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INDIAN BIRDS

Vol. 5 No. 4

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- To publish a newsletter that will provide a platform to birdwatchers for publishing notes and observations primarily on birds of South Asia.
- To promote awareness of birdwatching amongst the general public.
- To establish and maintain links/liaison with other associations or organized bodies in India or abroad whose objectives are in keeping with the objectives of the Trust (i.e. to support amateur birdwatchers with cash / kind for projects in ornithology).

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Front cover: Male Lesser Florican *Sypheotides indica* displaying.

Photographer: Ramki Sreenivasan

A conservation status survey of hornbills (Bucerotidae) in the Western Ghats, India

Divya Mudappa & T. R. Shankar Raman[1]

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Abstract

The Western Ghats biodiversity hotspot in India is threatened by habitat loss and fragmentation, which is likely to impact large-bodied, wide-ranging species with specialised requirements such as hornbills. In this survey along the Western Ghats, we surveyed for four hornbill species that occur here: Malabar Pied Hornbill *Anthracoceros coronatus*, and Indian Grey Hornbill *Ocyceros birostris* (endemic to South Asia), Malabar Grey Hornbill *Ocyceros griseus* (endemic to the Western Ghats), and the Great Hornbill *Buceros bicornis*. We visited 45 localities across five states: Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. These included 26 wildlife sanctuaries, 5 national parks, 13 reserved forests, and one plantation landscape. Across sites, we walked 80 transect surveys totalling a length of 286.4 km. In all, 631 individual hornbills (412 detections) were recorded across 35 localities. The Malabar Grey Hornbill was most frequently detected, and widely-distributed, followed by the Great, and Malabar Pied hornbills. The Indian Grey Hornbill, more widespread across India, was seen in only two locations in this survey. Hornbill encounter was up to five times higher in moist, and wet forests as compared to dry forest types. Based on hornbill distribution and protected areas, five important hornbill conservation landscapes were identified in the Western Ghats (Amboli–Goa–Dandeli, Anamalai–Parambikulam–Vazhachal, Nilgiris–Wayanad, Someshwara–Sharavati–Mookambika, Neyyar–Peppara–KMTR, and Periyar) along with key reserved forests (Kottiyoor, New Amarambalam, Vazhachal, Nelliampathy, Goodarickal, Kulathupuzha–Palode). Hornbill densities were estimated in two of the above landscapes, and are provided as a baseline. We highlight some key considerations for hornbill research and conservation, and future needs.

Introduction

A large body of research has shown that the threats of habitat loss, and fragmentation severely impact large-bodied, wide-ranging species as well as species that have highly restricted geographic ranges or specialised requirements. Among birds, for instance, this makes wide-ranging species such as hornbills, and restricted-range species (endemics), more significant for conservation attention. The sensitivity of hornbills to hunting and habitat disturbance, and their specialised requirements for diverse old-growth forests for feeding and nesting have been amply demonstrated across Asia (see Poonswad & Kemp 1993; Kinnaird & O'Brien 2007—for recent syntheses), including India (Reddy 1988; Kannan 1994; Kannan & James 1997, 2006; Mudappa & Kannan 1997; Mudappa 2000; Datta 1998, 2001; Datta & Rawat 2003, 2004; Balasubramaniam *et al.* 2004). Even in the case of the more widespread Indian Grey Hornbill, a species of drier and more open habitats, sensitivity to habitat alteration leading to local extinctions have been reported in studies at the northern extremity of the Western Ghats—Purna/Ratanmahal, Gujarat (Trivedi & Soni 2006). In central Indian forests, their sensitivity to habitat disturbance due to logging has also been reported (Mehta 1998).

Of the 54 species of hornbills known from the world (Kemp 1993), nine occur within India, and four occur in the Western Ghats: the Malabar Pied Hornbill *Anthracoceros coronatus*, and Indian Grey Hornbill *Ocyceros birostris* (endemic to the Indian Subcontinent), Malabar Grey Hornbill *Ocyceros griseus* (endemic to the Western Ghats), and the endangered Great Hornbill *Buceros bicornis*. Apart from the two smaller *Ocyceros* spp., all other hornbill spp., are rare and threatened, and have been placed under Schedule I of the Indian Wildlife (Protection) Act, 1972[1]. Past research on hornbills in India has addressed many aspects of their biology such as breeding, nest selection, and diet (Reddy 1988; Kannan 1994; Kannan & James 1997, 2006; Mudappa & Kannan 1997; Mudappa 2000, 2005; Datta 2001; Datta & Rawat 2003, 2004; Balasubramanian *et al.* 2004). Less information is available on distribution and abundance patterns of hornbills, particularly in the face of large scale landscape transformations and continuing fragmentation and disturbance (Datta 1998; O'Brien *et al.* 1998; Reddy *et al.* 1990; Raman & Mudappa 2003). A recent survey by Balasubramanian *et al.* (2004, 2007) recorded hornbill distribution in a number of sites in Kerala, Tamil Nadu, Karnataka, and Goa in the Western Ghats, as well as in parts of the Eastern Ghats. This survey found the Malabar Grey

1 All hornbills (Family: Bucerotidae) were earlier placed in Schedule I; however, the two smaller *Ocyceros* have been removed from the listing. In what is possibly an oversight, the Malabar Pied Hornbill *Anthracoceros coronatus* appears to have been omitted from the listing as currently (15 August 2008) evident on the website of the Ministry of Environment and Forests, Government of India (http://envfor.nic.in/legis/wildlife/wildlife1.html).

