Peninsular Malaysia's forgotten pheasant: recent records and distribution of the Crested Argus *Rheinardia ocellata*

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One of tropical Asia's most poorly known pheasants, the spectacular Crested Argus *Rheinardia ocellata*, is known to occur in two disjunct populations—in Vietnam and Laos (nominate subspecies *ocellata*), and the east-central part of Peninsular Malaysia (subspecies *nigrescens*). The little-studied Malaysian population, which is almost entirely restricted to Taman Negara National Park, has been sporadically surveyed since the late 1970s. Our study collates recent records of the Crested Argus in Peninsular Malaysia (2014–2016) from camera-trap surveys, and presents new information on its distribution. Our data extend the known range of the species outside Taman Negara into the Dungun Timber Landscape, Terengganu state. We infer the current altitudinal range of the species in Malaysia to extend from 850 to nearly 1,400 m, with no overlap with the ecologically similar Great Argus *Argusianus argus*. In view of the steep declines suffered by populations in Vietnam and Laos due to rampant hunting, and threats to the Malaysian population from forest degradation and increased poaching, we recommend (1) strengthened law enforcement across its range and (2) further research to clarify the taxonomic relationship between the two widely separated populations.

INTRODUCTION

The Crested Argus *Rheinardia ocellata* is among Asia's most spectacular pheasants, with the males possessing some of the largest tail-feathers of any avian species worldwide (Bird 2004). At the same time it is one of the world's least known pheasants, with very little documentation of its occurrence in recent years (Mamat & Yasak 1998). Endemic to mainland South-East Asia, the Crested Argus occurs as two widely separated populations. The nominate (Indochinese) subspecies *ocellata* has a wide latitudinal range across Vietnam and the Lao PDR, and extends marginally into the northern highlands of the two countries. In Vietnam it has a wide longitudinal range, but in Laos it is restricted to small pockets west of the Annamite Mountains, which are low enough for moisture-laden north-easterly winds to cross into Laos during the monsoon (Robson *et al*. 1991, Thewlis *et al*. 1998, BirdLife International 2001, Gray *et al*. 2014). By comparison, subspecies *nigrescens* has a geographically narrow range, occurring only in the mountains of east-central Peninsular Malaysia (Davison 1977, Mamat & Yasak 1998, Wells 1999). In recognition of this restricted distribution, plus increasing habitat loss due to deforestation and hunting pressure (through indiscriminate snaring) in Laos and Vietnam (Thewlis *et al*. 1998), the Crested Argus was recently uplisted to Endangered (BirdLife International 2018).

First described from specimens collected during the 1901 Waterstradt expedition (Rothschild 1902), subspecies *nigrescens* of Peninsular Malaysia shows a number of morphological differences from the nominate *ocellata* (Wells 1999, McGowan & Kirwan 2018). For instance, the nominate subspecies has a pale crest (about 60 mm) extending from the crown to the hindneck, while *nigrescens* has a longer (about 85 mm) dark crest that is usually not erected (Wells 1999, McGowan & Madge 2002). Additionally, *nigrescens* is darker and has a distinctive pale buffy supercilium and throat patch (McGowan & Madge 2002). Overall the plumage of *nigrescens* is generally darker, with less densely spaced ocellations (Rothschild 1902).

In Peninsular Malaysia, the Crested Argus is confined to the Taman Negara National Park (hereafter Taman Negara) and its immediate periphery (Davison 1979, Wells 1999). Surveys by the Department of Wildlife and National Parks Peninsular Malaysia (DWNP) have found the species to occur on five or six mountains in the park, most notably Gn Tahan (the highest peak in the peninsula at 2,187 m) and Gn Gagau in the East Coast Range (Davison 1978, 1979, Wells 1999). The species also occurs on Gn Rabong in Kelantan, marginally outside Taman Negara (Mamat & Yasak 1998). However, records from the Krau Wildlife Reserve, Gn Benom, were considered erroneous (Davison 1979, Wells 1999).

