

ZOO'S PRINT

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Climate change and Biodiversity



Part 2

Biodiversity is about **living things** and their relationships with each other. This includes species, ecosystems and the ecological processes of which they are a part. Every species worldwide is impacted by climate change. Rising temperatures and sea levels, less rain and more droughts. By 2100, an estimated 50% of all the world's species could go extinct.



Climate change is **affecting our wildlife** as it is changing species distribution through shifting habitat, changing life cycles, and development of new physical traits.



Many species won't be able to **adapt** quickly enough to changes in their **environment**.

Habitat fragmentation

occurs when construction such as river dams and highways which disrupt migration paths breaks up natural landscapes.

More **CO₂** and increased **temperatures** in the atmosphere could lead to long forest seasons.

A **shift in the range** of a species can mean the introduction of new rivalries and the unraveling of ecosystems.

Habitat destructions

Further droughts are likely to harm natural grassland growth. Extreme storms and rising sea levels may lead to coastal squeezing.



Climate change can cause **Range contraction** when already limited habitats change and shrink further.

Phenological mismatches

happen when the life cycles of dependent species change and no longer match up. E.g., migratory species arrive at a site after their prey has passed.



The **earlier arrival** of spring changes the **life cycles** of many plants that provide food and habitat for other species.

Global Warming

prevents the mixing of these layers to impact nutrient exchange, heat and CO₂. In some regions, the water does not contain any oxygen that is damaging to marine life.

Ocean acidification

– Too much CO₂ is absorbed into the water, making it difficult for some species to build shells and skeletal structures. Some waters are already considered 'corrosive' to these organisms.



Climate change is responsible for damaging the development of **marine ecosystems** that are also at danger of pollution, commercial fishing and drainage of wetlands.



Compiled and designed by **Latha G. Ravikumar, ZOO**

IMPACTS OF CLIMATE CHANGE

Agriculture Impacts

- ✘ Crop yields decrease --> will affect food supply
- ✘ Irrigation demands
- ✘ Less efficiency of hydropower plants --> Growing risks to electricity supply



Water Resource Impacts

- ✘ Changes in water supply
- ✘ Water quality
- ✘ Demand for water



Impacts on Coastal Ecosystems

- ✘ Sea level rise could erode and inundate coastal ecosystems and eliminate wetlands.
- ✘ Warmer and more acidic oceans are likely to disrupt coastal and marine ecosystems.
- ✘ Inundate coastal lands
- ✘ Costs to defend coastal communities



Forest and Species Impacts

- ✘ Change in forest compositions and shift geographic range of forests
- ✘ Widespread forest death
- ✘ Wildfires
- ✘ Invasion of pests and strong species Extinction of vulnerable plants and animals.
- ✘ Some warm weather species are expanding, and those that rely on cooler weather are declining habitats and potential extinction.



Health Impacts

- ✘ Weather-related mortality
- ✘ Infectious diseases
- ✘ Respiratory illnesses
- ✘ Increase in diseases transferred by mosquitoes, rats and ticks



MITIGATION

Action to reduce and curb greenhouse gas emissions



ADAPTATION

Actions to reduce vulnerability to climate change



Goal

Cut down greenhouse gas emissions

Goals

Enhance our adaptability

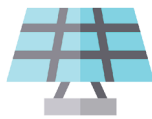
Improving our ability to thrive on various climate conditions

Develop resilience against extreme climate and climate change

Energy efficient technology



Greater use of renewable energy



Electrification of Industrial processes



Efficient (Sustainable) transport (electric, public, bicycles, etc.)



Increasing local agriculture Capacity -> reduce imports and, therefore, the use of fossil fuel over long distance



Carbon tax and emissions markets



Design of building and infrastructure

Forest protection - Landscape restoration (natural landscape) and reforestation



Changing agriculture practices - Flexible and diverse cultivation to be prepared for natural catastrophes



Conservation of water and energy



Research and development on possible catastrophes, temperature behaviour etc



Preventive and precautionary measures (evacuation plans, health issues etc.)



**Mitigation aims to reduce the causes of climate change
Adaptation includes changing our choices, actions
and approaches to adapt to climate change.**

UNSEEN NEIGHBOURS

The tale of species rendered invisible by the glow of balls of fur and spitfire.

Beyond spots and stripes

By VIDYA MARY GEORGE. PUBLISHED ON 22 JULY 2019

Dampa Tiger Reserve has more to boast about than the striped cats it is named after—it indeed has a green thumb!

Rare finds

Dampa Tiger Reserve in northeastern India is part of the Indo-Burman Biodiversity Hotspot. It is also the largest wildlife sanctuary in the state of Mizoram. The reserve is famed for the thriving populations of its big wild cats.

In April 2014, researchers collecting data on wild cats encountered two interesting plant species in the reserve. Further surveys and literature searches revealed that the spotted species were, in fact, incredibly rare floral gingers, *Globba spathulata* and *Hemiorchis pantlingii*.



Globba spathulata in Dampa Tiger Reserve.

Spice of life

The ginger family consists of important tropical herbs used in medicine, food, and perfumes and as ornamental plants. Around 200 species of the family are known from India.



Hemiorchis pantlingii in Dampa Tiger Reserve.

Both species sighted in Dampa are restricted to northeastern India and the adjoining regions of Bangladesh, Myanmar, and northern Thailand. Existing information on the gingers suggests that there are less than 20 mature individuals of each species in the wild. This qualifies both herbs as Vulnerable according to the IUCN Red List. This data, however, could be an outcome of limited survey effort. The species are indeed extremely hard to locate in the wild—after the flowering season, both species survive underground as rhizomes.

The newly-discovered populations of both gingers are relatively secure by virtue of their location within a protected area. There are, however, other threats lurking the background—conversion of land to oil-palm monocultures and controlled burning could sweep the populations to the brink of untimely local extinction.

Invisible species

The case from Dampa is yet another example of the plight of the less glamorous species on the planet. The lion’s share of conservation attention and funding is usually dedicated to the rescue of charismatic species worldwide. This worrisome trend assumes that a single species can be saved in isolation just as it ignores the immediate conservation needs of a wide variety of other equally important and often threatened species in the wild. The study also points to a serious lack

of scientific inventorying in the reserve, despite its ecological significance and vast forest cover.

- The small network of protected areas in Mizoram urgently requires biodiversity inventorying.
- With large areas being converted to oil-palm monocultures, it is important to extend the coverage of protection within the state.
- Habitat management practices in protected areas should not compromise the survival of rare native floral species.

Reference

Kumar, P. & P. Singh (2018). Conservation assessment of two rare gingers (Zingiberaceae) from Dampa Tiger Reserve, Mizoram, India. *Journal of Threatened Taxa* 10(5): 11599–11605. <https://doi.org/10.11609/jott.3797.10.5.11599-11605>.

This science communication was originally published in [Jottings](https://threatenedtaxa.org/jottings/ecology/beyond-spots-and-stripes/) at <https://threatenedtaxa.org/jottings/ecology/beyond-spots-and-stripes/>.

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Jottings is inviting articles that break down the findings in conservation to general audiences for a purposeful understanding and application of the results.

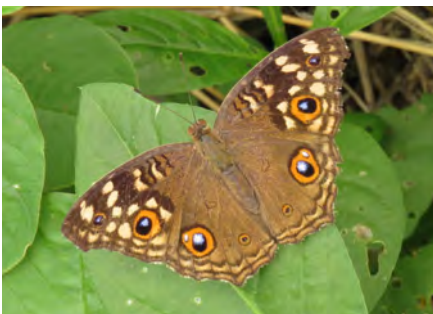
**Jot for Jottings
for the cause of conservation!**

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INSTAGRAM IMAGES



The thick and slightly pokey fur on its back gives the Spiny-backed Tree Mouse its common name. As its name further suggests, this small mammal lives in the canopy of tall trees in undisturbed jungles of the Western Ghats. It moves about actively at night, travelling between trees using vines and socializing and foraging for food on high branches of native trees. The vulnerable rodent is very docile during the day and tends to curl up and sleep when handled. Shot at Coorg by S. Molur, ZOO; posted on 22 Jul 2019.



The Lemon Pansy loves to stay close to the ground and can be commonly seen basking in the sun with its wings wide open. The lively butterfly is also an expert at camouflage—during the dry season, it dulls the brilliant eyespots and marvellous patterns on its brown wings to lie low in the leaf litter. Shot at Coimbatore by B. Ravichandran, ZOO; posted on 18 Jul 2019.



The Critically Endangered White Himalayan Lily *Lillium polyphyllum* is a rare, striking sight in its habitat in the northwestern Himalaya. The medicinal herb was first described by J.F. Royle in 1839 and can be easily identified by its small leaves and bell-shaped, pendant white flowers that sport many purple spots and stripes. Shot at Chamba by V. Ahuja, ZOO; posted on 16 Jul 2019.



Common Mynas are an all too familiar sight in most neighbourhoods, hopping about in their dark overalls and bright legs, bullying other species with their claims to food and shelter. By dusk, the quarrelsome birds retire from their busy day to gather in large flocks in communal roosts, where they fluff their feathers and bob their heads in unison to bid the sun a rather loud and unpleasant farewell. Shot at Coimbatore by B. Ravichandran, ZOO; posted on 09 Jul 2019.

