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Oriental pied hornbills and changeable hawk eagles nesting at Dover Forest East, Singapore

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Abstract. Some observations were made of Oriental pied hornbills and changeable hawk-eagles nesting sympatrically in Dover Forest East from mid-February to end-October 2022 from high-rise residential buildings off the south-eastern edges of the forest. Their observations reveal intra-species and inter-species interactions that would not be apparent to short-term surveyors observing from the ground. These show that the hornbills and the hawk-eagles can coexist in close proximity, while the intrusion of a brahminy kite was not tolerated by the latter. This article helps to highlight the importance of Dover Forest East and similar secondary forest patches in urban Singapore in supporting native wildlife, as well as offer convenient accessibility to nature for the average citizen.

Key words. Oriental pied hornbill, changeable hawk-eagle, nesting, Dover Forest East

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INTRODUCTION

Dover Forest is approximately 33 hectares of unmanaged green space embedded in the urban matrix of Singapore Island. The forest is divided in two at its approximate middle by a mowed grass lawn, with the eastern half between Dover MRT station and Ghim Moh Link being referred to as Dover Forest East herein. Dover Forest is the result of spontaneous regrowth of vegetation after its abandonment as a kampung (= village) in the 1970s. Although it is most often described as secondary forest, we are of the opinion that Dover Forest better fits the description of a novel tropical forest (Lugo, 2009). Secondary forests are generally understood to succeed to primary forests, but the novel mix of native and exotic species adapted to various human-induced conditions in and around Dover Forest would probably never result in succession to the primeval vegetation of Singapore. We also hesitate to label Dover Forest as abandoned-land forest or waste-woodlands (Yee et al., 2016). Although these labels reflect its land-use history, they do little to acknowledge that such vegetation is an adaptation to the Anthropocene in which the effects of human activities on the planet are becoming more tangible and alarming. They do little justice to the growing importance of such forests to the conservation of native species against the backdrop of the Anthropocene (Lugo, 2009).

Dover Forest East has long been known for its rich birdlife. In two morning surveys conducted in early 2007, the Nature Society (Singapore) found and catalogued 36 species, of which the native changeable hawk-eagle, *Nisaetus cirrhatus limnaeetus* (Accipitriformes: Accipitridae), stood out as a threatened and forest-dependent species (Nature Society [Singapore], 2007). Since then, with 6.4 hectares of the forest's east making way for the new public housing precincts of Ghim Moh Valley and Ghim Moh Edge, the current Dover Forest East stands at approximately 11 hectares. The completion of the 38-storey public housing apartment blocks of Ghim Moh Edge in mid-2017 and work-from-home arrangements from mid-2020 due to the Covid-19 pandemic opened up unprecedented opportunities for residents and amateur birdwatchers to experience and observe the rich birdlife of the forest from elevated vantage points right next to Dover Forest East. In early 2020, Kavidasan Gopalan began to frequently observe changeable hawk-eagles and Oriental pied hornbills, *Anthracoceros albirostris convexus* (Burocerotiformes: Bucerotidae), from Block 30, Ghim Moh Link. He documented the hornbills in June 2020 (Fig. 1; Gopalan, 2020), and one of the hawk-eagles in August 2020 (Fig. 2; Gopalan, 2021). Kavidasan's frequent observations of both species from early 2020 up to the time of writing has led him to believe that both have been resident and likely breeding in Dover Forest East. Both species were observed and documented in greater detail between mid-February to end-October 2022 by the authors from Block 31, Ghim Moh Link, and Block 18, Dover Crescent (Fig. 3). Condensed in this report, their observations reveal that, in addition to sympatricity, both species were indeed synchronously nesting and breeding in the forest. The authors also made observations of intra-species and inter-species interactions that would not be apparent to short-term surveyors observing from the ground.