Data from Taman Negara show Crested Argus to be altitudinally partitioned from the ecologically similar Great Argus *Argusianus argus*, which occurs up to about 900 m in lowland and hill dipterocarp forest in Peninsular Malaysia (Wells 1999, McGowan & Madge 2002). Although there was a record suggesting some overlap from around 680 m, most records of Crested Argus are in tall, lower montane forests between 800 and 1,080 m (Mamat & Yasak 1998). In recent years, there have been surprisingly few records of Crested Argus in Peninsular Malaysia. This is in part due to the difficulty in accessing mountains in the remote interior of Taman Negara, which has prevented recreational birdwatchers from reaching sites in the range of the species.

In this study, we report on the recent documentation of the Crested Argus within and outside the boundaries of Taman Negara, present new information which updates the known distribution and altitudinal range of the species, and summarise recent records of the species in Peninsular Malaysia from extensive camera-trap bycatch data. Finally, we discuss the conservation status of the Crested Argus based on recent information on the species in the broader context of South-East Asia, and recommend next steps to better conserve the species.

METHODS

The first locality of interest in Peninsular Malaysia is Taman Negara (4,343 km^2), which is the peninsula's largest protected area, straddling the states of Pahang, Terengganu and Kelantan. The park contains a wide range of vegetation types, from lowland dipterocarp forest at its low-lying fringes and valleys to upper montane forest and alpine scrub at its highest elevations. We compiled recent records of Crested Argus obtained from three widely separated localities, Gn Mandi Angin and Sungai Relau (both inside the park) and Gn Rabong (which lies marginally outside the park's north-west boundary), based on camera-trap surveys from 2014 to 2016. Two of the surveys conducted in 2014 and 2016 were primarily designed to sample large mammals, while a third in 2016 was carried out specifically to monitor the status of the Crested Argus.

The second locality of interest is the Dungun Timber Complex (DTC), which lies in the state of Terengganu abutting the south-east of Taman Negara. The DTC consists of logged-over lowland

mixed dipterocarp forests, hill and upper hill dipterocarp forests, and montane forests on the highest ridges. The production forests in the DTC are sustainably managed by Kumpulan Pengurusan Kayu Kayan Terengganu Sdn. Bhd. (KPKKT 2010), a subsidiary of Golden Pharos Berhad Group; the DTC is the only logging concession in Peninsular Malaysia certified by the Forest Stewardship Council. We compiled recent records of Crested Argus obtained from a large mammal camera-trap survey in part of the DTC (Table 1).

RESULTS

The surveys in Taman Negara and its periphery recorded a total of 13 detections from Gn Rabong (Kelantan), and two new sites at Gn Mandi Angin (Terengganu) and in the Sungei Relau (Pahang) area of Taman Negara. At Gn Mandi Angin, two camera-trap stations (982 m, 946 m) detected the Crested Argus, with all individuals being males. In the Sungei Relau area, a male Crested Argus was detected at 851 m in one of the 46 locations sampled during a large-mammal survey. Marginally outside the border of Taman Negara on Gn Rabong, two detections of Crested Argus (one male, one female, separated by a nine-day interval) were obtained at one of the eight camera-trap stations at 1,255 m.

During this survey, Great Argus were detected at 22 camera-trap stations located between 190–611 m. All camera-trap stations that detected Crested Argus were on the ridges of mountains and none of these had any detections of Great Argus during the surveys.

In the western part of the DTC, eight out of the 30 camera-trap stations photo-captured images of Crested Argus (Table 1). All eight camera-trap stations were on mountain ridges in old-growth, closed-canopy forests. Individual birds were clearly identified as males, females and subadults. The number of 'independent events' triggered by Crested Argus at each station ranged from 1 to 27, with a maximum of 258 images taken at site E (see Table 1). As with the surveys in Taman Negara, none of the camera-traps that detected Crested Argus showed evidence of Great Argus. Great Argus was only detected at three camera-trap stations (168 m, 242 m and 602 m) in lowland dipterocarp forest.

