

Project Update: May 2010

We focused on five species of hornbills, three of which are of international concern: rufous-necked hornbill *Aceros nipalensis*, listed as Vulnerable; great hornbill *Buceros bicornis* and brown hornbill *Anorrhinus austeni*, listed as Near Threatened; and wreathed hornbill *Rhyticeros undulatus* and oriental pied hornbill *Anthracoceros albirostris*, listed as Least Concern (IUCN, 2009).

Field sampling

We established 1.5 – 2.0 km trails - seven in Namdapha National Park and four in Tengapani Reserve Forest. Each transect was walked nine to 27 times between January to May 2009 following standard distance sampling protocol (Buckland *et al.* 2003). For each detection, we recorded species, group size and perpendicular distance (measured using rangefinder) from the transect. For animals, which occurred in groups, distances to group centers were measured. All transects were walked between 0530 and 1000 h in the morning and 1430 and 1700 h in the evening. Data from temporal replicates were pooled and treated as a single sample.

Analysis

Density estimates were produced using the Distance 5.0 program (Thomas *et al.* 2006). For software settings, we followed the recommendations of Buckland *et al.* (2003) and those used by others for estimating densities of the same or similar species in South-east Asia (Anggraini *et al.* 2000; Gale & Thongaree, 2006). Birds were entered as clusters and distance data were grouped automatically by software or in case manually. Cluster size was derived from mean observed cluster size, otherwise size-bias regression (regression of log cluster size against estimated detection function $g(x)$) was used when the regression was significant at $\alpha = 0.15$. We tested primarily uniform, half-normal and hazard key functions with either the cosine, polynomial or the hermite adjustment terms.

Table 1 Details of each of the trails in Namdapha National Park and Tengapani Reserve Forest. FF – Foothill Forest (300 – 1000 m), LMF – Lower Montane Forest (1000 – 2000 m) and Low – Lowland Forest (150 – 300 m).

| No. | Trail Name | Site | Forest Type | Trail Length | Total Effort |
|-----|------------|--------------|-------------|--------------|--------------|
| 1 | Haldibari | Namdapha NP | FF | 2 | 46 |
| 2 | Bulbulia | Namdapha NP | FF | 2 | 48 |
| 3 | Raja Jheel | Namdapha NP | FF | 2 | 50 |
| 4 | Rani Jheel | Namdapha NP | FF | 1.7 | 45.9 |
| 5 | Waa-si | Namdapha NP | LMF | 1.5 | 33 |
| 6 | 65 | Namdapha NP | LMF | 2 | 18 |
| 7 | 75 | Namdapha NP | LMF | 1.8 | 25.2 |
| 8 | C | Tengapani RF | Low | 1.5 | 33 |
| 9 | D | Tengapani RF | Low | 1.5 | 31.5 |
| 10 | E | Tengapani RF | Low | 1,5 | 34.5 |
| 11 | F | Tengapani RF | Low | 1.5 | 30 |

Results

Density Estimates

Namdapha

We had 373 observations of four species of hornbills (great (53), wreathed (27), rufous-necked (268) and brown hornbill (20)). The majority of the observations were aural rather than visual (68.1% vs 30.3%, and 1.6% were seen flying). Great and brown hornbills were detected only in the foothill forest while wreathed and rufous-necked hornbills were detected in foothill and lower montane forests. Wreathed hornbill was seen only in January 2009 in the foothill and the lower montane forests in large numbers. In February 2009 it was seen only once at a foothill forest site.

In spite of considerable effort (266.1 km), we had too few a visual detection for three species of hornbills (great = 17, wreathed = 14, and brown = 9) to estimate their densities reliably. On the other hand, we had 73 detections of the rufous-necked hornbill. As we did not have enough detection to independently estimate detection functions for each species, we pooled the data for the three similar-sized species of hornbills (great, wreathed and rufous-necked hornbills) to estimate a common detection function.

Table 2 Density estimates of four hornbill species for the foothill and lower montane forest site - Namdapha National Park

| Elevation Category ^a | Species ^b | Effort (km) | n | Mean flock size | Density/km ² | | | | |
|---------------------------------|----------------------|-------------|----|-----------------|-------------------------|-------------|--------|-------|------|
| | | | | | Group | Individuals | 95% CI | | CV% |
| | | | | | | | Low | High | |
| FF | GH | 187.9 | 17 | 1.6 | 0.8 | 1.2 | 0.3 | 3.8 | 48.9 |
| FF & LMF ^c | RNH | 264.1 | 73 | 1.8 | 3.6 | 6.5 | 4.5 | 9.4 | 17.9 |
| FF | RNH | 187.9 | 46 | 1.8 | 2.9 | 5.3 | 2.8 | 10.1 | 26.1 |
| LMF | RNH | 76.2 | 27 | 1.8 | 4.2 | 7.7 | 5.1 | 11.6 | 18.4 |
| FF | WH | 187.9 | 13 | 5.9 | 5.6 | 32.9 | 10.0 | 108.2 | 51.0 |
| FF | BH | 92 | 9 | 10.7 | 1.0 | 10.4 | 2.4 | 45.7 | 42.0 |

