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continued on the back inside cover

Cover: Rufous-headed Hornbill *Rhabdotorrhinus waldeni* © Philip Godfrey C. Jakosalem.



## Habitat preference and population density of threatened Visayan hornbills *Penelopides panini* and *Rhabdotorrhinus waldeni* in the Philippines

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**Abstract:** The habitat preference and population density of the Critically Endangered Rufous-headed Hornbill *Rhabdotorrhinus waldeni* and Endangered Visayan Tarictic Hornbill *Penelopides panini* were studied in the Central Panay Mountain range in Panay Island, western Visayas. Point counts were established to survey for hornbills and habitat variables were measured in a 30 x 30 m plot at each point. *P. panini* was recorded in primary and secondary forest, while records of *R. waldeni* were mostly in primary forest, with only one record in secondary forest. Spearman's rank order correlation and stepwise multiple regression showed that *R. waldeni* is positively correlated to density of large trees (>70cm DBH), with the Visayan Tarictic Hornbill showing moderate correlation with density of medium-sized trees (31–70 cm DBH). Central Panay Mountains is the largest remaining forests block in western Visayas. It is the stronghold area of *R. waldeni* and other western Visayas threatened species, supporting the need to declare the site a protected area.

**Keywords:** Critically Endangered, Endangered, Panay, Rufous-headed Hornbill, Tarictic Hornbill, western Visayas.

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## INTRODUCTION

There are 62 species of hornbills in the world, of which 10 species and six subspecies are endemic to the Philippines (Gonzalez et al. 2013; Poonswad et al. 2013). All Philippine hornbills occur in lowland forests below 1,200 m (Gonzalez et al. 2013), but forest loss in the lowlands may have pushed species to the upper limit of up to 1,500 m elevation (Poonswad et al. 2013). Of the 10 species in the Philippines, two are classified as Critically Endangered, two as Endangered, and six as Vulnerable (IUCN 2020). The Ticao Hornbill *Penelopides panini ticaensis*, subspecies of the Visayan Tarictic Hornbill was declared Extinct (Poonswad et al. 2013) because of habitat loss. The Rufous-headed Hornbill *Rhabdotorhinus waldeni* and *P. panini* are restricted-range species found only in the islands of Negros and Panay in western Visayas, where they inhabit lowland forest (Image 1 & 2). With continuing lowland forest loss, populations have been assessed by BirdLife and the International Union for the Conservation of Nature (IUCN) as decreasing. BirdLife International (2020) and the IUCN (2020) estimate the Panay population at 1,800 individuals, with 1,200 mature individuals, and declared the Negros population as possibly extinct.

Currently, only three protected areas (PAs) exist in Panay: Northwest Panay Peninsula Protected Landscape, Sibalom Natural Park, and Bulabog-Putian Natural Park. Despite ongoing conservation efforts, the largest remaining forest and stronghold of hornbill populations is in the Central Panay Mountains, and remains unprotected. This paper presents information on the habitat, abundance and conservation status of *P. panini* and *R. waldeni* in CPM. Conservation initiatives primarily led by local government units and Department of Environment and Natural Resources (DENR) are also presented. This research was undertaken as part of the Philippine Hornbills Conservation Programme of Philippines Biodiversity Conservation Foundation Inc.

## METHODS

### Study area

The Central Panay Mountain (CPM) refers to the chain of mountains that stretches and divides Panay Island into four provinces: Iloilo, Antique, Aklan, and Capiz (Klop et al. 2000; Mallari et al. 2000). The mountainous spine of CPM encompasses the largest forest area of montane and lowland forests. Survey for hornbill population and habitat preference was conducted in Mt. Camantra,



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Image 1. Visayan Tarictic Hornbill *Penelopides panini*



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Image 2. Rufous-headed Hornbill *Rhabdotorhinus waldeni*