Hornbill to be the most frequently observed species, and reported vegetation types in which each species occurred in the region.

The Western Ghats mountain chain, along the country's western coast, is recognised as one of the eight 'hottest hot spots' of biological diversity in the world (Myers *et al.* 2000; Mittermeier *et al.* 2004), and an ecologically important region within India. The Western Ghats have historically been heavily altered due to human impacts on natural landscapes through urbanisation, agriculture, plantations, hydro-electric projects, roads, and deforestation (Nair 1991; Menon & Bawa 1997; Williams 2003; Kumar *et al.* 2004). This is not surprising given that this region is one of the hotspots with the highest human population density (Cincotta *et al.* 2000). Jha *et al.* (2000) estimated that one-fourth (25.6%) of the Western Ghats's forest cover had been lost over a period of 22 years from 1973 to 1995, giving an annual deforestation rate of 1.16%.

The present survey targeted tropical forest areas restricted to elevations below 1,500 m along the Western Ghats from northern Maharashtra to Kerala. We aimed to: (1) assess distribution of hornbills using field surveys and secondary information, (2) identify important hornbill conservation units based on our survey, and (3) estimate population density of hornbills in some important conservation units to serve as a baseline. The survey covered 31 protected areas (wildlife sanctuaries and national parks) and 13 reserved forests along the Western Ghats. A larger goal was to identify key areas in the regional landscape, for conservation and management of these flagship species, and their habitats.

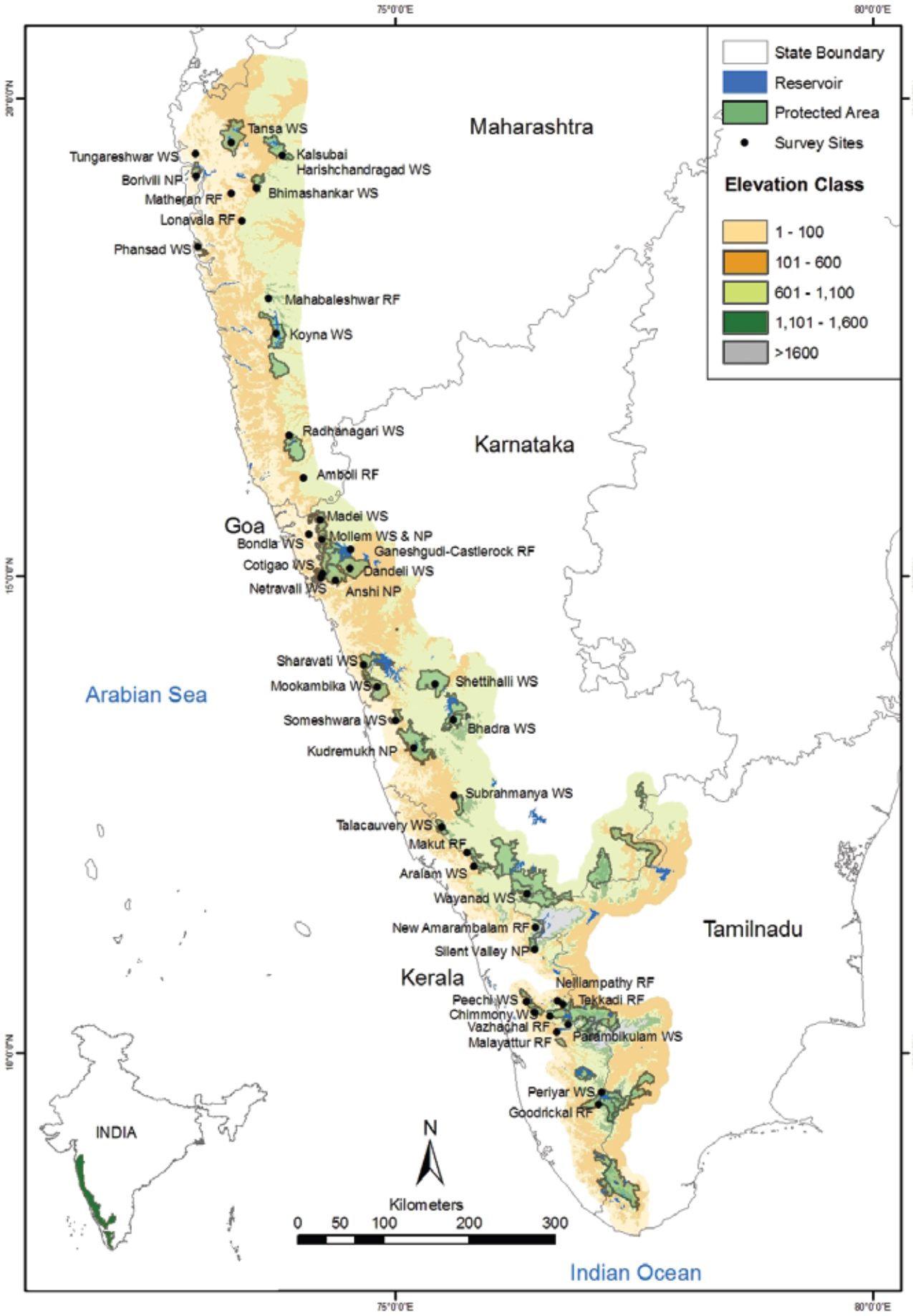
Study region

The Western Ghats is a 1,600 km long chain of hills running along the western coast of the Indian Peninsula, from near Kanyakumari at 8°N at the southern end, to the Tapti River in the north at 21°N (Fig. 1). The Western Ghats, distributed narrowly between 73° and 77°E, is less than 100 km wide over most of its length, being widest in the region of the Anamalai and Nilgiri ranges. Passing through the states of Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu, a number of hill ranges link up to form the Western Ghats. Going from north to south, these include the Sahyadri of Maharashtra and Goa, the hills of Uttara and Dakshina Kannada, Pushpagiri and Brahmagiri, and tall and imposing ranges of the Nilgiri (a meeting point with the Eastern Ghats), Anamalai, Palni, Cardamom (Elamalai), Varushanad, and Agasthyamalai hills (Nair 1991).

