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Title: Sun bear predation on an oriental pied hornbill nest

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Abstract: Sun bears (*Helarctos malayanus*) are opportunistic omnivores that feed predominantly on fruits and invertebrates, but predatory behavior by sun bears is rarely recorded. Although commonly described as a forest-dependent species, the sun bear is a generalist and seems to have some potential to adapt to changing environments. Here we report the first record of a sun bear predating on oriental pied hornbills (*Anthracoceros albirostris*) in their nest in the Lower Kinabatangan Wildlife Sanctuary in Sabah, Malaysian Borneo, during spring of 2019. It is a human-disturbed landscape surrounded by oil palm (*Elaeis guineensis*) plantations, with the remaining degraded forest providing a wildlife corridor for Borneo's wildlife. The sun bears photographed by camera traps along the wildlife corridor, including the predatory bear, appeared to be in good condition, therefore evidently finding sufficient food resources. Their opportunistic feeding behavior, not necessarily food shortage, may allow them to take vulnerable prey, such as this low-nesting hornbill.

Key words: *Anthracoceros albirostris*, Borneo, camera-trapping, feeding ecology, *Helarctos malayanus*, oriental pied hornbill, predation, sun bear

The sun bear (*Helarctos malayanus*) is the smallest and most arboreal of the bear species (Sasaki et al. 2005). This bear is currently distributed across Southeast Asia (Fitzgerald and Krausman 2002, Scotson et al. 2017), occurs in a variety of different habitat types (mostly tropical forest; Scotson et al. 2017), and is an opportunistic feeder (Wong et al. 2002, Schneider et al. 2014). Sun bears' main diet appears to consist of fruits, invertebrates, such as termites, ants, and beetle larvae, as well as honeycomb and honey (Scotson et al. 2017). In Borneo, sun bears are mostly insectivores, but feed on fruits during mast-fruiting events and on figs (*Ficus* ssp.) during inter-mast periods

(Fredriksson et al. 2006). In some instances, if the home range of the bear borders human landscapes, bears consume human crops, such as fruits, oil palm (*Elaeis guineensis*), and coconuts (*Cocos nucifera*), and are therefore described as a nuisance by local farmers (Fredriksson 2005, Scotsonet al. 2014, Wong et al. 2015, Guharajan et al. 2018). Wong et al. (2002) reported that sun bears have been found to also feed on vertebrates, such as lizards, bird eggs, turtles, and small rodents. In 2012, a sun bear was photographed by a camera trap 'handling' a Sunda pangolin (*Manis javanica;* Hedges and Aziz 2013). Here we report the first record, to our knowledge, of a sun bear predating on nesting oriental pied hornbills (*Anthracoceros albirostris*).

Oriental pied hornbills (Fig. 1) are monogamous (Chan et al. 2007) and breed from January to June (Kinnaird and O'Brien 2007). These hornbills prefer undisturbed areas, but do breed in secondary forest, choosing to nest in *Bombax, Lagerstroemia,* and Dipterocarps trees (Shukla et al. 2015). Hornbills are secondary cavity nesters, so they rely on tree cavities in large trees in order to nest (Datta and Rawat 2004, Shukla et al. 2015), with nest openings between 2 and 45 m off the ground (Poonswad 1995). When a nesting site has been chosen, the female seals herself into the nest, where she lays about 3 eggs (Chan et al. 2007, Ng et al. 2011). The male visits the nest to feed her and the chicks, making an average of 12 feeding trips a day (Rahman et al. 2019).

Study area

The observation took place in Lot 7 (N 05.40557° E 117.98779°) of the Lower Kinabatangan Wildlife Sanctuary (LKWS) in Sabah, Malaysian Borneo. The LKWS consists of 10 lots (forest fragments) of protected forest landscape, which form a wildlife corridor, connecting rainforest vegetation communities in central Sabah with the mangroves (Rhizophoraceae) on the east coast (Evans et al. 2016). Even though the

corridor is subjected to disturbances and consists mostly of degraded forest, it acts as a riparian buffer zone between plantations and the Kinabatangan River. The wildlife sanctuary also encompasses other landscape types, including semi-inundated areas and permanent swampland, dry lowland, small grassland, and swamp forests (Abram et al. 2014).

Methods

We found an oriental pied hornbill nest containing 2 eggs inside a Bayur tree (*Pterospermum javanicum*) on 23 February 2019. The nest was 1.6 m off the ground, and we decided to video-monitor the nest to learn more about the nesting and chick-rearing behavior in wild hornbills. When we set up the video camera trap on 28 February, 2 chicks had already hatched. Therefore, hatching occurred between 24 and 27 February. We changed the secure digital card and batteries once per week.

We video-recorded the sun bear predating the hornbill using an Infrared Mobile Digital Scouting Camera (Model: MG983G-30M, Boly Inc., Santa Clara, USA). We set the camera to hunting mode, video record, motion trigger, filming for 40 seconds with a 1-minute delay between triggers. We set up the camera approximately 2 m from the hornbill nest, facing the entrance. We monitored the nest for 41 days.