We bring to you every week shots and tidbits of incredibly diverse species from around the natural world! Follow us on Instagram to be part of a growing community that celebrates our natural heritage: <https://www.instagram.com/threatenedtaxa/>

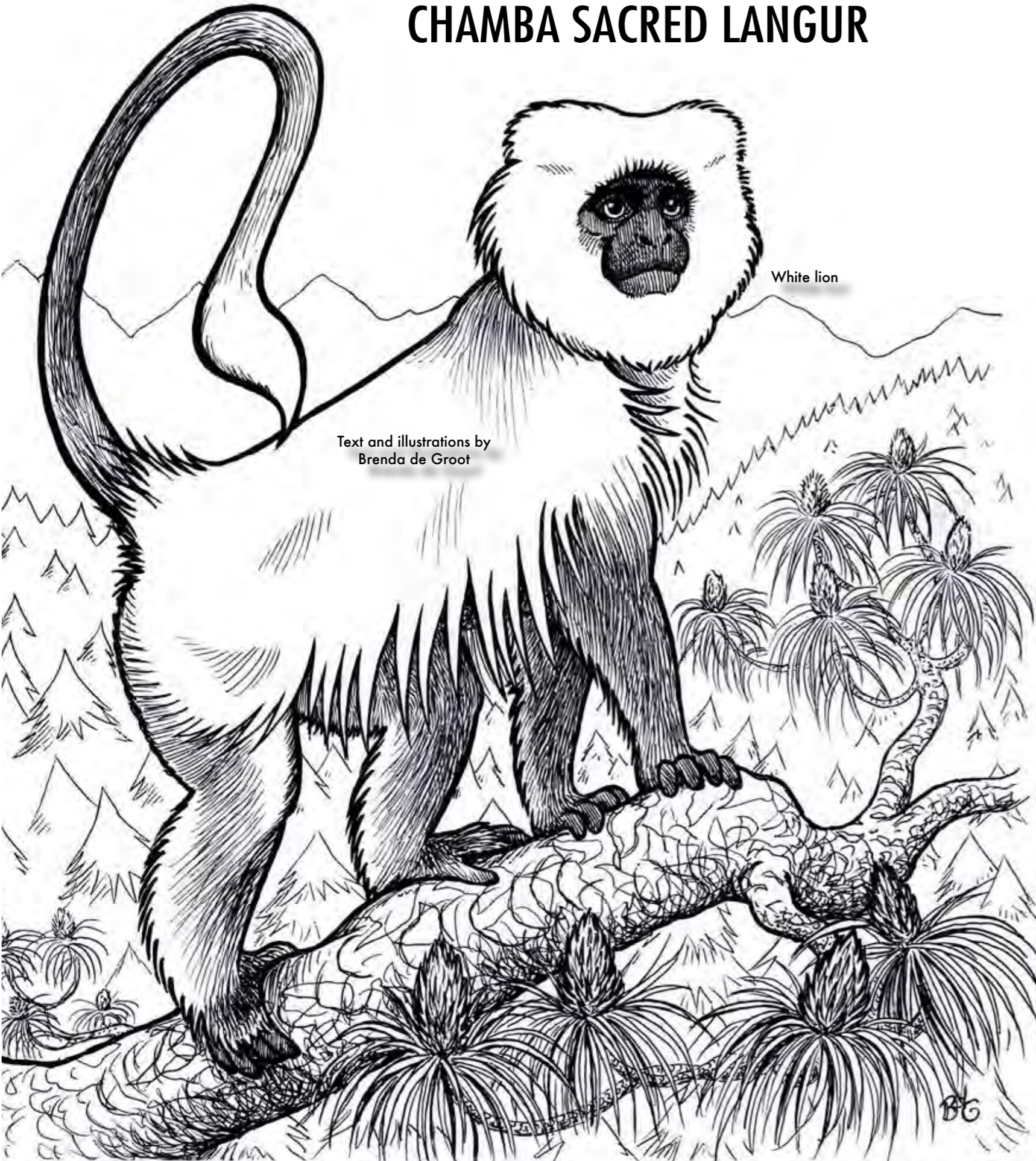
Follow B. Ravichandran on Instagram: <https://www.instagram.com/discoverravi/>

Follow S. Molur on Instagram: <https://www.instagram.com/molursanjay/>

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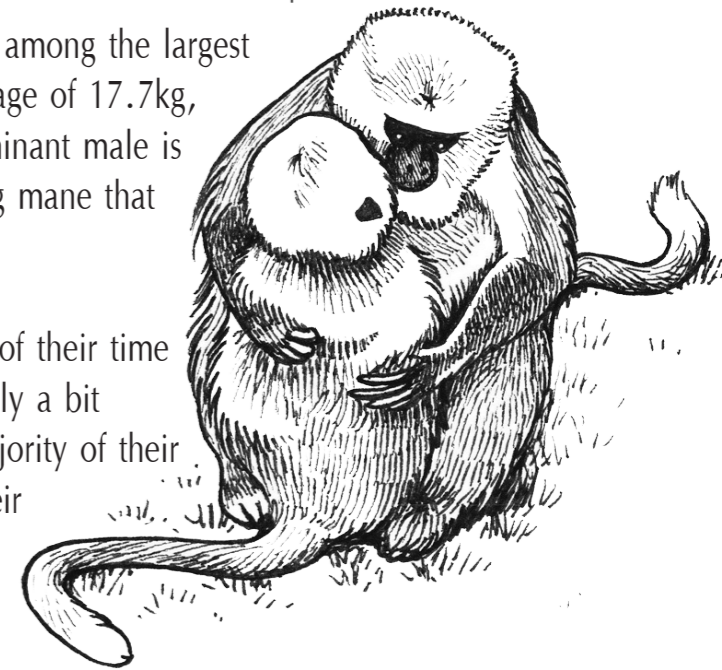
Captions by Vidya Mary George, ZOO.

CONSERVING LIVELIHOODS AND THE CHAMBA SACRED LANGUR



Text and illustrations by
Brenda de Groot

Did you know that the Chamba Sacred Langur is among the largest of the Hanuman langurs that exist? With an average of 17.7kg, these big guys are an impressive sight! The dominant male is the biggest of the group, and has a long flowing mane that makes it look somewhat like a white lion!



The gray langurs of India spend about 6–10 % of their time grooming each other. This percentage is generally a bit lower than primates that rely on fruit for the majority of their diet. An explanation for this probably lies in their leafy diet.

Leaf-eating monkeys, like the gray langurs, spend quite some time feeding to meet their daily calorie intake: plants do not contain as many calories as fruit. On top of that, they need to rest to let the heavy plant matter digest. As there are only 24 hours in a day, there is little time remaining for the langurs to socialize—at least not as much as for frugivorous monkeys.

However, this does not mean they are unsocial primates—far from that actually! Gray langurs are quite tolerant to group members, and not as strictly hierarchical as, for example, Rhesus Macaques. They love to sit next to each other and cuddle.

Embracing is one of the many social behaviours of the Chamba Sacred Langur. Hugging strengthens the bond between individuals, relieves stress and also helps keeping warm in cold Himalayan winters.

Follow the Himalayan Langur
Project: [facebook.com/HimLanPro/](https://www.facebook.com/HimLanPro/)



Largest record of Bibron's Coral Snake (*Calliophis bibroni* Jan, 1858) in Mudumalai Tiger Reserve, India



Road kill adult male *Calliophis bibroni* in Mudumalai Tiger Reserve. © J. Dalson Mani.

The Bibron's Coral Snake *Calliophis bibroni* Jan 1858 is a front-fanged venomous snake endemic to the Western Ghats of southern India (Smith 1943; Whitaker & Captain 2004). It is terrestrial in habit, inhabiting moist deciduous forests within an altitude range of 900–1000 m. The IUCN status of this species is Least Concern in view of its wide distribution and presumed large overall population (Srinivasulu et al. 2011).

Boulenger (1896) described scale count of four specimens collected by Beddome. Later on Wall (1919) reported on young specimen of this species and mentioned it as a rare species. Smith (1943) stated that the distribution range was known from

the Western Ghats as far north as Coorg. Gowrishankar and Ganesh (2009) reported that the range-extension of this species from Central Western Ghats. Recent new locality records from the Anamalai Hills and Agastiyar Hills have considerably extended the previously known range of this species (Deepak et al. 2010). Samson et al (2014) recorded the rediscovery of this species after 139 years from Mudumalai Tiger Reserve, South India.

This note reports the largest specimen of Bibron's Coral Snake recorded till date. On 16th September 2016, we found a road killed adult male snake in Kargudi at NH 67 in the Mudumalai Tiger Reserve (11.573°N & 76.561°E) at an elevation of



Table 1. Morphologic and metric details of the current record and the previous largest record (Deepak et al. 2010) of *Calliophis bibroni*.

Variables	Deepak et al. 2010 (Male)	Present Specimen (Male)
Snout to vent length (mm)	782	815
Total Length (mm)	880	913
Ventrals	229	227
Subcaudals	37	37
Dark Body Bands	40	38
Dark Tail Bands	9	9
Sex	Male	Male
Colour	Dark Purple	Dark Purple

894 m. Its measurements and scale details are provided in Table 1. According to Smith (1943) and Whitaker & Captain (2004), the snake was identified as Bibron's Coral Snake.

A total of 21 specimens of the species have been recorded from the Western Ghats so far (Deepak et al. 2010). Among these, the largest specimen was recorded at 880cm by Deepak et al (2010) from Anamalai Tiger Reserve. The present record is relatively larger than the earlier record.

Frequent records of the Bibron's Coral snake from Mudumalai Tiger Reserve show a healthy population of the species in the area. More scientific study is needed to predict the ecology of this snake in the region.

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Citation: Samson, A. & J.L. Princy (2019). Largest record of Bibron's Coral Snake (*Calliophis bibroni* Jan, 1858) in Mudumalai Tiger Reserve, India. *Reptile Rap* #195, In: *Zoo's Print* 34(8): 10–11.



