Round, P. D. and Jukmongkol R. (2001–2002) Recent reports. *Bird Conserv. Soc. Thai. Bull.* 18(6): 14, 19(1): 13, 19(12): 14.
Round, P. D. and Jukmongkol R. (2003) Recent reports. *Bird Conserv. Soc. Thai. Bull.* 20(4): 16.
Round, P. D. and Jukmongkol R. (2005) Recent reports. *Bird Conserv. Soc. Thai. Bull.* 20(4): 17–20.
Round, P. D. and Jukmongkol R. (2006a) Recent reports. *Bird Conserv. Soc. Thai. Bull.* 23(2): 15–19.
Round, P. D. and Jukmongkol R. (2006b) Recent reports. *Bird Conserv. Soc. Thai. Bull.* 23(3): 18–19.
Wells, D. R. (1999) *The birds of the Thai-Malay Peninsula*, Vol. 1. London: Academic Press.
Wolstencroft, J., Parr, J. and Goodey, M. (1993). *Survey of wetlands in north-east Thailand.* Kuala Lumpur: Asian Wetlands Bureau. (Publication no. 83).

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Infanticide-cannibalism in the Oriental Pied Hornbill *Anthracoceros albirostris*

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We report here infanticide followed by cannibalism in Oriental Pied Hornbill *Anthracoceros albirostris*, which to our knowledge has not been previously been reported in hornbills.

In December 2005–January 2006, video cameras were placed in four Oriental Pied Hornbill nest cavities (before they were occupied), in the forests of Pulau Ubin, an island off Singapore, as part of the Singapore Hornbill Project. Pulau Ubin (1°24′N 103°58′E) lies in the Straits of Johor, north-east of the main island of Singapore; it is 8 km in length and 1.3–1.7 km in breadth and has an area of 10.2 km^2. The habitat is mainly mixed secondary forest with old fruit plantations, primarily durian *Durio zibethinus*. The nest trees were 0.6–2.7 km apart, at an altitude of 1–5 m. The cavity openings were 7–12.1 m above the ground.

METHODS

Three CCTV cameras with infra-red capabilities were positioned at each nest: one inside the nest cavity, one at the nest entrance and one 5–10 m away. A DVD recorder, portable 12V 120AH batteries, inverter and monitor powered by 12V 80AH batteries were connected to the cameras. Images from all cameras were recorded 24 hours daily by a digital video recorder running the Telexper programme (Telexper International Inc, California, U.S.A.). Data were transferred fortnightly to external hard disks for storage. Data were reviewed and analysed daily, with the timing of events noted directly from the recordings.

Dimensions (e.g. egg size and beak length) were obtained by measuring the images and multiplying by the relevant magnification factor. Magnification factors were derived from an image of a reference object (a ruler placed inside the nest cavity). Parallax effects were minimised by taking the measurements at the bottom of the nest.

OBSERVATIONS

Three of the nests were subsequently occupied by females. The female in the first nest first entered the nest cavity on 27 December 2005, and she was sealed in by both her mate and herself on 4 January 2006. She laid four eggs, with the first on 10 January and the others at 3–4 day intervals. The nestlings hatched on 6–16 February, 28–29 days after the eggs were laid. The male brought food to the nest up to 31 times a day during the nesting period. During the 15 days from the hatching of the first chick to the death of the fourth chick, the items brought by the male comprised 50% fruits, 40% insects and 10% lizards. The duration of visits by the male ranged from 30 seconds to three minutes, depending on the size and amount of food.

All the chicks positioned themselves just under the opening through which the male brought the food, which was distributed whole by the female to the chicks. Visual estimations of the food intake by the individual chicks over these 15 days indicated that the food mass received by each of the eldest three chicks was similar. During individual feeding visits, chicks that were satiated did not fight for food as much as the hungrier chicks, and the female appeared to distribute food to the chicks that begged most vigorously.

