

Short Note

First Record of Fig Stipule Provisioning to a Chick by a Helmeted Hornbill (*Rhinoplax vigil*) in Sabah, Borneo

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Received 27 February 2026 | Accepted 17 July 2026 | Published 24 September 2026

Associate Editor: Ng Ting Hui

DOI: <https://doi.org/10.51200/jtbc.v23i.7413>

The critically endangered Helmeted Hornbill (*Rhinoplax vigil*) is the largest Asian hornbill within the family Bucerotidae and found across five countries in the Sundaic region: Brunei, Indonesia, Malaysia, Myanmar and Thailand (Poonswad et al., 2013). The species faces significant population decline driven by habitat loss and rampant poaching for its solid casque (also called red ivory), with documented trade networks extending across Asian countries like China and Laos (Environmental Investigation Agency, 2015; Beastall et al., 2016; BirdLife International, 2020). Helmeted Hornbill is known for its specialised diet which consists mainly of ripe figs (*Ficus* spp., Moraceae) (Leighton, 1982; Hadiprakarsa & Kinnaird 2004; Kitamura et al., 2011). There are also records of omnivorous feeding behaviour with documented preys like small birds, snakes and stick insects (Kheng, 1998; Kaur et al., 2015). Despite all these, their fruit consumption remains highly specialised, with no more than 6–7 non-fig fruit species recorded across their distribution (Kitamura et al., 2011; Poonswad et al., 2013). This short note reports the first evidence and observation of a male Helmeted Hornbill provisioning its chick with fig stipules after the disappearance of the female parent.

Our multi-year observation effort focusing on a specific Helmeted Hornbill pair was conducted within the protected area of the Lower Kinabatangan Wildlife Sanctuary, Sabah, Malaysian Borneo. Following the methods described in Poonswad & Kemp (1993) that include direct observations at nest sites, collection of discarded seeds beneath the nest, and documentation of individual identification features, our efforts have gained important insights into the species' breeding behaviour and nest ecology, including daily food delivery rate, the types and quantities of fruits provisioned, and observations of novel behaviours (Kaur et al., 2018). The pair first occupied a tree cavity located 37 m above ground in a 50-meter-tall *Shorea pauciflora* in 2013. Nest-site fidelity was evident from the repeated use of the same *Shorea pauciflora* tree for successive breeding cycles in 2014, 2015, 2017, and 2019 (Fig. 1), marking the final year of our monitoring effort.



Figure 1: A. The knob-shaped tree cavity on a *Shorea pauciflora* tree used as nest by the Helmeted Hornbill pair. B. Female Helmeted Hornbill sealing the nest entrance to commence nesting. C. Male Helmeted Hornbill feeding fruits to the female sealed in the tree cavity.

In 2019, nesting began on 19 May when the female was observed sealing the nest entrance. She successfully laid an egg and raised a male chick, emerging from the cavity on 30 September 2019, after which she assisted the male in provisioning the chick over the following weeks. However, the female disappeared suddenly on 18 October 2019. Around this time, several signs of trespassers were recorded in the study area, such as cigarette smells and sawing noises (Sanjitpaal Singh, pers. obs.). Three weeks later, on 10 November 2019, the team came face to face with two-armed trespassers between 06:00 and 07:00 AM. The team was forced to flee the area as the trespassers fired warning shots which triggered a field investigation by local authorities. While this confirmed the presence of armed individuals in the study area during the period surrounding the female disappearance, the authorities were unable to locate the trespassers or recover evidence to confirm poaching as the definitive cause (Helson Hassan, pers. obs.). Given the temporal overlap, poaching remains a plausible, though unconfirmed, explanation for the disappearance. Despite the female's absence, the single male continued provisioning the chick alone. During this period of single-parent care, two unusual observations were recorded: the provisioning of fig stipules to the chick, and a delay in fledging compared to previous nesting cycles.

The provisioning of an unusual food item was observed on 24 November 2019 when the male Helmeted Hornbill regurgitated fig stipules and provisioned them to the incarcerated chick at the nest. This behaviour was observed multiple times during the same day. The male was subsequently recorded provisioning bouts of stipules on additional observation days (Fig.2), instead of the usual fig fruits and stick insects previously reported as the primary diet components for this nesting pair (Kaur et al., 2018). The identity of these food items was initially unclear because such provisioning behaviour had not been documented before. However, several stipules and young leaves were dropped by the male during provisioning and collected beneath the nest tree for examination (Fig. 3). Based on the distinctive morphology of the large bracts, and with assistance from a botanical expert, the specimens were identified as *Ficus crassiramea*. In addition to this novel behaviour, a delay in chick fledging was also noted. While chicks from prior years typically fledged in early November (Table 1), the 2019 chick remained inside the cavity well into early December. This may perhaps indicate a slower development process of the chick, although no past studies could confirm this.