Amphibian diversity of Rajgir Wildlife Sanctuary, Bihar, India

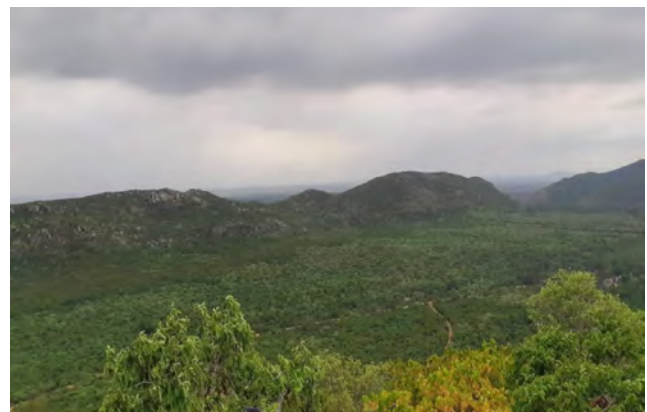
Amphibians hold vital positions in forest and aquatic food webs and are important for the nutrient portion of the vertebrate biomass (Hutchens & De Perno 2009). They are also indicators of the health of an ecosystem and therefore their conservation is critical. Currently, 7,707 species of amphibians are known from around the world and 384 from India (Dinesh et. al. 2015) and 432 (Dinesh et. al. 2019). Habitat fragmentation, pollution, and roadkill are the major threats to the amphibians today.

There is not much data available with respect to the herpetofauna of Bihar. Although Venkateswarlu & Murthy (1972) published a list of amphibians of Bihar, it only covered 12 species with some notes on their habit and habitat. Sarkar (1991) reported 11 species of frogs and toads from Chotanagpur (Bihar). This is the first detailed report on the amphibian diversity in and around Rajgir Wildlife Sanctuary in Nalanda, Bihar.

Rajgir Forest was notified in 1978 under Section 18 of the Wildlife Protection Act. Rajgir Wildlife Sanctuary (RWS) comes under the Gangetic floodplains. Coordinates of survey site is 25.003°N & 85.423°E. It is the only forested area left

in Nalanda District covering an area of 35.84km² which is surrounded by high hillocks. The sanctuary and the surrounding forests consist of a mixed type of foliage comprising dry deciduous, sal mixed moist deciduous, including dry deciduous scrublands, and uneven patches of bamboo grooves (Champion & Seth 1968). It is home to a number of herpetofauna that feeds on amphibians, such as Buff-striped Keelback Snake *Amphiesma stolatum*, Spectacled Cobra *Naja naja*, Common Bronzeback Tree Snake *Dendrelaphis tristis*, Common Sand Boa *Eryx conicus*, Common Krait *Bungarus caeruleus*, and Common Vine Snake *Ahaetulla nasuta*.

Surveys were conducted in various habitats of RWS in the pre-monsoon (June), monsoon (July–August), and post-monsoon (September) seasons from June 2017 to



Rajgir Wildlife Sanctuary, Nalanda, Bihar.



Table 1. Amphibians of Rajgir Wildlife Sanctuary, Bihar, India.

Family	Common name	Species	IUCN Status	Status of occurrence
Bufonidae (Gray, 1825)	Asian Common Toad	<i>Duttaphrynus melanostictus</i> Schneider, 1799	LC	Abundant
	Indian Marbled Toad	<i>D. stomaticus</i> Lütken, 1864	LC	Common
Dicroglossidae (Anderson, 1871)	Indian Bullfrog	<i>Hoplobatrachus tigerinus</i> Daudin, 1803	LC	Common
	Jerdon's Bullfrog	<i>H. crassus</i> Hoffman, 1932	LC	Common
	Skittering Frog	<i>Euphlyctis cyanophlyctis</i> Schneider, 1799	LC	Abundant
	Alpine Cricket Frog	<i>Fejervarya limnocharis</i> Gravenhorst, 1829	LC	Common
	Indian Burrowing Frog	<i>Spaerotheca berviceps</i> Schneider, 1799	LC	Uncommon
	Roland's Burrowing Frog	<i>S. rolandae</i> Dubois, 1983	LC	Uncommon
Microhylidae (Gunther, 1858)	Ornate Narrow-mouthed Frog	<i>Microhyla ornata</i> Duméril & Bibron, 1841	LC	Common
	Guangdong Rice Frog	<i>M. rubra</i> (Jerdon, 1854)	LC	Uncommon
	Marbled Balloon Frog	<i>Uperodon systoma</i> Schneider, 1799	LC	Rare
Rhacophoridae (Hoffman, 1932)	Indian Tree Frog	<i>Polypedates maculatus</i> J.E. Gray, 1830	LC	Common

August 2018 to document the amphibian and reptile species of the area. Only the amphibian fauna in the area is discussed in this note. The surveys were carried out after sunset (18.00–21.00 hr), at night (22.00–00.00 hr), and before dawn (04.00–05.00 hr). The most productive time for the amphibian survey was after sunset during the monsoon season. Individuals of all species documented were observed in their natural habitat. Roadkill specimens were also observed during the survey. Identification was done with help of Daniels (2005). The nomenclature of species placement follows Frost (2018).

We recorded 12 species of amphibians referable to eight genera from four families (Table 1). Our surveys yielded rich



Satellite google earth image of Rajgir Wildlife Sanctuary.



assemblage of species documented in undisturbed habitats as well as the adjoining agricultural lands. The Indian Bullfrog *Hoplobatrachus tigerinus*, Indian Skittering Frog *Euphlyctis cyanophlyctis*, Ornate Narrow-mouthed Frog *Microhyla ornata*, Roland's Burrowing Frog *Spaerotheca rolandae*, and Indian Tree Frog *Polypedates maculatus* were the common anurans easily found here. *Microhyla ornata* was found in the forest floor under leaf litter. Further studies are required to understand the herpetofauna of RWS.



Indian Bullfrog *Hoplobatrachus tigerinus* - Largest frog of the region, breeds before pre-monsoon. Mating was observed in pre-monsoon, monsoon and post-monsoon as well. Full grown adult frogs and tadpoles observed May onwards in ponds and puddles. Specimen were observed nearby the FRH, Circuit house, Jaiprakash udyan, Rajgir. Habitat loss/degradation and use excess of pesticides is major threats to the Bullfrogs.

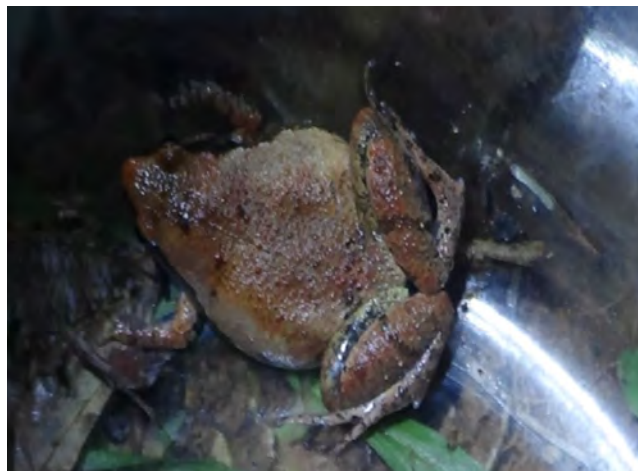


Indian Skittering Frog *Euphlyctis cyanophlyctis* - This frog was observed in good numbers in flooded paddy fields, ponds, puddles and stream. Mating was observed from June onwards. The Skittering Frog is most commonest frog in this region. *Euphlyctis cyanophlyctis* is closely related to *Euphlyctis hexadactylus* which has not yet been reported from study area. The skipper frog is collected in large number as laboratory specimen in india.



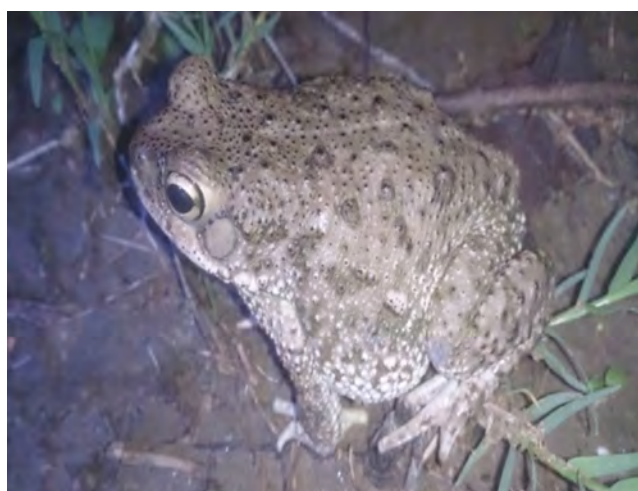
Jerdon's Bullfrog *Hoplobatrachus crassus* - Natural history of this species almost matches with its congener *H. tigerinus*. Roadkilled specimen were collected and fixed in 4 % solution of formaldehyde.

Voucher specimen were deposited in Zoological Survey of India Gangetic Regional Plain Centre Patna as national zoological collection.



Red Narrow-Mouthed Frog *Microhyla rubra* - Adults breed during monsoon season in agricultural lands. Uncommon frog seen on forest floor after rain. Dorsally reddish pink with dark brown sides and faintly cross-banded reddish limbs. Ventral side is white. In breeding male throat is black.

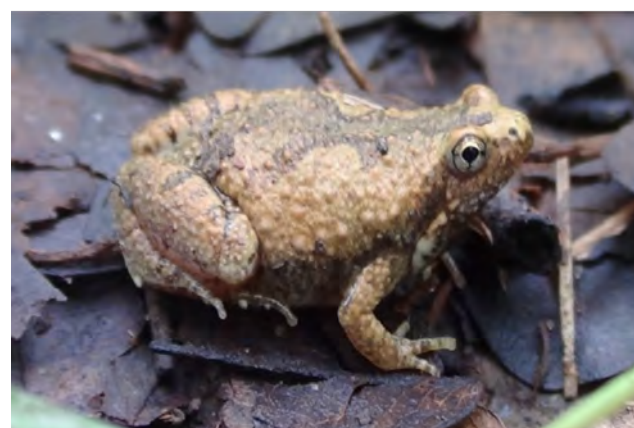
Indian Marbled Toad *Duttaphrynus stomaticus* - *Duttaphrynus stomaticus* was less common than its congener. Mating



was observed in June after pre-monsoon showers. I found many specimen in village. Observed to feed on variety of insects such as beetles, planthoppers, grasshoppers, may flies and moths.



