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THE ENDANGERED HIMALAYAN RED PANDA: FIRST PHOTOGRAPHIC EVIDENCE FROM ITS WESTERNMOST DISTRIBUTION RANGE

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The endangered Himalayan Red Panda: first photographic evidence from its westernmost distribution range

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Abstract: An endangered species, the Himalayan Red Panda *Ailurus fulgens* is one of the most iconic and sought-after species in the world. Although a symbolic species of the Himalayas, it is threatened by habitat loss, fragmentation, and poaching. The data collection was carried out in accordance with the Red Panda community-based monitoring protocol. Threats to the Himalayan Red Panda within the study area are reported based on key informant interviews and direct field observation. This paper provides new evidence for the presence of Himalayan Red Pandas beyond their previously-known westernmost limit (81.687778°E) across its distribution range. An average encounter rate of 0.92 signs/km was recorded from the surveyed community forests. Trees were the most preferred substrates used for defecation. Extensive resource collection, poaching, overgrazing and forest fires are identified as some of the most significant threats. In general, the study contributes to the conservation of the Himalayan Red Panda in western distribution ranges.

Keywords: *Ailurus fulgens*, arboreal, fire fox, indirect sign, photographic evidence.

Abbreviation: CF—Community Forest | DDC—District Development Committee | KII—Key informant interview.

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Author contribution: Saroj Shrestha (conceptualization; data curation; investigation; project administration; supervision; writing-original draft), Sony Lama (conceptualization; data curation; investigation; project administration; supervision; writing-original draft), Ang Phuri Sherpa (funding acquisition and project administration), Sonam Tashi Lama (investigation and project administration), Dinesh Ghale (data curation and writing-review and editing).

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INTRODUCTION

The language of photography is universal, and it plays a crucial role in educating people on wildlife and environmental issues (Lott 1992; Russell 1996; Montag et al. 2005). Photo identification is one of the studies in population ecology central to a range of applied fields such as biological diversity, conservation biology, and wildlife management (Bauwens et al. 2018). Photographic identification is critical when animals are difficult to capture and when the aim of the research is to understand natural population processes and animal behavior with negligible interference (Bradfield 2004; Bauwens et al. 2018).

Researchers are using photographic identification methods to survey biological communities (O'Connell et al. 2011). Photographic images are reliable and non-invasive data collection tools to track wildlife populations (Karlsson et al. 2005; Frisch & Hobbs 2007; Carpentier et al. 2016). Species identification and monitoring using photographs can produce useful ecological data including distribution patterns, abundance, and other population parameters for analysis while minimizing time to process bulky datasets (Karlsson et al. 2005; Swanson et al. 2016). Some photographic identification approaches now use artificial intelligence to assist field biologists and citizen scientists in recognizing the species (Kumar et al. 2012). Photographic identification has been successfully adopted for an extensive range of wild animals (e.g., *Puma concolor* (Kelly et al. 2008), *Mustela kathiah* (Phan et al. 2014), *Prionailurus planiceps* (Wadey et al. 2014), *Ailurus fulgens* (Shrestha et al. 2015), *Liopholis slateri slateri* (Treiliks et al. 2016), *Vipera berus* (Bauwens et al. 2018)).

The Red Panda *Ailurus fulgens*, an endangered mammal, classified as two subspecies: the Himalayan Red Panda *A. f. fulgens* and the Chinese Red Panda *A. f. styani* (Hu et al. 2020). The Himalayan Red Panda is an endangered species (IUCN Red Data Book; Glatston et al. 2015), confined to the region of southwestern China, Nepal, India, Bhutan, and Myanmar (Glatston 1989; Yonzon & Hunter 1989; Pradhan et al. 2001). Tila Karnali River in Kalikot District of Nepal is the westernmost distribution edge (81.66° E) of the Red Panda (Himalayan Red Panda) while its easternmost distribution edge (Chinese Red Panda) is the Minshan Mountain and Upper Min Valley in Sichuan Province, in central China (Hu et al. 1990; Schaller et al. 1985; DNPWC & DFSC 2018).

