

Building evidence for conservation globally

Journal of Threatened Taxa



Open Access

10.11609/jott.2022.14.2.20539-20702

www.threatenedtaxa.org

26 February 2022 (Online & Print)

14(2): 20539-20702

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

Email: 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 Illustration, 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. 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 Development

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 2019–2021

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. Karthigeeyan, 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. 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, Llandudno, 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

For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scope

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

For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

Cover: *Geodorum laxiflorum* Griff.—inflorescence (Orchidaceae) © Ashish Ravindra Bhojyar.



Lichens and animal camouflage: some observations from central Asian ecoregions

Mahmood Soofi¹ , Sandeep Sharma² , Barbod Safaei-Mahroo³ , Mohammad Sohrabi⁴ ,
Moosa Ghorbani Organli⁵ & Matthias Waltert⁶

^{1,2,6}Department of Conservation Biology, University of Goettingen, Bürgerstr. 50, 37073 Goettingen, Germany.

¹CSIRO Land and Water, PMB 44, Winnellie, Darwin, 0822, Northern Territory, Australia.

³Pars Herpetologists Institute, Corner of third Jahad alley, Arash Str., Jalal-e Ale-Ahmad Boulevard, Tehran, Iran.

⁴Department of Biotechnology, Iranian Research Organization for Science and Technology, Tehran, Iran.

⁵Haj-Asadi alley, 20-Metri-e Jey, Yadegar-e Emam, Dampezeshti Str., Tehran, Iran.

¹ mahmood.soofi@biologie.uni-goettingen.de (corresponding author), ² sandeeps17@gmail.com, ³ barbodsafaei@gmail.com,

⁴ sohrabi.mycolich@gmail.com, ⁵ ghorbanigeo@gmail.com, ⁶ mwalter@gwdg.de

Abstract: Camouflage is a fitness-relevant trait that supports survival and fosters evolutionary adaptation by which animals match their body pattern to a background setting. Lichens are among the most common of these backgrounds that several animal species use for camouflage. Lichens are omnipresent and grow in wide arrays of colorations and compositions. Their composition and phenotypic diversity might facilitate cryptic coloration and habitat matching by various animal species. Here, we describe the role of lichens in providing camouflage to various animal species in central Asian and Caucasus mountain ecoregions, which are categorized as global biodiversity hotspots. Despite multiple ecological studies, no information is available on the role of this regions' lichen diversity in providing animal camouflage. Casual field observations of lichen camouflage are reported for four (one mammal and three reptile) species: the Persian Leopard's *Panthera pardus saxicolor* body coat seems to closely match the colors and patterns of saxicolous lichens (*Acarospora* sp. and *Circinaria* sp.) in their habitat. A similar background matching pattern was observed in both morphs of the Caucasian Rock Agama *Paralaudakia caucasia* upon crustose lichens: *Caloplaca* spp., *Circinaria* spp., and the Radde's Rock Lizard *Darevskia raddei* to the crustose lichens *Acarospora* sp. and *Caloplaca* sp. Likewise, the Horny-scaled Agama's *Trapelus ruderatus* grey matches with the color of multiple lichens (*Lecanora* spp., *Circinaria* spp., *Protoparmeliopsis* spp., *Rinodina* spp., and *Anaptychia* spp.). Our observations preliminarily suggest that lichens play an important role for species of different trophic levels, ensuring adaptation and survival through camouflage. We call for more field-

based empirical and experimental studies in various terrestrial ecosystems in other parts of the world to test the role of lichens in local adaption and evolutionary plasticity of regional species.

Keywords: Caucasus, climate change, cryptic coloration, dry ecosystems, Irano-Anatolian, mammals, plasticity, phenotypic traits, reptiles, saxicolous.

Wildlife populations of various taxa are experiencing an unprecedented loss worldwide. The 2020 Global Living Planet Index reported an average 68% decline in the populations of mammals, birds, amphibians, reptiles, and fishes within a period of 46 years (1970–2016). Many of the listed species are subjected to anthropogenic impacts and environmental alterations such as climate change, pollution, disease, invasive species, and land degradation (Kettlewell 1955; Gomulkiewicz & Holt 1995; Gonzalez et al. 2013; Maxwell et al. 2016). Species persistence may also depend on phenotypic plasticity or adaptive evolution (Carlson et al. 2014). The inherent

Editor: Anonymity requested.

