



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

Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

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

NOTE

BREEDING BIOLOGY OF MALABAR TREE TOAD *PEDOSTIBES TUBERCULOSUS* (ANURA: BUFONIDAE) FROM CASTLE ROCK, KARNATAKA, INDIA

Deepak Deshpande & Nikhil Gaitonde

26 September 2020 | Vol. 12 | No. 13 | Pages: 16912–16915

DOI: 10.11609/jott.5308.12.13.16912-16915



For Focus, Scope, Aims, Policies, and Guidelines visit <https://threatenedtaxa.org/index.php/JoTT/about/editorialPolicies#custom-0>

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

For Policies against Scientific Misconduct, visit <https://threatenedtaxa.org/index.php/JoTT/about/editorialPolicies#custom-2>

For reprints, contact <ravi@threatenedtaxa.org>

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.

Member



Publisher & Host





Breeding biology of Malabar Tree Toad *Pedostibes tuberculosus* (Anura: Bufonidae) from Castle Rock, Karnataka, India

Deepak Deshpande¹ & Nikhil Gaitonde²

¹Vishwas Hospital, Old Pune Bangalore Road, Sakharwadi, Nipani, Karnataka 591237, India.

²7, Sukhaniwas, 10th lane, Prabhat road, Pune, Maharashtra 411004, India.

¹vishwashospital@rediffmail.com, ²nngaitonde@gmail.com (corresponding author)

The Western Ghats biodiversity hotspot harbors a wide variety of herpetofauna, especially anurans, with many endemic and endangered species (Roelants et al. 2004; Naniwadekar & Vasudevan 2006; Chandramouli & Ganesh 2010; Van Bocxlaer et al. 2012; Dahanukar et al. 2016). Anurans in the Western Ghats face numerous threats such as habitat loss, pollution and changing climate, and are endangered due to their small populations, specialized adaptations, and narrow distributions (Naniwadekar & Vasudevan 2006; Van Bocxlaer et al. 2012; Dahanukar et al. 2013; Gaitonde et al. 2016; Thorpe et al. 2018). Despite the endangered status of many Western Ghats endemic anurans, their natural history is largely unknown, hampering conservation efforts. We, therefore, report the breeding behavior of the Western Ghats endemic toad, *Pedostibes tuberculosus* from the northern Western Ghats and highlight the variation in their reproductive traits from populations distributed along the length of the Western Ghats. This will not only help in conservation prioritization, but also aid in the systematics of this group (Das et al. 2006).

The genus *Pedostibes* Günther, 1876 (Anura: Bufonidae) along with other endemic genera such as *Xanthophryne* and *Ghatophryne*, is a part of the Bufonidae lineage that dispersed into the Western

Ghats and diversified during the Miocene (Van Bocxlaer et al. 2009; Chan et al. 2016). Many species of these endemic genera are patchily distributed, and are highly specialized to their habitats with strict micro-habitat requirements, making them vulnerable to climate change (Biju et al. 2009; Gaitonde et al. 2016; Thorpe et al. 2018). For example, the northern Western Ghats endemic *Xanthophryne* species, exclusively use lateritic rocky outcrops as breeding habitats and lay eggs only in shallow ephemeral rocky pools/ semi-aquatic rocky habitats which are vulnerable to desiccation, and their embryos undergo largescale mortality due to stochastic fluctuations in humidity and temperature (Biju et al. 2009; Gaitonde et al. 2016; Thorpe et al. 2018). *Pedostibes* also exhibits several specialized adaptations such as, an arboreal habit, a short breeding period, and rapidly developing exposed embryos in aquatic/ semi-aquatic conditions and may be vulnerable to environmental fluctuations during their breeding period (Dinesh & Rahakrishnan 2013; Chan et al. 2016; Sayyed & Nale 2017). There is limited information on the reproductive biology of *P. tuberculosus* and its mating sequence and spawning behavior has not been documented in details.

Here, we describe the breeding behavior of *P. tuberculosus* with a pictorial sequence of their mating and spawning behavior, opportunistically encountered

Editor: Neelesh Dahanukar, Indian Institutes of Science Education and Research (IISER), Pune, India.