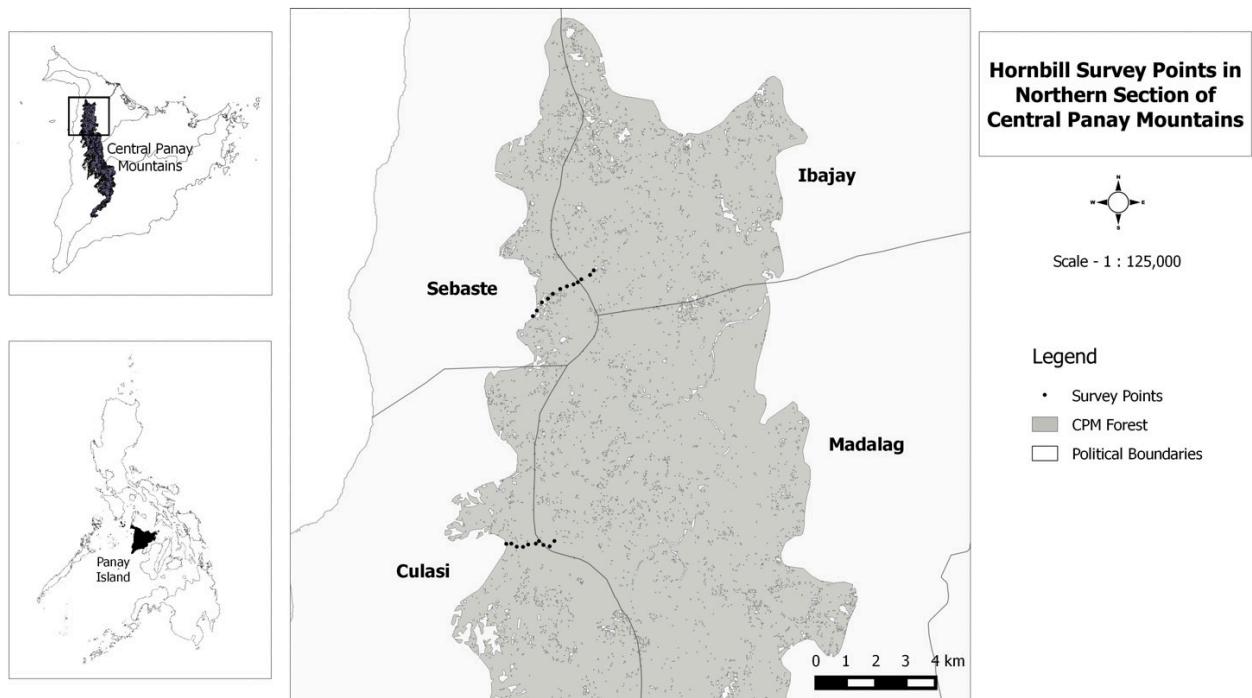


Figure 1. Map of northern Central Panay Mountain Range, showing location of sampling sites.

Sebaste, Antique from 25 July 2016 – 3 August 2016 and from 4–9 August 2016 for Mt. Igpako, Culasi in Central Panay Mountains. At the onset of the field surveys, severe tropical storm Nida affected the weather conditions in the country including Panay Island. Field research was authorized by DENR Region VI through a gratuitous permit issued to Philippines Biodiversity Conservation Foundation Inc. (PhilBio).

#### **Mt. Camantra (11.544778°N & 122.148408°E)**

The Mt. Camantra is located in the municipality of Sebaste (Figure 1) with elevation range of 444–996 m. The primary forest covers steep ridges and gullies. The average height of trees was 25 m and majority have more than 30 cm diameter at breast height. Canopy cover ranges 60–100% forest cover. Thick and tall undergrowth cover the trail and some areas were almost inaccessible with fallen dead trees and decaying logs. Forest trails were hardly visible indicating limited human-related activities. The secondary lowland forest habitat (11.544139° N & 122.147083° E) was located at 419 m. Majority of the trees have heights ranging 10–15 m with average diameter at breast height of 30 cm ( $n=41$  plots). The trails were visible following rivers, streams, and mountain ridges. The canopy cover ranged from 40–80%. Abandoned agricultural clearings and presence of pineapple and coconut plantations were

observed in the lower sections of the forests closer to the town and lower reaches of rivers and streams.