Roland's burrowing frog *Spaherotheca rolandae* - These little frogs are seen after rains. We have found this frog inside the sanctuary region and in the adjacent villages while surveying. *Spaherotheca rolandae* were photographed in its natural habitat, the call has been also observed near water bodies.



Ornate Narrow-Mouthed Frog *Microhyla ornata* - A very small sized microhylid in this



region can be observed under leaf litter. Its sound can be heard in the evening around paddy fields and near water bodies.



Alpine Cricket Frog *Fejervarya limnocharis* - Medium-sized semi-aquatic frog. A good number of Indian Cricket Frog was observed also photographed after rain. *Fejervarya limnocharis* starts breeding after rain. This species is common frog throughout the study area and found usually around water bodies.

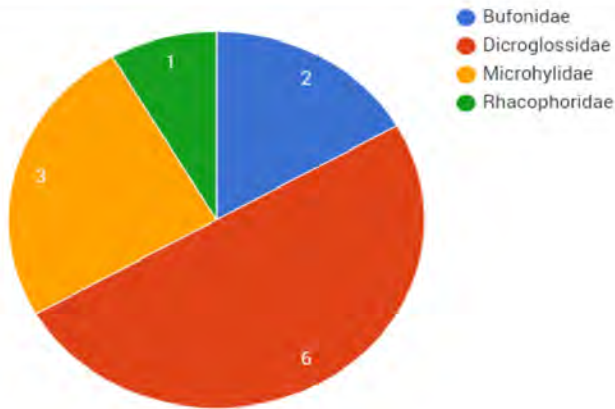


Indian Tree Frog *Polypedates maculatus* - Very common Rhacophorid throughout the area. Active during rains only. Genus

Polypedates represented by single species the *P. maculatus*. During dry season was found under water tanks. Active at night, observed to feed on moths, small beetles and bugs around bulbs, often found in and around human habitation. The call of the male frog and mounted pair is observed after at night. Males have been observed to call from hanging branch of shrubs near pond. Female lay eggs in protective foam nest. Males have single internal vocal sac. Generally females are larger than males. While surveying the rajgir forest and nearby villages, where we found 27 specimen of *Polypedates maculates*. Road Killed specimen was collected for preservation .



Common Indian Toad *Duttaphrynus melanostictus*: Common throughout the sanctuary found in and around the human settlements. Observed in good number near FRH, Jaiprakash udyan, Ropeway site, Venuvana etc.



Pie chart showing observed number of species in each family.

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Butterfly diversity of the Central University of Tamil Nadu Campus in Thiruvarur, Tamil Nadu, India

The present study was an attempt to document the butterfly diversity of the Central University of Tamil Nadu (CUTN) campus in Thiruvarur, Tamil Nadu, India. CUTN (10.819°N & 79.610°E) is situated on both sides of Vettaru River, a major tributary of Cauvery River in the heart of the Cauvery Delta, 7km to the northwest of Thiruvarur Town with 2.09 Km² of land in two revenue villages of Neelakudi and Nagakudi. The Thiruvarur district has a tropical climate, an average annual temperature of 28.5°C, and an average annual rainfall of 1,178mm. The campus is situated in a riverine freshwater wetland characterized by productive alluvial soil which attracts much floral and faunal diversity. Apart from common birds, CUTN also attracts a large number of waterbirds such as painted storks, open-billed storks, egrets, and spot-billed ducks. CUTN has varied vegetation types such as grasslands, woodlands, shrubs, and herbs.

Methods

The butterflies of CUTN were surveyed during February–December 2017. Adult butterflies were photographed and

identified with standard reference books such as Evans (1932), Wynter-Blyth (1957), Haribal (1992), Feltwell (2001), Kunte (2006) and Pajni et al. (2006). For common names of butterflies, Wynter-Blyth (1957) and Varshney (1983) were followed.

The butterfly survey was carried out between 10.00h and 16.00h on days with less than 50% cloud cover and moderate light. Census routes were conceptualized as transects with width of 12m (40ft). Totally, six line transects were made within the campus every month, totalling to 132 transects in 11 months. The directional radiuses of roughly 6m (20ft) to each side of the route were maintained for the survey. The nectar and host plant species most preferred by the butterfly species were also identified for each section of the census route.

Results and Discussion

During the study period, we recorded a total of 48 species of butterflies (Table 2) and photographed 24 butterflies falling within five families. The dominant family was Nymphalidae with 27 species, followed by

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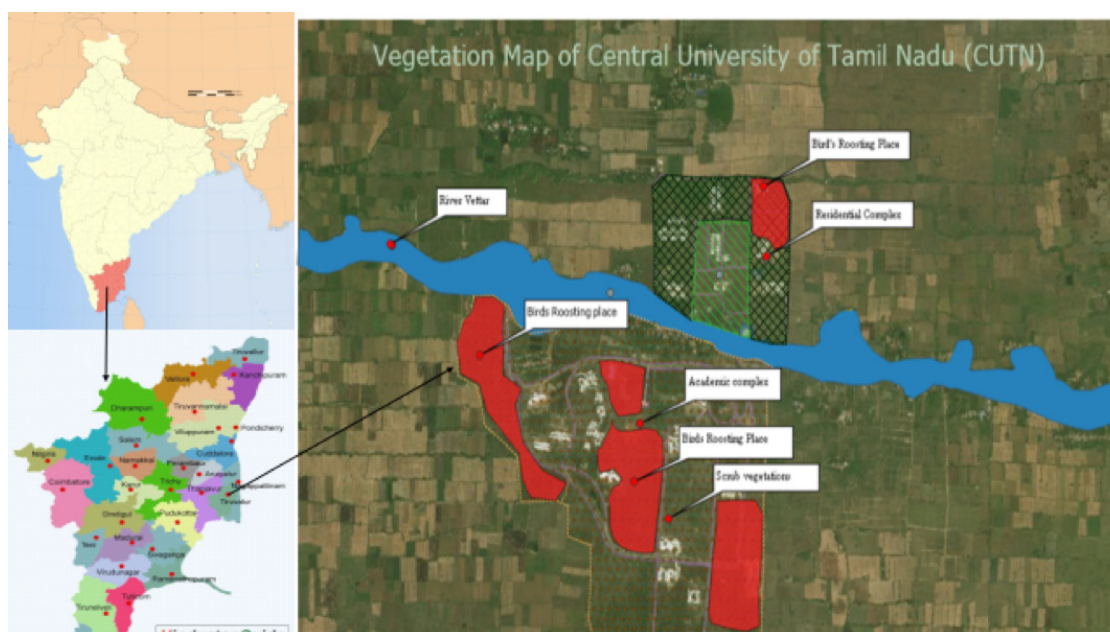
Table 1. Nectar plant species that attract butterflies in the Central University of Tamil Nadu campus in Thiruvavur, India.

	Common name	Scientific name	Family	Habit
1	Blue Porterweed	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	Shrub
2	Common Leucas	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Herb
3	Lantana	<i>Lantana camara</i> L.	Verbanaceae	Shrub
4	Shaggy Button Weed	<i>Spermacoce hispida</i> L.	Rubiaceae	Herb
5	Burr Bush	<i>Triumfetta rhomboidea</i> Jacq.	Tiliaceae	Herb
6	Jungle Geranium	<i>Ixora coccinea</i> L.	Rubiaceae	Shrub
7	Coat Buttons	<i>Tridax procumbens</i> (L.) L.	Asteraceae	Herb
8	Sleepy Morning	<i>Waltheria indica</i> L.	Malvaceae	Herb
9	Little Ironweed	<i>Vernonia cinerea</i> (L.) Less.	Asteraceae	Herb
10	Three-flower Beggar Weed	<i>Desmodium triflorum</i> (L.) DC.	Leguminosae	Herb
11	Purple Fruited Pea Eggplant	<i>Solanum trilobatum</i> L.	Solanaceae	Herb
12	Sessile Joyweed	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae	Herb
13	Devil-bean	<i>Crotalaria retusa</i> L.	Leguminosae	Shrub
14	Madagascar Periwinkle	<i>Catharanthus roseus</i> (L.) G. Don.	Apocyanaceae	Herb
15	Bitter Bush	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Asteraceae	Herb
16	Indian Heliotrope	<i>Heliotropium indicum</i> L.	Boraginaceae	Shrub
17	Bellyache Bush	<i>Jatropha acerooides</i> (Pax & K.Hoffm.) Hutch	Euphorbiaceae	Shrub
18	Earpod Wattle	<i>Acacia auriculiformis</i> Benth.	Leguminosae	Tree
19	Teak	<i>Tectona grandis</i> L.f.	Lamiaceae	Tree
20	Crested Flower	<i>Isodon adenanthus</i> (Diels) Kudô	Lamiaceae	Shrub
21	Ceylon Slitwort	<i>Leucas zeylanica</i> (L.) W.T. Aiton	Lamiaceae	Herb
22	China Rose	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Shrub
23	Fringed Rosemallow	<i>Hibiscus schizopetalus</i> (Dyer) Hook.f.	Malvaceae	Herb
24	Burr Bush	<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae	Herb
25	Paper Flower	<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	Climbing shrub
26	Great Bougainvillea	<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae	Climbing shrub
27	Royal Jasmine	<i>Jasminum grandiflorum</i> L.	Oleaceae	Climbing shrub
28	Winter Jasmine	<i>Jasminum multiflorum</i> (Burm.f.) Andrews	Oleaceae	Climbing shrub
29	Indian Pellet Shrub	<i>Pavetta indica</i> L.	Rubiaceae	Shrub
30	Chinese Chaste Tree	<i>Vitex negundo</i> L.	Lamiaceae	Tree
31	Crown Flower	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Shrub
32	Indian Plum	<i>Ziziphus mauritiana</i> Lam	Rhamnaceae	Shrub
33	South West Thorn	<i>Prosopis juliflora</i> (Sw.) DC.	Fabaceae	Tree

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The Map showing Central University of Tamil Nadu campus in Thiruvarur, Tamil Nadu, India.