Date of publication: 26 September 2020 (online & print)

Citation: Deshpande, D. & N. Gaitonde (2020). Breeding biology of Malabar Tree Toad *Pedostibes tuberculosus* (Anura: Bufonidae) from Castle Rock, Karnataka, India. *Journal of Threatened Taxa* 12(13): 16912–16915. <https://doi.org/10.11609/jott.5308.12.13.16912-16915>

Copyright: © Deshpande & Gaitonde 2020. 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: NG was supported by a bridging postdoctoral fellowship from the National Centre for Biological Sciences during the writing of the manuscript.

Competing interests: The authors declare no competing interests.



during field-work at Castle Rock, Karnataka, India.

Castle Rock (Latitude 15.41 & Longitude 74.33) is situated at an altitude of 620m, on the Goa-Karnataka border and has tropical semi-evergreen forests with numerous mountain streams. *Pedostibes tuberculosus* is locally abundant at Castle Rock and is found near perennial streams and agricultural canals. Observations for the current study were taken in an agricultural water-channel situated in a patch of evergreen forest. The channel was mostly dry and had a single 0.3m wide and 10m long pool of water fed by a small water cascade at one end. The water column was ~2–3 inches deep and channel was filled with leaf litter and surrounded by thick undergrowth.

During a light pre-monsoon rainfall, we opportunistically encountered an aggregation of *P. tuberculosus* males at around 23.00h near an agricultural canal fed by a perennial stream. Males were observed calling repeatedly while perched on vegetation at a height of about ~1m from the ground (Image 1, A). Approximately, 15 males were observed in a 10m² area. The males were calling repeatedly, and constantly shifted their positions on nearby vegetation. At times, they wrestled with each other in short duels lasting 10–30 seconds. At 01.00h, the first pair in an axillary amplexus was observed on the ground, initially motionless, but soon started moving around presumably searching for a suitable oviposition site (Image 1B). At 03.00h the pair entered shallow water but were chased away by a *Duttaphrynus* sp. males in full breeding-color, who had also aggregated to breed in the same pool, slightly further away. Eventually, at 03.45h the *P. tuberculosus* pair found shallow water where they were not disturbed and started oviposition (Image 1C). The female was submerged in water up to her throat whereas; only a small part of the male's hindquarters was submerged (Image 1D). The male's hind limbs were positioned between the hind limbs of the female and the male's feet were spread beneath the female's abdomen (Image 1C). During oviposition, the female arched her back downwards and extended her hind limbs and deposited 10–20 eggs at a time. The male simultaneously performed 2–3 pelvic thrusts presumably to release sperms over the freshly released eggs. After depositing the eggs, the pair moved 10–20 cm away from the previous oviposition site and sat motionless until the female was ready to lay the next set of eggs. The female laid eggs in several bouts and the initial clutches contained 20–60 eggs (first two bouts) while subsequent clutches had fewer eggs (next four to five bouts). The female laid approximately 150 eggs by the time the mating concluded. The fresh eggs

were brownish in color and a clump of eggs laid was later extended as a loose string with few detached single eggs. Subsequently, a few more pairs started oviposition at the same site. After about an hour, the focal pair had finished laying all the eggs and the male released the female from a tight axillary amplexus and crawled into the bushes. We observed the female arch her back after being released from amplexus, and soon left the oviposition site, completing the mating sequence. The other pairs formed later continued oviposition in the same manner described above until early morning (05.00h). Sympatric anurans at the breeding site of *P. tuberculosus* included *Raorchestes* sp., and *Duttaphrynus* sp. We also observed two species of snakes, *Macropisthodon plumbicolor* Green Keelback and *Xenochrophis piscator* Checkered Keelback, near the breeding site and may be potential predators of *P. tuberculosus*. The stagnant water pool where eggs were deposited and tadpoles developed, contained *Chironomus* larvae and plenty of leaf litter.

