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Cover: Parts of *Vachellia nilotica*, medium - watercolours. © P Kritika



First successful post-release breeding of captive-bred White-rumped Vultures *Gyps bengalensis* (Accipitriformes: Accipitridae) in the wild at Buxa Tiger Reserve, India

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Abstract: The population of White-rumped Vulture *Gyps bengalensis* declined catastrophically across South Asia during the 1990s due to diclofenac poisoning, prompting captive-breeding programmes aimed at eventual species recovery through reintroduction. Between 2021 and 2023, the Buxa Vulture Conservation Breeding Centre and Aviary in West Bengal released 31 captive-bred individuals into Buxa Tiger Reserve. In 2023, six released birds formed three pairs and constructed nests; one pair (tags N3 ♂ and P6 ♀) successfully hatched and fledged a chick after a 112-day nestling period in 2024. The two remaining nests failed during incubation, likely due to first-breeder failure. This represents the first confirmed post-release reproduction of captive-bred *Gyps bengalensis* in India, and the second documented site globally — successful breeding by captive-bred released birds was previously reported only from Nepal. This observation provides initial evidence that captive-bred individuals can successfully reproduce when released into an NSAID-safe landscape.

Keywords: Conservation breeding, Critically Endangered, Diclofenac, NSAID-safe zone, platform transmitter terminal, reintroduction, satellite telemetry, vulture conservation.

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INTRODUCTION

The White-rumped Vulture *Gyps bengalensis* was once among the most abundant large scavenging raptors of the Indian subcontinent, but populations declined by more than 99% during the 1990s and early 2000s due to poisoning from the veterinary non-steroidal anti-inflammatory drug (NSAID) diclofenac (Oaks et al. 2004; Shultz et al. 2004; Prakash et al. 2007), and the species is currently listed as 'Critically Endangered' (IUCN 2024). In response, a national conservation breeding programme was initiated in India in the early 2000s with the dual aim of preventing extinction and supporting future reintroductions once environmental threats had been mitigated (MoEF 2006).

While captive breeding and release have been achieved at multiple Indian centres, evidence of successful post-release reproduction by captive-bred individuals — a key benchmark of behavioural competence and ecological adaptation — has remained largely undocumented. Between 2021 and 2023, 31 captive-bred White-rumped Vultures were released from the Buxa Vulture Conservation Breeding Centre and Aviary (BVCBC&A) into Buxa Tiger Reserve, West Bengal. Here we report the first confirmed case of successful post-release breeding by captive-bred White-rumped Vultures in India and discuss its implications in the context of comparable vulture reintroduction programmes worldwide.

MATERIALS AND METHODS

Study Area

The study was conducted in Buxa Tiger Reserve (760.87 km²), West Bengal, India, bordered by Bhutan to the north and Assam to the east. The reserve lies at the junction of the Central Himalayas, Lower Gangetic Plains, and Brahmaputra Valley (NTCA 2016), with an elevation of 60–1,750 m and a tropical moist deciduous forest dominated by *Sal* *Shorea robusta* (Image 1). The breeding season of White-rumped Vultures in the region typically extends from October to May, with egg-laying between October and December and fledging by April–May (Manigandan et al. 2024).

Release and tagging

The BVCBC&A, located at Rajabhatkhawa village within Buxa Tiger Reserve, was established by the Forest Department, Govt. of West Bengal, to revive the wild populations of selected vulture species