The lack of attention to long-term species interactions within a nature area is a shortcoming in environmental impact studies conducted in Singapore, which can be partly mitigated by gathering the observations of the residents living in the vicinity. When it was announced in December 2020 that Dover Forest was to be cleared for public housing, the Housing and Development Board published an environmental baseline study of the forest (AECOM, 2020) which was

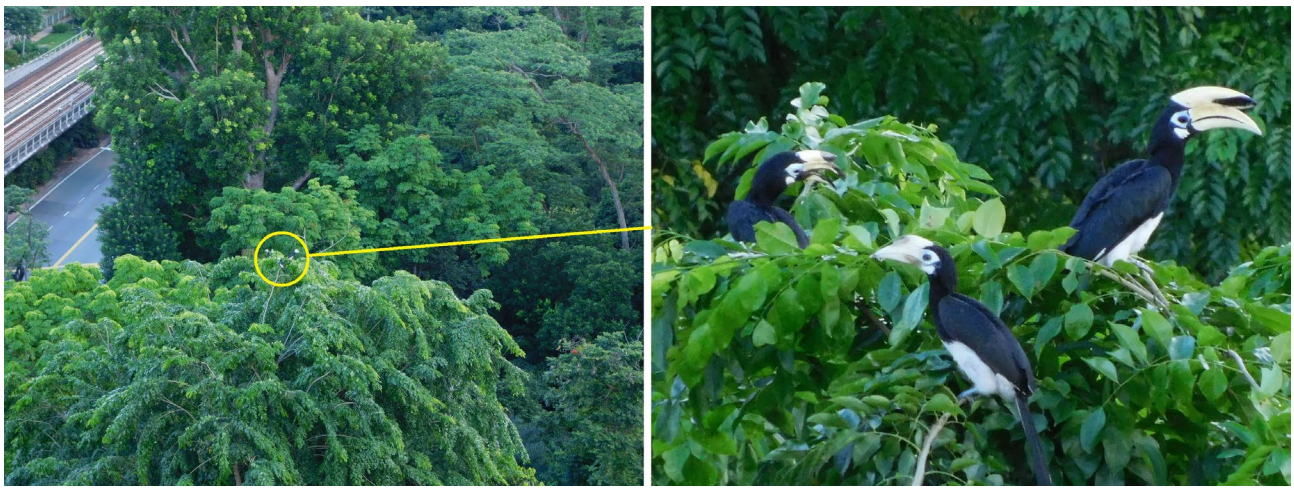

Fig. 1. Three Oriental pied hornbills perched at the top of an angsana tree in the southeastern corner of Dover Forest East in June 2020 (left). Zooming in (right) revealed an adult male with the most prominent casque (right), an adult female with a less pronounced casque (left), and a juvenile with an undeveloped casque (centre). (Photographs by: Kavidasan Gopalan).

Fig. 2. Adult pale-morph changeable hawk-eagle in Dover Forest East, August 2020. (Photographs by: Kavidasan Gopalan).

in essence a catalogue of flora, fauna and hydrological features of the forest — long-term interactions of the forest's species were not considered. It remains to be seen if the environmental monitoring and management plan to be published before the clearing of Dover Forest East in the second half of 2022 addresses this shortcoming.

Fig. 3. Map of Dover Forest East, between Dover MRT station and Ghim Moh Link. The two nests of interest are marked with red pins. The approximate crowns of the albizia trees hosting the nests are traced out in red. Two adjacent stands of albizias favored by the changeable hawk-eagles (CHE) are circles in green and blue, with pins indicating points of interest where observations of the changeable hawk-eagles are described in this record. Confrontations between the Oriental pied hornbills (OPH) and changeable hawk-eagles described in this record took place on an albizia close to both nests, at the spot marked by the orange pin. The approximate crown of this contested albizia is circled in orange. All observations in this record were made at elevation from three tower blocks in the public housing estates of Ghim Moh Edge and Dover Ville – Blocks 30 and 31 Ghim Moh Link, and Block 18 Dover Crescent, marked by grey pins. (Base map by: Google Earth).

OBSERVATIONS

1–8 March. Observed from Dover Crescent. An adult male hornbill was observed foraging alone around the south-eastern edge of the forest. On 8 March, a hornbill nest was discovered on an albizia tree, *Falcataria falcata* (Fabales: Fabaceae), at 1.30982°N 103.7826°E (Fig. 4). From 8 March to 9 April, the male hornbill was recorded on video delivering a variety of food to the nest, including fruit, insects and lizards (https://www.youtube.com/watch?v=RF9rE4SP5Ow by Birds Bond; Fig. 5). Food delivery and sanitisation of the nest by the adult male was observed throughout the day from 0700 hrs to 1830 hrs.