The fourth (youngest) chick appeared to receive much less food than the other three chicks (Fig. 1a) and it looked much smaller and weaker. Whereas the mean feeding frequency of the three larger chicks during their first four days was 17.4 times a day, the fourth chick received just eight feeds on its second day after hatching and three on its fourth day. The three older chicks grew steadily and at similar rates (Fig. 1b), but the fourth appeared to stop growing after its second day.

On the fourth day after hatching, the fourth chick ceased giving begging calls (although it continued gaping). At 15h59, the female picked up the fourth chick and killed it by repeatedly crushing it with her beak. Then she tried to feed it to the remaining chicks. All three chicks attempted to swallow it, and after 30 minutes the second oldest chick succeeded (Plate 1).

We recorded the disappearance of a fourth-hatched chick in another nest, but unfortunately the battery failed at the critical time and we were unable to obtain a video recording. In this nest the female sealed herself into the nest on 5 February 2006. The first egg was laid on 12

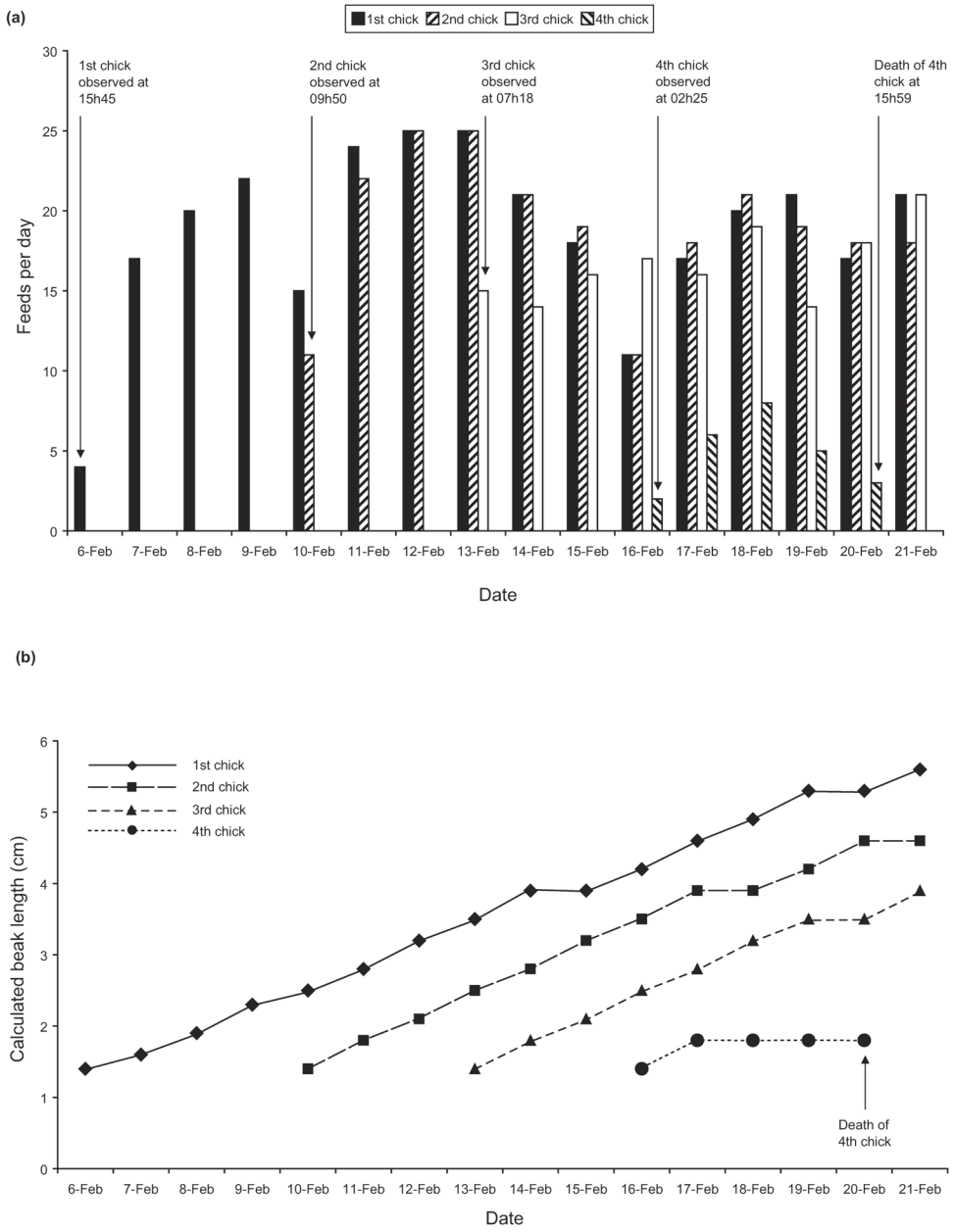

Figure 1. Feeding frequency (a) and growth rate (b) for the four chicks.

February, and the fourth egg was laid on 20 February. The first egg hatched on 12 March, and the fourth hatched on 18 March. The fourth chick disappeared four days after it hatched. The last recording before the batteries failed at 06h54 on 22 March revealed four chicks. When the recording restarted at 11h02, there were only three chicks left. No remains of the chick were seen in the nest or on the ground outside. We presume that the female killed the chick and ate it or fed it to the other chicks. There were only two eggs in the third occupied nest cavity.

