, Pp. 19870–19873

**Additional distribution records of *Ceropegia anjanerica*, an endemic and 'Endangered' lantern flower of the northern Western Ghats, India**  
– Samir Shrikant Maity, Ajay Natha Gangurde, Sharad Suresh Kambale, Avinash Ramchandra Gholave, Avinash Asraji Adsul, Ganesh Babaso Pawar & Kumar Vinod Chhotupuri Gosavi, Pp. 19874–19877

**Notes on the extended distribution of *Impatiens megamalayana*, a recently described balsam in Western Ghats, India**  
– Anoop P. Balan & A.J. Robi, Pp. 19878–19883

#### Book Review

**A look over on the scented tree of India (*Santalum album*)**  
– S. Suresh Ramanan & A. Arunachalam, Pp. 19884–19886

Publisher & Host