^a FF – Foothill forest; LMF – Lower montane forest

^b GH – great hornbill; RNH – rufous-necked hornbill; WH – wreathed hornbill; BH – brown hornbill

^c Pooled estimates for Foothill and Lower montane forest

Tengapani

We had 93 observations of five species of hornbills (great (14), wreathed (3), rufous-necked (1), brown (15) and oriental pied (8)). All the five species of hornbills, which are likely to be seen in the area, were detected. However, rufous-necked hornbill was detected only twice. Like in Namdapha, the majority of the observations were aural rather than visual (51.6% vs 37.6%, and 10.7% were seen flying). Wreathed hornbills were detected across the 3 months of sampling (February-April 2009).

In spite of significant amount of effort (127.5 km), we had more than 10 visual sightings of only two species, which could be used to estimate their densities. In past, densities of hornbills have been estimated with limited number of sightings. The only concern in such studies is the fact that the density estimates are not precise and are therefore characterized by high Coefficients of Variation (CV). Thus even in our case due to limited number of sightings the CVs associated with the density estimates are high (GH = 44%; BH = 56%; see Table 3).

Table 3 Density estimates of two hornbill species for the lowland forest site - Tengapani Reserve Forest

| Species | Effort (km) | n | Mean flock size | Density/km ² | | | | |
|----------------|-------------|----|-----------------|-------------------------|-------------|--------|------|------|
| | | | | Group | Individuals | 95% CI | | CV% |
| | | | | | | Low | High | |
| Great hornbill | 127.5 | 16 | 1.7 | 1.4 | 1.7 | 0.5 | 5.5 | 44.1 |
| Brown hornbill | 127.5 | 15 | 4.2 | 1.5 | 6.1 | 1.3 | 28.5 | 55.7 |

Encounter rates

Namdapha: Foothill forests

Only four species of hornbills were detected in the foothill forests of Namdapha. Oriental pied hornbill was not seen or heard during the sampling period. Three species of hornbills, great, rufous-necked and brown, did not exhibit significant changes in the mean encounter rates across the 4 months of sampling (Fig. 1). There was a drastic decline the encounter rate of the wreathed hornbill across the 4 months (Fig. 1). After February 2009, wreathed hornbills were not detected in the foothill forests. Even in February 2009, we had only two detections of wreathed hornbills.

Comparing across the species, rufous-necked hornbill was the commonest. Wreathed hornbill encounter rates were comparable with rufous-necked hornbills only in January 2009. Brown hornbills were the rarest. Encounter rates of great hornbills were lower than that of rufous-necked hornbills.

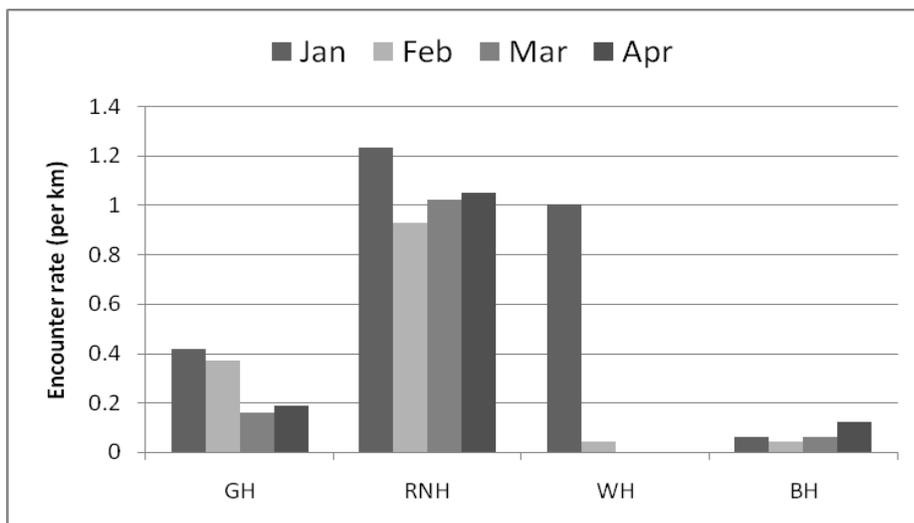


Fig. 2 Mean encounter rates (visual and aural detections) for four species of hornbills across 4 months. GH – great hornbill, RNH – rufous-necked hornbill, WH – wreathed hornbill, BH – brown hornbill.

