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Citation for final published version:

Kunde, Miriam N. and Goossens, Benoît ORCID: <https://orcid.org/0000-0003-2360-4643> 2021. Sun bear predation on an oriental pied hornbill nest. URSUS 2021 , pp. 1-4. 10.2192/URSUS-D-19.00018.1 file

Publishers page: <http://dx.doi.org/10.2192/URSUS-D-19.00018.1>
<<http://dx.doi.org/10.2192/URSUS-D-19.00018.1>>

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

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

23
24 The sun bear (*Helarctos malayanus*) is the smallest and most arboreal of the
25 bear species (Sasaki et al. 2005). This bear is currently distributed across Southeast Asia
26 (Fitzgerald and Krausman 2002, Scotson et al. 2017), occurs in a variety of different
27 habitat types (mostly tropical forest; Scotson et al. 2017), and is an opportunistic feeder
28 (Wong et al. 2002, Schneider et al. 2014). Sun bears' main diet appears to consist of
29 fruits, invertebrates, such as termites, ants, and beetle larvae, as well as honeycomb and
30 honey (Scotson et al. 2017). In Borneo, sun bears are mostly insectivores, but feed on
31 fruits during mast-fruiting events and on figs (*Ficus* ssp.) during inter-mast periods

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

41 Oriental pied hornbills (Fig. 1) are monogamous (Chan et al. 2007) and breed
42 from January to June (Kinnaird and O’Brien 2007). These hornbills prefer undisturbed
43 areas, but do breed in secondary forest, choosing to nest in *Bombax*, *Lagerstroemia*, and
44 Dipterocarps trees (Shukla et al. 2015). Hornbills are secondary cavity nesters, so they
45 rely on tree cavities in large trees in order to nest (Datta and Rawat 2004, Shukla et al.
46 2015), with nest openings between 2 and 45 m off the ground (Poonswad 1995). When
47 a nesting site has been chosen, the female seals herself into the nest, where she lays
48 about 3 eggs (Chan et al. 2007, Ng et al. 2011). The male visits the nest to feed her and
49 the chicks, making an average of 12 feeding trips a day (Rahman et al. 2019).

50 **Study area**

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

56 corridor is subjected to disturbances and consists mostly of degraded forest, it acts as a
57 riparian buffer zone between plantations and the Kinabatangan River. The wildlife
58 sanctuary also encompasses other landscape types, including semi-inundated areas and
59 permanent swampland, dry lowland, small grassland, and swamp forests (Abram et al.
60 2014).

61 **Methods**

62 We found an oriental pied hornbill nest containing 2 eggs inside a Bayur tree
63 (*Pterospermum javanicum*) on 23 February 2019. The nest was 1.6 m off the ground,
64 and we decided to video-monitor the nest to learn more about the nesting and chick-
65 rearing behavior in wild hornbills. When we set up the video camera trap on 28
66 February, 2 chicks had already hatched. Therefore, hatching occurred between 24 and
67 27 February. We changed the secure digital card and batteries once per week.

68 We video-recorded the sun bear predated the hornbill using an Infrared Mobile
69 Digital Scouting Camera (Model: MG983G-30M, Boly Inc., Santa Clara, USA). We set
70 the camera to hunting mode, video record, motion trigger, filming for 40 seconds with a
71 1-minute delay between triggers. We set up the camera approximately 2 m from the
72 hornbill nest, facing the entrance. We monitored the nest for 41 days.

73 **Results and discussion**

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

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

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

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

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

103 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

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

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

141 **Acknowledgments**

142 We would like to express our sincere gratitude to our students and research
143 assistants who have assisted in monitoring the hornbill nest. We would like to thank R.
144 Appleby for providing the video camera that captured this behavior. Lastly, we would
145 like to thank the reviewers and editors for their valuable feedback.

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212



213
214 **Fig. 1. Two adult oriental pied hornbills (*Anthracoceros albirostris*), female at the**

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



216

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

220

221



222

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