Lycaenidae (eight species), Pieridae (seven species), Papilionidae (five species), and Hesperidae (one species). The diversity and abundance of butterfly species were highly correlated with the availability of food plants in the surroundings (Kunte 2000; Raut 2010; Ghosh & Saha 2016). The nymphalid species (Table 1) were especially attracted by *Crotalaria retusa* which attracted migratory butterflies in December 2017.

Two nymphalids, namely *Parantica aplea* and *Danaus chrysippus*, are dominant butterfly species in CUTN. The distribution and abundance of most families except Hesperidae were highest during May–July 2017. Hesperidae was abundant in September. Tiny Grass Blue *Zizula hylax*,

Common Crow *Euploea core*, Crimson Rose *Pachliopta hector*, Common Rose *Pachliopta aristolochiae*, and Blue Pansy *Junonia orithya* were the commonest butterflies throughout the study period. The present study concluded with study conducted by (Gaude & Janarthanam, 2015). High plant diversity which provides host and food plants for butterflies. During the November–December 2017 Rattle weed *Crotalaria retusa*, *Tridax procumbens* were bloom in the campus that attracted diverse butterfly species in the campus. In the late monsoon season (September–October), the number of plants producing nectar was few; therefore, butterflies chose flowers of *Ziziphus mauritiana*, *Tridax procumbens*, and *Alternanthera sessilis* as sources of nectar in the study

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1-3 - *Cortalaria retusa* attracts a flock of Striped tiger and Blue tiger and 4 - *Prosopis juliflora* support butterflies within the Central University of Tamil Nadu campus in Thiruvaur, India.

area. During September–November, CUTN attracted a greater number of Glassy Tiger *Parantica aglea* and Striped Tiger *Danaus genutia* butterflies. The present study recorded a greater number of butterfly species during the winter season than the summer season. These findings coincide with a study conducted by Sneha (2018), which concluded that butterfly diversity and abundance varies with seasons.

Conclusion

The present study was the first of its kind in exploring the butterfly diversity of CUTN. Reduction of native vegetation and

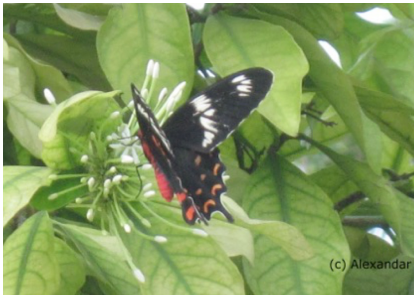
spreading of *Prosopis juliflora* are major threats to the diversity and abundance of butterfly species in the area (Tiple et al. 2007; Majumder et al. 2012). Conservation of the butterfly diversity of CUTN encompasses the conservation of the ecosystem with varieties of native herbs, shrubs, and trees with foliage, nectar, pollen, and seeds. Butterflies need diverse habitats (Ave et al. 2014) and, therefore, protection of nectar and vegetation heterogeneity within CUTN will ensure butterfly diversity as well as conservation and sustenance of the ecosystem (Tiple 2012). Conservation of butterflies is

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Butterflies recorded in the Central University of Tamil Nadu campus in Thiruvavur, India.



(c) Alexandar

Pachliopta hector



(C) Alexandar

Pachliopta aristolochiae



(C) Alexandar

Catopsilia pomona



(c) Alexandar

Delias eucharis



(C) Alexandar

Castalius rosimon



(C) Alexandar

Zizula hylax



(C) Alexandar

Ariadne ariadne



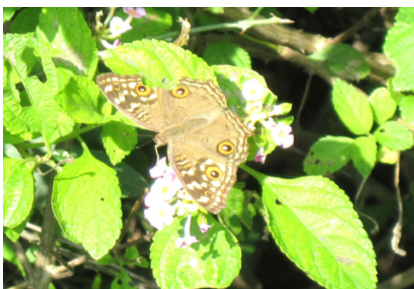
(C) Alexandar

Hypolimnas bolina



(C) Alexandar

Junonia iphita



Junonia lemonias



(C) Alexandar

Junonia almana



(C) Alexandar

Junonia orithya

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Tirumala limniace



Danaus chrysippus



Danaus genutia



Euploea core



Byblia ilithyia



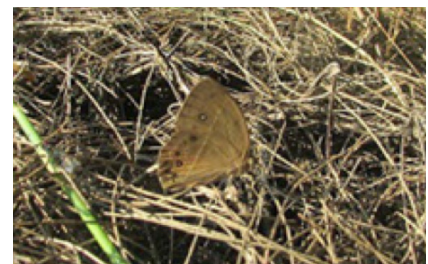
Ariadne merione



Pareronia valeria



Eurema hecabe



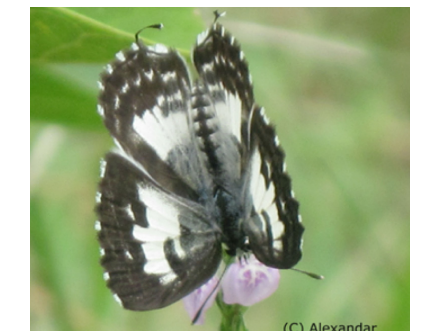
Heteropsis malsara



Papilio demoleus



Acraea terpsicore



Caleta roxus

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Table 2. Butterflies species recorded in the Central University of Tamil Nadu campus in Thiruvavur, India.

	Family	Common name	Scientific Name	Wildlife (Protection) Act Schedule (Rahul and Agarwala 2015)
1	Papilionidae	Crimson Rose	<i>Pachliopta hector</i> (Linnaeus, 1758)	Schedule I
2		Common Rose	<i>P. aristolochiae</i> (Fabricius, 1775)	
3		Red Helen	<i>Papilio helenus</i> (Linnaeus, 1758)	
4		Lime Swallowtail	<i>P. demoleus</i> (Linnaeus, 1758)	
5		Common Mormon	<i>P. polytes</i> (Linnaeus, 1758)	
6		Blue Mormon	<i>P. polymnestor</i> (Cramer, 1775)	
7	Pieridae	Mottled Emigrant	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	
8		Common Emigrant	<i>C. pomona</i> (Fabricius, 1775)	
9		Common Wanderer	<i>Pareronia valeria</i> (Cramer, 1776)	
10		Common Jezebel	<i>Delias eucharis</i> (Drury, 1773)	
11		White Cabbage	<i>Pieris brassicae</i> (Linnaeus, 1758)	
12		Green-Veined White	<i>P. napi</i> (Linnaeus, 1758)	
13		Common Grass Yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)	
14		Crimson Tip	<i>Colotis danae</i> (Boisduval, 1836)	
15	Lycaenidae	Common Pierrot	<i>Castalius rosimon</i> (Fabricius, 1775)	Schedule I
16		Tiny Grass Blue	<i>Zizula hylax</i> (Fabricius, 1775)	
17		Dark Grass Blue	<i>Zizeeria karsandra</i> (Moore, 1865)	
18		Zebra Blue	<i>Leptotes plinius</i> (Fabricius, 1793)	
19		Pea Blue	<i>Lampides boeticus</i> (Linnaeus, 1767)	Schedule II
20		Common Cerulean	<i>Jamides celeno</i> (Cramer, 1775)	
21		Blue Gram	<i>Euchrysops cnejus</i> (Fabricius, 1798)	Schedule II
22		Grass Jewel	<i>Freyeria trochylus</i> (Freyer, 1845)	
23	Nymphalidae	Common Costor	<i>Ariadne merione</i> (Cramer, 1779)	
24		Great Egg Fly	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Schedule I
25		Danaid Egg Fly	<i>H. misipus</i> (Linnaeus, 1758)	Schedule II
26		Common Hedge-blue	<i>Lycaenopsis puspa prominens</i> (Toxopeus, 1927)	Schedule I
27		Chocolate Pansy	<i>Junonia iphita</i> (Cramer, 1779)	
28		White-line Bush-brown	<i>Telinga malsara</i> (Moore, 1857)	
29		Grey Pansy	<i>Junonia atlites</i> (Linnaeus, 1763)	
30		Lemon Pansy	<i>J. lemonias</i> (Linnaeus, 1758)	
31		Peacock Pansy	<i>J. almana</i> (Linnaeus, 1758)	
32		Blue Pansy	<i>J. orithya</i> (Linnaeus, 1764)	

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	Family	Common name	Scientific Name	Wildlife (Protection) Act Schedule (Rahul and Agarwala 2015)
33	Nymphalidae	Blue Tiger	<i>Tirumala limniace</i> (Cramer, 1775)	
34		Plain Tiger	<i>Danaus chrysippus</i> (Linnaeus, 1758)	
35		Striped Tiger	<i>D. genutia</i> (Cramer, 1779)	
36		Common Crow	<i>Euploea core</i> (Cramer, 1780)	Schedule IV
37		Common Five Ring	<i>Ypthima baldus</i> (Fabricius, 1775)	
38		Common Four Ring	<i>Y. huebneri</i> (Kirby, 1871)	
39		Common Leopard	<i>Phalanta phalantha</i> (Drury, 1773)	
40		Tawny Coster	<i>Acraea violae</i> (Fabricius, 1775)	
41		Baronet	<i>Euthalia nais</i> (Forster, 1771)	
42		Straight Pierret	<i>Caleta roxus</i> (Godart, 1823)	
43		Common Evening Brown	<i>Melanitis leda</i> (Linnaeus, 1758)	
44		Spotted Joker	<i>Byblia ilithyia</i> (Drury, 1773)	
45		Angled Castor	<i>Ariadne ariadne</i> (Linnaeus, 1763)	
46		Common Sailer	<i>Neptis hylas</i> (Moore, 1872)	
47		Glassy Tiger	<i>Parantica aglea</i> (Stoll, 1782)	
48		Hesperiidae	Common Straight Swift	<i>Parnara guttatus</i> (Moore, 1865)

essential for a sustainable green campus (Mandal 2016). This study emphasizes the need for establishing a butterfly garden (Kunte 2000) within CUTN.