Nepal represents the westernmost distribution of the Himalayan Red Panda (Shrestha et al. 2021). In Nepal, the Himalayan Red Pandas are distributed in 24

districts with the potential habitat of 21,680 km² (Thapa et al. 2020); however, they are vulnerable to extinction due to habitat loss and fragmentation (Acharya et al. 2018) and poaching (Bista et al. 2017). Understanding the distribution of the species is a crucial prerequisite in formulating an effective conservation-dependent species management strategy (Braun 2005; Titeux et al. 2020). Nevertheless, gathering information with regard to such endangered species is both a prolonged and labor-intensive process. In addition, its elusiveness, rarity, and distribution in remote-rugged habitat limits its detection probability during field surveys (Shrestha et al. 2015). Only a few indirect evidences of the Himalayan Red Panda's occurrence have been recorded from Kalikot District in the past (Dangol & Chalise 2018). Based on direct sighting, the current study aims to reconfirm the presence and distribution of the Himalayan Red Panda in the westernmost edge of its potential habitat range in Kalikot District of Nepal.

METHODS

Study area

Nepal lies between China in the north and India to the south, east, and west. The majority of Nepal's landmass lies along the Himalaya, within a small latitudinal range of approximately 200km, the country undergoes vast altitudinal changes from 60m along the southern border, up to 8,848m of Mount Everest. This difference causes dramatic vicissitudes in Nepal's landscape and climate. Our study area, i.e., Kalikot District lies in western Nepal. Kalikot District includes six rural municipalities (RM) and three municipalities (Figure 1). This remote and rugged mountainous district spans an elevation of 728–4,790 m and is located between 28.62222° to 29.12556°N and 81.82278° to 82.57944°E (DDC 2008). This district possesses a significant proportion of temperate, tropical, and sub-tropical zones (Lillesø et al. 2005). The average annual temperature ranges from a minimum of 17.2°C to a maximum of 29.1°C (DHM 2017). Likewise, other districts in the mid-western development region, Kalikot also experience low average annual precipitation of 830.9mm (DHM 2017). This district is ranked as a highly vulnerable locale to climate-induced disasters such as floods, wildfires, landslides, and droughts (Ministry of Forests & Soil Conservation 2016). In Nepal, the Red Panda's presence has been documented from 24 districts and seven protected areas with potential habitat of 23,977km² (DNPWC & DFSC 2018).

The study was conducted in the community forest

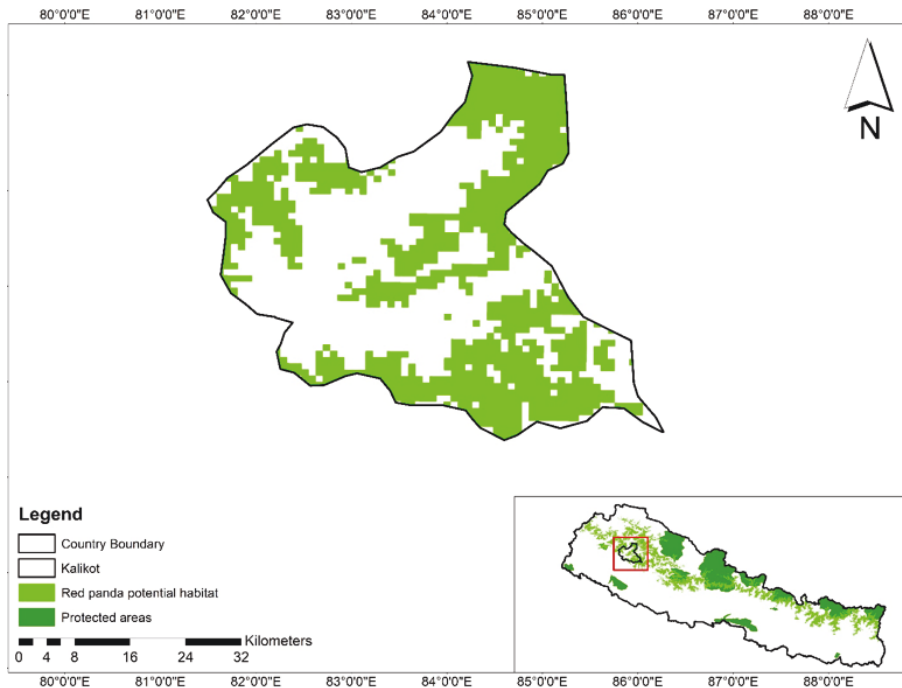


Figure 1. Study area showing potential Himalayan Red Panda habitat.