Anurans have evolved a high diversity of reproductive behaviors in response to the varied habitats they occupy, and exhibit distinct reproductive strategies to overcome numerous biotic and abiotic challenges (Haddad & Prado 2005; Wells 2007; Crump 2015). The Western Ghats endemic toad lineages have locally adapted to specific microhabitats (Van Bocxlaer et al. 2010; Thorpe et al. 2018), and understanding the reproductive biology of anurans of the Western Ghats will not only help conservation prioritization by identifying breeding sites and specific micro-habitat requirements, but also help understand the role of ecological factors in shaping reproductive behaviors and mating systems. *Pedostibes tuberculosus* shares several traits with other Bufonid lineages, such as, a semi-terrestrial adult niche, parotid glands, ability to use a wide variety of oviposition sites, and, rapidly developing exotrophous tadpoles, that aided the dispersal of the Bufonid lineage helping it attain a global distribution (Pramuk et al. 2007; Van Bocxlaer et al. 2010). On the other hand, reproductive traits such as, a small clutch size and loose single eggs often exposed to semi-aquatic conditions, seem to have evolved in response to local conditions in Western Ghats endemic toads *Pedostibes* and *Xanthophryne*, and highlight the adaptive nature of reproductive traits in the Bufonid lineage (Gaitonde et al. 2016). A novel case of pelvic thrusts during amplexus was first reported in *Xanthophryne* toads (Gaitonde et al. 2016), but we observed similar behavior in *P. tuberculosus* from the northern Western Ghats, and the pelvic thrusts seems to be widespread among bufonid species, where they possibly function to increase fertilization success,