The Western Ghats has a tropical climate that shows pronounced variation along north–south, east–west, and altitudinal gradients. A comprehensive account of climate and vegetation in the Western Ghats is beyond the scope of this report, and is available in other publications (Champion & Seth 1968; Subramanyam & Nayar 1974; Puri *et al.* 1983; Pascal 1988). In general, the vegetation becomes drier as one progresses from west to east (rain shadow) across the hills. Lower elevations on the eastern aspect, receiving less than 1,200 mm annual rainfall, contain tropical dry deciduous and thorn forest, with tropical moist deciduous forests in more well-watered areas (Champion & Seth 1968). With increasing elevation, tropical wet evergreen rainforest appears along the higher slopes and ridges. The western aspect of the hills tends to have mostly tropical moist deciduous and wet evergreen forest types at lower elevations, giving way to the latter type as one climbs higher. The tropical wet evergreen forests of the Western Ghats, which are a main focus of this survey, have been classified by Pascal (1988) into low- (mostly below < 700 m), medium- (700–1,400 m), and high-elevation (>1,400 m) types.

Photo: *Kalyan Varma*

Malabar Pied Hornbill pair.



Map: Arundhati Das and Jagdish Krishnaswamy, ATREE, and R. Raghunath, NCF

Fig. 1. The Western Ghats of India showing protected areas and reserved forests and surveyed sites.

Table 1. Localities visited and effort in sites where transect survey was carried out.

State	Site	Transects	Duration (min)	Length (km)
Maharashtra	Amboli RF	—		
	Bhimashankar WS	2	223	4.31
	Borivili NP	1	60	2.04
	Kalsubai–Harishchandragad WS	1	45	1.04
	Koyna WS	4	383	8.65
	Lonavla RF	—		
	Mahabaleswar RF	1	85	1.56
	Matheran RF	1	84	2.20
	Phansad WS	1	115	3.01
	Radhanagari WS	2	315	24.62
	Tansa WS	1	68	1.41
	Tungareshwar WS	1	70	1.68
	TOTAL	15	1448	50.51
Goa	Bondla WS	3	204	5.75
	Cotigao WS	3	198	5.56
	Madei WS	3	263	5.31
	Mollem WS & NP	6	699	18.07
	Netravali WS	1	56	1.12
	TOTAL	16	1420	35.81
Karnataka	Anshi NP	2	123	4.15
	Bhadra WS	1	60	1.44
	Dandeli WS	3	295	7.96
	Ganeshgudi–Castle Rock RF	—	+	—
	Kudremukh NP	1	60	1.34
	Makut RF	—	+	—
	Mookambika WS	1	69	1.41
	Sharavati WS	1	51	1.47
	Shettihalli WS	1	60	1.34
	Someshwara WS	1	60	1.59
	Subrahmanya WS	1	64	2.10
	Talacauvery WS	1	60	1.61
	TOTAL	13	902	24.41
Kerala	Aralam WS	1	60	1.34
	Chimmony WS	1	60	1.34
	Goodrickal RF	1	65	1.22
	Malayattur RF	1	61	1.47
	Nadugani RF	—	+	—
	Nelliampathy RF	2	120	2.35
	New Amarambalam RF	—	+	—
	Parambikulam WS	1	61	1.21
	Peechi WS	1	59	1.04
	Periyar WS	2	120	2.68
	Silent Valley NP	1	60	1.94
	Tekkadi RF	—	+	—
	Vazhachal RF	5	405	8.97
	Wayanad WS	1	60	1.41
	TOTAL	17	1131	24.96
Tamil Nadu	Indira Gandhi WS* survey	4	344	6.93
	Indira Gandhi WS* transects	11	c. 6000	117.5
	Valparai fragments transects	4	c. 1800	33.2
	TOTAL	15	c. 7800	157.63

WS—Wildlife Sanctuary, NP—National Park, TR—Tiger Reserve, RF—Reserved Forest, +—visited briefly, *—now known as Anamalai Tiger Reserve.

Materials and Methods

Survey localities and effort

We visited 45 localities across five states along the Western Ghats: Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. These included 26 wildlife sanctuaries, five national parks, 13 reserved forests, and one plantation landscape. Logistics restricted the amount of time spent in each area; although we passed through a number of other sites, it was not possible to gather first-hand information due to various limitations.

We covered 135.69 km in 65 line transect surveys in various sites across Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu (Table 1; locations in Appendix). In addition, 15 line transects in Tamil Nadu were repeatedly surveyed five times each (for a total distance of 150.7 km). Besides the approximately 211 hours spent on transect surveys, we spent substantially more time (around 80 field-days) in various sites excluding Tamil Nadu.