DISCUSSION AND CONCLUSION

This work provides the first recent documentation of the Crested Argus in Peninsular Malaysia, and extends its known distribution into the submontane forest belt of Terengganu state outside Taman Negara. As none of the camera-traps that detected Crested Argus

Table 1. Number of camera-trap triggers and images at the eight camera-trap stations with detections of Crested Argus in the western part of the Dungun Timber Complex, Terengganu.
The time gap between individual 'independent events' is 30 minutes. Each independent event could have more than one trigger, with each trigger capturing three images. This is to limit the over-representation of capture rate when an individual Crested Argus triggered images continuously by staying in front of the camera-trap for an extended period.

Camera-trap station	Elevation (m)	Number of independent events	Number of images
A	910	12	126
B	1,142	1	39
C	1,387	1	6
D	1,222	2	18
E	953	27	258
F	1,119	3	30
G	965	2	12
H	920	2	42

Figure 1. Altitudinal range (based on our empirical data) of Crested Argus *Rheinardia ocellata* and Great Argus *Argusianus argus* in Taman Negara and the Dungun Timber Complex. (Illustrations by Dana Gardner)

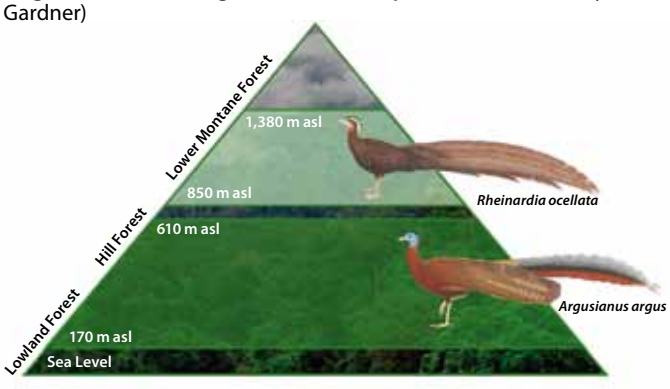

Plate 1. Camera-trap images of the Crested Argus *Rhienardia ocellata* from the surveys in Taman Negara and the Dungun Timber Complex. (a) Adult male, (b) adult male and female, (c) adult female and juvenile.

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found any evidence of Great Argus, our data suggest that the altitudinal overlap of the species is minimal or non-existent.

In 1998, no evidence of the Crested Argus was found in the DTC during surveys made to assess its wildlife (Davison *et al.* 1998), possibly owing to the use of a different survey methodology and sampling intensity. The new records obtained from the large mammal camera-trap surveys covered an altitudinal range of 910–1,387 m (Table 1). The survey in 2016 at Gn Rabong recorded the species at 1,255 m, which was also higher than the then known range of 680–1,134 m. Put together, our data indicate an upper altitudinal limit of nearly 1,400 m compared with the published upper limit in Malaysia of about 1,200 m (Davison 1979, Mamat & Yasak 1998, Wells 1999). However, it is unclear if this increased elevational range is the result of a genuine (climate-driven) shift or the result of a different sampling methodology.

Our work demonstrates the importance of hill dipterocarp and lower montane forests for the Crested Argus in Peninsular Malaysia. Because all the detections of Crested Argus were from survey sites in tall, old-growth and unlogged forests we suggest that Crested Argus in Malaysia is dependent on closed-canopy, little-disturbed forest and is probably sensitive to logging-induced disturbance and forest degradation. Selective logging on slopes of a gradient less than 25°, which now extends to well over 1,000 m in the DTC, may thus negatively impact Crested Argus in the long term through increased land erosion and associated habitat degradation. The data also suggest that subspecies *nigrescens* may be less tolerant of habitat degradation than the nominate subspecies. Based on survey data in three protected areas in the Vietnamese Annamites, Gray *et al.* (2014) reported Crested Argus in logged and secondary forests, but noted that its occurrence was associated with increasingly dense, closed-canopy forest cover. Similarly, field surveys in Laos also widely detected the species in secondary and logged forests (J. W. Duckworth *in litt.*).