#### **Mt. Igpako (11.466167°N & 122.1355°E)**

The Mt. Igpako site is located in the municipality of Culasi (Figure 1) with primary lowland forests reaching up to 631 m. The forest understory was thick with *Pandanus* sp. and few climbing bamboo species. Large uprooted trees from recent typhoons were encountered. Canopy cover ranges 60–90% with patches of openings created from uprooted trees. In elevations above 900 m, moss cover thickly covered the forest floor and barks of trees.

#### **Hornbill distribution and abundance: point-count sampling**

Twenty-four-point count stations were established and surveyed, 15 located in the primary lowland forests of Mt. Camantra, Sebaste (5 points) and Mt. Igpako, Culasi (10 points), and nine in the secondary lowland forest in Mt. Camantra, Sebaste. Each sampling point was at least 250 m apart and the observation record bands are 100 m radius. Bird observations were conducted from 0600 h to 1100 h. Two to three observers recorded the distance of the hornbill from the center of the point station as well as the number of individuals seen or heard. Distance of the hornbill was recorded only through estimate. Observation per point was around 10

minutes. 8 x 42 and 10 x 42 roof-type binoculars were used during the survey.

We identified forest type following the definition from the Convention on Biological Diversity (CBD): Primary forest is a forest that has never been logged and has developed following natural disturbances and under natural processes. Secondary forest is a forest that has been logged and has recovered naturally or artificially.

### Habitat assessment

Twenty-four 30 x 30 m plots were established in each of the 24 sampling points to determine habitat characteristics (Table 1). Canopy cover was measured using an improvised densiometer, and a tape measure was used in acquiring diameter at breast height (DBH). Understory cover percentage was measured through visual estimate. Garmin GPS was used to measure elevation and coordinates.

### Data analyses

Hornbill density was acquired by calculating the average number of hornbills per point and dividing it by the total area sampled (3.14 hectares/point \* number of point count stations) (Raman & Mudappa 2003). Density and population estimate using DISTANCE program was not used due to insufficient number of encounters for both species of hornbill.

Mann-Whitney U-test was used to compare the habitat variables between primary and secondary forest. Spearman's rank-correlations and multiple linear regression (stepwise) were used to identify relationship between habitat variables and hornbill abundance.

## RESULTS

### Hornbill distribution and records

We recorded a total of 12 detections (22 individuals) of *P. panini* and 31 detections (94 individuals) of *R. waldeni*. *P. panini* was recorded four times in primary forest and eight times in secondary forest while 99% of the records of *R. waldeni* were in primary forest. There were 13 *R. waldeni* positively identified as female and 18 as males and the rest were heard in groups. The highest number of individuals observed in a cluster was 25 (eight females, 13 males and four immature) while the average number of individuals encountered in a flock was 10. In the case of *P. panini*, three were positively identified as males and four were females.

We observed *R. waldeni* in secondary forests feeding on fruiting native trees together with *P. panini*, Pink-

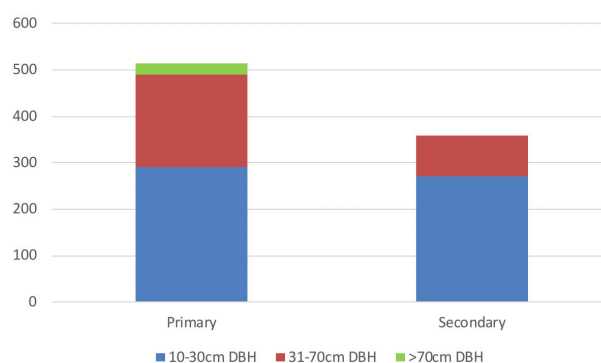


Figure 2. Tree densities per hectare between primary and secondary forest, with the three diameter at breast height (DBH) size classes.

bellied Imperial Pigeon *Ducula poliocephala*, Green Imperial Pigeon *Ducula aenea*, Philippine Cuckoo dove *Macropygia tenuirostris* and other fruit-eating species.