To examine broad habitat affiliations, we also categorised the transects into four major habitat types: dry forests (dry thorn and deciduous forests), moist forests (moist deciduous and semi-evergreen forests), wet forests (primarily tropical wet evergreen forest), and Sahyadri or northern wet forests (evergreen forests typical of the northern Sahyadri portion). The survey effort was distributed across major vegetation types as follows: dry forests—12 transects, 24.52 km; moist forests—17 transects, 30.6 km; wet forests—32 transects, 79.4 km; and, hilltop evergreen forests—4 transects, 8.07 km.

Identifying key sites for hornbill conservation

The information on number of hornbill species and their abundance (encounter rates, density) within sites was examined with other landscape and habitat characteristics that are likely to be relevant for the conservation of these large and wide-ranging birds. We shortlisted landscapes with contiguous protected areas of at least 500 km², giving higher priority to larger areas and those adjoining suitable buffer habitats (reserved forests, plantations with shade tree cover). We also examined habitat status ratings based on a number of criteria assessing the type and intensity of threats that were used in a related conservation assessment

across the Western Ghats (CEPF 2007). Using a semi-quantitative approach that combined these rankings, we arrived at a list of potentially important sites for hornbill conservation.

Population density estimation

Besides occurrence, and encounter rates of species, population estimation from line transect surveys is an important aspect in identifying key areas for conservation of hornbills, especially for the larger, threatened species. Among the identified areas, given constraints of survey effort and logistics, we were able to carry out line transect density estimation across two landscapes: Dandeli–Goa, and Anamalai–Parambikulam.

From hornbill detections obtained during the line transect surveys we estimated population densities using distance sampling techniques as implemented in the DISTANCE computer program (version 5.0, Buckland *et al*. 2003; Thomas *et al*. 2005). All hornbills detected by sight, or call, in the field were categorised into the following perpendicular distance (from the transect line) intervals in metres: 0–5, 5–10, 10–20, 20–30, 30–50, 50–75, 75–100, >100, with a maximum detection distance (truncation point) of 150 m. Distances were estimated visually to most sightings or calls, by pace-length in a few cases, or measured with a rangefinder whenever possible. We took each detection (=cluster) to represent an individual, pair, or flock found in relatively close proximity and apparently moving or foraging together, and estimated flock or cluster density. Since flocks could not be counted in many cases for visual detections (and all aural detections), we used estimated average flock (cluster) size and its SE from data within and outside transects where complete counts of individuals were obtained. We multiplied the average flock size (F) by the average cluster density (C) to obtain individual hornbill density (D). Standard error of individual density (seD) was calculated using standard error of cluster density (seC) and standard error of average cluster size (seF) using Goodman's (1960) formula: $(seD)^2 = C^2(seF)^2 + F^2(seC)^2 - (seC)^2(seF)^2$. We evaluated different models of detection probability (half-normal, uniform, and hazard-rate) with cosine adjustment terms and used standard model selection procedures in DISTANCE to select the best model for estimating density.

Results & discussion

In all, 631 individual hornbills (412 detections) were recorded in 35 localities across the entire Western Ghats during this survey. The Malabar Grey Hornbill was the most frequently observed, and widely-distributed species (342 individuals, 33 localities), followed by the Great Hornbill (146 individuals, 13 localities), and the Malabar Pied Hornbill (131 individuals, 10 localities). The Indian Grey Hornbill, more common and widespread across the Indian peninsula, was seen at only 2 locations (12 individuals) along the Western Ghats, in this survey.

State-wise summaries

Maharashtra

All four hornbill species were recorded in Maharashtra (33 detections comprising 45 individuals). Malabar Grey Hornbills (14 detections, 15 individuals) were seen in Amboli, Phansad, and Radhanagari, Great Hornbills (nine detections, 18 individuals) in Amboli, Radhanagari, and Mahabaleshwar (latter seen by Tanya Balcar and Bob Stewart—*verbally*), whereas Malabar Pied Hornbills (four detections, five individuals) were recorded only in Amboli and Phansad during the survey. The Indian Grey Hornbill (six detections, seven individuals) was recorded only from Borivili.

Goa

During the survey across five protected areas in Goa, and nearby areas, we recorded only two hornbill species: Malabar Grey Hornbill (59 detections, 75 individuals), and Malabar Pied Hornbill (18 detections, 25 individuals). The Malabar Grey Hornbill was seen in all five sites, whereas the Malabar Pied Hornbill was recorded in Mollem, Madei, and Cotigao. Local reports indicate that it also, occasionally, occurs in Bondla, and Netravali.

Karnataka

All four hornbill species were recorded during the survey across 13 sites in Karnataka (193 individuals, 103 detections). The Indian Grey Hornbill was detected thrice in Dandeli Wildlife Sanctuary (five individuals). The Malabar Grey Hornbill was most widespread, being detected 77 times (85 individuals) across all sites. The Malabar Pied Hornbill was detected 17 times across four sites: Dandeli, Ganeshgudi–Castlerock, Bhadra, and Mookambika, and we counted 96 individuals including those at roost sites. We had only six detections (seven individuals) of Great Hornbill, three each from Dandeli and Mookambika.

Kerala

Three hornbill spp., Malabar Grey, Malabar Pied, and Great hornbills, were recorded across 14 sites in Kerala (151 detections, 212 individuals). The Malabar Grey Hornbill was detected 118 times (158 individuals) across all sites except Peechi, Silent Valley, and Wayanad (where it almost certainly was overlooked due to short survey period). We obtained only four detections (five individuals) of Malabar Pied Hornbill, all from the Vazhachal-Athirampilly area. Great Hornbills were detected 29 times (49 individuals), from Chimmony, Goodrickal, Nelliampathy, Parambikulam, Periyar, Thekkadi, and Vazhachal. The Indian Grey Hornbill was not recorded, although there were reports of its occurrence near the Trichur and Chalakudi foothills.