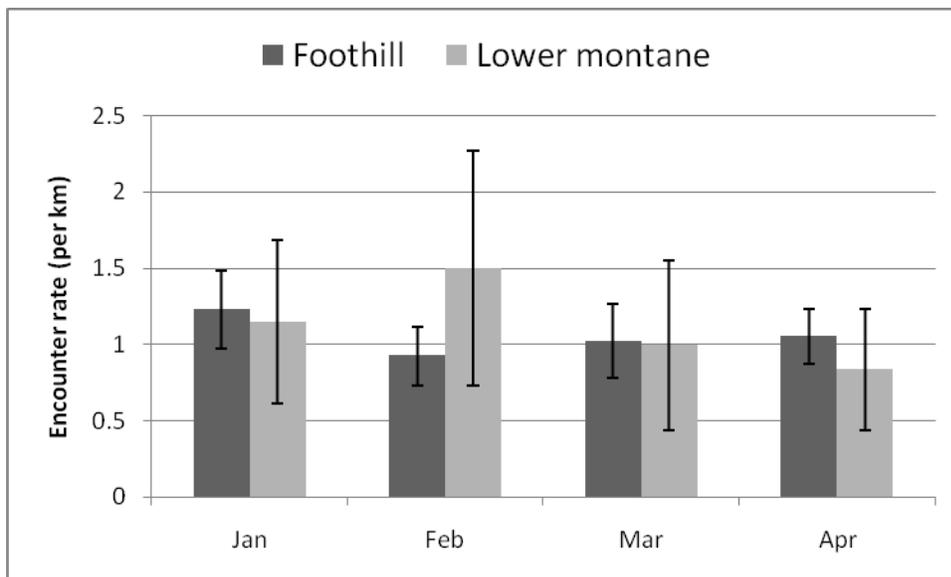


Fig. 3 Showing the mean encounter rate (visual and aural detections) \pm SE of rufous-necked hornbill in the foothill and lower montane forests across four months.

Namdapha: Lower montane forests

In the lower montane forests, only the rufous-necked hornbill was detected. The encounter rates of the rufous-necked hornbills were comparable across the 4 months and also with the foothill forests (Fig. 2). The standard errors of the lower montane forests were probably higher because of lesser effort in Lower montane forests (76.2 km) as compared to the foothill forests (187.9 km).

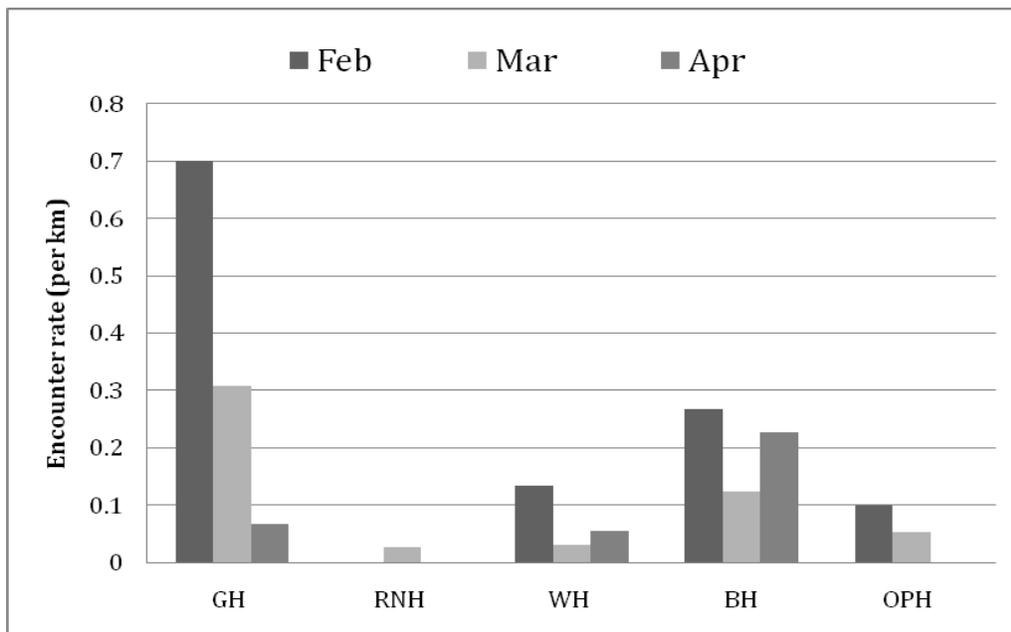


Fig. 3 Showing the mean encounter rates (visual and aural detections) for five species of hornbills across 3 months in Tengapani RF. GH – great hornbill, RNH – rufous-necked hornbill, WH – wreathed hornbill, BH – brown hornbill, OPH – oriental pied hornbill

Tengapani

In the lowland forest site, at Tengapani Reserve Forest, the patterns were very different from the foothill and the lower montane forests of Namdapha National. All the five species of hornbills were detected at this site (Fig. 3). However, rufous-necked hornbill was detected only twice during the entire sampling period (Fig. 2). There were not significant variations in the mean monthly encounter rates of the wreathed and brown hornbills. However, great hornbill encounter rates declined across the 3 months of sampling, being lowest in April 2009.