15 March–1 April. Observed from Dover Crescent and Ghim Moh Link. Interactions were observed between the adult male Oriental pied hornbill and an adult pale-morph changeable hawk-eagle. By 15 March, it had been observed that the hornbill vocalised "kek-kek-kek-kek-kek" and hopped around before delivering food into its nest in the mornings. On at least three occasions the presence of the hawk-eagle was observed to be the cause of this behaviour.

On 25 March, an active changeable hawk-eagle's nest was discovered at 1.31023°N 103.7825°E, about 50 m northeast from the Oriental pied hornbill's nest (Fig. 1). The hawk-eagle's nest was a pile of twigs in the fork of an albizia tree (Fig. 6), and it contained an almost adult-size pale-morph juvenile. An adult male dark-morph changeable hawk-eagle was seen visiting the nest, and after it left, an adult female pale-morph hawk-eagle, possibly the same individual that interacted with the hornbill, arrived (Fig. 7). This adult female picked up a lizard from the nest, tore it up and fed it to the juvenile. All the above were captured on video (https://www.youtube.com/watch?v=bhGI4novI0g by Birds Bond).

Fig. 4. The Oriental pied hornbill nest was in a hollow of the trunk of an albizia in Dover Forest East. The hollow was likely formed when a branch broke off from the albizia's trunk, leaving a stump. (Photographs by: Eng Keong Chng).

Fig. 5. Over an approximately one-month observation period 8 March to 9 April 2022, a variety of food items were delivered by the male Oriental pied hornbill to his mate nesting in the hollow of an albizia in Dover Forest East. These include fruit (A, D), insects (B, C), lizard (H), and other unidentified items (E, F, G). The male Oriental pied hornbill would perch comfortably on the natural ledge above the entrance to the nest, regurgitate the food items from his crop and into his beak, then bend down to deliver the food to his mate in the tree hollow. (Screengrabs from video footage https://www.youtube.com/watch?v=RF9rE4SP5Ow by Birds Bond).

On 1 April, an interaction between a hornbill and a hawk-eagle at around 0745 hrs was documented (https://www.youtube.com/watch?v=JW1RckgM_1w by Birds Bond; Fig. 8). The hawk-eagle was perched on an albizia close to the hornbill's nest (Fig. 3 — orange pin on map). Its presence agitated the hornbill, which appeared to harass the hawk-eagle by hopping around and vocalising. The hawk-eagle did not budge and only flew off after an hour, following which the hornbill approached its nest to perform its food delivery and sanitisation routine.

Fig. 6. The nest of the changeable hawk-eagle was a pile of twigs in the fork of an albizia in Dover Forest East. The trunk of the albizia is covered with the darker green leaves of the climbing fig, *Ficus punctata*, which is abundant on trees and on the forest floor in the southeastern section of Dover Forest East where the hawk-eagle's nest is located. In the inset, the nest juvenile can be seen perched above the nest, facing left. (Main photograph by: Eng Keong Chng; inset by: Chin Tat Chua).

9 April. Observed from Dover Crescent. A single juvenile hornbill emerged from the hornbills' nest and fledged at 0835 hrs. It was later seen on the ground at the edge of Dover Forest East (and once more the next day on a tree in the Dover Ville public housing estate opposite the forest, across the six-lane road Commonwealth Avenue West). At 1500 hrs an adult female hornbill emerged from the nest.

10–19 April. Observed from Dover Crescent and Ghim Moh Link. Throughout this period the previously described juvenile changeable hawk-eagle (henceforth nest juvenile) was heard calling in a single note vocalisation. This and the calls from other changeable hawk-eagles in the forest could often be heard throughout the day.

From 10 to 15 April, the nest juvenile was observed preening itself and hopping about within the nest. It ventured outside the nest sometimes, but was always perched or hopping on nearby branches. It flapped its wings on occasion (Fig. 9A, B).

On 16 April, the nest juvenile was seen flying around in the immediate vicinity of the nest (Fig. 9C), eventually settling back into it. It had fledged but was still nest-dependent.

Fig. 7. The resident changeable hawk-eagle family of Dover Forest East on 25 March 2022. The size of the nest juvenile was comparable to its parents, a dark-morph (left), and a pale-morph (right). The nest juvenile is crouched in the nest in the left of both photographs. The dark-morph was slightly smaller than the pale-morph, and was deemed to be the male of the pair, since female hawk-eagles are generally larger than males. The food item in the mouth of the female was possibly a skink which could have been placed in the nest by the male. (Photographs by: Eng Keong Chng).