Results and discussion

On 15 March, it appeared that the nest only contained the female and one chick. The video camera-trap footage did not capture the fate of the other chick and we therefore hypothesized cannibalistic infanticide, as has been observed previously in this species (Chan et al. 2007).

On 12 April, we found the nest empty and scratch marks by the nest entrance. We did not find feathers on the ground, so we decided to look inside the nest cavity to

see if the female was still present. From previous visits, video recordings, and observations, we have learned that females respond differently to different threats approaching the nest. When a bearded pig (*Sus barbatus*) or a common palm civet (*Paradoxurus hermaphroditus*) approaches the nest, the female defends the nest fiercely and vocalizes loudly. When humans approach the nest, the female climbs into the hollow tree cavity, being very quiet and exposing the chick. On this visit, we did not see the chick and, when looking up into the cavity, we saw that the female was not in the nest. We therefore reviewed the video footage of the camera trap.

The footage showed a sun bear investigating the hornbill nest on 10 April 2019 at 1045 hours. The nest was quiet (neither chick nor female vocalized) and the female was not visible. The video captured the bear starting to claw away at the nest, circling the tree, and then returning to claw at the entrance of the nest. We did not capture the hornbill female emerging from the nest before 10 April, so we assumed that she was present at the time of the incident. The sun bear then reached into the hollow and clawed out what we perceived to be the female. We concluded that the animal taken from the nest in the footage was the female because the wing feathers were mature (Figs. 2, 3).

In the second video, the sun bear was captured at 1050 hours (5 min after the video that captured the predation event) climbing down the hornbill nesting tree. The bear appeared to have blood around its muzzle, suggesting that the bear had killed and consumed the bird(s) in close proximity to the nest (possibly up in the tree). In this video, the bear investigated the nest once more, but the footage was not conclusive enough to identify whether remains of the birds were present.

The bear was captured a third time on video camera on the same afternoon, at

104 1703 hours. In the third video, the bear was seen clawing the inside of the nest cavity,
105 but again it remained inconclusive whether there were further remains of the birds
106 inside.
107 The video footage also showed the male hornbill returning to the nest site at
108 1143 hours, an hour after the predation event, with food for the female and chick. He
109 was calling, but his calls were not answered, and no female or chick appeared. We
110 recorded the male returning on the following days with food, but no female or chick
111 responded to the feeding attempts.
112 We video monitored the nest for another week to confirm that the female had
113 not escaped the predation event (e.g., to confirm that no female returned to the nest).
114 Although the camera-trap footage was not conclusive enough to capture a second
115 predation event, the fact that the nest was empty and no female was filmed leaving the
116 nest prior to or after the incident, we concluded that the bear killed the female and the
117 chick. The chick would have been a maximum of 45 days old when killed.
118 On 21 April, we returned to the nest site to take measurement of the nest space.
119 The entrance hole was 23 cm long and 6 cm wide. Oriental pied hornbills appear to
120 select for nest openings that are elongated and relative to their body size (Shukla et al.
121 2015). The nest cavity (the hollow space inside the tree trunk) measured 3.2 m in height
122 and 25.5 cm in depth. Most oriental pied hornbills choose nest sites that are between 4
123 and 25 m off the ground (Poonswad 1995). The nest was only 1.6 m off the ground
124 (possibly due to the lack of more favorable nesting sites), so the female was probably
125 exposed to unusual threats, such as humans, bears, and pigs.
126 From this predation we hypothesize that sun bears, being opportunistic feeders,
127 may engage in predatory behavior as described here if the opportunity presents itself. In

previous and ongoing camera-trap detections of sun bears in the LKWS, all resident sun bears appeared to be in a healthy condition, suggesting sufficient food abundance. This predation event was recorded in a degraded forest corridor, surrounded by plantations and heavy human disturbance. Interestingly, this incident occurred at 1045 hours, although sun bears in a heavily disturbed habitat have been described as nocturnal (Griffiths and Van Schaik 1993). In the Lower Kinabatangan, sun bears appear to be active throughout the day and can be seen on camera traps in the morning hours until noon and then from late afternoon throughout the night. The predatory sun bear on the camera had a 'fair' body score (according to the scoring system developed by Wong et al. [2005]) and appeared in good health, suggesting that this bear was not starving (in which case it may have used food sources that it would not normally consume).

Camera traps allow new insight into secretive and unusual behaviors. To our knowledge, this is the first recording of a sun bear predating on nesting hornbills.

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Literature cited

Abram, N.K., P. Xofis, J. Tzanopoulos, D.C. MacMillan, M. Ancrenaz, R. Chung, L. Peter, R. Ong, I. Lackman, B. Goossens, L. Ambu, and A.T. Knight. 2014. Synergies for improving oil palm production and forest conservation in floodplain landscapes. PLoS ONE 9(6):e95388.

Chan, Y.H., M. Zafirah, M. Cremades, M. Devet, C.H.R. Teo, and S.C. Ng. 2007.

Infanticide–cannibalism in the oriental pied hornbill *Anthracoceros albirostris*. Forktail 23:170–173.