(CF) of three rural municipalities, i.e., Mahawai RM, Panchal Jhara RM, Shubhakalika RM of Kalikot District (Figure 1). The community forests: Himkalika CF, Dimreni CF, Jillitreveni CF and, Gairemela CF have temperate evergreen forests with a high dominance of common plant species such as *Abies spectabilis*, *Tsuga dumosa*, *Betula utilis*, *Bombax ceiba*, *Juglans regia*, *Cedrus deodara*, *Pinus wallichiana*, *Rhododendron* spp., and *Quercus semecarpifolia*. The study area is rich in medicinal and aromatic plants such as *Ophiocordyceps sinensis*, *Annona squamosa*, *Nardostachys jatamansi*, *Picrorhiza kurroa*, *Swertia chirata*, *Paris polyphylla*, *Delphinium denudatum*, *Morchella esculenta*, *Moringa oleifera*, *Rheum austral*, and *Dactylorhiza hatagirea* (DDC 2008). In general, forests of Kalikot harbors wide range of wildlife and bird species. The most commonly found fauna include *Muntiacus muntjak*, *Ursus thibetanus*, *Ailurus fulgens* (Dangol & Chalise 2018), *Semnopithecus schistaceus*, *Moschus* spp., *Cervus elaphus*, *Hemitragus jemlahicus*, *Capricornis thar*, *Lophura leucomelanos*, and *Lophophorus impejanus* (Jnawali et al. 2011).

Methods

A team comprising eight field biologists surveyed four CFs of three respective RMs of Kalikot District in autumn season, i.e., October/November 2019. Altogether, 12 linear transects with an average length of 1km were established covering an area of 5.5km² of potential Himalayan Red Panda habitat (Ministry of Forests &

Soil Conservation 2015). The transects were surveyed based on the elevation gradient of 2,500–3,400 m and accessibility of the terrain. A total of 11.98km transect length was traversed during 362 working hours in search of indirect evidence (such as scat, footprints, scratch marks, feeding signs, and/ or remains of dead animal parts) and direct sightings of the Himalayan Red Panda. Relative abundance was measured by estimating the encounter rate (ER) of Himalayan Red Panda signs per unit km of transect walk within the survey area. ER is total numbers of signs/total length of the transects traversed in kilometers (Ministry of Forests & Soil Conservation 2015).

A Canon Powershot SX40 HS camera along with GPS (Garmin eTrex 10) was used to capture photographs and record geographical location during the field survey. Predominant substrates (such as fallen logs, trees, and forest floors) used by the Himalayan Red Panda for defecation was recorded for habitat use analysis.

Potential threats to the Himalayan Red Panda were determined from direct field observation and key informant interviews (KII). Altogether, 12 divisional forest officials and 47 community forest users group (CFUG) members of all surveyed CFs were interviewed with respect to their socio-economic status, involvement in Himalayan Red Panda stewardship, knowledge on conservation importance, and the potential hazards to the species. Chi-square test was conducted to evaluate the responses from the survey interviewees regarding

the pervasive human disturbances in the core habitat of the species.

RESULTS

Scats of the Himalayan Red Panda was found at 81.687778° E (Pachal Jharana RM) at an elevation of 3,216m while photographic evidence of an adult was recorded at 81.77080°E (Mahawai RM) at an elevation of 2,784 m (Image 1; Figure 2). The signs of its presence was documented from all surveyed CFs. The photographed animal was captured while foraging on the branch of *Betula utilis* at 09.33h (Image 2, 3). The nearby vegetation of the photographed site was dominated by *Rhododendron campanulatum*, *Pinus wallichiana*, and dense bamboo understory (51–75 %). The nearest water body was approximately 80m away from the camera station.

Himalayan Red Panda presence signs were documented at the elevation range of 2,500–3,400 m; 70% of the records were in the range 2,650–3,100 m. An average encounter rate of 0.92 signs per km were recorded from the surveyed forests with Himkalika CF

having the highest rate (ER= 1.53 signs/km) followed by Dimreni CF (ER= 0.83 signs/km), Jilli Triveni CF (ER= 0.78 signs/km), and Gairemela CF (ER= 0.55 signs/km) (Table 1).

Droppings (n= 163 piles) of Himalayan Red Panda were observed on four different substrates, i.e., ground, rock, trees, and fallen logs (Figure 3). Trees were the most preferred substrate (50.92%) followed by ground (28.83%), and fallen logs (13.50%). Rocks (6.75%) were rarely used for defecation in the study area.