On 17 April, while the nest juvenile was in the nest, the adult female pale-morph was observed arriving and depositing food into the nest before flying off. The nest juvenile ate by itself without assistance (Fig. 9D).

On 18 April, the previously described breeding pair of hornbills were seen in Dover Ville without their juvenile. The male was observed vocalising for at least five minutes before the pair flew off (Fig. 10).

On 19 April, the changeable hawk-eagle nest juvenile was observed perched on an albizia near the edge of the forest by Ghim Moh Link (Fig. 9E), the furthest it had been seen from its nest so far.

20 April–25 May. Observed from Dover Crescent and Ghim Moh Link. Throughout this period the changeable hawk-eagle nest juvenile developed a wider repertoire of vocalisations beyond its initial single note calls. Calls of changeable hawk-eagles, including those of the nest juvenile, could often be heard from the forest throughout the day.

On 20 April, the adult female pale-morph changeable hawk-eagle was sighted perched on an albizia resting and preening.

On 23 April, the breeding pair of hornbills were again seen in Dover Ville without their juvenile. As on 18 April, the male hornbill vocalised for at least five minutes before flying away with his mate.

On 1 May, the nest juvenile hawk-eagle was observed feeding on a lizard by itself in its nest. It could not be determined if this prey item was supplied by its parents.

On 11 May, as observed from Dover Crescent at 0940 hrs, the adult female pale-morph and a juvenile pale-morph changeable hawk-eagle were both perched on the albizia on which the former had its standoff with the Oriental pied hornbill on 1 April (see video https://www.youtube.com/watch?v=kdhqHQpDWIM by Birds Bond; Fig. 11). The juvenile (henceforth second juvenile) was observed to have a darker crown and a more prominent eye stripe compared to the nest juvenile. The breast of the second juvenile was lightly streaked with brown, as opposed to the completely white breast of the nest juvenile. The adult female vocalised but not the juvenile. At 1020 hrs the second juvenile flew off in the southeast direction followed by the adult. At 1320 hrs (observed by Chua from Ghim Moh Link), the nest juvenile was perched on its favourite branch outside the nest, vocalising in what appeared to be a question-and-answer with another hawk-eagle somewhere else in the forest (see video https://www.youtube.com/watch?v=-7TP--IzsGU by Chua Chin Tat; Fig. 12A). It remained perched in the same position for the duration of the afternoon's observations. At 1334 hrs, the second juvenile was spotted on an albizia tree near the Ulu Pandan Park connector (see video https://www.youtube.com/watch?v=0e_qRHF9haA by Chua Chin Tat; Fig. 12B; Fig. 3 — map pin G3). It flew away at

Fig. 8. An interaction between the male Oriental pied hornbill and the adult pale-morph female changeable hawk-eagle on an albizia near the nests of both birds. Throughout March 2022, several such incidents were observed in which the male hornbill apparently tried to harass the female hawk-eagle into leaving her perch near the hornbill's nest. (Photograph by: Eng Keong Chng).

1340 hrs. At 1406 hrs, the female adult pale-morph hawk-eagle was found on another albizia further west along the Ulu Pandan Park connector (Fig. 3 — map pin G2), and was observed to vocalise in response to the calls of the nest juvenile (see video https://www.youtube.com/watch?v=0e_qRHF9haA by Chua Chin Tat; Fig. 12C). It remained perched in the same position for the rest of the afternoon's observations. At 1540 hrs, a pale morph hawk-eagle was spotted flying low through the trees on the edge of the forest beside Ghim Moh Link. It alighted on a branch that was well below the forest canopy (Fig. 12D; Fig. 3 — map pin B2) and remained there for about three minutes before flying away. This individual was most likely the second juvenile, since the nest juvenile and the adult female had not moved from their perches. Observations ceased at 1600 hrs.

On 13 May, the adult female pale-morph hawk-eagle was observed perched on a tree preening and looking out (Fig. 13) while multiple-note vocalisations were heard coming from another conspecific in the forest. The source of the vocalisations could not be determined. The adult female later flew towards the source of the calls, which continued to be heard for about 30 minutes.