Date of publication: 26 February 2022 (online & print)

Citation: Soofi, M., S. Sharma, B. Safaei-Mahroo, M. Sohrabi, M.G. Organli & M. Waltert (2022). Lichens and animal camouflage: some observations from central Asian ecoregions. *Journal of Threatened Taxa* 14(2): 20672–20676. <https://doi.org/10.11609/jott.7558.14.2.20672-20676>

Copyright: © Soofi et al. 2022. 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: See Acknowledgements section.

Competing interests: The authors declare no competing interests.

Acknowledgements: The work leading to this publication was supported by the PRIME programme of the German Academic Exchange Service (DAAD-PRIME, project No. 57436650, 2019–2021) with funds from the German Federal Ministry of Education and Research (BMBF) and Feodor Lynen Fellowship of the Alexander von Humboldt Foundation (award No. DEU 1220304 FLP-P, 2021–2023) provided to M.S. There are no conflicts of interests and all relevant parties involved in the underlying research are either co-authors or listed in here.



genetic variation in a species may help species to adapt towards stressors if these exert strong selection pressure (Gonzalez et al. 2013).

One of the fitness-relevant traits that support survival and foster evolutionary adaptation is camouflage (Pérez de Lanuza & Font 2016; Cuthill 2019; Price et al. 2019; Smith & Ruxton 2020). Camouflage is a trait or mechanism by which animals match or tune their body pattern to the background of their habitat, often varying over time and space and across populations (Baling et al. 2019; Cuthill 2019; Smith & Ruxton 2020). Animals employ camouflage in multiple ways to facilitate various strategies including; background matching (i.e., animals resemble the shape of the habitat background) and disruptive coloration (i.e., developing high contrast patches to break up the body's edge). Cryptic coloration and display of specific behaviours may reduce visual detection or recognition by predators (Cuthill 2019). Cryptic coloration can occur seasonally (e.g., as in the form of change of coat colour from brown in summer to white in winter) and may change with patterns and color of habitat, affecting the selection of phenotypic traits for crypsis (Mills et al. 2013). A recent study identified polymorphic regions for some color molting mammal species (e.g., Snowshoe Hare *Lepus americanus*, Arctic Fox *Vulpes lagopus*), suggesting that these regions can function as evolutionary rescue sites in the rapidly changing world due to climate change (Mills et al. 2013).

The most quoted classic example of rapid plasticity in response to anthropogenic climate change affecting the effectiveness of camouflage is that of the Peppered Moth *Biston betularia* (Grant & Howlett 1988; Majerus et al. 2000; Cuthill 2019). During the industrial revolution (ca. 1760–1840), the Silver Birch Trees' *Betula pendula* bark became darker due to pollution (Grant & Howlett 1988). As a result, the melanic forms of the Peppered Moth (dark) in polluted regions had low predation pressure over lichen-like individuals (pale speckled), which were easily spotted by their avian predators due to contrasting dark background. When pollution levels in these regions declined, and the lichens grew back on the trees, the pale speckled morphs regained abundance (Kettlewell 1955; Grant & Howlett 1988). In an experimental study Walton & Stevens (2018) showed that the pale-speckled form of the Peppered Moth closely resembles the crustose lichen found on tree barks, making them less vulnerable to predation by birds, compared to melanic forms. This example provides striking evidence about the importance of the rapid evolutionary response of animals to environmental alterations under the influence of strong selection pressure. It also emphasizes the

role of lichens in sustaining populations by providing important ecosystem services such as camouflage that helped reversing population decline (Walton & Stevens 2018).

There are several other examples reported from various parts of the world, where lichens were employed by various species not only as habitat and food source, but also for camouflage (Zedda & Rambold 2011). The larvae of insect species such as Lacewing (Neuroptera: Chrysopidae) and Bagworm (Lepidoptera: Psychidae) use lichens as food and camouflage to escape from predators (Skorepa & Sharp 1971; Cannon 2010). Another interesting case of lichen camouflage is reported in the nymph of the katydid *Lichenodraculus matti* that mimics epiphytic lichens. A species of beetle *Gymnopholus lichenifer* and a land snail species *Napaeus barquini* use lichens as food and cover their body with live lichen to actively carry the camouflage with them (Gressitt 1977; Allgaier 2007). The Lichen Huntsman Spider *Pandercetes gracilis* hides among lichens for predation (Botsford-Comstock 1986; Mukherjee et al. 2010). There are several other species of frogs and lizards that use tree and rock lichens for camouflage (Braun et al. 1997; Hocking & Semlitsch 2007; Zedda & Rambold 2011; Sumoatha et al. 2012).