Discussion

Density estimates

These are some of the first density estimates of hornbills from Arunachal Pradesh. The densities of great hornbill in Namdapha were comparable with western Arunachal Pradesh (0.66 individuals/km²) (Datta & Rawat, 2003) and central Thailand (1.88 individuals/km²) (Poonswad *et al.* 1988) but were lower than in southern Western Ghats (3.4 – 9.55 individuals/km²) (Raman & Mudappa, 2003). These are some of the first estimates of the globally threatened rufous-necked Hornbill. They are occurring at high densities in Namdapha National Park thus making it one of the global strongholds. Densities of other two hornbill species however showed large coefficient of variances. Both the wreathed hornbill and the brown hornbill were detected only 13 and nine times respectively, leading to high coefficient of variances in their density estimates. Wreathed hornbill visits the area only for a period of 3 – 4 months and the data used for estimating densities spanned only 2 months, thereby leading to limited number of sightings of wreathed hornbill. Both the wreathed hornbill and brown hornbill move in large flocks in the winters in the non-breeding season as compared to the rufous-necked hornbill and great hornbill. In winter, wreathed hornbills can be seen in flocks of more than 50 in Namdapha National Park. We have seen brown hornbills in a flock of more than 20. Brown hornbills are also cooperative breeders and offspring of the previous year often tag along with their parents (Kemp, 2001).

Interestingly, when we compared densities of great hornbill from Namdapha National Park and Tengapani Reserve Forest, there were not significant differences between the two sites. We were however only able to compare the densities of the great hornbill. Tengapani Reserve Forest is a typical lowland forest and does not harbor the foothill forests, which are occupied by rufous-necked hornbill. The densities of the other species had high coefficient of variances therefore comparisons were not possible. This also suggests that hornbills might be able to tolerate logging to a certain extent.

Encounter rates

Great hornbill, rufous-necked hornbill and brown hornbill were detected across the 4 months in the foothill forests. These three species therefore are probably resident during this time period in the area and do not appear to show strong seasonal movements across the elevation gradient. However, they show fluctuations in their encounter rates, which might be a function of varying food availability. Annraini *et al.* (2000) have demonstrated strong seasonal movements of hornbills in response to fluctuations in fruit availability. Other studies have also demonstrated fluctuations in Wreathed Hornbill numbers in response to changes in ripe fruit availability (Suryadi *et al.* 1994; Kinnaid *et al.* 1996). The encounter rates of Rufous-necked hornbill also do not differ across the months and across the two forest types namely, the lowland forest and the foothill forest.

The encounter rates of the wreathed hornbill in Namdapha National Park on other hand drop down significantly from January to May. We did not have any sightings of wreathed hornbills after February 2009. Wreathed Hornbills are seasonal visitors to Namdapha National Park in the winter. They probably

breed in the lowland forests in areas adjoining to Namdapha National Park. Namdapha National Park does not have typical lowland forests. One of the sites where they possibly breed is the Tengapani Reserve Forest. Tengapani Reserve Forest covers ca. 400 km². We have seen wreathed hornbills in Tengapani Reserve Forest in early May, which is well into their breeding season. There are no other lowland forest sites adjacent to Namdapha National Park. The other potential patch of lowland forest is further south-west in Deomali Forest Division and in the Dehing Patkai Wildlife Sanctuary in Assam, which is around 100 km straight-line distance from Namdapha National Park. We also suspect that a large portion of the population of wreathed hornbills in the area might be coming from Burma. The adjoining areas in Burma seem to have vast tracts of lowland forest around 50 – 60 km from Namdapha National Park. This also suggests that Tengapani Reserve Forest is the last remaining contiguous forested area where wreathed hornbills are breeding in areas around Namdapha National Park. Wreathed hornbills therefore appear to use a much wider landscape, which might have strong implications on its conservation in the near future. It is thus imperative that the breeding habitat of the wreathed hornbill, the lowland forest, and the non-breeding habitat, the foothill and lower montane forests are preserved to ensure their survival in the area. Currently, Namdapha and Kamlang Wildlife Sanctuary together harbour more than 1500 km² of foothill and lower montane forest in eastern Arunachal Pradesh, however. It is thus one of the most important areas for conservation in the eastern Arunachal Pradesh landscape.

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