Chi-square statistics ($X^2= 9.96$, $df= 4$, $p\text{-value}= 0.041$) was determined from the interview responses

Table 1. Encounter rate of Himalayan Red Panda in Kalikot District, Nepal.

Community forests	No. of sign plots	Transect surveyed (no)	Length of transect (km)	ER (signs/km)
Himkalika	6	4	3.92	1.53
Dimreni	2	2	2.4	0.83
Jilli Triveni	3	4	3.85	0.78
Gairemela	1	2	1.81	0.55
Total	12	12	11.98	3.69

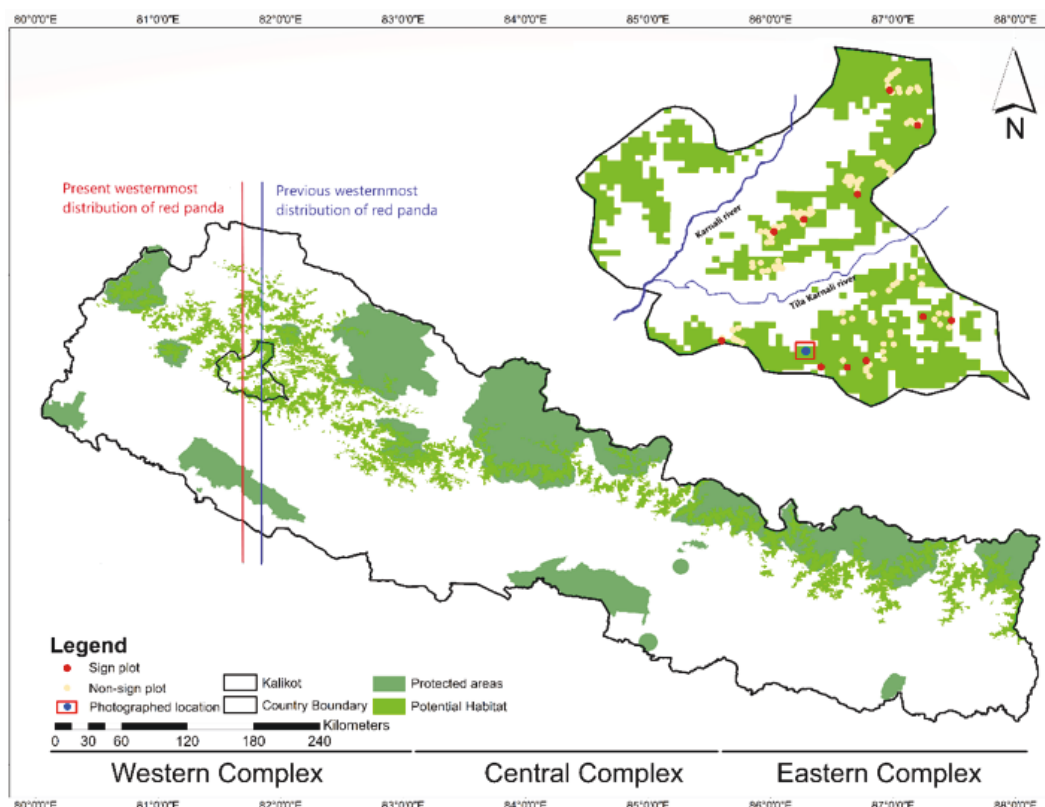


Figure 2 . Photographed location of Himalayan Red Panda



Image 1. Himalayan Red Panda scat on the tree branch

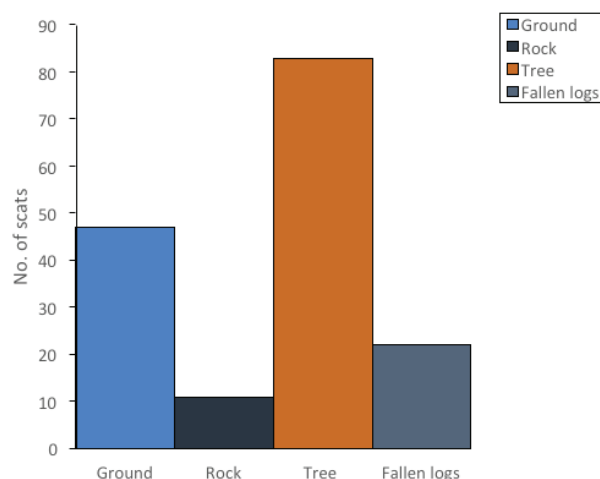


Figure 3. Substrate used for defecation by Himalayan Red Pandas.