Lichens and animal camouflage in central Asian mountain ecoregion

Lichens are a symbiotic group of organisms that occur in terrestrial ecosystems. They cover approximately 8% of the global land surface (Nash 2008), and grow in wide arrays of colorations, compositions and patterns on substrates such as rocks, trees or shrubs' bark, and even anthropogenic material such as concrete (Nash 2008). They are specifically more diverse and abundant in dry high altitude grasslands and tundra ecosystems (Asplund & Wardle 2017). Lichens are sensitive to a wide range of pollutants and climatic alterations and thus serve as indicators of ecosystem health (Munzi et al. 2014; Root et al. 2015). For instance, the depletion of lichens also indicates population decline of Caribou in the arctic ecosystem (Joly et al. 2009).

Here, we describe the importance of lichens in providing camouflage to various animal species of central Asian mountain ecoregion. The Irano-Anatolian, Caucasus, and central Asian mountains ecoregions are mainly characterized by vast dry scrublands, grasslands and steppic mountainous landscapes and are categorized amongst the global biodiversity hotspots (Olson & Dinerstein 2008; Marchese 2015). These ecoregions are vulnerable to climate change as well as intense human

use (Stone 2015). Despite several long-term ecological studies on many species from this region, no information is available on the role of regional lichen species in providing animal camouflage. We here present examples from four animal species (one mammal and three reptilian) that represent and occupy different trophic levels in the Irano-Anatolian, Caucasus, and central Asian mountains ecoregions.

The Persian Leopard *Panthera pardus saxicolor*, synonym: *P. p. tulliana* was described by R.I. Pocock in 1927. The etymological meaning of 'saxicolor' in its scientific name is 'stone-grey' or 'stone-color' (Pocock 1927). Persian Leopard has a grey and yellowish-buff coat interspersed with black rosette patterns (Pocock 1927) that seem to closely match and merge with the colors and patterns of regional saxicolous lichen species such

as *Acarospora* sp. (Ascosporaceae) and *Circinaria* sp. (Megasporeaceae) (Image 1), and other families of lichens including Candelariaceae, Collemataceae, Lecanoraceae, Lecideaceae, Lichinaceae, Megasporeaceae, Parmeliaceae, Physciaceae, Rhizocarpaceae, Teloschistaceae, Umbilicariaceae, and Verrucariaceae that are also found in their habitat in these ecoregions. The Persian Leopard is an apex predator of these ecoregions, that inhabits rocky mountainous habitats in western and central Asia (Jacobson et al. 2016). Their arid and rocky habitat is covered by saxicolous lichens that help them in camouflage, which is often useful in their ambush hunting technique. It reduces their chances of visual detection by their prey species and might improve their ambush predation success.

To further illustrate the importance of lichens in



Image 1. a—Persian Leopard (*Panthera pardus tulliana*, synonym *P.p. saxicolor*) resting on the calcareous rocks in Golestan National Park, Iran. Its coat colors and patterns closely resemble the crustose lichens: *Acarospora* sp. and *Circinaria* sp. (© J. Hasanzadeh) | b—represents the background matching of Radde's Rock Lizard (*Darevskia raddei*) on the volcanic rocks in Arasbaran National Park, the lesser Caucasus ecoregion in Iran (© B. Safaei-Mahroo) and the crustose lichens *Acarospora* sp. and *Caloplaca* sp. | c—shows Caucasian Rock Agama (*Paralaudakia caucasica*) in an alert position on the calcareous rock, in Iran-Turkey border (Sero). The background matching is enhanced by several crustose lichens: *Circinaria* sp. and *Protoparmeliopsis* sp. and *Rinodina* sp. (© B. Safaei-Mahroo) | d—represents the Caucasian Rock Agama in an alert position, its dorsal coloration resembling the crustose lichens *Caloplaca* sp. and *Circinaria* sp. (© J. Hasanzadeh).