Fig. 9. A-E, the nest-dependent juvenile changeable hawk-eagle from 10 to 19 April 2022. (Photographs by: Eng Keong Chng).

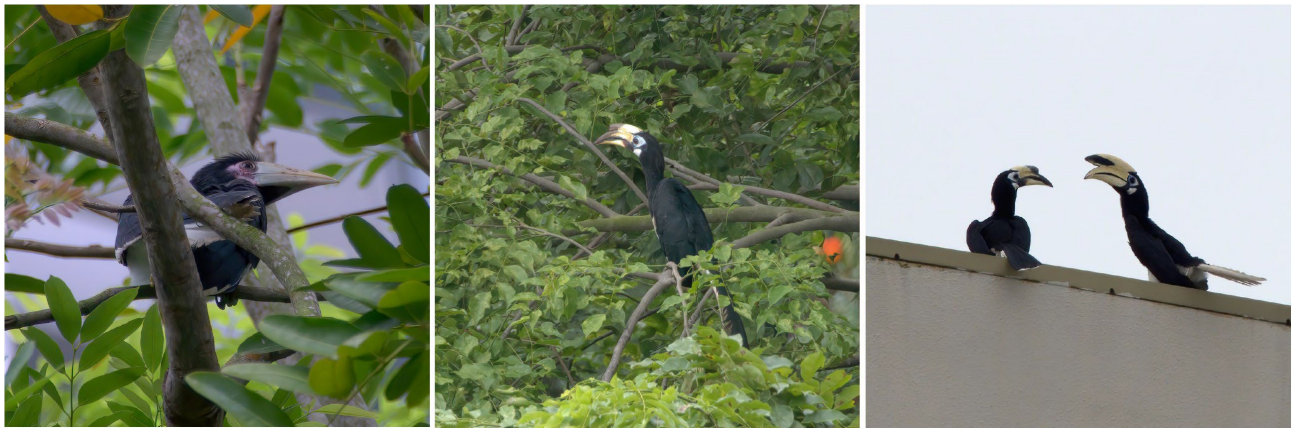

Fig. 10. The Oriental pied hornbill family that was resident in Dover Forest East in early 2022. One juvenile hornbill fledged and left the nest on 9 April 2022 at 0835 hrs (left). The adult female OPH emerged from the nest at 1500 hrs on the same day (centre). On 18 April 2022, the breeding pair of hornbills were spotted at the Dover Ville public housing precinct without their juvenile (right). The juvenile was last seen at Dover Ville on 10 April 2022 a day after it fledged. Both adults were last seen at Dover Ville on 23 April 2022. (Photographs by: Eng Keong Chng).

On 18 May, the second juvenile changeable hawk-eagle was spotted (by Chua from Ghim Moh Link) at about 1130 hrs, perched on an albizia on the edge of the forest close to the Ulu Pandan Park connector (Fig. 3 — map pin G2). This was the same tree in which the adult female hawk-eagle was observed perched on the afternoon of 11 May. At 1200 hrs observing from along the park connector, the male dark-morph hawk-eagle, the more elusive parent of the nest juvenile, was found on another albizia on the edge of the forest by the park connector (Fig. 14; Fig. 3 — map pin G1). The nest juvenile was vocalising throughout the day. Observing from the base of the albizia that was hosting the hawk-eagle's nest, the nest juvenile was found perched on one of its branches (Fig. 15), vocalising and sounding hoarse at times, like a human attempting to reach an unattainably high pitch when whistling.

On 25 May, at about 1030 hrs, the adult male changeable hawk-eagle was spotted (by Chua from Ghim Moh Link) moving from branch to branch among the albizias in the vicinity of pin B1 on the map (see video https://youtu.be/i-eZR8iSAQE by Chua Chin Tat; Fig. 3 — map pin B1).