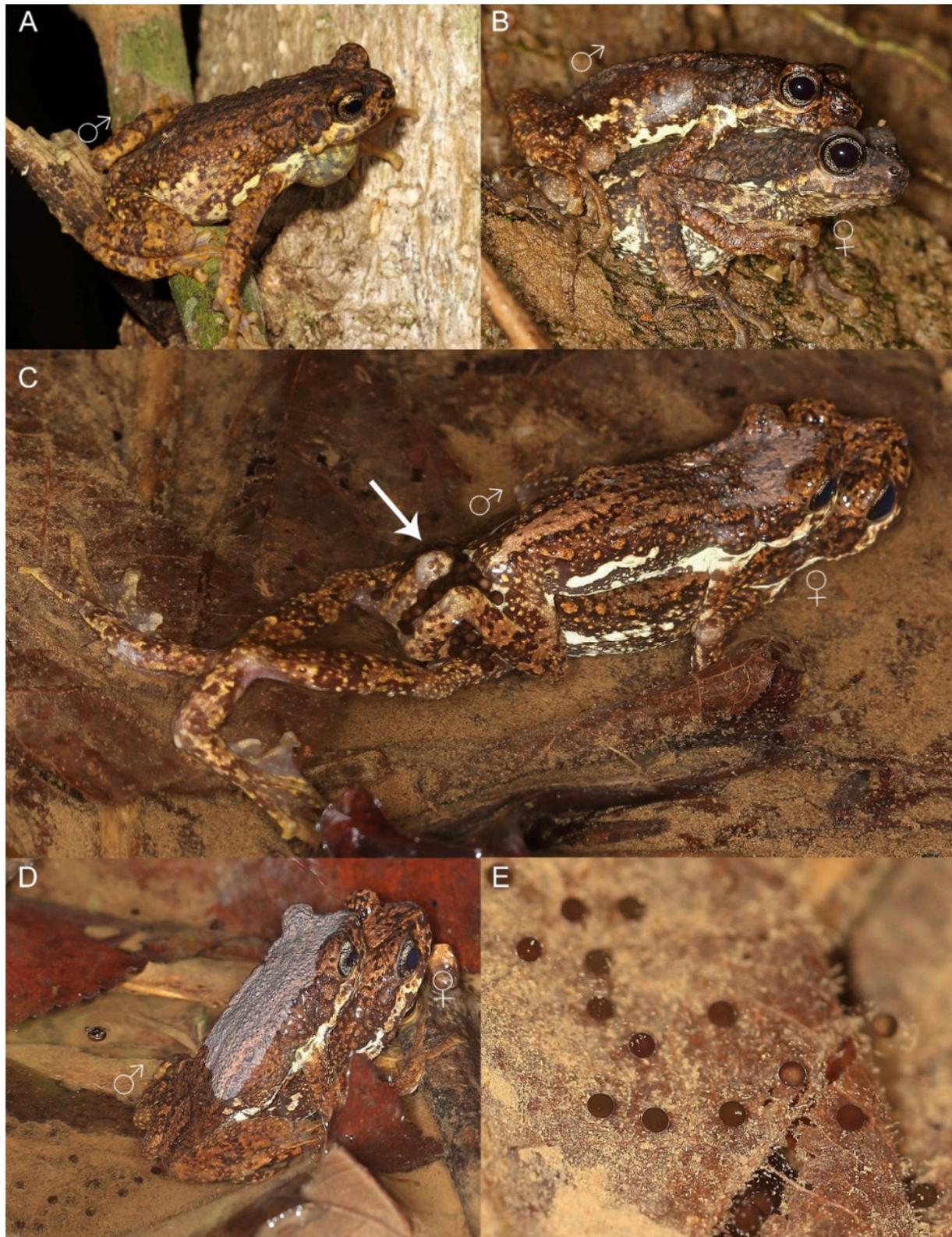


Image 1. Mating sequence of *Pedostibes tuberculosus* from Castle Rock, Karnataka, India: A—males usually perch on vegetation at about ~1m above ground and have a single gular vocal sac | B—a mating pair in a tight axillary amplexus | C—the female carries the male in amplexus in search of suitable oviposition sites, and the female extends her hind limbs and arches her back to release a clump of eggs. As soon as the female spawns, the male simultaneously thrusts his pelvis probably to deposit sperms on the eggs while holding the egg clump with its hind limbs | D—the oviposition site is a shallow stagnant pool of water filled with leaf litter | E—as the pair moves forward before depositing more eggs, the deposited egg clump is later extended in loosely attached eggs which float on the shallow water column. © Deepak Deshpande.

especially in species breeding in semi-aquatic habitats. Precise estimates of fertilization and hatching success, however, need to be measured in *P. tuberculosis*. We observed tadpoles of *P. tuberculosis* to develop rapidly and metamorphose in approximately a month, which is consistent with earlier study (Dinesh & Rahakrishnan 2013).

Pedostibes tuberculosis populations in the Western Ghats exhibit substantial variation in crucial life history traits such as clutch size and choice of the oviposition site. For example, *P. tuberculosis* populations in southern India are reported to oviposit approximately 1,100 eggs after a single mating (Chan et al. 2016), whereas, at Castle Rock we observed females to lay only 150 eggs. A clutch size of 250 eggs is also reported for *P. tuberculosis* from an unknown location as a personal observation (Van Bocxlaer et al. 2009). Such magnitude differences in crucial life history traits such as clutch size are unlikely to be observed within a species; and life history traits of *P. tuberculosis* need to be estimated in other populations along with evaluating species diversity. Apart from clutch size, *P. tuberculosis* seems to exhibit substantial variation in oviposition sites, and populations from southern Western Ghats are reported to lay eggs in hollow cavities on tree barks, or, in clumps of *Ochlandrae* (Dinesh & Rahakrishnan 2013; Chan et al. 2016); whereas, populations in the northern Western Ghats lay eggs in shallow ephemeral pools of water or on wet ground at the edge of streams without considerable standing water (Van Bocxlaer et al. 2009; Sayyed & Nale 2017). The variation in oviposition sites indicates the utilization of suitable sites in local habitats and suggests reproductive behavior of *P. tuberculosis* to be influenced by local availability of resources.