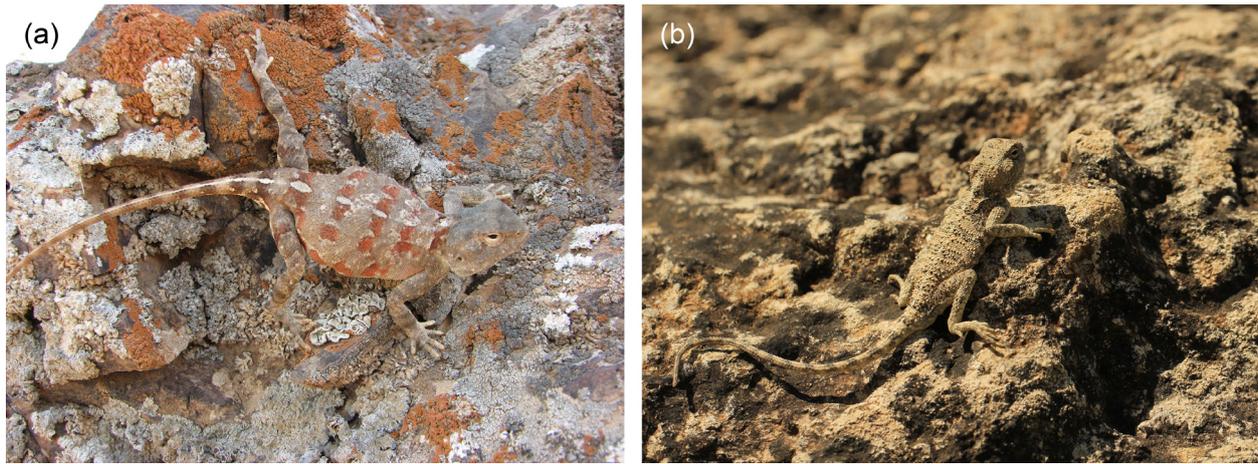


Image 2. a—illustrates a summer morph of the Horny-scaled Ground Agama (*Trapelus ruderatus*), Zagros mountains, Iran. Its body scales closely match with lichens covered rocks: fire-dot lichen *Caloplaca* sp., lim lichen *Lecanora* sp., sunken disk lichen *Circinaria* sp., *Protoparmeliopsis* sp., *Rinodina* sp., and *Anaptychia* sp. Whereas | b—shows the early spring morph of the Horny-scaled Ground Agama (Kabir-kuh, Malekshahi, Zagros mountains, Iran), matching finely lichens: *Verrucaria* sp. or *Anema* sp. or *Peccania* sp. (© B. Safaei-Mahroo).

animal camouflage, we present examples of three species of reptiles, which are adapted to rocky high steppe habitats. They are Radde's Rock Lizard *Darevskia raddei* (Lacertidae), Caucasian Rock Agama *Paralaudakia caucasia* (Agamidae) and Horny-scaled Ground Agama *Trapelus ruderatus* (Agamidae) (Images 1, 2). The Radde's Rock Lizard is a polymorphic group of lizards. Their dorsal coloration largely corresponds to the lichen-covered rocks on which they live. A similar background matching pattern occurs in both morphs of the Caucasian Rock Agama *Paralaudakia caucasia*. The dorsal coloration of both morphs matches to the crustose lichens *Caloplaca* sp. and *Circinaria* sp. (Image 1c,d). Several crustose lichens *Circinaria* sp. (Megasporeaceae) and *Protoparmeliopsis* sp. (Lecanoraceae) and *Rinodina* sp. (Physciaceae) appear to enhance their background matching (Image 1c). Likewise, the Horny-scaled Agama's grey head matches with the color of the following lichens: lim lichen *Lecanora* sp. (Lecanoraceae), sunken disk lichen *Circinaria* sp. (Megasporeaceae), *Protoparmeliopsis* sp. (Lecanoraceae), and *Rinodina* sp. and *Anaptychia* sp. (Physciaceae). The dark-orange spots on the dorsal side correspond to the color and pattern of *Caloplaca* sp. (Teloschistaceae) (Image 2a). The dorsal coloration of the Horny-scaled Ground Agama can change seasonally, which also corresponds to growth stage changes in *Verrucaria* sp. (Verrucariaceae), or *Anema* sp., and or *Peccania* sp. (Lichinaceae) (Image 2b).