Although the reason behind the provisioning of these food items remains unclear, several plausible explanations can be considered. One possibility is that this behaviour may be a result of food shortage. *Ficus crassiramea* trees were previously documented in the study area by authors, but no fruiting individuals were observed during this current observation period. Moreover, these fruits are highly sought after by wildlife and are generally available only between August and November (Kaur, 2020). As male Helmeted Hornbill chicks consume nearly 2 kg of figs per day toward the end of the nestling period (Kaur et al., 2018), fig stipules may have served as supplemental food resources during periods of low fig availability.

Past studies have documented Helmeted Hornbills provisioning chicks with young and immature figs (Chong, 2011; Kaur, 2020), including this nesting pair during a prior nesting cycle of 2017 (Kaur et al., 2018). Because ripe figs are documented as the preferred food resource of Helmeted Hornbills (Poonswad et al., 2013), the feeding of unripe figs may indicate behavioural plasticity when ripe fig fruits are scarce. The provisioning of *Ficus crassiramea* stipules observed in 2019 may represent a further extension of this flexibility, with the male parent exploiting alternative parts of the same food plant when preferred fruits were unavailable. Additionally, the female disappeared several weeks before this behaviour was recorded which left the male solely responsible for provisioning the chick. In birds exhibiting

biparental care, the loss of a mate can result in compensatory increases in parental effort by the remaining parent. For example, a deserted male Olive-backed Sunbird (*Nectarina jugularis*) was found to increase its feeding rate nearly threefold following the disappearance of the female parent (Fithri & Sari, 2018). A similar increase in provisioning effort may have taken place in the male Helmeted Hornbill, hence the feeding of readily available stipules may represent a behavioural response to the increased demands of single-parent care. Another possible explanation for provisioning fig stipules is that these materials may help meet the chick's increasing nutritional needs. Chicks of large-bodied hornbills require substantial nutrients, particularly protein to support feather growth and development (Poonswad et al., 2004). Similarly, the provisioning of unripe figs observed in 2017 may have provided access to pollinator fig wasps (Agaonidae) or their larvae contained within the fruits (Ravinder Kaur, pers. obs.), which may have served as an alternative protein source for the growing chick. Whether *Ficus crassiramea* stipules themselves provide important nutritional benefits remains unknown and warrants further investigation.

Our observations reveal a previously undocumented feeding ecology in the Helmeted Hornbill and highlight a critical knowledge gap in our understanding of the species' nutritional ecology during the nesting period. The repeated provisioning of *Ficus crassiramea* stipules suggests that Helmeted Hornbill may exhibit greater dietary flexibility than previously recognised, perhaps under the conditions of reduced food availability or increased parental demands. Whether this dietary shift was associated with fruit scarcity, the loss of the female parent, or other ecological factors remains unclear and warrants further investigation. Further investigation into the specific nutrients provided by these uncommon food items and the circumstances under which they are incorporated into chick provisioning is of great importance and may help biologists understand the reason behind this dietary shift. While poaching could not be conclusively confirmed, the disappearance of the female Helmeted Hornbill had led to a termination of our multi-year observation effort, which started in 2013, and no nesting event was recorded in the area since 2019. Lastly, the conservation of Helmeted Hornbills will require both habitat-based and direct protection measures. This includes habitat enrichment through the planting of key food trees to maintain food availability, alongside intensified anti-poaching patrols, stricter law enforcement, and enhanced protection of breeding habitats across Sabah and Malaysia.



Figure 2: A deserted male Helmeted Hornbill provisioning *Ficus crassiramea* stipules to a chick sealed in a tree cavity. Photograph was taken on 28 November 2019.