through conservation breeding. The centre maintains populations of three Critically Endangered *Gyps* species of vultures, namely, the White-rumped Vulture *Gyps bengalensis*, Slender-billed Vulture *Gyps tenuirostris*, and Long-billed Vulture *Gyps indicus* (Table 1); however, to date only captive-bred White-rumped Vultures have been released. Sub-adult captive-bred White-rumped Vultures (2–4 years old) bred at the BVCBC&A under standard conservation-breeding protocols were selected for release. Birds were transferred to a 30.48 × 12.19 × 6.10 m pre-release aviary in the reserve core (Image 2) three months prior to release for acclimatisation; food was provided both inside and outside the aviary to encourage interaction with wild conspecifics (Terrasse et al. 2004). All the birds were previously fitted with polyvinyl chloride coloured leg rings and microchips as identification. One month before release, each bird was fitted with wing tags and a 70 g solar-powered Platform Transmitter Terminal (PTT; Microwave Telemetry Inc., Columbia, MD, USA) attached using the thoracic X-strap method (Anderson et al. 2020), with linen thread sewn through the sternum cross-point as a biodegradable weak link. Total device weight (~85 g) remained well below 3% of body mass (birds 4.2–5.2 kg; Kenward 2001). The entire conservation breeding of vultures at the centre and the release of captive-bred birds with PTT are approved by the Government of West Bengal. After attaching the PTTs, harness-related abnormalities in flight, feeding, preening, and bathing were monitored in the pre-release aviary; none were observed in the 31 individuals. Subsequent long-distance movements across Nepal, Bhutan, Assam, and the Bangladesh border, together with successful breeding, further confirmed unimpaired function. PTT detachment generally occurred 4–5 years post-release. Releases occurred in 2021 (n = 10), 2022 (n = 10), and 2023 (n = 11).

NSAID safety surveys

Under-cover veterinary-NSAID availability surveys were conducted in three districts of West Bengal surrounding Buxa Tiger Reserve (Alipurduar, Coochbehar, Jalpaiguri) in 2021–22 (n = 42 pharmacies) and 2023–24 (n = 44 pharmacies), as part of a long-term surveillance programme operating within a 100-km radius of the BVCBC&A since 2009. Surveys followed the covert two-person decoy protocol developed for the multi-country South Asian NSAID surveillance programme (Cuthbert et al. 2011; Galligan et al. 2020): a local field staff member, posing as a cattle owner, requested “a painkiller for an injured cow” from each pharmacy without naming any