We acknowledge that the camouflage of various animal species as described above due to the lichen species in their habitat might just be a perception due to limitations of human vision, which is different from

what these animal species and their predators or prey perceive. An experimental study by Majerus et al. (2000) compared the ultra-violet characteristics of both forms of the Peppered Moths in the backdrop of foliose and crustose lichens. They report that the colour patterns of the pale-speckled moth is an effective cryptic match to the crustose lichen *Lecanora conizaeoides*, in both human-vision and ultra-violet visions to the crustose lichens. However, the camouflage behaviour in animals via matching habitat does not essentially depend on lichens (Walton & Stevens 2018), because habitat types and their background characteristics can largely vary across time and space and other factors like vegetation might play a role in camouflage as well (Baling et al. 2019). For example, the melanic form of the peppered moth is adapted closely to plain tree barks, whereas the speckled form adapted to the crustose lichens (Walton & Stevens 2018). In urban ecosystems, even the plain anthropogenic substrates such as roads and pavements are voluntarily selected by animal species that can play a crucial role in their adaptation and population persistence (Camacho et al. 2020).

We conclude that despite several examples of the role of lichens in animal camouflage for a handful of faunal species from a few selected ecosystems, there is insufficient knowledge about lichens and their role in animal camouflage in various terrestrial ecosystems of the world. Lichens are omnipresent and their species composition, richness, and phenotypic diversity might facilitate crypsis coloration and habitat matching by various animal species across different trophic levels. Under variable environments and changing climate

scenarios, these traits would also be able to ensure adaptation and survival of those species. We therefore call for more field and experimental studies in various terrestrial ecosystems in other parts of the world to document more examples of habitat matching by animals utilizing local lichen species, and the role of lichens in local adaptation and evolutionary plasticity.