Tamil Nadu

In Tamil Nadu, our focus was on estimation of hornbill population density in and around the Anamalai Tiger Reserve (formerly Indira Gandhi Wildlife Sanctuary). During the survey, detections on transects and other supplementary observation resulted in around 500 detections of Malabar Grey Hornbill and over 100 detections of Great Hornbills numbering over 750 and 250 individuals,

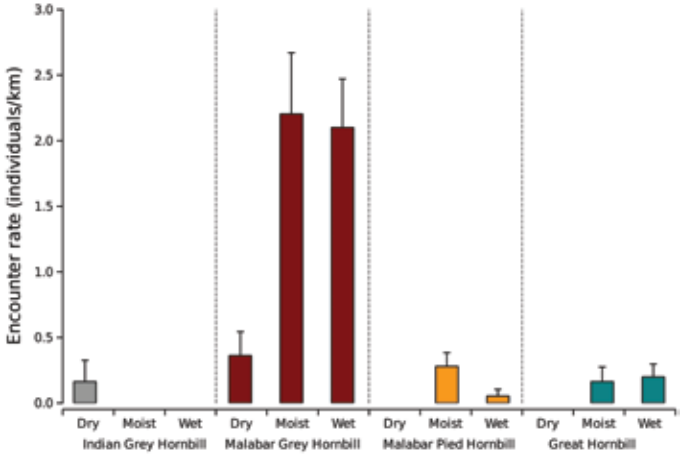


Fig. 2. Encounter rates of hornbill species in three broadly categorised vegetation types in the Western Ghats (vertical bars represent standard errors).

respectively (exact numbers are not provided as many are counts over repeatedly surveyed transects or locations).

Species-wise summaries

Great Hornbill

This species was recorded in 13 of the 45 survey sites, chiefly in or in close proximity to wet evergreen forests at elevations from 50 m to 1500 m asl. The records range from southern Maharashtra (Radhanagari and Amboli) to the southern-most sites in the Western Ghats. Relatively higher numbers were encountered in Radhanagari, Anamalai hills (Anamalai, and Parambikulam Tiger Reserves and, Vazhachal Reserved Forests), and Periyar during the survey.

Malabar Pied Hornbill

Recorded in ten localities of the 45, the Malabar Pied Hornbill was relatively more frequently encountered in moist deciduous and riverine areas on the western aspect of the Ghats. All detections were at elevations <600 m, with most being at elevations between 100 and 450 m. The main stronghold of this species appears to be in the central portion of the Western Ghats (Goa–Dandeli to Sharavati–Mookambika), with scattered populations or more sporadic occurrence further north (Amboli, Phansad) and in the southern Western Ghats (e.g., Athirapilly–Vazhachal).

Malabar Grey Hornbill

This endemic species is clearly the most widely distributed (recorded in 33 of 45 localities) and relatively common hornbill in the Western Ghats, distributed over a range of forest types from moist deciduous, riverine, and semi-evergreen forests to tropical wet evergreen forests. Our records of this species extend from around 50 m elevation to 1500 m elevation, from Phansad in Maharashtra to the southernmost sites in the Western Ghats.

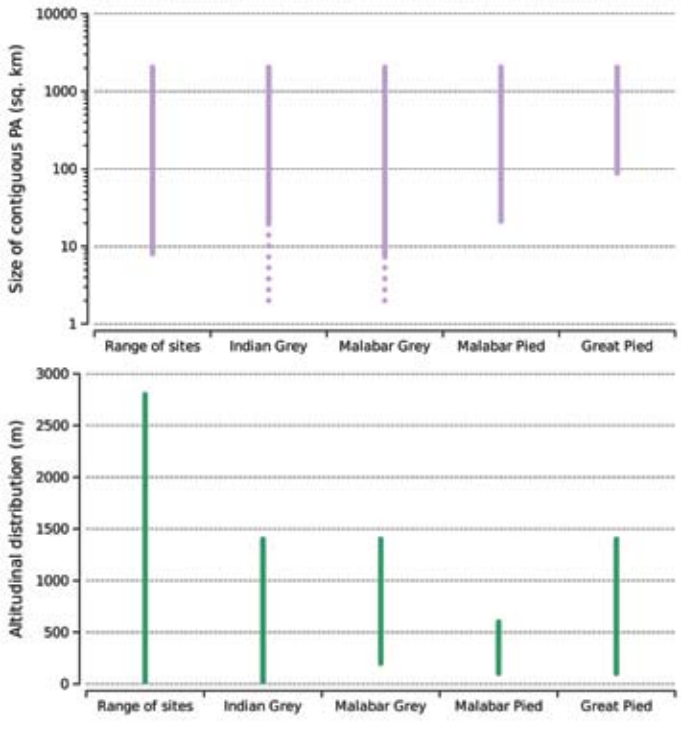


Fig. 3. Distribution of range of sites surveyed and individual hornbill species in relation to size of contiguous protected area and altitude. Broken lines indicate records from outside the survey.