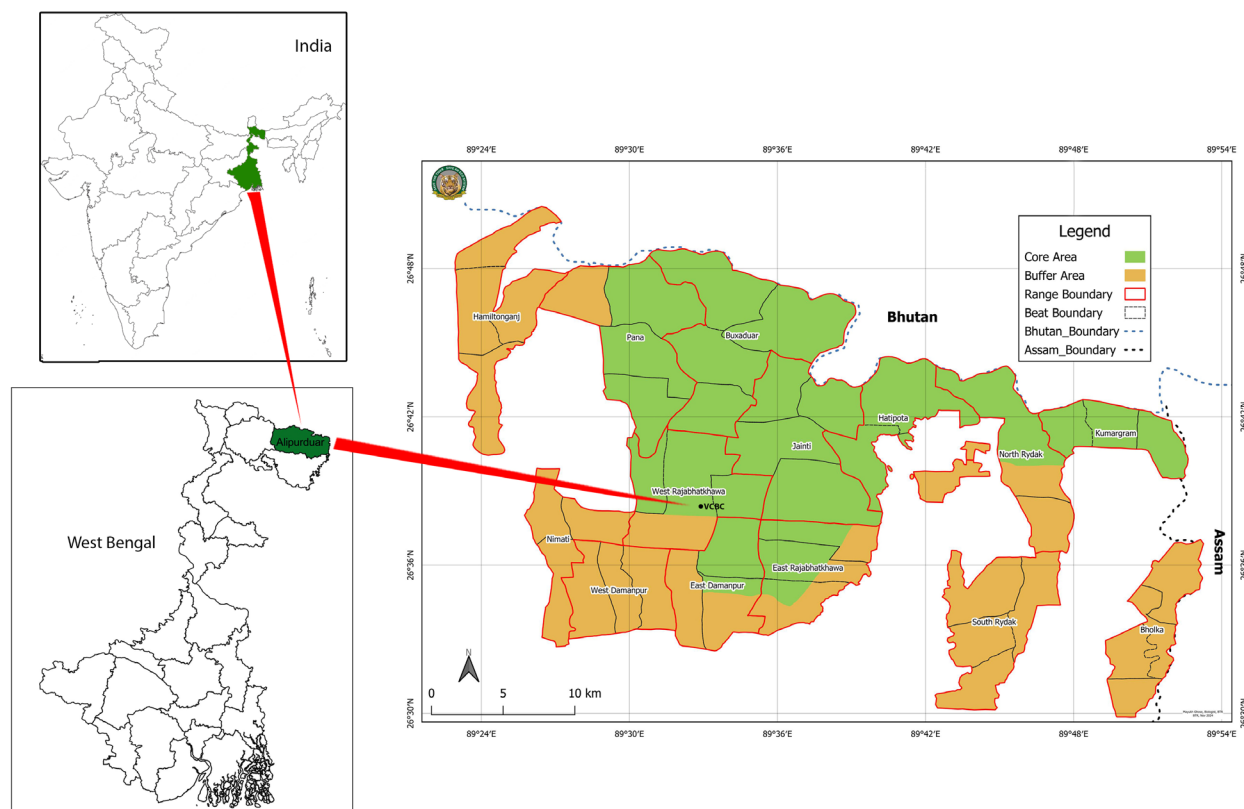


Image 1. Location of the Buxa Vulture Conservation Breeding Centre and Aviary (BVCBC&A), Rajabhatkhawa.

specific drug, and the first drug offered was purchased. The active ingredient of each drug was identified from the manufacturer's product labelling and consolidated at BVCBC&A. No diclofenac was offered or dispensed in any of the 86 pharmacies surveyed across the two release-period rounds.

Post-release monitoring

Of the 31 captive-bred individuals released between 2021 and 2023, six birds formed three breeding pairs by the 2023 breeding season; the remainder did not engage in breeding behaviour during the study period.

Released birds were monitored throughout by two biologists and four trained field staff using telemetry, ground observation, and camera trapping, with increased intensity during the breeding season (October–May). A pair was defined as two GPS-tagged individuals consistently co-locating at a nest tree with observed pair-bonding behaviour (displays, copulation, nest-material collection, and nest building).

PTT locations were monitored regularly; a stationary signal persisting for more than 48 hours triggered immediate deployment of a ground-truthing team to verify the status of the individual (living, sick, injured,



Image 2. Pre-release aviary of the Buxa Vulture Conservation Breeding Centre and Aviary (BVCBC&A), Rajabhatkhawa.

Table 1. Stock-population of vultures at the Buxa Vulture Conservation Breeding Centre & Aviary (BVCBC&A), Rajabhatkhawa, in 2021.

Vulture Species	Wild-caught	Captive-bred	Total
White-rumped Vultures	42	51	93
Slender-billed Vultures	12	6	18
Long-billed Vultures	14	18	32
Total	68	75	143