Image 2. Satellite imagery of Himalayan Red Panda observation site.

on the existential threats in the potential habitat of the Himalayan Red Panda within the surveyed area. Of the total interviewed respondents, 38% of key informants believed that haphazard collection of fuelwood, fodder, timber, and non-timber forest products on both Government forest regimes and CFs is a key threat to Himalayan Red Panda habitat and their survival. Besides poaching (27% of respondents), unsustainable grazing practices (23% of respondents) and forest fires (12% of respondents) are some other prevailing anthropogenic

activities that make this species vulnerable to extinction. The major threats identified through direct field observation include traditional transhuman herding activities, extensive resource collection, and human-induced forest fires.

DISCUSSION

This study provides documentation of photographic

evidence of live Himalayan Red Panda from the westernmost distribution of its habitat range. Previously, the only indirect sign of the species was documented from Kalikot District (DNPWC & DFSC 2018). Based on ground-truthing, the occurrence of the Himalayan Red Panda has now been confirmed from Mahawai RM of Kalikot District. The distance between the recent photographed site and the location where the indirect sign was detected is 21.5km. The photographed location revealed some important information about the habitat preferences of the Himalayan Red Panda, which was photographed feeding on *Betula utilis* leaves; more than 80% of its diet includes bamboo species (Reid et al. 1991; Yonzon & Hunter 1991; Wei et al. 1999). Interestingly, feeding on leaves and fruits of this tree species has been sporadically documented in Nepal (Panthi et al. 2015; Sharma et al. 2014). Fondness for these sites with diverse vegetation such as *Betula utilis* other than bamboo leaves and shoots might be a survival approach to remain resilient in unfavorable circumstances. A similar study conducted in eastern and central Nepal showed the forests dominated by *Betula utilis*, *Rhododendron* spp., and *Abies* spp. with bamboo in the understory to be the most preferable plant species by the Himalayan Red Panda (Bista & Paudel 2013; Bista et al. 2017).

The average relative abundance (ER= 0.92 signs/km)

of Himalayan Red Panda scats were found lower than the Taplejung District of eastern Nepal where an average ER was observed to be 1.36 signs/km (Lama 2019). This might be due to profligate propagation of the shrub layer and ground layer that had reduced the detection rate of indirect signs (Hemami & Dolmen 2005). On the contrary, Bista et al. (2017) detected comparatively lower encounter of 0.36 signs/km in Rasuwa District of central Nepal. The length of transect covered during the survey might not be precise enough due to inaccessible geographical terrain, which might have resulted in the varied relative abundance of Himalayan Red Panda signs in the study area. Besides, environmental factors such as precipitation, temperature, humidity, and wind can affect the detection rate of indirect signs during wildlife surveys. For instance, heavy precipitation probably degrades or takes away scats from the landscape over time (Reid et al. 2011).

Prior studies have suggested that fallen logs are an important habitat component for the Himalayan Red Panda (Wei et al. 2000; Pradhan et al. 2001) and could benefit the foraging strategy of this species. In accordance with the requirement of a nutritive diet, the Himalayan Red Panda changes the defecation substrate seasonally (Williams 2003). For instance, defecations mostly take place on the forest floor throughout the growth season of bamboo shoots (Thapa et al. 2020).



Image 3. Himalayan Red Panda spotted feeding on *Betula utilis* (© Nam Raj Shahi).

Similarly, this study discovered trees as the most commonly used defecation substrate. Likewise, Bista et al. (2017) observed similar results where 62.21% of total substrates recorded were the branches of the tree.

The increasing dependency of locals on forest resources has rapidly caused the Himalayan Red Panda habitat loss and fragmentation. Like eastern parts of Nepal, the study area has witnessed excessive bamboo, fuelwood, and fodder extraction in the core habitat of this species (Williams 2004). The lack of public understanding towards Himalayan Red Panda conservation has even escalated the issues. As a result, poaching and trafficking have increased at an alarming rate in western Nepal. Recently, Kalikot District was recognized as a crucial transit hub for the illegal trade of wildlife parts and medicinal plants (Red Panda Network 2019). Furthermore, unsustainable livestock grazing activities inside the CFs are causing detrimental impact on the natural resources and habitat. Panthi et al. (2017) and Lama et al. (2020) reported overgrazing pressure as one of the significant factors intensifying the effects of habitat loss and fragmentation. Another challenge to the Himalayan Red Panda conservation includes forest fires triggered due to the climate crisis and increasing anthropogenic disturbances. Slash-and-burn is a common way of cultivating medicinal plants such as *Swertia chiraita* particularly in eastern Nepal (Ministry of Forests & Soil Conservation 2015).