Datta, A., and G.S. Rawat. 2004. Nest-site selection and nesting success of three hornbill species in Arunachal Pradesh, north-east India: Great hornbill *Buceros bicornis*, wreathed hornbill *Aceros undulatus* and oriental pied hornbill *Anthracoceros albirostris*. Bird Conservation International 14:249–262.

Evans, M.N., S.H. Vickers, and B. Goossens. 2016. Small carnivores of the Lower Kinabatangan Wildlife Sanctuary, Sabah, Borneo, including a new locality for the otter civet *Cynogale bennettii*. Small Carnivore Conservation 54:26–38.

Fitzgerald, C., and P. Krausman. 2002. *Helarctos malayanus*. Mammalian Species 696:1–5.

Fredriksson, G.M., L.S. Danielsen, and J.E. Swenson. 2006a. Impacts of El Niño related drought and forest fires on sun bear fruit resources in lowland dipterocarp forest of East Borneo. Biodiversity and Conservation 16:1823–1838.

———, S.A. Wich, and Trisno. 2006b. Frugivory in sun bears (*Helarctos malayanus*) is linked to El Niño-related fluctuations in fruiting phenology, East Kalimantan, Indonesia. Biological Journal of the Linnean Society 89:489–508.

Griffiths, M., and C.P. Van Schaik. 1993. The impact of human traffic on the abundance and activity periods of Sumatran rain. Conservation Biology 7:623–626.

Guharajan, R., T.W. Arnold, G. Bolongon, G.H. Dibden, N.K. Abram, T.S. Woan, M.A. Magguna, B. Goossens, S.T. Wong, S.K.S.S. Nathan, D.L. Garshelis. 2018. Survival strategies of a frugivore, the sun bear, in a forest-oil palm landscape. Biodiversity and Conservation 27:3657–3677.

Hedges, L., and S.A. Aziz. 2013. A novel interaction between a sun bear and pangolin

in the wild. International Bear News 22:31.

Kinnaird, M.F., and T.G. O'Brien. 2007. The ecology and conservation of Asian hornbills: Farmers of the forest. University of Chicago Press, Chicago, Illinois, USA.

Ng, S.-C., H. Lai, M. CRremades, M.T-S. Lim, and S.B.M. Tali. 2011. Breeding observations on the oriental pied hornbill in nest cavities and in artificial nests in Singapore, with emphasis on infanticide–cannibalism. Raffles Bulletin of Zoology Supplement 24:15–22.

Poonswad, P. 1995. Nest site characteristics of four sympatric species of hornbills in Khao Yai National Park, Thailand. Ibis 137:183–191.

Rahman, F., A. Ismail, and M.J. Nurul-Huda. 2019. Food items and foraging sites of the oriental pied-hornbill (*Anthracoceros albirostris*) during breeding season in sungai panjang, sabak bernam, Malaysia. Pertanika Journal of Tropical Agricultural Science 42:251–259.

Sasaki, M., H. Endo, Ø. Wiig, A.E. Derocher, T. Tsubota, H. Taru, M. Yamamoto, K. Arishima, Y. Hayashi, N. Kitamura, and J. Yamada. 2005. Adaptation of the hindlimbs for climbing in bears. Annals of Anatomy 187:153–160.

Schneider, M., G. Nogge, and L. Kolter. 2014. Implementing unpredictability in feeding enrichment for Malayan sun bears (*Helarctos malayanus*). Zoo Biology 33:54–62.

Scotson, L., G.M. Fredriksson, D. Augeri, C. Cheah, D. Ngoprasert, and W. Wai-Ming. 2017. *Helarctos malayanus*. International Union for Conservation of Nature Red List of Threatened Species 2017. http://www.iucnredlist.org. Accessed 16 Nov 2020.

———, K. Vannachomchan, and T. Sharp. 2014. More valuable dead than deterred? Crop-raiding bears in Lao PDR. Wildlife Society Bulletin 38:783–790.

Shukla, U., S. Prasad, M. Joshi, S. Sridhara, and D.A. Westcott. 2015. Nest site characterization of sympatric hornbills in a tropical dry forest. Current Science 108:1725–1730.

Wong, S.T., C. Servheen, and L. Ambu. 2002. Food habits of Malayan sun bears in lowland tropical forests in Borneo. Ursus 13:127–136.

———, ———, ———, and A. Norhayati. 2005. Impacts of fruit production cycles on Malayan sun bears and bearded pigs in lowland tropical forest of Sabah, Malaysian Borneo. Journal of Tropical Ecology 21:627–639.

Wong, W.M., N. Leader-Williams, and M. Linkie. 2015. Managing human–sun bear conflict in Sumatran agroforest systems. Human Ecology 43:255–266.

Fig. 1. Two adult oriental pied hornbills (*Anthracoceros albirostris*), female at the

back, male in front (picture credit: Rudi Delvaux).

Fig. 2. Screenshot of the camera trap video. An adult sun bear (*Helarctos malayanus*) predating on an oriental pied hornbill nest (*Anthracoceros albirostris*). Here the bear appears to pull the female out of the nest.

Fig. 3. Screenshot of the camera trap video. A sun bear (*Helarctos malayanus*) pulls a female oriental pied hornbill (*Anthracoceros albirostris*) from the nest, killing her in the procedure.