Indian Grey Hornbill

This species, more typical and widely distributed across the plateaux and plains of India, than in the Western Ghats, was noted only in a few peripheral localities, or the foothills, during this survey. This included direct records only from Borivili and Dandeli, besides received reports of its occurrence around Trichur and Chalakudi in Kerala, and an earlier record from Panchgani, Maharashtra (Gole 1998). Despite the few records obtained in this survey, we would like to observe that this species is clearly still relatively common and widely distributed across India, even in urban centres (e.g., New Delhi, Nagpur, and Mysore, to name a few). However, being a species endemic to South Asia and one of the large-bodied species, it merits continuing conservation attention (R. Sankaran, *verbally*). Even during this survey, we obtained reports of hunting, and poaching, of nests of hornbills in the Western Ghats.

Habitat affiliations of hornbills

Hornbill encounter rates were calculated from transect data in vegetation types broadly categorised as dry forests (tropical dry thorn and dry deciduous), moist forests (chiefly tropical moist deciduous and riverine), and wet forests (tropical semi-evergreen and wet evergreen). No hornbills were detected in the four sites in the northern wet evergreen forests of Maharashtra and hence these sites were excluded from analysis. The overall encounter rate of hornbills varied significantly by habitat type (Kruskal-Wallis ANOVA $\chi^2 = 12.4$, $df = 2$, $P = 0.002$). The encounter rate was around five times higher in moist forests (mean = 2.65 hornbills/km, ± 0.51 SE), and wet forests (2.36 ±0.38), as compared to dry forests (0.52 ±0.22). The encounter rates of the four hornbill species in these three broad vegetation types indicates their main habitat affinities (Fig. 2). It is clear that the Indian Grey Hornbill is restricted to dry forests, although variation in encounter rates were not statistically significant due to the few locations in which the species was seen on transects (Kruskal-Wallis $\chi^2 = 4.1$, $df = 2$, $P = 0.13$). The Malabar Grey Hornbill is more widely distributed, and showed significant differences in encounter among habitat types ($\chi^2 = 13.2$, $df = 2$, $P = 0.001$), occurring chiefly in moist forest types and some dry deciduous areas adjoining moist forest tracts. The two larger hornbills are restricted to moist/wet forests. The Malabar Pied was more frequent in moist deciduous and riverine areas ($\chi^2 = 10.2$, $df = 2$, $P = 0.006$). The Great Hornbill was a species largely of wet evergreen zone, spilling over into some adjoining moist forest types, but statistical significance could not be established due to its rarity and low detections on transects ($\chi^2 = 2.0$, $df = 2$, $P = 0.37$).

Identifying important hornbill conservation landscapes

Compiling the occurrence data from our survey and the work of Balasubramanian *et al.* (2004, 2007) presents a picture of hornbill occurrence in relation to altitude and area of contiguous habitat within protected areas (PA) where the hornbill species occurred (Fig. 3). As seen from Fig. 3, the two smaller *Ocyceros* hornbills are seen across a wider range of sites in terms of contiguous PAs and altitudes than the larger species. In particular, the Malabar Pied Hornbill appears to have the narrowest altitudinal distribution in the Western Ghats coupled with an occurrence primarily in PAs at least larger than 20 km². It must be noted, however, that this analysis excludes areas of forest that may adjoin PAs and currently lack the same level of protection (e.g., reserved forests, plantations). The effective area of contiguous forest that determines the occurrence of these hornbill species (especially the larger species) is thus likely to be higher than illustrated here.

Based on the occurrence of the four hornbill species, encounter rates/densities from the sites for which these indices of abundance are available, and the configuration and size of contiguous protected areas along the Western Ghats, a priority list of conservation units are identified. The main sites and some key aspects regarding each are listed below (in rough order of priority):

Amboli–Goa–Dandeli: This is a key region being perhaps the most important region for the conservation of the Malabar Pied Hornbill as evidenced from the preponderance of the records of this species being from this region and the relatively high encounter rates and density. Besides three crucial wildlife sanctuaries (Mollem, Madei, and Dandeli), a significant proportion of the population is found outside designated protected areas in reserved forests such as at Amboli, Ganeshgudi, Dandeli, and around Mollem–Madei. All four species of hornbills are found in the Amboli–Goa–Dandeli region. A detailed survey of the reserved forests and their fragmentation and conservation status is required for Amboli and around Dandeli, for consideration of possible inclusion with protected areas.

Anamalai–Parambikulam–Vazhachal: Again, a region with all four species of hornbills, this area appears significant particularly in terms of conservation of the Great Hornbill. Population densities estimated in and around Anamalai Tiger Reserve provide a baseline for this, and the Malabar Grey Hornbill (see next section). While the large area of forest and abundance of these two species indicate that their populations here are relatively secure, there is concern over the status of the Malabar Pied Hornbill that is threatened by the proposed Athirapilly dam, and lack of protected area status for reserved forests where it occurs (e.g., Vazhachal, Nelliampathy).

Nilgiris–Wayanad: This is one of the important conservation areas of the Western Ghats although fragmented due to dams, roads, agriculture, and timber and monoculture plantations. It gains importance due to the large areas of dry and wet forests, and the occurrence of all four species of hornbills. Quantitative estimates of hornbill encounter/abundance are, however, lacking. The patchy occurrence of Malabar Pied Hornbills on the eastern (Coimbatore forest division) and western/northern (Wayanad–Bandipur) parts requires better documentation. The region adjoins the Mysore Plateau to the north, which appears to be an area where Indian Grey Hornbills are still relatively frequently seen.