### Hornbill habitat preference

The primary lowland and secondary forests in CPM varied across sites. There were more large and tall trees in the primary and secondary forests of Mt. Camantra in Sebaste than in Mt. Igpako in Culasi. We tested for significant differences between primary and secondary forests using Mann-Whitney U-tests. Trees with a range of 16–20 m tall and trees with 31–70 and >70cm DBH varied significantly between primary and secondary forests (Table 1; Figure 2). This difference influenced the abundance of the hornbills. The *R. waldeni* was significantly correlated to the density of trees with 31–70cm DBH ( $r_s = 0.614$ ,  $P = 0.001$ ) and trees greater than 70cm DBH ( $r_s = 0.618$ ,  $P = 0.001$ ). This species was recorded almost strictly to primary forest with only one record in secondary forest. There was no significant correlation between habitat variable and *P. panini*, abundance. *P. panini* was recorded in both primary and secondary forest with most of the records in the latter.

Stepwise multiple regression showed that *P. panini* abundance was positively correlated with understory cover ( $R^2 = 0.127$ ,  $P = 0.049$ , Table 3) while the *R. waldeni*, abundance was positively related with presence of trees with >70cm DBH (adjusted  $R^2 = 0.340$ ,  $P = 0.002$ ).

## DISCUSSION

The forests in Sebaste and Culasi still contain significant lowland tropical rainforests. Both hornbills were encountered in primary and secondary lowland forest. Undisturbed forests with tall and large trees were

**Table 1. Mean values and Mann-Whitney U-test results of habitat variables between primary and secondary forest.**

Habitat variable	Primary forest	Secondary forest	U	p
Elevation	646.7	266.8	135	0.000
Density of 10–15 m tall trees (no./ha)	369	257		
Density of 16–20 m tall trees (no./ha)	126	71	103	0.035
Density of >20 m tall trees (no./ha)	45	33		
Canopy cover (%)	67.3	70		
Understory cover (%)	67.3	53.5		
Density of trees with 10–30 cm DBH (no./ha)	291	272		
Density of trees with 31–70 cm DBH (no./ha)	200	87	116.5	0.007
Density of trees with >70 cm DBH (no./ha)	24	0	112.5	0.005
Standing dead tree (no./ha)	20	6.3		

**Table 2. Stepwise multiple regression analysis of hornbill abundance with significant habitat variables and values.**

Species	Variables	Standard error (SE)	Standardized coefficient Beta	p
Visayan Tarictic Hornbill	Constant	1.077		0.296
	Understory cover	0.017	0.406	0.049
Rufous-headed Hornbill	Constant	0.596		0.233
	Density of trees with >70 cm DBH	0.331	0.607	0.002

**Table 3. Estimates of forest in Panay and Negros island.**

Name of area	Size (ha)	Estimated forest cover	Forest <1,200 m (ha)
Northwest Panay Peninsula Protected Landscape	12,009	8,000	5,000
Central Panay Mountain Range	105,200	105,200	30,049
Sibalom Natural Park	5,511.47	672	672
Northern Negros Natural Park	70,826.16	24,000	~10,000
Mt. Kanlaon Natural Park	24,388	8,000	~2,500
Balinsasayao Twin Lakes Natural Park	8,016.05	3,000	~2,500
Cuernos de Negros Mountains	4,096	2,000	~500

Source: Condono (2018); Schade (2018); NAMRIA (2010); DENR FMB (2013); de Alban et al. (2004); Quimpo et al. (2014); PBCFI – BMB (2019).

positively correlated with the occurrence of the hornbill. The CPM remains as the main population stronghold of the Critically Endangered *R. waldeni* as it retains the largest lowland tropical rainforest on the island.