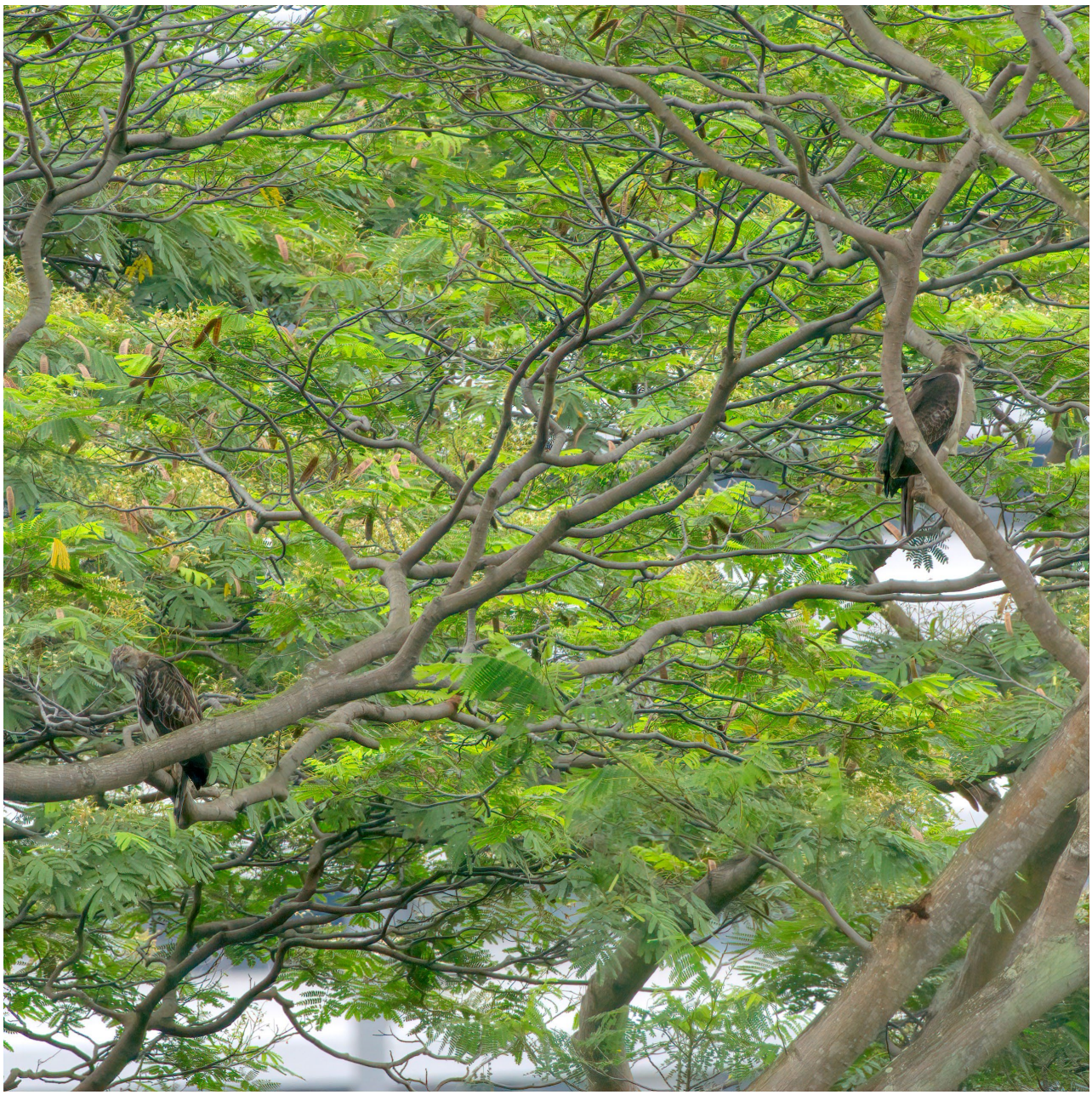

Fig. 11. The adult female pale-morph changeable hawk-eagle (left) perched on the same tree as the second juvenile (right) on 11 May 2022, 0940 hrs. The second juvenile's crown was distinctly darker than the nest juvenile's, being of a similar brown to the adult female. Its eyeline was also distinctly darker than the nest juvenile's. (Photograph by: Eng Keong Chng).

Fig. 12. At least three distinct pale-morph changeable hawk-eagles observed in Dover Forest East between 1320 hrs and 1600 hrs on 11 May 2022: the nest juvenile (A), the second juvenile (B), the adult female (C), and possibly the second juvenile again (D). (Photographs by: Chin Tat Chua).