References

- Biju, S., I. Van Bocxlaer, V.B. Giri, S.P. Loader & F. Bossuyt (2009). Two new endemic genera and a new species of toad (Anura: Bufonidae) from the Western Ghats of India. *BMC Research Notes* 2(1): 241. <https://doi.org/10.1186/1756-0500-2-241>
- Chan, K.O., L.L. Grismer, A. Zachariah, R.M. Brown & R.K. Abraham (2016). Polyphyly of Asian Tree Toads, Genus *Pedostibes* Günther, 1876 (Anura: Bufonidae), and the description of a new genus from southeast Asia. *PLOS ONE* 11(1): e0145903. <https://doi.org/10.1371/journal.pone.0145903>
- Chandramouli, S.R. & S.R. Ganesh (2010). Herpetofauna of southern Western Ghats, India – Reinvestigated after decades. *Taprobanica* 02(02): 72–85.
- Crump, M.L. (2015). Anuran reproductive modes: evolving perspectives. *Journal of Herpetology* 49(1): 1–16. <https://doi.org/10.1670/14-097>
- Dahanukar, N., K. Krutha, M.S. Paingankar, A.D. Padhye, N. Modak & S. Molur (2013). Endemic Asian chytrid strain infection in threatened and endemic anurans of the northern Western Ghats, India. *PLoS ONE* 8(10): e77528. <https://doi.org/10.1371/journal.pone.0077528>
- Dahanukar, N., N. Modak, K. Krutha, P.O. Nameer, A.D. Padhye & S. Molur (2016). Leaping frogs (Anura: Ranixalidae) of the Western Ghats of India: an integrated taxonomic review. *Journal of Threatened Taxa* 8(10): 9221–9288. <https://doi.org/10.11609/jott.2532.8.10.9221-9288>
- Das, A., J. Krishnaswamy, K.S. Bawa, M.C. Kiran, V. Srinivas, N.S. Kumar & K.U. Karanth (2006). Prioritisation of conservation areas in the Western Ghats, India. *Biological Conservation* 133(1): 16–31. <https://doi.org/10.1016/j.biocon.2006.05.023>
- Dinesh, K.P. & C. Rahakrishna (2013). Description of tadpole stages of the Malabar Tree Toad *Pedostibes tuberculosis* Günther, 1875 (Anura: Bufonidae). *Journal of Threatened Taxa* 5(14): 4910–4912.; <https://doi.org/10.11609/JoTT.o3398.4910-2>
- Gaitonde, N., V. Giri & K. Kunte (2016). 'On the rocks': reproductive biology of the endemic toad *Xanthophryne* (Anura: Bufonidae) from the Western Ghats, India. *Journal of Natural History* 2933(July): 1–16. <https://doi.org/10.1080/00222933.2016.1200686>
- Haddad, C.F.B. & C.P.A. Prado (2005). Reproductive modes in frogs and their unexpected diversity in the Atlantic Forest of Brazil. *BioScience* 55(3): 207. [https://doi.org/10.1641/0006-3568\(2005\)55\(3\):207](https://doi.org/10.1641/0006-3568(2005)55(3):207)
- Naniwadekar, R. & K. Vasudevan (2006). Patterns in diversity of anurans along an elevational gradient in the Western Ghats, South India. *Journal of Biogeography* 34(5): 842–853. <https://doi.org/10.1111/j.1365-2699.2006.01648.x>
- Pramuk, J.B., T. Robertson, J.W. Sites & B.P. Noonan (2007). Around the world in 10 million years: biogeography of the nearly cosmopolitan true toads (Anura: Bufonidae). *Global Ecology and Biogeography* 17(1): 72–83. <https://doi.org/10.1111/j.1466-8238.2007.00348.x>
- Roelants, K., J. Jiang & F. Bossuyt (2004). Endemic ranid (Amphibia: Anura) genera in southern mountain ranges of the Indian subcontinent represent ancient frog lineages: evidence from molecular data. *Molecular Phylogenetics and Evolution* 31(2): 730–740. <https://doi.org/10.1016/j.ympev.2003.09.011>
- Sayyed, A. & A. Nale (2017). New Distribution Record and Intergeneric Amplexus in the Malabar Tree Toad, *Pedostibes tuberculosis* Günther 1875 (Amphibia: Anura: Bufonidae). *Reptiles and Amphibians: Conservation and Natural History* 24(3): 193–196.
- Thorpe, C.J., T.R. Lewis, S. Kulkarni, A. Watve, N. Gaitonde, D. Pryce & M.E. Knight (2018). Micro-habitat distribution drives patch quality for sub-tropical rocky plateau amphibians in the northern Western Ghats, India. *PLOS ONE* 13(3): e0194810. <https://doi.org/10.1371/journal.pone.0194810>
- Van Bocxlaer, I., S.D. Biju, S.P. Loader & F. Bossuyt (2009). Toad radiation reveals into-India dispersal as a source of endemism in the Western Ghats-Sri Lanka biodiversity hotspot. *BMC Evolutionary Biology* 9(1): 131. <https://doi.org/10.1186/1471-2148-9-131>
- Van Bocxlaer, I., S.D. Biju, B. Willaert, V.B. Giri, Y.S. Shouche & F. Bossuyt (2012). Mountain-associated clade endemism in an ancient frog family (Nyctibatrachidae) on the Indian subcontinent. *Molecular Phylogenetics and Evolution* 62(3): 839–847. <https://doi.org/10.1016/j.ympev.2011.11.027>
- Van Bocxlaer, I., S.P. Loader, K. Roelants, S.D. Biju, M. Menegon & F. Bossuyt (2010). Gradual adaptation toward a range-expansion phenotype initiated the global radiation of toads. *Science* 327(5966): 679–682. <https://doi.org/10.1126/science.1181707>
- Wells, K.D. (2007). *The Ecology and Behavior of Amphibians*. University of Chicago Press.