In 2017, the Haribon Foundation estimated 2,960–3,700 individuals remaining in Panay (Condono 2018), slightly higher than the 2014 estimates of 2,880–3,600 (Quimpo et al. 2014). Based on the estimates, *R. waldeni* appears to have maintained its population since 2007 (Alabado et al. 2009; Quimpo et al. 2014; Condono 2018). BirdLife International (2016) estimated population of *R. waldeni* at 1,000–2,499 mature individuals with total number of individuals at 1,500–4,000. From this study,

we acquired a density of 0.2 individuals/hectare (20 individuals/km<sup>2</sup>) for the *P. panini* and 0.47 individuals/hectare (47 individuals/km<sup>2</sup>) for the *R. waldeni*. This is a crude estimate from our field observations and basic density calculation from number of recorded hornbills and the sampled area and accuracy can be improved with more data particularly on adjacent forest areas and to run the analysis in the DISTANCE program.

Mynott et al. in 2021 estimated the population density of *P. panini* in Northwest Panay Peninsula Natural Park (NWPPNP) through DISTANCE analysis to be at 17.8 individuals/km<sup>2</sup> (0.178 individuals/ha) in primary forests and 3.7 individuals/km<sup>2</sup> (0.037 individuals/ha).

Though we were not able to acquire density estimates using DISTANCE analysis and per forest type our crude estimate of 20 individuals/km<sup>2</sup> (0.2 individuals/ha) was close with their primary forest density estimate. In terms of encounters between forest types, we detected the *P. panini* more in the secondary forest (8 encounters) than the primary forest (4 encounters) while Mynott et al. in 2021 encountered more *P. panini* in primary forest (31 encounters) than in secondary forest (12 encounters). We suspect that this was the case for the sites we surveyed in CPM because of the presence of *R. waldeni*, which we observed to be more abundant and dominant particularly in the primary forests. *R. waldeni* is almost certainly extirpated in NWPPNP (Birdlife International 2022) and its presence needs to be confirmed. With that, there is lesser competition for space and resources for the *P. panini* in NWPPNP, most significantly in the primary forests. Though the two species of hornbills co-exist and form flocks, there will be competition for nesting trees during breeding season. The *P. panini* having a broader habitat preference, requiring less pristine conditions than the *R. waldeni*, were able to occupy the secondary forests if competition for resources ensues.

*P. panini* shows preference to areas with medium-sized trees (30–70 cm DBH) which could be one of their minimum requirements for nesting. This was similar to the results of Klop et al. (2000) in their study of nest site characteristics, where the mean DBH of nesting trees of *P. panini* was 34 cm. Klop et al. (2000) only measured one nesting tree of *R. waldeni* that was 90 cm. These results indicate that *P. panini* has a wider range of habitat preference, and thus it is able to survive in secondary forests and tolerate some level of disturbance. *R. waldeni* on the other hand has a narrow preferred habitat range, requiring large trees and undisturbed forests. Among the sites in Panay, CPM holds the largest lowland forest cover in Panay followed by Northwest Panay Peninsula Protected Landscape and Sibalom Natural Park.

### Hornbill distribution

The past distribution of *P. p. panini* was on Negros, Panay, Masbate, Sicozon, Pan de Azucar and Guimaras Islands. However, it is now extinct on the latter three and only survives in small forest fragments on Negros and Panay (Poonswad et al. 2013; Paguntalan et al. 2002, 2004). It is uncertain if populations still remain on Masbate Island although locals have reported the presence of the species in small forest fragments in Milagros and Mobo watershed in 2013. The loss of forests, combined with hunting, have threatened the survival of the bird in the wild, exemplified by the

extinction of Ticao hornbill (Klop et al. 2000; Poonswad et al. 2013).

*R. waldeni* was known to occur on Negros, Panay and Guimaras Island. It is now extinct on Guimaras and survives in lowland forests in Negros and Panay. There were very few records of the species in the last 30 years in Negros (Poonswad et al. 2013). We have encountered two females and two males in Northern Negros Natural Park on 20 March 2013 and two females and five males in 16 February 2017. A lone female was observed from the viewing deck in Balinsasayao Twin Lakes Natural Park last on 22 June 2017 while a group of three individuals composed of one female and two males were seen on 19 August 2019.