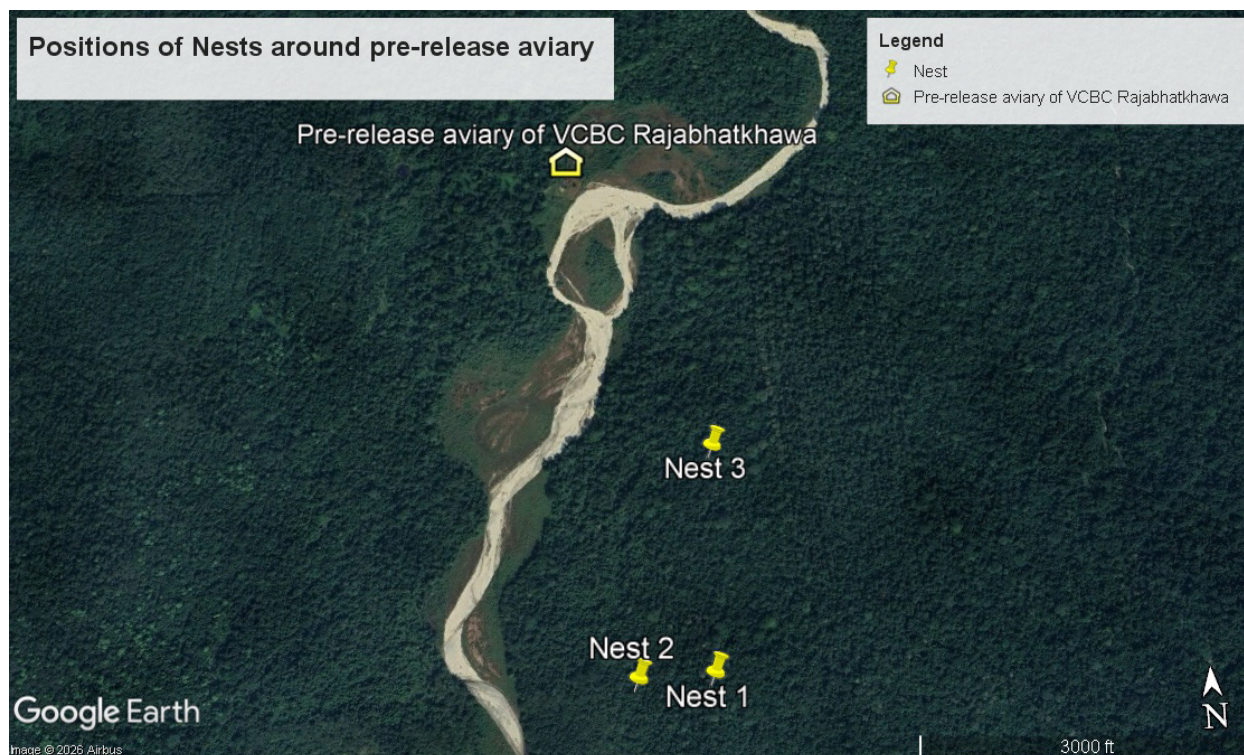


Image 3. Satellite image showing locations of nests around the pre-release aviary in 2023 (Google Earth Image).

Table 2. Summary of nesting attempts by released White-rumped Vultures in Buxa Tiger Reserve (2023–2024).

Nest ID	Pair (Tag ID)	Nest Detection Date	Egg Detection Date	Outcome	Key Observations
Nest 1	P3 (♂) – P2 (♀)	25 Nov 2023	6 Dec 2023	Failed	Activity ceased during incubation (3–6 weeks); no disturbance recorded
Nest 2	N3 (♂) – P6 (♀)	1 Dec 2023	1 Dec 2023	Successful	Chick hatched ~20 Jan 2024; fledged 11 May 2024 (~112 days observed); nest ~1.56 km from aviary
Nest 3	N5 (♂) – N12 (♀)	15 Dec 2023	26 Dec 2023	Failed	Activity ceased during incubation; cause undetermined

dead or PTT detachment). Whenever any carcass of the released birds was recovered, post-mortem examination was carried out by qualified veterinarians at BVCBC&A or, in collaboration with veterinary services of the country concerned for cross-border cases (as carcasses were found in Bhutan). Across the post-release period (2021–2025), seven mortalities of released birds were documented, attributed to leopard predation, electrocution, slingshot injury, traumatic shock and starvation; none were related to NSAID poisoning. Visceral gout—the pathognomonic indicator of NSAID poisoning in *Gyps* vultures (Oaks et al. 2004)—was not detected in any case where post-mortem examination was conducted.

Observations

Released White-rumped Vultures showed high

survival, normal ranging behaviour, integration with wild conspecifics, and species-typical foraging. The first cohort of 10 birds released in 2021 reached breeding age by 2023. During the 2023 breeding season, several pairs from this cohort showed nesting behaviour, including pair displays, copulation, and nest-material collection. GPS data analysis identified frequent visits to clustered locations within a 2-km radius of the pre-release aviary, leading to the discovery of three nests, all built on silk-cotton trees *Bombax ceiba* (Image 3) at approximately 30 m height with species-typical architecture. Nest-site access was constrained by terrain and the presence of Asian Elephants *Elephas maximus* and Gaurs *Bos gaurus*, but visual monitoring was conducted from a distance.