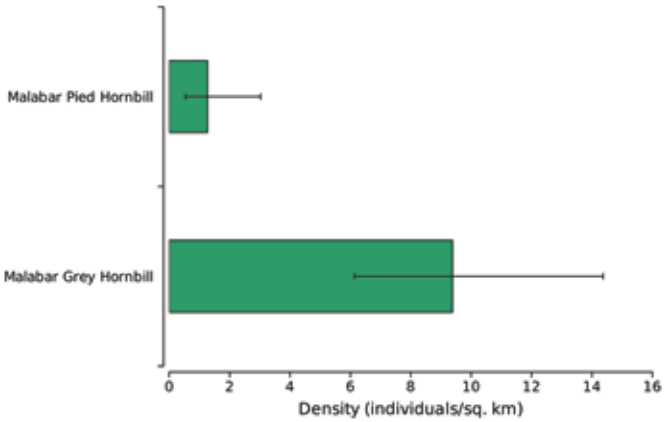


Fig. 4. Density of two hornbill species in the Dandeli-Goa region (error bars are 95% confidence intervals).

Someshwara–Sharavati–Mookambika: In Karnataka, this area appears to be an important complex for conservation of hornbills, including the Malabar Pied Hornbill, after the Anshi–Dandeli region. Only limited time could be devoted to this region during the present survey. However, earlier reports (Balasubramanian 2004) and sight records of flocks (up to 32, H. N. Kumara & Sushma Rao, *in litt.*) indicate its potential.

Neyyar–Peppara–Kalakad–Mundanthurai Tiger Reserve: A large, contiguous tract of over 400 km² of tropical wet evergreen forest across the two wildlife sanctuaries in Kerala and the Kalakad-Mundanthurai Tiger Reserve make this an important conservation area. Malabar Grey, and Great hornbills are widespread in the evergreen forests, and Balasubramanian (2004) has recorded Malabar Pied Hornbill at Neyyar Wildlife Sanctuary and Tenmala reserved forests. We did not survey these areas.

Periyar: The tract of 777 km² under the Periyar Tiger Reserve has extensive wet evergreen, moist deciduous, and riverine habitats. While only Malabar Grey, and Great hornbills were

Table 2. Density estimation of hornbills in Anamalai-Parambikulam region using distance sampling: models and estimated detection parameters

Detail	Malabar Grey Hornbill			Great Hornbill		
	Wildlife Sanctuaries	Reserved Forests	Rainforest Fragments	Wildlife Sanctuaries	Reserved Forests	Rainforest Fragments
Number of transects	16*	8	4	16*	8	4
Number of repeats	5*	1	5	5*	1	5
Total line length, km	125.68	12.78	33.18	125.68	12.78	33.18
Number of clusters†	346	40	76	57	2	10
Model	Hazard-rate	Half-normal	Hazard-rate	----------Half-normal----------		
Adjustment	Cosine	Polynomial	Cosine	----------Cosine----------		
Detection probability (SE)	0.51 (0.02)	0.25 (0.03)	0.47 (0.03)	----------0.80 (0.14) ----------		
Effective strip width, m (SE)	77.0 (3.0)	37.1 (4.5)	70.3 (5.3)	----------80.2 (13.8) ----------		
Encounter rate, detections/km	2.75	3.13	2.29	0.28	0.16	0.24
Encounter rate %CV	5.38	15.81	11.47	16.9	70.7	35.4
Density of clusters, number/km²	17.9	42.2	16.3	1.74	0.98	1.50
%CV of cluster density	6.67	19.90	13.70	24.10	72.77	39.31
95% CI of cluster density	15.7 – 20.4	28.3 – 62.87	12.4 – 21.4	1.08 – 2.80	0.26 – 3.63	0.70 – 3.23

* One transect in Parambikulam Wildlife Sanctuary was surveyed only once.
† 'Clusters' in distance sampling terminology are detections, i.e. one or more birds detected together.

recorded here during the present survey, the Malabar Pied Hornbill has been recorded here in other surveys (Periyar Foundation, http://www.periyarfoundation.org/pdf/birds.pdf, accessed 16 April 2009).

Crucial reserved forests: Some key reserved forest (RF) areas in the southern region, especially those adjoining protected areas, appear important for hornbill conservation:

Kottiyoor RF (adjoining Aralam/Brahmagiri Wildlife Sanctuary).

New Amarambalam RF (adjoining Silent Valley National Park).

Vazhachal and Nelliampathy RFs (adjoining Anamalai–Parambikulam).

Goodarickal RF (adjoining Periyar Tiger Reserve).

Kulathupuzha-Palode RFs (adjoining Peppara–Kalakad–Mundanthurai Tiger Reserve).

Population density estimation in two important hornbill conservation landscapes

Dandeli—Goa

All four hornbill species occurred in the Dandeli–Goa landscape. While the Indian Grey Hornbill was only seen near Dandeli town, the other three species were seen in both Goa and Karnataka. The wider survey also revealed the importance of this landscape for the Malabar Pied Hornbill. Two-thirds of the 131 Malabar Pied Hornbills recorded during the entire survey were seen across the Dandeli– Goa landscape in Karnataka, Goa, and adjoining areas of Maharashtra (Amboli). Dandeli was particularly important as large numbers (*c.* 80 birds) were seen using the forests in the area, and roosting in large flocks of up to 30 individuals along the Kali River in Dandeli, and Ganeshgudi. Transect data also revealed that the highest encounter rates of this species were in Mollem National Park and Wildlife Sanctuary (range = 0.13/km to 1.61/km across six transects), with high encounter rates in Madei Widlife Sanctuary, Goa (0/km to 0.84/km across three transects), and Dandeli Wildlife Sanctuary, Karnataka (0/km to 0.6/km across three transects).