CONCLUSION

Wildlife photographic evidence is critical for sparking passion and interest among researchers and policymakers to take steps to help conserve fragile habitats and ecosystems. Wildlife photographs of endangered species, are valuable and hold importance in conservation efforts. This paper documents the first record (photographs from the wild) of the Himalayan Red Panda from its westernmost distribution. The Himalayan Red Panda is exposed to different anthropogenic threats as seen in this study and reported in others. Therefore, the Himalayan Red Panda habitat needs to be demarcated into two zones—a core zone and a buffer zone—in order to reduce human-related disturbances while at the same time respecting community rights of access to forest resources. This will help to conserve and protect the westernmost limit of Himalayan Red Panda distribution in the long run. The Himalayan Red Panda's habitat attributes, distribution, and food ecology in the study area need to be further researched.

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Articles

Spatiotemporal movement pattern of Asian Elephants *Elephas maximus* Linnaeus, 1758 in Sindhudurg District, Maharashtra, India

– Milind Digambar Patil, Vinayak Krishna Patil & Ninad Avinash Mungi, Pp. 18099–18109

Conservation ecology of birds in Mt. Hilong-hilong, a Key Biodiversity Area on Mindanao Island, the Philippines

– Arturo G. Gracia Jr., Alma B. Mohagan, Janezel C. Burlat, Welfredo L. Yu Jr., Janine Mondalo, Florfe M. Acma, Hannah P. Lumista, Riah Calising & Krizler Cejuela Tanalgo, Pp. 18110–18121

Nesting and hatching behaviour of Olive Ridley Turtles *Lepidochelys olivacea* (Eschscholtz, 1829) (Reptilia: Cryptodira: Cheloniidae) on Dr. Abdul Kalam Island, Odisha, India

– P. Poornima, Pp. 18122–18131

Communications

Feeding ecology of Walia Ibex *Capra walie* (Mammalia: Artiodactyla: Bovidae) in Simien Mountains National Park, Ethiopia

– D. Ejigu, A. Bekele & L. Powell, Pp. 18132–18140

Assessment of crop and property damage caused by *Semnopithecus vetulus nestor* (Bennett, 1833) (Mammalia: Primates: Cercopithecidae) in Gampaha District, Sri Lanka

– Sunil Wijethilaka, Lakshani S. Weerasekara, Saumya Bandara & Kithsiri B. Ranawana, Pp. 18141–18147

Habitat preference of the Indian Pangolin *Manis crassicaudata* inhabiting Margalla Hills National Park, Islamabad, Pakistan

– Tariq Mahmood, Shaista Andleeb & Faraz Akrim, Pp. 18148–18155

The endangered Himalayan Red Panda: first photographic evidence from its westernmost distribution range

– Saroj Shrestha, Sony Lama, Ang Phuri Sherpa, Sonam Tashi Lama & Dinesh Ghale, Pp. 18156–18163

Ecological niche modelling predicts significant impacts of future climate change on two endemic rodents in eastern Africa

– Aditya Srinivasulu, Alembrhan Assefa & Chelmala Srinivasulu, Pp. 18164–18176

Avian diversity in a fragmented landscape of central Indian forests (Bhopal Forest Circle)

– Amit Kumar, Yogesh Dubey & Advait Edgaonkar, Pp. 18177–18188

Nest tree preference shown by Ring-necked Parakeet *Psittacula krameri* (Scopoli, 1769) in northern districts of Tamil Nadu, India

– M. Pandian, Pp. 18189–18199

Two new species of *Euphaea* Selys, 1840 (Odonata: Zygoptera: Euphaeidae) from northern Western Ghats, India

– Shriram Dinkar Bhakare, Vinayan P Nair, Pratima Ashok Pawar, Sunil Hanmant Bhoite & Kalesh Sadasivan, Pp. 18200–18214