Nest details and outcomes are summarised in Table 2. Eggs were confirmed in all three nests between late November and early December 2023. Two nests (Nest

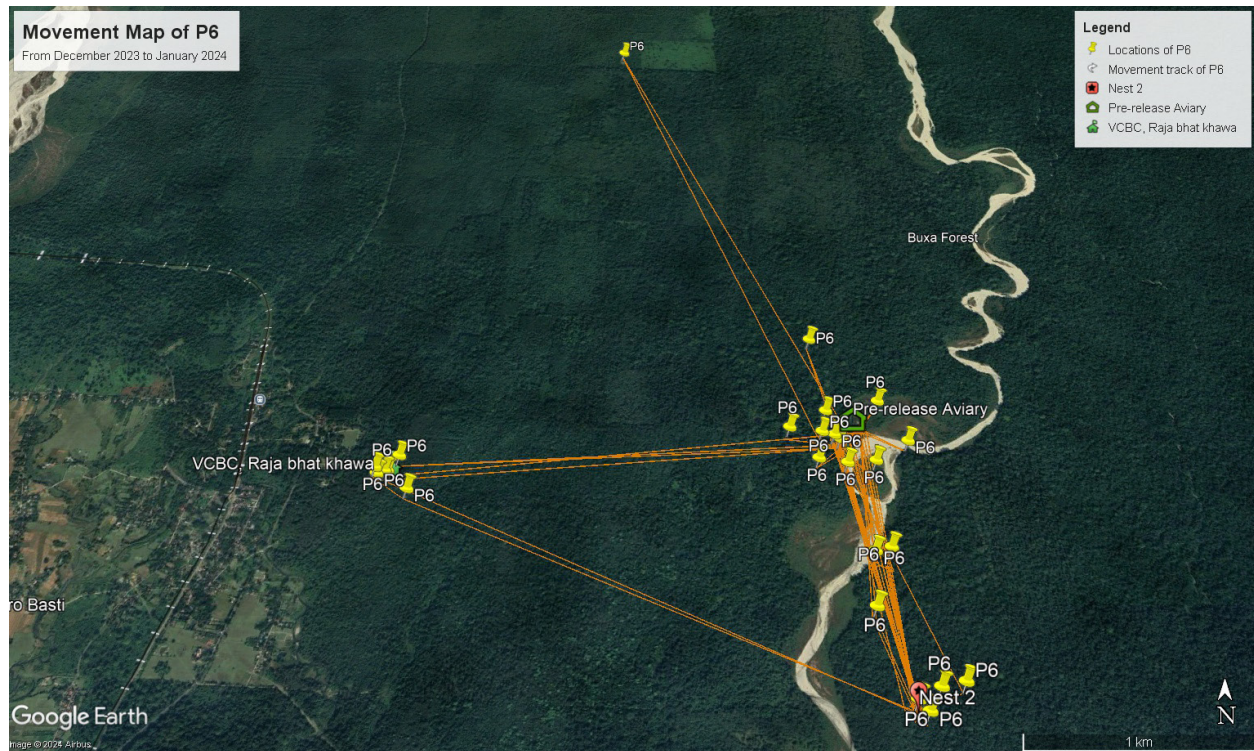


Image 4a. Satellite image showing movement pattern of P6 from December 2023 to March 2024.



Image 4b. Satellite image showing movement pattern of N3 from December 2023 to March 2024.



Image 5. First wild-fledged White-rumped Vulture nestling at Nest 2, BVCBC&A reintroduction programme, Buxa Tiger Reserve. © VCBC, Buxa.