DISCUSSION

Although four eggs in a clutch have been recorded in captivity, it has been generally assumed from observations of fledglings in the wild that the largest clutches of Oriental Pied Hornbills are of three eggs (Kemp 1995). Our study is the first in which nest interiors in the wild have been monitored continuously. It shows that four-egg clutches may not be uncommon. This is supported by another study in which nests of a number of hornbill species (including Oriental Pied Hornbill) were examined daily, and unexplained chick losses were observed (P. Poonswad *in litt*. 2006).

We hypothesise that the female committed infanticide of the youngest chick and fed it to the other chicks to improve their chance of survival. As the frequency of feeding appeared to be high, we do not believe that a dearth in food supply was the main factor behind this behaviour. Infanticide has also been reported in House Sparrow *Passer domesticus* (Veiga 2003), Barn Swallow *Hirundo rustica* (Møller 2004), European Starling *Sturnus vulgaris* (Smith *et al*. 1996) and Guira Cuckoo *Guira guira* (Macedo and Bianchi 1997) among other species. Siblicide amongst chicks is also well-known, for example in the Nazca Booby *Sula granti* (Clifford and Anderson 2002) and Madagascar Fish Eagle *Haliaeetus vociferoides* (Watson *et al*.1999). In obligately siblicidal bird species (such as boobies *Sula* spp.), aggressive behaviour by a dominant chick typically reduces the brood size to one. Facultative siblicide has been documented in several