Given that the distribution of the Crested Argus in Peninsular Malaysia falls largely within a major protected area and lies mostly in inaccessible submontane and mid-montane forests, habitat loss is unlikely to be an immediate conservation concern for this subspecies. However, submontane and lower montane forests are increasingly threatened in Peninsular Malaysia by logging activities and development (Peh *et al.* 2011). In the Titiwangsa range, extensive areas in the Genting, Cameron and Lojing Highlands have already been cleared for the development of hill resorts and farms. As timber stocks in lowland forest become increasingly depleted in Peninsular Malaysia, logging activities may increasingly turn towards more inaccessible forests on slopes in hill and montane forests, threatening these ecosystems and providing more access for poachers. Protection of the old-growth montane forests in the DTC will be important to the conservation of the Crested Argus, alongside management measures to ensure strong connectivity of the forests in this landscape with Taman Negara, to the north-west, under the Central Forest Spine Master Plan for Ecological Linkages (DTCPPM 2009). Additionally, enforcement operations by the DWNP and NGOs to tackle poaching will have to be strengthened to conserve large-bodied birds and mammals.

Certainly illegal hunting is a threat to the species in Indochina. In Vietnam and Laos, the Crested Argus is heavily snared by local hunters. In a camera-trap study of mammals in Khe Nuoc Trong forest, Quang Binh province, north-central Vietnam, by Vu *et al.* (2017), detections of Crested Argus were highest in the least accessible areas, and there were no detections of the species in parts of the forests where there was evidence of trapping specific to the Crested Argus. In our surveys, some evidence of poaching was recorded (e.g. snares), mostly targeted at large-bodied, commercially valuable mammals although it is possible that arguses would be incidentally captured as a result.

One major caveat is that the surveys of the Crested Argus were incidental to the study of large mammals. Some earlier studies have shown that camera-traps set for larger mammals may be too high for smaller-bodied or shorter mammals (SHL unpubl. data), leading to systemic under-detection of smaller and low-stature species in general. How this may affect detections of terrestrial birds is unclear. Ongoing research led by SHL comparing the effectiveness of camera-traps set at two different heights (30 cm *vs* 45 cm) may provide some insights into the detectability of Crested Argus and other smaller ground-dwelling birds.

Having been assessed as under severe threat from hunting, forest degradation and with a 'rapid rate of population decline, which is projected to continue', the Crested Argus was uplisted to Endangered in 2018 (BirdLife International 2018). Although the Malaysian population appears relatively less threatened, the species has been extirpated from some sites in the Annamites in Vietnam (LTT pers. obs.) and is suffering rapid declines in both Vietnam and Laos due to intensive hunting pressure and habitat loss. The lack of records since 2010 of this highly detectable species from Bạch Ma National Park (LTT pers. info.), a site where it was formerly abundant (Robson *et al.* 1991) and which continues to be well-watched for wildlife, suggests that even populations in legally protected areas are extremely vulnerable to hunting. Recognising the increasingly widespread evidence of steep declines and heavy hunting pressure, we recommend strengthened law enforcement to address poaching threats across range states. In addition, there is a need for genetic sampling and analysis to clarify the taxonomic status and relationships of the two widely separated subspecies, to help guide future conservation work.

ACKNOWLEDGEMENTS

We are grateful to the Golden Pharos Berhad Group for facilitating camera-trap work at DTC and for funding support from Panthera. Yong Ding Li thanks Dana Gardner for permission to use his illustrations, and Paul Insua-Cao and Geoffrey Davison for useful comments during the preparation of the manuscript. We also thank David Bakewell, James Eaton and Will Duckworth for their feedback, which have greatly helped improve the manuscript.

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