REFERENCES

- Allgaier, C. (2007). Active camouflage with lichens in a terrestrial snail, *Napaeus (N.) barquini* Alonso and Ibáñez, 2006 (Gastropoda, Pulmonata, Enidae). *Zoological Science* 24: 869–876. <https://doi.org/10.2108/zsj.24.869>
- Asplund, J. & D.A. Wardle (2017). How lichens impact on terrestrial community and ecosystem properties. *Biological Reviews* 92: 1720–1738. <https://doi.org/10.1111/brv.12305>
- Baling, M., D. Stuart-Fox, D. Brunton & J. Dale (2019). Spatial and temporal variation in prey color patterns for background matching across a continuous heterogeneous environment. *Ecology and Evolution*, 10: 2310–2319. <https://doi.org/10.1002/ece3.6024>
- Botsford-Comstock A. (1986). *Handbook of Nature Study*. Comstock Publishing, Sacramento, 912pp.
- Braun, R.F., J.W. Ferner & A.C. Diesmos (1997). Definition of the Philippine parachute gecko, *Ptychozoon intermedium* Taylor 1915 (Reptilia: Squamata: Gekkonidae): rede-scription, designation of a neotype, and comparison with related species. *Herpetologica* 53: 357–373.
- Camacho, C., A. Sanabria-Fernández, A. Baños-Villalba & P. Edelaar (2020). Experimental evidence that matching habitat choice drives local adaptation in a wild population. *Proceedings of the Royal Society B: Biological Sciences* 287(1927): 20200721. <http://doi/10.1098/rspb.2020.0721>
- Cannon, P. (2010). Lichen camouflage and lichen mimicry. *The British Lichen Society Bulletin* 106: 39–41.
- Carlson, S.M., C.J. Cunningham & P.A.H. Westley (2014). Evolutionary rescue in a changing world. *Trends in Ecology & Evolution* 29: 521–530. <https://doi.org/10.1016/j.tree.2014.06.005>
- Cuthill, I.C. (2019). Camouflage. *Journal of Zoology* 308: 75–92. <https://doi.org/10.1111/jzo.12682>
- Gonzalez, A., O. Ronce, R. Ferriere & M.E. Hochberg (2013). Evolutionary rescue: an emerging focus at the intersection between ecology and evolution. *Philosophical Transactions of the Royal Society B* 368: 20120404. <https://doi.org/10.1098/rstb.2012.0404>
- Gomulkiewicz, R. & R.D. Holt (1995). When does evolution by natural selection prevent extinction?. *Evolution*, 49: 201–207. <https://doi.org/10.2307/2410305>
- Grant, B. & R.J. Howlett (1988). Background selection by the peppered moth (*Biston betularia* Linn.) individual differences. *Biological Journal of the Linnean Society* 33(3): 217–232. <https://doi.org/10.1111/j.1095-8312.1988.tb00809.x>
- Gressitt, J.L. (1977). Symbiosis runs wild on the backs of high-living weevils. *Smithsonian* 7: 135–136.
- Hocking, D.J. & R.D. Semlitsch (2007). Effects of timber harvest on breeding-site selection by gray treefrogs (*Hyla versicolor*). *Biological Conservation* 138: 506–513. <https://doi.org/10.1016/j.biocon.2007.05.018>
- Joly, K., R. Randi, R.R. Jandt & D.R. Klein (2009). Decrease of lichens in Arctic ecosystems: the role of wildfire, caribou, reindeer, competition and climate in north-western Alaska. *Polar Research* 28: 433–442. <https://doi.org/10.1111/j.1751-8369.2009.00113.x>
- Kettlewell, H.B.D. (1955). Recognition of appropriate backgrounds by the pale and black phases of Lepidoptera. *Nature* 175: 943–944. <https://doi.org/10.1038/175943a0>
- Pérez i de Lanuza, G. & E. Font (2016). The evolution of colour pattern complexity: selection for conspicuousness favours contrasting within-body colour combinations in lizards. *Journal of Evolutionary Biology* 29: 942–951. <https://doi.org/10.1111/jeb.12835>
- Marchese, C. (2015). Biodiversity hotspots: A shortcut for a more complicated concept. *Global Ecology and Conservation* 3: 297–309. <https://doi.org/10.1016/j.gecco.2014.12.008>
- Majerus, M.E.N., C.A.F. Brunton & J. Stalker (2000). A bird's eye view of the peppered moth. *Journal of Evolutionary Biology* 13: 155–159. <https://doi.org/10.1046/j.1420-9101.2000.00170.x>
- Maxwell, S.L., R.A. Fuller, T.M. Brooks & J.E.M. Watson (2016). The ravages of guns, nets and bulldozers. *Nature* 536: 143–145. <https://doi.org/10.1038/536143a>
- Mills, L.S., M. Zimov, J. Oyler, S. Running, J.T. Abatzoglou & M.P. Lukacs (2013). Camouflage mismatch in seasonal coat color due to decreased snow duration. *Proceedings of the National Academy of Sciences of the United States of America* 110: 7360–7365.
- Mukherjee, A., B. Wilske, R.A. Navarro, A. Dippenaar-Schoeman & L.G. Underhill (2010). Association of spiders and lichen on Robben Island, South Africa: a case report. *Journal of Threatened Taxa* 2(4): 815–819. <https://doi.org/10.11609/JoTT.o2295.815-9>
- Munzi, S., O. Correia, P. Silva, N. Lopes, C. Freitas, C. Branquinho & P. Pinho (2014). Lichens as ecological indicators in urban areas: beyond the effects of pollutants. *Journal of Applied Ecology*. 51: 1750–1757. <https://doi.org/10.1111/1365-2664.12304>
- Nash, T.H. (2008). *Lichen Biology*. Cambridge University Press, Cambridge, 486pp.
- Olson, D.M. & E. Dinerstein (2008). The Global 200: a representation approach to conserving the Earth's most biologically valuable ecoregions. *Conservation Biology* 12: 502–515. <https://doi.org/10.1046/j.1523-1739.1998.012003502.x>
- Price, N., S. Green, J. Troscianko, T. Tregenza & M. Stevens (2019). Background matching and disruptive coloration as habitat specific strategies for camouflage. *Scientific Reports* 9: 7840. <https://doi.org/10.1038/s41598-019-44349-2>
- Pocock, R.I. (1927). XXVII. Description of two subspecies of leopards. *Annals and Magazine of Natural History* 2: 213–214.
- Root, H.T., L.H. Geiser, S. Jovan & Neitlich, P. (2015). Epiphytic macrolichen indication of air quality and climate in interior forested mountains of the Pacific Northwest, USA. *Ecological Indicators* 53: 95–105. <https://doi.org/10.1016/j.ecolind.2015.01.029>
- Skorepa, A.C. & A.J. Sharp (1971). Lichens in “packets” of lacewing larvae (Chrysopidae). *Bryologist* 74: 363–364.
- Smith, M.Q.R.P. & G.D. Ruxton (2020). Camouflage in predators. *Biological Reviews*, 95: 1325–1340. <https://doi.org/10.1111/brv.12612>
- Stone, R. (2015). Fragile ecosystems under pressure. *Science*, 349: 1046–47. <https://doi.org/10.1126/science.349.6252.1046>
- Sumotha, M., O.S.G. Pauwels, K. Kunya, C. Limlikhitaksorn, S. Ruksue, A. Taokratok, M. Ansermet & L. Chanhome (2012). A new species of Parachute Gecko (Squamata: Gekkonidae: genus *Ptychozoon*) from Kaeng Krachan National Park, western Thailand. *Zootaxa* 3513: 68–78.
- Walton, O.C. & M. Stevens (2018). Avian vision models and field experiments determine the survival value of peppered moth camouflage. *Communications Biology* 1–118. <https://doi.org/10.1038/s42003-018-0126-3>
- Jacobson, A.P., P. Gerngross, J.R. Lemeris, R.F. Schoonover, C. Anco, Ch. Breitenmoser-Würsten, S.M. Durant, M.S. Farhadinia, P. Hensche, J.F. Kamler, A. Laguardia, S. Rostro-García, A.B. Stein & D. Dollar (2016). Leopard (*Panthera pardus*) status, distribution, and the research efforts across its range. *PeerJ* 4:e1974. <https://doi.org/10.7717/peerj.1974>
- Zedda, L. & G. Rambold (2011). Lichens and their importance for the monitoring of environmental changes in southern Africa. <http://publikationen.uni-frankfurt.de/frontdoor/index/index/docId/23334>