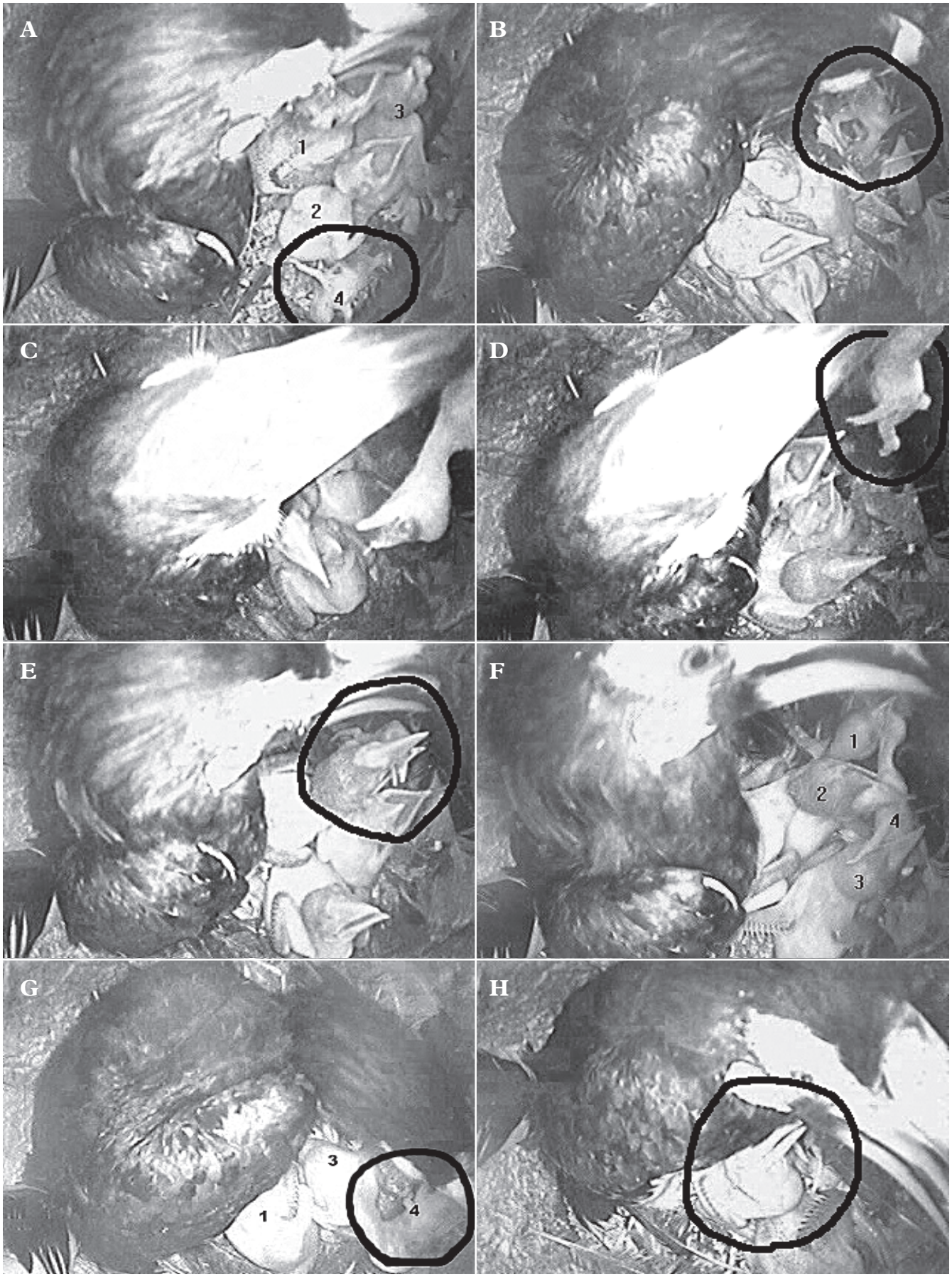

Plate 1. Sequence of video images of the infanticide and cannibalism event: (A) adult female feeding chicks (fourth chick circled at bottom of image); (B) female picking up the fourth chick (circled); (C) female killing fourth chick by shaking and crushing it in her beak; (D) remaining chicks reacting to dying chick (circled) with reflex begging; (E) largest chick trying to swallow dead chick (circled); (F) all three chicks trying to swallow dead chick; (G) third chick trying to swallow dead chick (circled); (H) second chick with enlarged food pouch (circled) having eaten dead chick.

raptor species; for example, observations indicate a relationship between food resources and brood reduction in Northern Goshawk *Accipiter gentilis* (Estes *et al.* 1999) and Osprey *Pandion haliaetus* (Machmer and Ydenberg 1998). Cannibalism has been reported in the Common Pheasant *Phasianus colchicus* (Cain *et al.* 1984) and the domestic hen, and may be related to dietary factors (Ambrosen and Petersen 1997). We suggest that the behaviour of infanticide and cannibalism may have evolved in Oriental Pied Hornbill because it pays females to lay more eggs than the number of chicks that can be most effectively raised, reduce brood size to invest resources in the healthiest chicks, and to 'recycle' those in the youngest and weakest chick among its siblings.