1 and Nest 3) failed during incubation, with parental visits ceasing by mid-January 2024 — approximately 3–6 weeks after egg confirmation and well before expected hatching dates. No signs of predation or anthropogenic disturbance were recorded. The identified nests were visited at least weekly by the ground monitoring team, while telemetry data were checked continuously to confirm the presence of breeding adults at the nests. Because nests were located approximately 30 m above ground within the reserve core, direct visual observation of eggs from the ground was not possible. Initial presence of an egg was inferred from the onset of sustained incubation behaviour of the breeding birds, and when the birds were found not visiting the nests for more than 24 hours (confirmed by telemetry data), a short unmanned aerial vehicle (UAV) flight was conducted to check the condition of the nest, presence of an egg or any other sign of nest disturbance. Nest structures were inspected (with binoculars) for damage during each ground visit. However, no indications of nest disturbance, structural damage, or predator activity were recorded at any of the three nests.

The successful pair, wing-tagged N3 (♂) and P6 (♀), were 3.1 years old when released in 2021. Their initial visit to the nesting tree was confirmed using telemetry in the second week of October 2023 (Image 4a,b). Hatching at Nest 2 was confirmed on 20 January 2024 through the first recorded begging calls — yielding an observed incubation period of approximately 50 days, slightly shorter than the 56 days reported for the species (Naoroji 2006). The discrepancy likely reflects egg laying occurring a few days before first visual confirmation of the egg.

The nestling was first sighted from the ground on 23 February 2024, when approximately 34 days old (Images 5 & 6). It fledged on 11 May 2024 after 112 days, from a nest located 1.56 km south-east of the pre-release aviary. The fledged juvenile was subsequently observed near the pre-release aviary on 3 July 2024.



Image 6. An adult of the successful breeding pair attending the nestling at Nest 2, Buxa Tiger Reserve. © VCBC, Buxa.

DISCUSSION

These observations provide early evidence that captive-bred White-rumped Vultures released into the wild can survive, integrate into local landscapes, attain reproductive maturity within expected timeframes, and successfully reproduce. Nesting was concentrated within ~2 km of the pre-release aviary, consistent with strong initial site fidelity during early post-release establishment. The use of *Bombax ceiba* and species typical nest architecture indicates appropriate habitat selection by released individuals. The successful pair fledged a chick after approximately 112 days, slightly longer than the 104-day nestling period reported in Pakistan (Gilbert et al. 2002), most likely reflecting delayed initial detection of the nestling rather than extended development. The two failed nests are most plausibly attributed to first-breeder failure, consistent with the well-documented pattern of inexperienced breeders systematically performing more poorly than experienced ones (Cam & Monnat 2000).

This timeline can be contextualised against other vulture reintroduction programmes. Eurasian Griffon Vultures *Gyps fulvus* released in southern France from 1981 produced their first successful breeding in 1982 and grew to ~110 pairs by 2003 (Terrasse et al. 2004); Cinereous Vultures *Aegypius monachus* released in the same landscape from 1992 produced their first successful breeding pair four years later (Terrasse et al. 2004). In Bulgaria, reintroduced Cinereous Vultures showed pair formation one year after the first releases

and produced their first wild-fledged chick three years post-release (Ivanov et al. 2023). For White-rumped Vultures specifically, releases in Nepal beginning in November 2017 produced the first known post-release breeding events of this species in the wild (Mallord et al. 2024); the present case at Buxa is the second documented site globally and the first in India. The Buxa programme — first wild-fledged chick three years after the first release — is consistent with timelines documented in these comparable programmes, and demonstrates that captive-bred *Gyps bengalensis* can adapt rapidly to free-ranging conditions when released into an NSAID-safe landscape.

Limitations of the study

Several limitations apply. The sample is small (three nests, one successful breeding event), and the findings should be considered preliminary rather than representative of population-level trends. Direct nest access was restricted by terrain and large-mammal presence, introducing uncertainty into the precise timing of egg-laying and hatching. The causes of nest failure could not be determined directly. Continued monitoring will be required to establish whether early-stage spatial clustering reflects long-term habitat preference or transient establishment behaviour.