The two threatened hornbills are reported to occur in at least five Protected Areas in Panay and Negros. Of the five, two are in Panay (Sibalom Natural Park and Northwest Panay Peninsula Protected Landscape) and three in Negros (Northern Negros Natural Park, Mt. Kanlaon Natural Park and Balinsasayao Twin Lakes Natural Park) (Table 4). Two of the significant forest blocks (Cuernos de Negros Mountain Range in Negros and the Central Panay Mountain Range in Panay) remain unprotected. With the known forest areas where the *R. waldeni* exists, of which there are few, the CPM is the stronghold and the most important sanctuary for the species.

### Threats

The primary lowland forests in Sebaste and Culasi are still relatively undisturbed. Part of the reason for this is the topography of the area. The forests are found on steep mountain ridges and gullies that are difficult to access. Trails follow the rivers and streams and bisect steep slopes to reach the mountain ridges. The lower reaches and areas close to the villages showed evidence of disturbances while the forest interior remained relatively pristine. As one moves farther away from the villages and rivers, less disturbance in forests was encountered.

In areas close to the villages and towns, habitat destruction and hunting remain as the main threats to hornbill populations. Large trees were observed being selectively logged for timber needed to make boats and houses or sold as lumber in the nearby town. Clearings were then planted with subsistence crops. Locals were also reportedly using marble guns for hunting birds and other animals for protein and for sport.

During the survey, two of the six known nesting trees of *R. waldeni* in Mt. Camantra were uprooted by previous typhoons. We also recorded two additional



nesting holes suspected to be that of *R. waldeni* based on the size of the tree, location and size of the nesting hole and the larger seeds found at the base of the tree trunk directly below the nest hole. Locals have also reported this nest as that of *R. waldeni*.

### Conservation efforts

The national threatened status of *R. waldeni* remained at Critically Endangered status, but *P. panini* was changed from Endangered to Critically Endangered status in the recent revision of the National List of Threatened Fauna and their categories in the Department Administrative Order 2019 – 19 (BMB DENR 2020).

The enactment of the Expanded National Integrated Protected Areas System (ENIPAS) Act of the Philippines effectively legislated into law the declaration of two Protected Areas in Negros (Balinsasayao Twin Lakes Natural Park and Northern Negros Natural Park) and two in Panay (Northwest Panay Peninsula Protected Landscape and Sibalom Natural Park). Mt. Kanlaon Natural Park has its own Republic Act declaring it as a protected area in 2002.

The DENR Region VI initiated the protected area suitability assessment (PASA) last December 2020–January 2021 as the first step in declaring Central Panay Mountain Range as a protected area. This was in response to the resolution passed by the Regional Development Council of Region VI in 2018. There were several attempts in the past to declare the CPMR as a nationally declared protected area, but only local legislations were enacted.

### MANAGEMENT RECOMMENDATIONS

Declaration of Central Panay Mountains as Protected Area – The Regional Development Council of Region VI and the Department of Environment and Natural Resources (DENR) Region VI had initiated the process of declaring Central Panay Mountains as a protected area last October 2018. The move to declare CPM as PA started in the early 1990s and with millions of funds poured in the last two decades, this has remained a suggestion. Local Government Units (LGU) of all four provinces should seriously investigate securing the very mountains that provided its life support system: freshwater.

Collaboration with LGUs and stakeholders in monitoring protected areas – average annual national budget allocations for monitoring PAs is US \$581 while class A local government units have annual funds of at least US \$19,380 for environmental programs including

monitoring PAs. The Protected Areas Management Board of each PA, DENR and LGU within Key Biodiversity Areas (KBAs) should institutionalize the conduct of synchronized bio-monitoring and hornbill count in each Protected Area and KBA using improved line-point and DISTANCE analysis.

Surveys on threatened hornbills of western Visayas – Surveys are needed in the other identified forests patches, e.g., Northwest Panay Peninsula Protected Landscape, Sibalom Natural Park, Cuernos de Negros Mountain Range, Sta. Catalina forest, Masbate Island, to determine the presence of surviving populations.