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REFERENCES

Ambrosen, T. and Petersen, V. E. (1997) The influence of protein level in the diet on cannibalism and quality of plumage of layers. *Poultry Sci.* 76: 559–563.

Cain, J. R., Weber, J. M., Lockamy, T. A. and Creger, C. R. (1984) Grower diets and bird density effects on growth and cannibalism in Ring-necked Pheasants. *Poultry Sci.* 63: 450–457.

Clifford, L. D. and Anderson, D. J. (2002) Clutch size variation in the Nazca booby: a test of the egg quality hypothesis. *Behav. Ecol.* 13: 274–279.

Estes, W. A., Dewey, S. R. and Kennedy, P. L. (1999) Siblicide at Northern Goshawk nests: does food play a role? *Wilson Bull.* 111: 432–436.

Kemp, A. (1995) *The hornbills.* Oxford, U.K.: Oxford University Press.

Macedo, R. H. F. and Bianchi, C. A. (1997) When birds go bad: circumstantial evidence for infanticide in the communal South-American Guira Cuckoo. *Ethol. Ecol. Evol.* 9: 45–54.

Machmer, M. M. and Ydenberg, R. C. (1998) The relative roles of hunger and size asymmetry in sibling aggression between nestling ospreys, *Pandion haliaetus*. *Can. J. Zool.* 76(1): 181–186.

Møller, A. P. (2004) Rapid temporal change in frequency of infanticide in a passerine bird associated with change in population density and body condition. *Behav. Ecol.* 15: 462–468.

Smith, H. G., Wennerberg, L. and von Schantz, T. (1996) Adoption or infanticide: options of replacement males in the European starling. *Behav. Ecol. Sociobiol.* 38: 191–197.

Veiga, J. P. (2003) Infanticide by male house sparrows: gaining time or manipulating females? *Proc. Roy. Soc. Lond. B* 270: S87–89.

Watson, R. T., Razafindramanana, S., Thorstrom, R. and Rafanomezantsoa, S. (1999) Breeding biology, extra-pair birds, productivity, siblicide and conservation of the Madagascar Fish Eagle. *Ostrich* 70: 105–111.

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Chestnut-cheeked Starling *Sturnus philippensis*: new for the Indian subcontinent

PIERRE VAN DER WIELEN

On the afternoon of 28 March 2006, Alma Leegwater, Mario Renden, Rob Struyk and I were birding in a wide grassy strip amidst tall forest at Nameri National Park (26°56′4″N 92°51′09″E), Assam, north-eastern India. One of the highlights of the afternoon was the flocks of up to 80 Spot-winged Starlings *Saroglossa spiloptera* spread over the area. As this was a new species for all of us we took our time to get a good look at this gorgeous starling. Whilst examining a flock of about 40 Spot-winged Starlings, I saw an individual which, at first glance, looked like a male Purple-backed Starling *Sturnus sturninus*. Realising that this would be a vagrant in India, I alerted the others and pointed out the bird. We observed the bird for about 30 minutes through binoculars and a 20–60 × 60 spotting scope at a range of about 60 m. After consulting the two field guides we had with us (Kazmierczak and van Perlo 2000, Rasmussen and Anderton 2005), we quickly realised that several of the observed field marks did not fit Purple-backed Starling. The most obvious differences on 'our' bird were the whitish head with a large reddish cheek/ear-covert patch and the lack of a black cap. Because there was no species in either book that matched it we decided to take a detailed description and to try to obtain some photographs.