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Notes on breeding and management of Black-headed Ibis *Threskiornis melanocephalus* (Aves: Pelecaniformes: Threskiornithidae) at Thiruvananthapuram Zoo, Kerala, India



Black-headed Ibis during the incubation stage in Trivandrum Zoo.

Black-headed Ibis *Threskiornis melanocephalus* (hereafter Ibis) is a resident wading waterbird which breeds in southern and southeastern Asia. Though a fairly common wetland bird in Kerala, its nesting was recorded only in Panamaram in Wayanad District (Balakrishnan & Thomas 2004), Kumarakom in Kottayam District (Narayanan et al. 2006), and Manthakad in Palakkad District (Roshnath et al. 2017).

The study was carried out in January–March 2018 at Thiruvananthapuram Zoo in the heart of Thiruvananthapuram City (8.5102°N & 76.9550°E), towards the southern limits of mainland India. Of the 12 Ibises maintained in the newly designed aviary of the zoo, three pairs were found displaying nesting behaviour from mid-January.

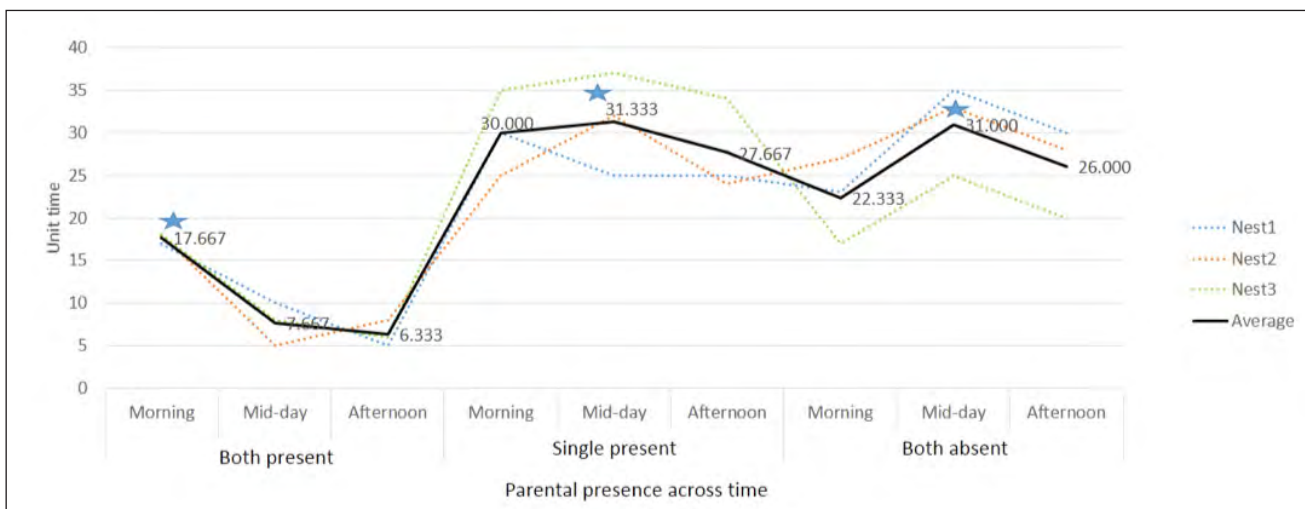
Nests were closely monitored from 9.00h to 14.00h using focal animal sampling method (Altmann 1974) from 7 February to 19 March. The nests were numbered according to the sequence in which they were built (i.e., the first nest was numbered 1). Each nest was observed for 10min followed by an interval of 5min. For ease of interpretation, time was clubbed as morning (9.00–10.40 h), mid-day (10.45–12.25 h), and afternoon (12.30–13.55 h). The activities of the parent birds (present or absent, incubation, feeding, and nest arrangement) were recorded during different nesting stages (incubation, nestling, and fledgeling) in each 10min observation unit. A total of 2000min observation over a period of 10 days (daily 200min of observation; i.e., 20 units of 10min each) was recorded during the study. Also, a ladder placed parallel to the aviary

Table 1. Nesting success of Black-headed Ibis in Trivandrum Zoo.

Condition	Nest 1	Nest 2	Nest 3
No. of eggs	3	3	3
No. of eggs hatched	3	3	3
No. of nestling	3	3	2
No. of fledgling	3	2	2
Nesting success	100	66.7	66.7

helped the observer record the number of eggs and hatchlings to determine nesting success.

In southern India, November–March is the general breeding season for Ibises (Ali & Ripley 1983; Ali 1996); in Kerala (Kumarakom Heronry), however, they were found nesting in July–September (Narayanan et al. 2006). In general, Ibises are known to breed during the heronry season which coincides with



Frequency of parental presence of Black-headed Ibis across the observation period in Trivandrum Zoo.

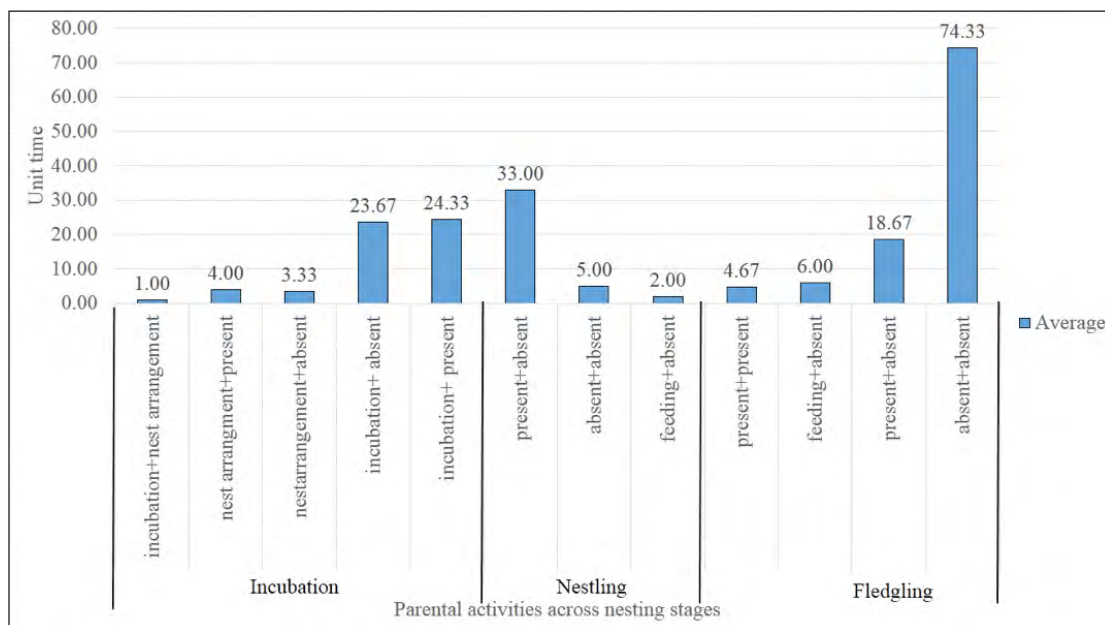
the southwestern monsoon in Kerala. At the Trivandrum Zoo, adequate food and protection provided under captive conditions might have been the reason for breeding during the summer season. The Ibises in the aviary showed courtship displays and mating behaviours in mid-January. Collection of twigs was observed and a platform nest was constructed on a dead tree (*Copperpod Peltophorum pterocarpum*) at a height of 6m in late January.

During the present study, nesting success was 100% in nest 1, while nests 2 and 3 lost one chick each (Table 1). The first egg of nest 1, 2, and 3 hatched on 6, 8, and 19 February, respectively. The chicks from nests 1 and 2 fledged by 12 March and

those from nest 3 by 21 March. The average fledging period was found to be 32 days.

Parent birds were mostly found to be present at the nest during morning hours, where either both (n=17.66) or one of the parents (n=30) was found guarding the nest. Parental presence in the nests was least recorded (i.e., both absent) during mid-day hours (n=31). When present, the birds showed activities such as incubation, nest rearrangement, feeding, or merely standing on or near the nests. When absent, the birds were away from the nests engaged in activities like foraging, flocking, or perching.

Different combinations of parental actions were observed during different nesting stages. During the incubation stage, either



Parental activities shown by Black-headed Ibis during different nesting stages in Trivandrum Zoo.

with the presence of both (n=24.33) or one (n=23.67) of the parents, incubation was the major activity shown by the parental birds. Along with incubation, parents were found to engage in nest building and rearrangement activities (n=8.33). Unguarded nest condition, i.e., absence of both parents at a time, was not recorded during this stage. Parental guarding behaviour (n= 33) was prominent during the nestling stage.

The complete absence of both parents (n=5) was also recorded during this stage, which may have been due to the assured security and absence of predators in the aviary.

The fledgeling stage was found to involve less parental interventions and nests were found unguarded most of the time during this stage (n=74.33).

Parental feeding behaviour was generally recorded less, but with increased frequency, during the fledgeling stage compared to the nestling stage. Low record of feeding behaviour may have been because feeding as a fast process may have happened during non-observatory periods (5min interval) and hence not documented in the data sheet.

Both parents contributed equally to nest arrangements, incubation, and feeding. Stealing of nesting material from

neighbouring nests was observed quite regularly. Frequent fighting was observed between neighbouring pairs. Many sub-adult Ibises were found perching near the nests and some were found disturbing the nesting pairs occasionally. Although courtship behaviours were noted among these birds, none was found nesting during the study period.