www.threatenedtaxa.org

PLATINUM
OPEN ACCESS



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

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

September 2020 | Vol. 12 | No. 13 | Pages: 16715–16926

Date of Publication: 26 September 2020 (Online & Print)

DOI: 10.11609/jott.2020.12.13.16715-16926

Review

A history of primatology in India (In memory of Professor Sheo Dan Singh)

– Mewa Singh, Mridula Singh, Honnavalli N. Kumara, Dilip Chetry & Santanu Mahato, Pp. 16715–16735

Communications

University campuses can contribute to wildlife conservation in urbanizing regions: a case study from Nigeria

– Iliyasu Simon, Jennifer Che & Lynne R. Baker, Pp. 16736–16741

Killer Whale *Orcinus orca* (Linnaeus, 1758) (Mammalia: Cetartiodactyla: Delphinidae) predation on Sperm Whales *Physeter macrocephalus* Linnaeus, 1758 (Mammalia: Cetartiodactyla: Physeteridae) in the Gulf of Mannar, Sri Lanka

– Ranil P. Nanayakkara, Andrew Sutton, Philip Hoare & Thomas A. Jefferson, Pp. 16742–16751

The Critically Endangered White-rumped Vulture *Gyps bengalensis* in Sigur Plateau, Western Ghats, India: Population, breeding ecology, and threats

– Arockianathan Samson & Balasundaram Ramakrishnan, Pp. 16752–16763

Avifauna of Saurashtra University Campus, Rajkot, Gujarat, India

– Varsha Trivedi & Sanjay Vaghela, Pp. 16764–16774

Five new species of trap-door spiders (Araneae: Mygalomorphae: Idiopidae) from India

– Manju Siliwal, Rajshekhar Hippargi, Archana Yadav & Dolly Kumar, Pp. 16775–16794

Rapid multi-taxa assessment around Dhamapur Lake (Sindhudurg, Maharashtra, India) using citizen science reveals significant odonate records

– Neha Mujumdar, Dattaprasad Sawant, Amila Sumanapala, Parag Rangnekar & Pankaj Koparde, Pp. 16795–16818

Commercially and medicinally significant aquatic macrophytes: potential for improving livelihood security of indigenous communities in northern Bihar, India

– Shailendra Raut, Nishikant Gupta, Mark Everard & Indu Shekhar Singh, Pp. 16819–16830

Leaf nutrients of two *Cycas* L. species contrast among in situ and ex situ locations