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

Fishes

Dr. 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. 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
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. Kumar, SACON, Anaikatty P.O., Coimbatore, Tamil Nadu, India
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India
Dr. H. Raghuram, The American College, Madurai, Tamil Nadu, India
Dr. Paul Bates, Harison Institute, Kent, UK
Dr. Jim Sanderson, Small Wild Cat Conservation Foundation, Hartford, USA
Dr. Dan Challender, University of Kent, Canterbury, UK
Dr. David Mallon, Manchester Metropolitan University, Derbyshire, UK
Dr. Brian L. Cypher, California State University-Stanislaus, Bakersfield, CA
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India
Prof. Karan Bahadur Shah, Budhanilankantha 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 2019–2021

Due to pausity 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. 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 2022 | Vol. 14 | No. 2 | Pages: 20539–20702

Date of Publication: 26 February 2022 (Online & Print)

DOI: 10.11609/jott.2022.14.2.20539-20702

www.threatenedtaxa.org

Article

Distribution, diet, and trophic level of *Arvicantis abyssinicus* and *Tachyoryctes splendens* around the area of recently extinct Ethiopian Wolf *Canis simiensis* on Mount Guna, northwestern Ethiopia

– Hirpasa Teressa, Wondimu Ersino & Tadele Alemayo, Pp. 20539–20549

Communications

Seasonal composition of avian communities in different habitats of Harike Wetland, a Ramsar site in Punjab, India

– Jagdeep Singh & Onkar Singh Brraich, Pp. 20550–20565

Temporal changes in species richness of waterfowl (Anseriformes) community in D’Ering Memorial Wildlife Sanctuary, Arunachal Pradesh, India

– Tapak Tamir & Daniel Mize, Pp. 20566–20575

Reptilian assemblages in the wetlands of Amboli hill complex, northern Western Ghats, Maharashtra, India during the monsoon season

– Sachinkumar R. Patil & Kiran Choudaj, Pp. 20576–20583

Butterfly diversity and composition at Chemerong Amenity Forest, Terengganu, Malaysia

– Muhammad Hafiz Sulaiman, Abdul Munir Mohd Zaki, Geok Chin Yap, Nur Atiqah Aniruddin & Ju Lian Chong, Pp. 20584–20596

Ecological niche modeling for reintroduction and conservation of *Aristolochia cathcartii* Hook.f. & Thomson (Aristolochiaceae), a threatened endemic plant in Assam, India

– Bhaskar Sarma & Bhaben Tanti, Pp. 20597–20605

New host plant records of Fig Wax Scale *Ceroplastes rusci* (Linnaeus, 1758) (Hemiptera: Coccoomorpha: Coccidae) from India

– Arvind Kumar & Renu Pandey, Pp. 20606–20614

Seasonal variations influencing the abundance and diversity of plankton in the Swarnamukhi River Estuary, Nellore, India

– Krupa Ratnam, V.P. Limna Mol, S. Venkatnarayanan, Dilip Kumar Jha, G. Dharani & M. Prashanthi Devi, Pp. 20615–20624