Devkar et al. (2006) observed increased reproductive success of Ibises under captive conditions due to favourable conditions and remarkable management in the zoo. At Thiruvananthapuram Zoo, the aviary was designed to cover a large area (1,823.89m²) with a pond at the centre, ensuring free movement and exhibition of normal behaviours. Raised platforms were provided for roosting and nesting. Adequate amount of sticks and twigs were provided in the aviary during the nesting phase. More feed (selectively, freshwater fishes) were provided inside the aviary owing to the high energy needs during the nesting season and to ensure the survival of hatchlings. Movement of zookeepers inside the aviary was also restricted and keepers were specially appointed to watch the birds and provide adequate care.

The incident of breeding of Ibises at the Thiruvananthapuram Zoo indicates that the species can be bred successfully in captive conditions. Being a conservation-

priority species, along with the proper documentation of captive ecological studies, studies from natural habitats can help in planning scientific reintroduction programmes.

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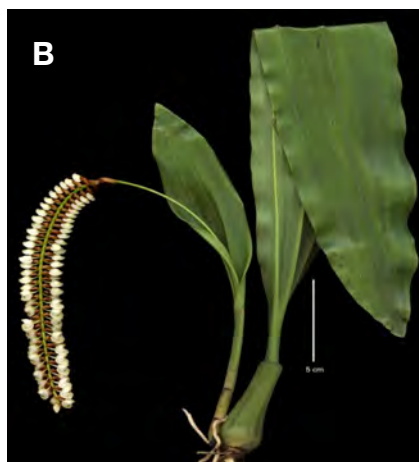
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Pholidota pallida Lindl. (Orchidaceae): a new record for northern India from Uttarakhand



Pholidota pallida Lindl.: A - natural habitat, B - in flowering condition, C - close-up of flowers on rachis. © Dinesh K. Agarwal (B&C).

Pholidota Lindl., a taxonomically interesting genus belonging to the family Orchidaceae, was established by Lindley in 1825, which comprises c. 41 species in the world (Govaerts et al. 2014) and 11 species in India (Chowlu & Rao 2015). The genus is known to be distributed in India, southeastern Asia, New Guinea, and the Pacific Islands to Australia. One of its threatened endemic species *P.*

pallida Lindl., so far reported from the eastern parts of India, is reported here for the first time from the virgin forest areas of Nandhour Wildlife Sanctuary in Nainital District of Uttarakhand as a new distribution record for northern India.

During floristic exploration in Nandhour WS of Uttarakhand, an interesting plant species of Orchidaceae was collected

from the dense forest areas at Nandhour River bank on the way to Anwalakhera in Nandhour range. The detailed critical study of the collected specimen with the other allied species of the genus, herbarium consultation at the Botanical Survey of India, Dehradun (BSD), the Botanical Survey of India, Kolkata (CAL), and the Forest Research Institute, Dehradun (DD), and perusal of available literature (Hooker 1890; Osmaston 1927; Babu 1977; Gaur 1999; Uniyal et al. 2007; Chowdhery et al. 2009; Chowlu & Rao 2015) confirmed the specimen as *Pholidota pallida* Lindl. The specimens studied were deposited at the herbarium of BSD.

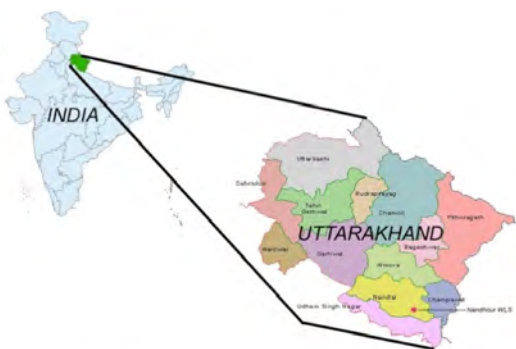
Pholidota pallida Lindl., Edwards's Bot. Reg. 21: ad t. 1777. 1835; H.J. Chowdhery et. al., Mat. Fl. Arunachal Pradesh. 3:144. 2009; K. Chowlu & A.N. Rao, Richardiana. XVI:10-12.2015. *P. calceata* Rchb.f.,

Bonplandia 4: 329.1856. *Coelogyne calceata* (Rchb.f.) Rchb.f. in Walp., Ann. Bot. Syst. 6: 238. 1861. *Pholidota imbricata* sensu Hook.f., Fl. Brit. India 5 (2): 845. 1890. *Pholidota imbricata* var. *sessilis* Hook.f., Fl. Brit. India 5(2): 846. 1890; H.J. Chowdhery, Orch. Fl. Arunachal Pradesh 594. 1998. *Pholidota pallida* var. *sessilis* (Hook.f.) Sarkar, J. Econ. Tax. Bot. 5: 1008. 1984.

Epiphytic, unifoliolate herbs. Pseudobulbus cylindric, furrowed, 3.0–4.6 cm long, base covered with inconspicuous 3.5–5.5 cm long sheaths; leaf solitary, oblong-lanceolate to oblanceolate, 10–25 cm × 1.5–4.5 cm, acute at apex; petiole 0.6–1.2 cm long; prominently trinerved at the base. Inflorescence a raceme, 20–36 cm long, synanthous, peduncle 9–15 cm long, terete, rachis densely many-flowered; floral bracts ovate-sagittate, 4.0–7.0 mm × 4.0–5.0 mm, acute, membranous, palebrown; creamy-yellow; sepals sub-equal, creamy-white, the dorsal ones oblong-elliptic, 4.0–5.0 mm × 2.0–3.5 mm, obtuse, the lateral ones oblong-ovate, 5.0–7.0mm × 4.0–5.0 mm, connate at base; petals oblong-falcate, 3.0–5.0mm × 1.0–2.5 mm; lip broadly 3-lobed, 4.0–6.5 mm long, lateral lobes 3.0–3.5 mm long, erect, apical lobe divided into two lobules, irregularly quadrate; column winged, spatulate; anther cap dark brown; pollinia 4 in two pairs.

Flowering and fruiting: March–June.

Habitat: The species was found growing in a tropical dense forest in moist areas along a river bank.



Location Map of Nandhour Wildlife Sanctuary.

Distribution: India (Kumaon region and Nandhour WS in Uttarakhand, West Bengal, Arunachal Pradesh, Manipur, and Sikkim), Bhutan, Laos, Myanmar, Thailand, and Vietnam.

Specimen examined: 124315 (BSD), 17.iv.2015, India, Uttarakhand, Nainital District, Nandhour Wildlife Sanctuary, 29°08.710"N & 79°48.654"E, 552m, coll. K. Ambrish.

Additional specimens examined: 66257, 28.v.1979, Uttarakhand, Kumaon, Pithoragarh District, Kaflani, coll. C.M. Arora; 75647 (BSD), 18.iv.1984, Baram, coll. Bipin Balodi.

Note: This taxonomically interesting species is similar to *P. imbricata* Lindl.



Herbarium sheet of *Pholidota pallida* [124315 (BSD)].

Earlier workers like Hooker (1890), King & Pantling (1898) and Duthie (1903) placed *P. imbricata* and *P. pallida* together (Deva & Naithani 1986). But with the critical examination, *P. pallida* is distinct with *P. imbricata* in diagnostic characters like thin leaf, herbaceous habit, and lateral sepals connate at the base (Chowlu & Rao 2015). Due to this confusion, this species had never been reported from northern India, hence reported for the first time.

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Ethnomedic treatment of colic in captive safari Asian Elephants *Elephas maximus* (Mammalia: Proboscidea: Elephantidae) with classical symptoms - an update

Elephants are the largest land mammals and most primeval mega herbivore (Shoshani 2000) with evolutionary history of more than 60 million years (Fowler & Mikota 2006). Humans have maintained Asian elephants in captivity for over 4,000 years (Vimalraj & Jayathangaraj 2012). The large body size of the Asian Elephant produces serious problems and places significant limitations (Ramiro & Robert 2004; Varma 2007).

Worldwide, most frequent emergency cases encountered in elephant practices were colic and aged between 2–60 years (Boon et al. 2015). Spasmodic and obstructive



Elephant on lateral recumbency



Mouldy sugarcane tops fed to elephants

colic have been described in elephants (Schmidt 1986; Du Toit 2001). Spasmodic colic is usually caused by mouldy fodder and can be treated by spasmolytic drugs and also by copious, soapy water enema (Wildpro.Twycrosszoo.org) repeated until relief. Obstructive colic due to excessive intake of clay and high-fibre food produces hard fecal balls that pass with difficulty through the gastro-intestinal tract and can be treated by parenteral administration of muscle relaxants (Firyal & Naureen 2007). A correct clinical diagnosis and the type of treatment is often difficult as prognosis was also necessary, therefore remains the



Bloated abdomen

deciding factor for whether to treat or not (Blikslager & Roberts 1995). The present case study was planned to evaluate the usefulness of commonly encountered colic in elephants using handy traditional ethnomedic treatment and was best resulted.

Results and Discussion

Out of eight female captive safari Asian Elephants protected under Western Circle Forest Division (29°24'–29.62" °N & 79°07'–33.97" °E), Nainital, India, three elephants aged around 53 years (Kalina), 56 years (Pawan Kali) and 35 years (Rani) exhibited mild to moderate colic symptoms observed from very early morning including restlessness, dull, bloated abdomen, belching/ eructation, lie down and getting up frequently, micturation, absence of defecation, complete loosening of trunk on the ground, to and fro movement of the body (saw- horse stance). History

revealed that they were dewormed a month before with fenbendazole and found that abdominal pain was due to overfeeding mouldy sugarcane tops prior night. They were treated successfully with a handful ethnomedic preparation consisting of mildly browned cumin, fennel seeds, asafoetida powder and black salt, altogether thrice, every three hours (07.00hr, 10.00hr & 13.00hr) along with Jaggery (a coarse dark brown sugar made in India by evaporation of the sap of palm trees). Over a period after five hours they, recovered uneventfully by passing loose and watery faecal balls and drank water. They stopped lying down but did not take feed. All the three elephants were taken for a walk twice to facilitate activity and around 18.00hr they started feeding on its own in moderate quantity.