– Thomas E. Marler & Anders J. Lindström, Pp. 16831–16839

Contribution to the Macromycetes of West Bengal, India: 69–73

– Diptosh Das, Prakash Pradhan, Debal Ray, Anirban Roy & Krishnendu Acharya, Pp. 16840–16853

Short Communications

A new species of *Platylestes* Selys (Odonata: Zygoptera: Lestidae) from the coastal area of Kannur District, Kerala, India

– K.G. Emiliyamma, Muhamed Jafer Palot & C. Charesh, Pp. 16854–16860

A first complete documentation of the early stages of Hampson's Hedge Blue *Acytrolepis lilacea lilacea* Hampson, 1889 (Lepidoptera: Lycaenidae) from Western Ghats, Kerala, India

– V.K. Chandrasekharan & Muhamed Jafer Palot, Pp. 16861–16867

A checklist of butterfly fauna of Bankura Town, West Bengal, India

– Ananya Nayak, Pp. 16868–16878

A diversity of spiders (Arachnida: Araneae) from a cashew ecosystem in Kerala, India

– Mamparambath Subramanian Smitha & Ambalaparambil V. Sudhikumar, Pp. 16879–16884

Clinical and pathological findings in a Dwarf Red Brocket *Mazama rufina* (Mammalia: Cetartiodactyla: Cervidae) attacked by dogs

– Eduardo Alfonso Díaz, Gustavo Donoso, Carolina Sáenz, Ivette Dueñas & Francisco Cabrera, Pp. 16885–16890

Indigenous uses and traditional practices of endemic and threatened Chilgoza Pine *Pinus gerardiana* Wall. ex D. Don by tribal communities in Kinnaur District, Himachal Pradesh, northwestern Himalaya

– Swaran Lata, P.S. Negi, S.S. Samant, M.K. Seth & Varsha, Pp. 16891–16899

Notes

Range extension and first confirmed record of the Flightless Anomalure *Zenkerella insignis* (Matschie, 1898) (Mammalia: Rodentia: Anomaluridae) in Nigeria

– Dolapo Oluwafemi Adejumo, Taiye Adeniyi Adeyanju & Temidayo Esther Adeyanju, Pp. 16900–16903

Power lines as a threat to a canopy predator: electrocuted Harpy Eagle in southwestern Brazilian Amazon

– Almério Câmara Gusmão, Danilo Degra, Odair Diogo da Silva, Lucas Simão de Souza, Angélica Vilas Boas da Frota, Carlos Augusto Tuyama, Maria Cristina Tuyama, Thatiane Martins da Costa, Ana Paula Dalbem, Adrian A. Barnett, Francisca Helena Aguiar-Silva & Manoel dos Santos Filho, Pp. 16904–16908

First record of the Assam Leaf Turtle *Cyclemys gemeli* (Fritz et al. 2008) (Reptilia: Testudines: Geoemydidae) from the Darjeeling-Sikkim Himalaya, India

– Aditya Pradhan, Niranjana Chettri & Saibal Sengupta, Pp. 16909–16911

Breeding biology of Malabar Tree Toad *Pedostibes tuberculosus* (Anura: Bufonidae) from Castle Rock, Karnataka, India

– Deepak Deshpande & Nikhil Gaitonde, Pp. 16912–16915

First record of *Ourapteryx dierli* Inoue, 1994 (Lepidoptera: Geometridae: Ennominae) from India

– Sanjay Sondhi, Dipendra Nath Basu & Krushnamegh Kunte, Pp. 16916–16919

Notes on a communal roosting of two oakblues (Lepidoptera: Lycaenidae: *Arhopala*) and the Common Emigrant (Pieridae: *Catopsilia pomona*) butterflies in Uttarakhand, India

– Sohom Seal, Debanjan Sarkar, Agnish Kumar Das & Ankush Chowdhury, Pp. 16920–16923

First report of mango leaf gall midge *Procontarinia robusta* Li, Bu & Zhang (Diptera: Cecidomyiidae) from India

– Duraikannu Vasanthakumar, Senthilkumar Palanisamy & Radheshyam Murlidhar Sharma, Pp. 16924–16926

Member



Publisher & Host