CONCLUSION

This first documented post-release breeding by captive-bred White-rumped Vultures in India represents a critical milestone for the recovery of a Critically Endangered species, supporting the underlying premise of the Indian Vulture Action Plan (MoEF 2006). Sustained release effort, ongoing monitoring, and continued NSAID surveillance in the release landscape will be essential to consolidate this success into a self-sustaining wild population and to extend reintroduction efforts to other South Asian *Gyps* species.

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Articles

The need for rigorous peer-review of Environmental Impact Assessments: a case from the Western Ghats, India

– Malaika Mathew Chawla, Sinead D'Silva, Madhushri Mudke, Anushka Rege, Nisha Bhakat, Nandini Velho, Vidyadhar Atkore, R. Sahanashree, Jerusha D'Souza, Aparna Kolekar, Anuja Date, Anish Paul, Aayush Gupta, Karthik Teegalapalli, Giridhar Kulkarni, Pronoy Baidya, Ajinkya Bagal, Katrina Fernandez, Omkar Dharwadkar & Parag Rangnekar, Pp. 29159–29180

Regional, ecological and biodiversity context of the Kashmir Valley, northwestern Himalaya, India

– Mohsin Javid, Khurshed Ahmad, Orus Ilyas, Junid N. Shah & Affiullah Khan, Pp. 29181–29195

Metabarcoding-based diet characterization of the Kolar Roundleaf Bat *Hipposideros hypophyllus* Kock & Bhat, 1994 (Chiroptera: Hipposideridae) and its peninsular Indian congeners

– Bhargavi Srinivasulu, Aditya Srinivasulu & Chelmala Srinivasulu, Pp. 29196–29211

A decadal study on the waterbirds and an analysis of the declining species in Perur-Sundakamuthur Lake, Coimbatore, Tamil Nadu, India

– G. Parameswaran, R. Sivashankar & R. Vridhi, Pp. 29212–29225

Diversity and habitat associations of avifauna in the Poovar Estuary, Kerala, India

– B.S. Bipitha, V. Reshmi, H. Maitreyi & H. Byju, Pp. 29226–29237

Abyssinian Blue-winged Goose *Cyanochen cyanoptera* Rüppell, 1845 population size, distribution, and habitat association in the central-south highlands of Ethiopia

– Solomon Mengistu & Afework Bekele, Pp. 29238–29250

Foraging postures and techniques used by the White-bellied Heron *Ardea insignis* Hume, 1878 (Aves: Pelecaniformes: Ardeidae) in Namdapha Tiger Reserve, India

– Himadri Sekhar Mondal & Gopinathan Maheswaran, Pp. 29251–29260

Breeding ecology and nest-site characteristics of the Black-necked Stork *Ephippiorhynchus asiaticus* in Khijadiya Bird Sanctuary, a Ramsar Wetland of Gujarat, India

– Sandeep Munjpara, Divyrajsinh Jadeja, Nita Solanki, Amitkumar Nayak & B.P. Pati, Pp. 29261–29268

An updated checklist and new records of butterfly species in Kedarnath Musk Deer Sanctuary (western Himalaya), Uttarakhand, India

– Anand Kumar, Priyanshu Kumar, Gourav Lochan, Prachi Arya & Rajeev Lochan, Pp. 29269–29286

Abundance, habitat preference, and ethnobiological assessment of the invasive Golden Apple Snail *Pomacea canaliculata* (Lamarck, 1822) in selected rice fields in Lanao del Sur, Philippines

– Ashiah M. Dimalutang, Mohammad Al-Thanie U. Paudac, Jonald C. Bornaes, Rosabeth M. Macapil, Mayleen P. Malagamba & Naima R. Sirad, Pp. 29287–29301