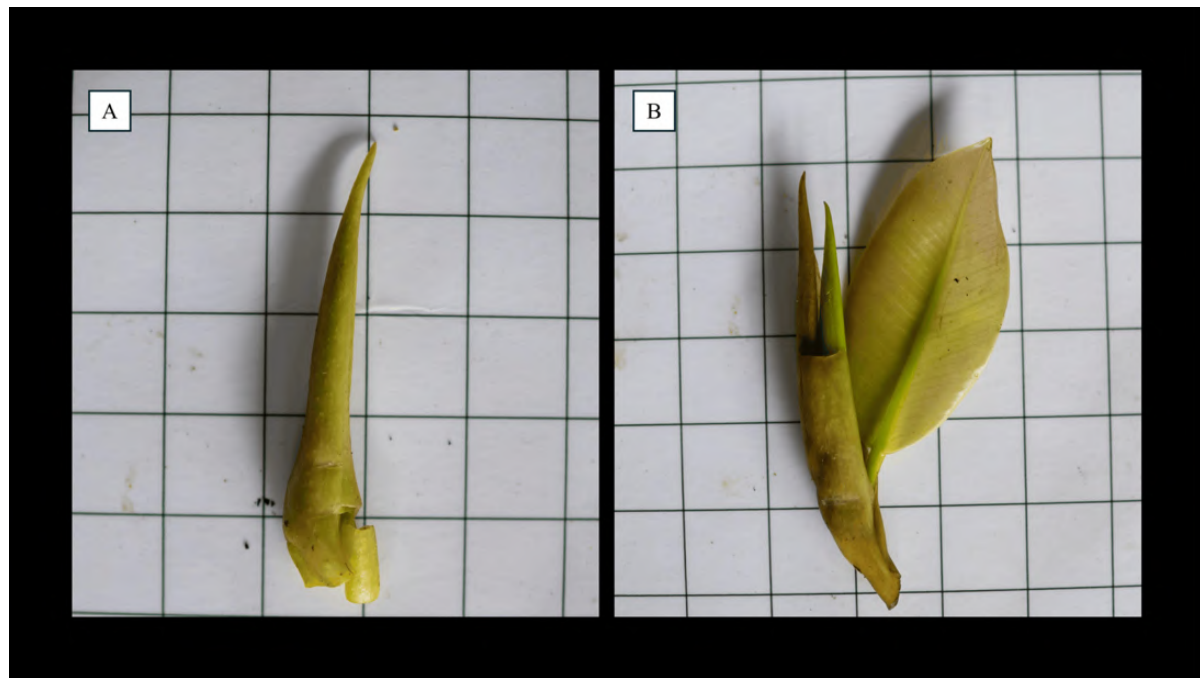


Figure 3: Food items dropped by the male parent during provisioning and collected beneath the nest tree. **A.** *Ficus crassiramea* stipule. **B.** *Ficus crassiramea* stipule with a young leaf attached. Food items were collected and photographed on 24 November 2019, during the first observation.

Table 1: Timing of key breeding events observed across multiple years based on combination of opportunistic observation (in 2013, 2014, and 2015) and detailed monitoring (in 2017 and 2019).

Year	Number & sex of chick	Nest sealing	Female emergence	Chick fledging
2013	1 male	No observation conducted	October	November
2014	1 male	No observation conducted	October	November
2015	1 female	No observation conducted	No observation conducted	No observation conducted
2017	1 male	May	October	November
2019	1 male	May	September	December

ACKNOWLEDGEMENTS

We extend our sincere gratitude to the local authorities: 1) Royal Malaysian Police, specifically Battalion 20's Tiger Platoon Unit; 2) Sabah Wildlife Department; and 3) HUTAN-KOCP's Honorary Wildlife Wardens and the directors for their swift response in investigating the study area following alerts from field staff. We are grateful to have continued the November and December observations under the platoon's protection and this also helped offer a certain degree of protection to the remaining chick and the male Helmeted Hornbill. We gratefully acknowledge the support of the Rufford Foundation and Chester Zoo. All authors thank Rohit Naniwadekar for providing helpful insights into the earlier version of the manuscript. The authors also thank Quentin Phillipps for his expertise in helping to identify the fig species.

DECLARATIONS

Research permit(s). We extend our gratitude to the Sabah Biodiversity Centre, Sabah Wildlife Department, and Sabah Forestry Department for granting permission for our monitoring work in the Lower Kinabatangan Wildlife Sanctuary (Licence Ref. No. JKM/MBS.1000-2/2 Jld.5 (61)).

Ethical approval/statement. Not applicable.

Generative AI use. I/we declare that generative AI was not used in this study nor in the writing of this article.

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