Fig. 13. Adult female pale-morph changeable hawk-eagle on 13 May 2022. (Photograph by: Eng Keong Chng).

June to end-October. The breeding pair of Oriental pied hornbill family and their young (the previously described juvenile) returned to visit their nest in the albizia tree hole occasionally, possibly to evict the fauna that were attempting to claim and make use of the tree hole. One such instance was documented on 27 June 2022 (Fig. 16). The breeding pair were no longer observed to be accompanied by their young from October 2022. The latter presumably left its parents on achieving independence or was made to leave by the parents in preparation for the start of their next breeding cycle in December 2022. The breeding pair of hornbills were frequently seen flying between Dover Forest East and the forested spaces within Singapore Polytechnic, calling raucously. In the same period, the breeding pair of changeable hawk-eagles were evidently still resident in Dover Forest East. They were observed mating on 17 September 2022 (Fig. 17).

Calls of changeable hawk-eagles heard from Dover Forest East throughout this period were distinct from the type observed to be used between the nest juvenile and the female adult pale-morph in their vocal interactions from March to May 2022 (see video https://www.youtube.com/watch?v=-7TP--IzsGU by Chua Chin Tat).

On 28 October 2022, an aerial confrontation between the male dark-morph hawk-eagle and a brahminy kite, *Haliastur indus* (Accipitriformes: Accipitridae) was observed and documented (Fig. 18). Dover Forest East is a known hunting ground for brahminy kites, and the male hawk-eagle was presumably attempting to exert his dominance over the brahminy kite or to warn it off its territory.

Fig. 14. The adult male dark-morph changeable hawk-eagle on 18 May 2022 (left), and with eye covered by nictitating membrane (right). (Photographs by: Chin Tat Chua).

Fig. 15. The nest juvenile changeable hawk-eagle on 18 May 2022. (Photograph by: Chin Tat Chua).