Two new light attracted rove beetle species of *Astenus* Dejean, 1833 (Coleoptera: Staphylinidae: Paederinae) from Kerala, India

– P. Sreevidhya, S.V. Akhil & C.D. Sebastian, Pp. 18215–18226

A new distribution record of mason wasp *Pison punctifrons* Shuckard, 1838 (Hymenoptera: Sphecidae: Larrinae) from Noida, Uttar Pradesh, India

– Rajiv K. Singh Bais & Aakash Singh Bais, Pp. 18227–18236

Diversity of freshwater molluscs from the upper Brahmaputra Basin, Assam, India

– Jyotish Sonowal, Munmi Puzari & Devid Kardong, Pp. 18237–18246

Diversity of understory flowering plants in the forest patches of Marilog District, Philippines

– Florfe M. Acma, Noe P. Mendez, Noel E. Lagunday & Victor B. Amoroso, Pp. 18247–18256

Legumes of Kerala, India: a checklist

– Anoop P. Balan & S.V. Predeep, Pp. 18257–18282

Legumes (Angiosperms: Fabaceae) of Bagalkot District, Karnataka, India

– Jagdish Dalavi, Ramesh Pujar, Sharad Kambale, Varsha Jadhav-Rathod & Shrirang Yadav, Pp. 18283–18296

Indigenous knowledge of ethnomedicinal plants by the Assamese community in Dibrugarh District, Assam, India

– Pranati Gogoi & Namita Nath, Pp. 18297–18312

Short Communications

Marine mammal strandings in the northern Palk Bay from 2009 to 2020

– Vedharajan Balaji & Veeramuthu Sekar, Pp. 18313–18318

First distribution record of the Asiatic Toad *Bufo gargarizans* Cantor, 1842 from India – Dibang Valley in Arunachal Pradesh

– Sahil Nijhawan, Jayanta Kumar Roy, Iho Mitapo, Gata Miwu, Jibi Pulu & M. Firoz Ahmed, Pp. 18319–18323

A checklist of fishes of Telangana State, India

– Kante Krishna Prasad & Chelmala Srinivasulu, Pp. 18324–18343

Report on the stingless bees of Bhutan (Hymenoptera: Apidae: Meliponini)

– Tshering Nidup, Pp. 18344–18348

New records of six termite (Blattodea: Termitidae) species from Kerala, India

– Poovoli Amina & K. Rajmohana, Pp. 18349–18354

Status, abundance, and seasonality of butterfly fauna at Kuvempu University Campus, Karnataka, India

– M.N. Harisha & B.B. Hosetti, Pp. 18355–18363

Observations on butterflies of non-protected areas of Titabar, Assam, India

– Abhijit Konwar & Manashi Bortamuly, Pp. 18364–18377

Three new distribution records of Conidae (Gastropoda: Neogastropoda: Conoidea) from the Andaman Islands, India

– Jayaseelan Benjamin Franklin & Deepak Arun Apte, Pp. 18378–18384

A new record of an endangered and endemic rare Rein Orchid *Habenaria rariflora* from Gujarat, India

– Mital R. Bhatt, Pp. 18385–18389

Glimpse of climber diversity in Saharanpur District, Uttar Pradesh, India

– Lalita Saini, Archasvi Tyagi, Inam Mohammad & Vijai Malik, Pp. 18390–18397

First report of the fleshy mushroom *Trichaleurina javanica* (Rehm) M. Carbone et al. (Ascomycota: Pezizales: Chorioactidaceae) from southern India

– Munuswamy Kumar, Sekar Nithya & Antony Agnes Kayalvizhi, Pp. 18398–18402

Notes

Photographic record of Temminck's Tragopan *Tragopan temminckii* (Gray, 1831) (Aves: Galliformes: Phasianidae) from eastern Bhutan: an evidence of its westward range expansion

– Tshering Dorji, Kinley Kinley, Letro Letro, Dawa Tshering & Prem Nanda Maidali, Pp. 18403–18405

The Malay Cardamom *Meistera aculeata* (Roxb.) Škorničk. & M.F. Newman (Zingiberaceae: Alpinioideae) from the Palghat gap: a new record to Kerala, India

– Vadakkevedu Jagadesh Aswani, Manjakulam Khadhera Jabeena & Maya Chandrashekar Nair, Pp. 18406–18410

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