Short Communications

First record of *Prosopeonoides* Millidge & Russell-Smith, 1992 (Araneae: Linyphiidae) from India, with the description of a new species

– Anusmitha Domichan & K. Sunil Jose, Pp. 20625–20630

Rediscovery of *Platerus pilcheri* Distant (Hemiptera: Reduviidae), a forgotten assassin bug from India, with comments on its range extension

– H. Sankararaman, Anubhav Agarwal, Valérie A. Lemaître & Hemant V. Ghate, Pp. 20631–20636

First Indian DNA barcode record for the moth species *Pygospila tyres* (Cramer, 1780) (Lepidoptera: Crambidae: Spilomelinae) distributed in Asia and Australia

– Aparna S. Kalawate, A. Shabnam & K.P. Dinesh, Pp. 20637–20642

First record and description of female *Onomarchus leuconotus* (Serville, 1838) (Insect: Orthoptera: Tettigoniidae) from peninsular India

– Sunil M. Gaikwad, Yogesh J. Koli & Gopal A. Raut, Pp. 20643–20647

New records of odonates (Insecta: Odonata), *Archibasis oscillans* Selys, 1877 and *Merogomphus tamaracherriensis* Fraser, 1931 from Maharashtra, India

– Akshay Dalvi & Yogesh Koli, Pp. 20648–20653

A checklist of dragonflies & damselflies (Insecta: Odonata) of Kerala, India

– Sujith V. Gopalan, Muhamed Sherif & A. Vivek Chandran, Pp. 20654–20665

***Aldama macbridei* (Heliantheae: Compositae): notes on its distribution and vulnerable habitats in central Peru**

– Daniel B. Montesinos-Tubée & Federico García-Yanes, Pp. 20666–20671

Lichens and animal camouflage: some observations from central Asian ecoregions

– Mahmood Soofi, Sandeep Sharma, Barbod Safaei-Mahroo, Mohammad Sohrabi, Moosa Ghorbani Organli & Matthias Waltert, Pp. 20672–20676

Notes

First photographic evidence of Asiatic Black Bear *Ursus thibetanus* in Kaziranga Tiger Reserve, India

– Priyanka Borah, Jyotish Ranjan Deka, Mujahid Ahamad, Rabindra Sharma, Ruchi Badola & Syed Ainul Hussain, Pp. 20677–20679

First record of Small Minivet *Pericrocotus cinnamomeus* (Aves: Passeriformes: Campephagidae) from Kashmir, India

– Zakir Hussain Najjar, Bilal A. Bhat & Riyaz Ahmad, Pp. 20680–20682

***Cotesia anthelae* (Wilkinson, 1928) (Hymenoptera: Braconidae) a natural parasitoid of *Cirrochroa thais* (Fabricius, 1787) (Lepidoptera: Nymphalidae), first report from the Oriental region**

– Ankita Gupta & P. Manoj, Pp. 20683–20685

***Melastoma imbricatum* Wall. ex Triana (Melastomataceae): a new addition to the flora of Manipur, India**

– Rajkumari Jashmi Devi, Deepashree Khuraijam, Peimichon Langkan & Biseshwori Thongam, Pp. 20686–20688

***Geodorum laxiflorum* Griff. (Orchidaceae), a new distribution record for Maharashtra state of India**

– Ashish Ravindra Bhojar, Swapnil Nandgawe, Syed Abrar Ahmed & Saduram Madavi, Pp. 20689–20691

Photographic record of *Armillaria mellea* a bioluminescent fungi from Lonavala in Western Ghats, India

– Swanand R. Patil & Shubham V. Yadav, Pp. 20692–20694

Response & Reply

Correction to Catalogue of herpetological specimens from Meghalaya, India at the Sálím Ali Centre for Ornithology and Natural History (SACON)

– Pandi Karthik, Pp. 20695–20697

Reply to the “Correction to Catalogue of herpetological specimens from Meghalaya, India at the Sálím Ali Centre for Ornithology and Natural History (SACON)” by P. Karthik

– S.R. Chandramouli, R.S. Naveen, S. Sureshmarimuthu, S. Babu, P.V. Karunakaran & Honnavalli N. Kumara, Pp. 20698–20700

Book Review

Conservation Kaleidoscope: People, Protected Areas and Wildlife in Contemporary India

– L.A.K. Singh, Pp. 20701–20702

Publisher & Host