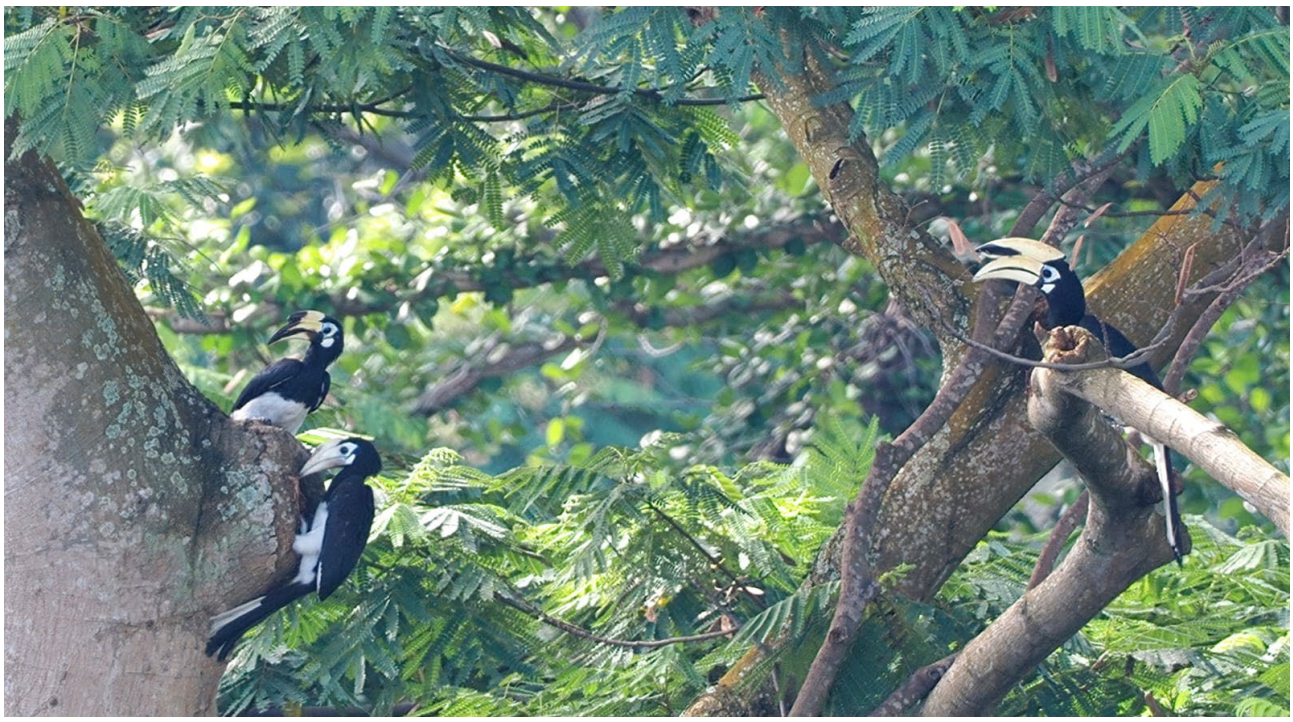

Fig. 16. The breeding pair of Oriental pied hornbill occasionally visited the albizia tree hole in which their young was successfully bred. This picture, taken on 27 June 2022, shows (left to right) the adult female, juvenile and adult male. The juvenile, likely a female from the first evidence of black markings on her beak, has her left leg inserted into the very same tree hole in which she was born. By October 2022, this juvenile was no longer observed in the company of her parents. (Photograph by: Eng Keong Chng).

Fig. 17. The resident pair of changeable hawk-eagles were observed mating on 17 September 2022, by which time their young the nest juvenile described in this paper had achieved independence and left Dover Forest East. (Photograph by: Eng Keong Chng).

Fig. 18. Aerial duel between the resident male dark-morph changeable hawk-eagle of Dover Forest East and an intruding brahminy kite, on 28 October 2022. The hawk-eagle is at the bottom in A and B, and on the left in C. (Photographs by: Eng Keong Chng).

REMARKS

The elevated canopy view of Dover Forest East from neighbouring HDB flats offers bird observers a vantage point and non-intrusive citizen scientist's perspective to observe the behaviour of birds in a natural setting such as flying, flocking, preening, branch hopping, foraging, vocalisations, territoriality, breeding, nidification, etc. This concept of birding in built-up areas serves as a safe (free from mosquitos, snakes and other harmful organisms) and non-invasive (from a distance) observation hide to study natural behaviours of birds even during bad weather. Such an activity helps to educate and raise awareness about urban wildlife in land-scarce Singapore.

Both the Oriental pied hornbill and the changeable hawk-eagle are considered threatened species in Singapore, although the local populations of the two species have been on the rise in recent years (Cremades & Ng, 2012; Tan, 2012). Dover

Forest East provides a refuge and nesting site for both species. This article shows that Dover Forest East is an excellent location to study the behaviour of these two large and conspicuous species.

The observations suggest that Oriental pied hornbills and changeable hawk-eagles are adaptable to life in secondary vegetation. They show that these large birds can coexist with their respective nests in close proximity and their breeding cycles occurring over the same period of time (end 2021 to April 2022). The documentation of an aerial altercation between the resident male hawk-eagle and a brahminy kite (Fig. 18) implies that the hawk-eagles may not be as tolerant of another raptor species. The authors believe the aggressive interaction to be a territorial rebuttal as the hawk-eagles have been actively engaged in mating and nidification in the previous few months.

Small patches of secondary forest in urban areas are often dismissed by conservationists and government officials alike, but these can play a significant role in supporting native wildlife. Nature conservation can be more nuanced than simply eradicating exotic organisms and multiplying native ones. The relationship between exotic and native organisms is complex and specific exotics can be of benefit to our local ecosystem. This is herein illustrated by the non-native albizia tree (see Tan et al., 2010 as *Falcataria moluccana*) offering valuable roosting and nesting sites to Oriental pied hornbills and changeable hawk-eagles.

Small forest patches scattered throughout the urban matrix on Singapore Island are close to the average Singapore citizen in terms of physical proximity, convenient accessibility and emotional attachment. These are also not as restrictive to non-permit exploration compared to nature reserves and nature parks. Dover Forest East is adjacent to private and public housing estates, the Ulu Pandan Park connector and the Singapore Polytechnic. It offers various ecosystem services and has value in education and research. It also lies along the newly identified Clementi – Ulu Pandan Nature Corridor (National Parks Board, 2021; Urban Redevelopment Authority, 2022), that is supposed to provide some connectivity for animals moving through the urban matrix between the nature reserves in the centre of Singapore Island and the forested Southern Ridges. As such, the authors strongly advocate for its preservation.

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