An annotated checklist of bryophytes of Rajouri District, Jammu & Kashmir, India

– Manju Sharma, Nazia Kouser, P.L. Uniyal & Shreekar Pant, Pp. 29302–29313

Communications

First successful post-release breeding of captive-bred White-rumped Vultures *Gyps bengalensis* (Accipitriformes: Accipitridae) in the wild at Buxa Tiger Reserve, India

– Soumya Sundar Chakraborty, Debal Ray, Apurba Sen, P.J. Harikrishnan & Nabi Kanta Jha, Pp. 29314–29321

A checklist of the avifauna of the Noakhali Science and Technology University campus, Noakhali, Bangladesh

– Ashikur Rahman Jibon, Tanzina Alam & M. Rakibur Rahman, Pp. 29322–29330

Record of the crambid moth *Aethaloessa calidalis* (Guenée, 1854) (Lepidoptera: Crambidae: Spilomelinae) from Chhattisgarh, India

– Akanksha Chandrakar & Shashi Gupta, Pp. 29331–29335

Short Communications

First photographic record of the Northern Swamp Deer *Rucervus duvaucelii* *duvaucelii* in Upper Ganga River Ramsar Site, India

– Aftab Alam Usmani, Pichaimuthu Gangaamaran, Ruchi Badola & Syed Ainul Hussain, Pp. 29336–29339

First image-based evidence of Wroughton's Free-tailed Bat *Otomops wroughtoni* (Thomas, 1913) (Chiroptera: Molossidae) from the Yamuna Floodplain, New Delhi, India

– Umendra Sirohi, Mohan Singh, M. Faisal, Ekta Khurana, Sumit Dookia & Faiyaz A. Khudsar, Pp. 29340–29344

New distribution record of *Hydrocotyle bonariensis* Lam. (Magnoliopsida: Apiales: Araliaceae) from India

– Balasiewdor Kharsyntiew, H.T. Lalmuankima, Vijay, Poonam Sharma & Rambir Singh, Pp. 29345–29349

Recorded and lost: *Methles indicus* Régimbart, 1899 (Coleoptera: Dytiscidae) a new distribution record from the state of Telangana: a case study on habitat loss due to urban encroachment

– Shiva Shankar, Deepa Jaiswal & Devadoss Kumar, Pp. 29350–29353

Notes

Camera-trap record of the Indian Grey Wolf *Canis lupus pallipes* (Sykes, 1831) (Mammalia: Carnivora: Canidae) from Karlapat Wildlife Sanctuary, Odisha, India

– Siddhanta Kumar Mohanta & R. Kalaivanan, Pp. 29354–29356

Decline in winter visiting Common Kestrel *Falco tinnunculus* (Falconiformes: Falconidae) at Rani, Assam 2011–2024

– Sachin Ranade, Pp. 29357–29359

Coprophagy in Egyptian Vulture *Neophron percnopterus* (Accipitriformes: Accipitridae) at Jorbeer carcass dump, Rajasthan

– Sachin Ranade & Hemant Bajpai, Pp. 29360–29363

New record of cob-web spider species *Steatoda albomaculata* (De Geer, 1778) (Araneae: Theridiidae) from Kachchh, India with detailed distribution of Indian species of *Steatoda* Sundevall, 1833

– Subhash I. Parmar, Vivek U. Chauhan, Ketankumar Yogi & Pranav J. Pandya, Pp. 29364–29366

Predation record of the hornet *Vespa basalis* Smith, 1852 (Hymenoptera: Vespidae) by the orb-weaver spider *Nephila pilipes* (Fabricius, 1793) (Araneae: Araneidae)

– Shantam Ojha & Gautam, Pp. 29367–29369

Notes on the occurrence of southeastern Asian taxon *Scopellaria marginata* (Blume) W.J.de Wilde & Duyfjes (Cucurbitaceae) in the Nicobar Islands: a new distribution record in the Indian part of Sundaland

– K. Pradheep, K. Joseph John, I. Jaisankar & P.K. Singh, Pp. 29370–29374

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