- Cumin contains bioactive constituents such as terpenes, phenols, and flavonoids,



Ethnomedic preparation



Belching position

and its main constituent Thymoquinone (TQ). Cumin seeds aid in digestion and have stimulatory effect on the digestive enzymes (Platel & Srinivasan 1996). They are commonly used in traditional medicine as antihypertensive, liver tonics, diuretics, digestive, anti-diarrheal, appetite stimulant, analgesics, anti-bacterial, anti-oxidants, anti-inflammatory effects and in skin disorders (Krishnapura 2018).

- Fennel is one of the oldest spice plants and world's most important medicinal plants (Shamkant et al. 2014). It has several in vitro and in vivo pharmacological properties such as anti-microbial, anti-viral, anti-inflammatory, anti-mutagenic, anti-nociceptive, anti-pyretic, anti-spasmodic, anti-thrombotic, apoptotic,

cardiovascular, chemomodulatory, anti-tumor, hepatoprotective, hypoglycemic, hypolipidemic, and memory enhancing property (Wesam et al. 2015).

- Asafoetida is used as a digestive aid in food as a condiment and thins down the blood and lowers blood pressure. It is used in modern herbalism in the treatment of hysteria, some nervous conditions, bronchitis, asthma, whooping cough and flatulent colic. The oleo- gum resin is antispasmodic, carminative, expectorant, laxative, and sedative (Poonam & Shradha 2012).

- Black Salt is rich in minerals, removes bloat and soothes heartburn, increases water absorption within the digestive system and surrounding organs, alkaline properties of black salt; reduces excess



Loosening of trunk



To and fro movements of the body to relieve gas and pain (saw-horse stance)

acid in the stomach and its minerals present help lessen the damage caused by acid reflux (Debojyoti et al. 2015). It effectively reduce muscle cramps & spasms and act as natural air ionizers that can remove harmful ions from the air we breathe (Apurbo et al. 2016).

The elephants, like other herbivores, have no fiber-digesting enzymes of their own (Ullrey et al. 1997). The physicochemical characteristics of dietary fiber play an important role in normal gastrointestinal function, although highly fibrous type of diet may lead to impaction (Vidya & Sukumar 2005).

The quality of food an animal feeds on with respect to available nitrogen is important for its well being, as well as for management implications (Foguekem et al. 2011) and also the flexures in large intestine are the site of constipation and

colic (Elephantaidinternational.org). Dusty, mouldy or infested with beetles, poisonous plants, or other dangerous substances should never be used. Behavioral problems (Eltringham 1982), and a number of poor husbandry and feeding practices, including stress due to changes in routine, insufficient roughage of appropriate quality, rapid consumption of grains or pelleted feed, sudden changes in amounts or types of



Feces passed after treatment-2hr



Feces passed after treatment-6hr

feeds/roughage, and lack of continuously available fresh and clean water reduce the gut motility. Mineral oil, wheat bran or sugar beet pulp to the diet have been tried as a prophylactic measure along with regular exercise that promotes normal gut motility (Ullrey et al. 1997 & Miller et al. 2015).

Conclusion

Our case study represents the key first step of ensuring the most important needs for captive elephant health and their conservation in highest priorities and to develop interest on a new approach. However, there is a dearth of broad-scale studies on alternative veterinary medicine on elephants and other wild animals that are most likely to have a beneficial impact on health.

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Zoo “Middle Management Officers Training Programme” - Report

The Central Zoo Authority CZA has identified various capacity building training schedule programme at regular intervals for Indian Zoo Directors, Veterinarian, Biologists, Education officer and Animal keepers.

As part of this, Zoo Middle Management Officers training programme was organized by CZA on 15-16 March, 2019. The training was attended by Curators, Assistant Directors, Zoo veterinarian, Biologists and Education Officers. Negi, Additional Director General of Forests, Ministry of Environment Forest and Climate Change inaugurated the training and gave impressive and motivational talk on cause of wildlife conservation through ex-situ centre in the country. Anup Kumar Nayak, Member Secretary, Central Zoo Authority highlighted on the role of wildlife act, policy and



Anup Kumar Nayak, MS, CZA spoke on wildlife act, policy and guidelines for operation and management of zoos.

guidelines for operation and management of zoos in India. Brij Kishor Gupta, Scientific Officer emphasized master plan to reach the scientific standard.

Anupam Srivastav, Captive Breeding and Zoo Management Cell, Wildlife Institute of India handled the sessions on studbook as tools for wildlife population management and species-specific environmental enrichment in captive facilities.

The day long programme was continued with the following topics viz., zoo animals health management, enclosure design



Anupam Srivastav, WII handled the session on studbook maintenance and environmental enrichment.



Kshithija, IFS, Curator, Nehru Zoological Park, Hyderabad presenting group activity results on preparation of strategic plan for translocation of captive animals to wild.

protocols, education and interpretation, animal diet chart, protocols of health care management of captive animals.

The next day interactive session dealt with the topics on health care management of wildlife and improvement of the conservation centre. Some of the major topics covered were: record keeping, species-specific enrichment, zoo landscape, latest approach on disease diagnostic in wild animal, ex-situ and in-situ conservation agency linkage, disaster management and management of reptiles, amphibians in captivity.

Umapathi, Senior Scientist – CCMB, Hyderabad gave a talk on conservation of endangered animals using biotechnology success and who visualized the recent mouse deer breeding success in the Nehru Zoological Park, Hyderabad; artificial insemination, modern technique of fertilization, collection of semen from

wild animals were eye opening to the participants.

Group activities on various themes related to zoo management were conducted. Kshithija, IFS, Curator, Nehru Zoological Park, Hyderabad, Akhilesh Pandey, Veterinarian, M. Sekar, Biologist and the author prepared strategy plan for translocation of captive population to the wild and submitted to the training committee. On the final day the participants were taken to the National Zoological Park, New Delhi, for on the spot exposure on management of wild animals. The author is thankful to C.H. Padma, IFS., Wildlife Warden, Chennai for her constant encouragement to have hands on experience for the betterment of the zoos.

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Tata Steel Zoological Park, Jamshedpur, Jharkhand Celebrations

International Tiger Day at District Children Home

International Tiger Day is an annual celebration to raise awareness for tiger conservation, held annually on 29 July. In addition to regular education initiatives taken by Tata Zoo for raising awareness amongst the general public, one of the prime responsibilities is also to reach out to those people in the society who do not have easy access to zoos either due to their social status, remoteness or disability etc.

In keeping with our goal, Tata Zoo organized a programme at District Children Home, Ghaghidih in association with District Child Welfare Branch, East Singhbhum and local NGO Sanskriti. At first, Seema Rani, Biologist cum Education Officer, Tata Zoo conducted an interaction session with the children explaining about the need



District children home inmates plant the saplings.



Tiger awareness rally at the zoo premise.

and importance of plantation. She also explained about the relationship between plants and animals to understand the fact that “where tigers thrive, it is a sign that the ecosystem is healthy”. Then plantation programme was held. A total of 20 plant saplings were planted. Chanchal Kumari, District Child Protection Officer, Sanjukta Choudhary, Mentor, Children home and Secretary, Sanskriti were graced the occasion.

Besides we organized a rally on “Save tiger, save yourself” with placards and banner inside Zoo premise to raise public awareness and get support for tiger conservation. A total of 35 school children and teachers Sangita Sarkar of NML, KPS and Zoo staff Pratap Singh Gill participated in the rally.

Friendship Day at Zoo

The Zoo celebrated “Friendship Day” on 4th August 2019. A total of 75 school children from NML KPS and underprivileged children from local NGO Sanskriti participated. The programme was kicked off with urging the children to make a pledge to conserve and protect nature and sustains their friendship with nature. They need our help at this time and children must befriend with them. Further, children tied friendship bands to the trees and took an oath to save them.

Later on, a “Keeper Talk on Mandrill” was organized for the participants where the Dilip Day, the animal keeper along with his team members briefed about the animal.



Animal keeper talk on Mandrill.

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Children tying friendship band to the trees.

ZOO'S PRINT

Communicating science for conservation

ZOO'S PRINT Publication Guidelines

We welcome articles from the conservation community of all SAARC countries, including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and other tropical countries if relevant to SAARC countries' problems and potential.

Type — Articles of semi-scientific or technical nature. News, notes, announcements of interest to conservation community and personal opinion pieces.

Feature articles — articles of a conjectural nature — opinions, theoretical, subjective.

Case reports: case studies or notes, short factual reports and descriptions.

News and announcements — short items of news or announcements of interest to zoo and wildlife community

Cartoons, puzzles, crossword and stories

Subject matter: Captive breeding, (wild) animal husbandry and management, wildlife management, field notes, conservation biology, population dynamics, population genetics, conservation education and interpretation, wild animal welfare, conservation of flora, natural history and history of zoos. Articles on rare breeds of domestic animals are also considered.

Source: Zoos, breeding facilities, holding facilities, rescue centres, research institutes, wildlife departments, wildlife protected areas, bioparks, conservation centres, botanic gardens, museums, universities, etc. Individuals interested in conservation with information and opinions to share can submit articles ZOO'S PRINT magazine.

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Articles which should contain citations should follow this guideline: a bibliography organized alphabetically and containing all details referred in the following style: surname, initial(s), year, title of the article, name of journal, volume, number, pages.

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Articles will be edited without consultation unless previously requested by the authors in writing. Authors should inform editors if the article has been published or submitted elsewhere for publication.

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ZOO'S PRINT magazine is informal and newsy as opposed to a scientific publication. ZOO'S PRINT magazine sometimes includes semi-scientific and technical articles which are reviewed only for factual errors, not peer-reviewed.

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