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#### Article

##### Distribution and habitat-use of Dhole *Cuon alpinus* (Mammalia: Carnivora: Canidae) in Parsa National Park, Nepal

– Santa Bahadur Thing, Jhamak Bahadur Karki, Babu Ram Lamichhane, Shashi Shrestha, Uba Raj Regmi & Rishi Ranabhat, Pp. 20703–20712

#### Communications

##### Habitat preference and population density of threatened Visayan hornbills *Penelopides panini* and *Rhabdotorrhinus waldeni* in the Philippines

– Andrew Ross T. Reintar, Lisa J. Paguntalan, Philip Godfrey C. Jakosalem, Al Christian D. Quidet, Dennis A. Warguez & Emelyn Peñaranda, Pp. 20713–20720

##### Nest colonies of Baya Weaver *Ploceus philippinus* (Linnaeus, 1766) on overhead power transmission cables in the agricultural landscape of Cuddalore and Villupuram districts (Tamil Nadu) and Puducherry, India

– M. Pandian, Pp. 20721–20732

##### Status and distribution of Mugger Crocodile *Crocodylus palustris* in the southern stretch of river Cauvery in Melagiris, India

– Rahul Gour, Nikhil Whitaker & Ajay Kartik, Pp. 20733–20739

##### Dragonflies and damselflies (Insecta: Odonata) of Jabalpur, Madhya Pradesh, India

– Ashish Tiple, Vivek Sharma & Sonali V. Padwad, Pp. 20740–20746

##### Spatial and temporal variation in the diversity of malacofauna from Aripal stream of Kashmir Himalaya, India

– Zahoor Ahmad Mir & Yahya Bakhtiyar, Pp. 20747–20757

##### A checklist of blue-green algae (Cyanobacteria) from Punjab, India

– Yadvinder Singh, Gurdarshan Singh, D.P. Singh & J.I.S. Khattar, Pp. 20758–20772

#### Short Communications

##### Breeding biology of Sri Lanka White-eye *Zosterops ceylonensis* (Aves: Passeriformes: Zosteropidae) in tropical montane cloud forests, Sri Lanka

– W.D.S.C. Dharmarathne, P.H.S.P. Chandrasiri & W.A.D. Mahaulpatha, Pp. 20773–20779

##### Two new species of army ants of the *Aenictus ceylonicus* group (Hymenoptera: Formicidae) from Kerala, India

– Anupa K. Antony & G. Prasad, Pp. 20780–20785

##### Addition of three new angiosperm taxa to the flora of Bangladesh

– M. Ashrafuzzaman, M. Khairul Alam & A.K.M. Golam Sarwar, Pp. 20786–20791

##### A new distribution record of *Memecylon clarkeanum* Cogn. (Melastomataceae) to Karnataka from Sharavathi river basin, central Western Ghats, India

– Malve Sathisha Savinaya, Jogattappa Narayana, Venkatarangaiah Krishna & KalamANJI Govindaiah Girish, Pp. 20792–20797

#### Notes

##### First record of Doherty's Dull Oakblue *Arhopala khamti* Doherty, 1891 from upper Assam, India

– Arun Pratap Singh, Pp. 20798–20800

##### A new species of *Pancratium* Dill. ex L. (Amaryllidaceae) from Eastern Ghats of India

– R. Prameela, J. Prakasa Rao, S.B. Padal & M. Sankara Rao, Pp. 20801–20804

##### *Tribulus ochroleucus* (Maire) Ozenda & Quezel (Zygophyllaceae) - a new addition to the flora of India

– K. Ravikumar, Umeshkumar Tiwari, Balachandran Natesan & N. Arun Kumar, Pp. 20805–20807

##### Abnormalities in the female spikelets of *Coix lacryma-jobi* L. (Poaceae) India

– Nilesh Appaso Madhav & Kumar Vinod Chhotupuri Gosavi, Pp. 20808–20810

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