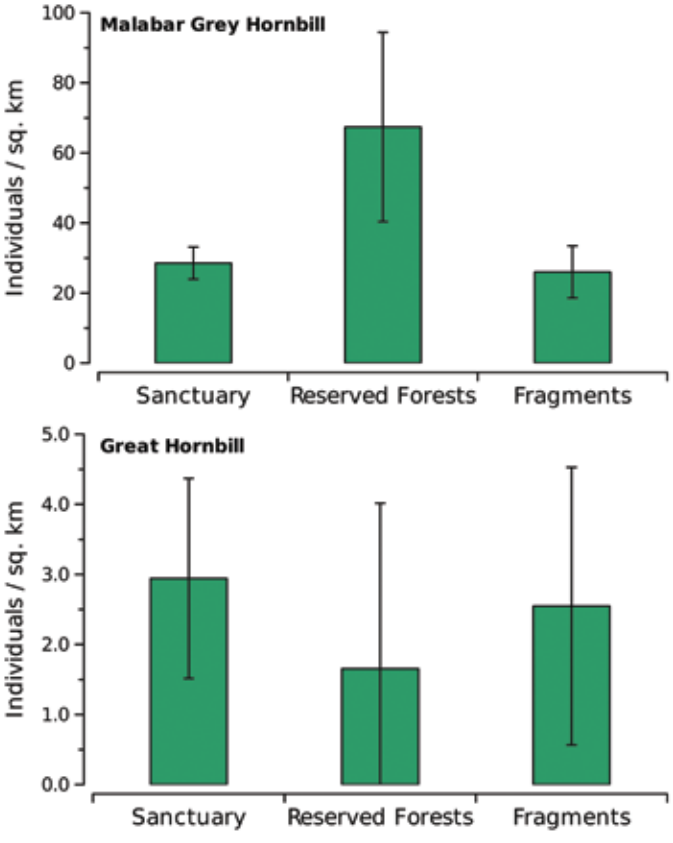


Fig. 5. Hornbill densities in Wildlife Sanctuaries (Indira Gandhi and Parambikulam), Reserved Forests, and rainforest fragments in the Anamalai Hills and Valparai plateau. Vertical bars are 95% confidence intervals.

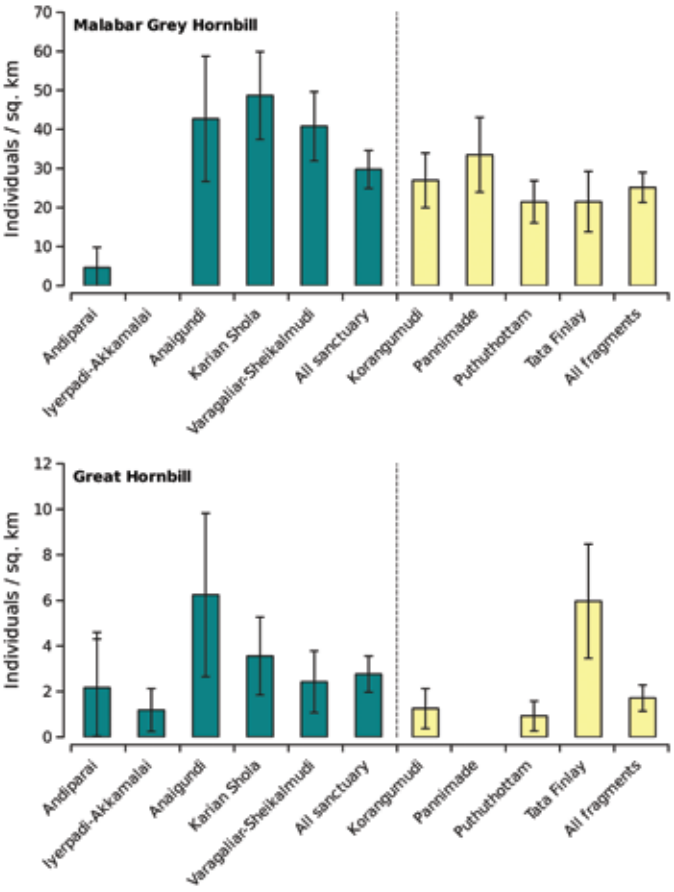


Fig. 6. Hornbill densities across sites within the Indira Gandhi Wildlife Sanctuary and rainforest fragments in the Valparai plateau. Vertical bars represent 95% confidence intervals.

We were able to obtain initial density estimates of Malabar Grey and Malabar Pied Hornbills from the transect data in this region (Fig. 4). We obtained 56 detections of Malabar Grey Hornbills and estimated a density of 9.4 individuals per km² (95% confidence interval: 6.1–14.4 individuals/km²). We obtained 11 detections of Malabar Pied Hornbills and estimated a density of 1.3 individuals per km² (95% CI: 0.5–3.0 individuals/km²). It would be worthwhile establishing a system of transects for monitoring.

A large number of Malabar Pied Hornbills were also seen outside the existing protected areas in reserved forests and some disturbed areas around Dandeli. There appear to be a number of roost sites along the Kali River in Dandeli and Ganeshgudi (and possibly in other areas). During three evenings at different roosts, we counted 30 individuals at one roost site (Kali main bridge, 14 October 2005), 21 at another (Kali old bridge, 17 October 2005), and 24 in Ganeshgudi. More recently, an intensive study on the Malabar Pied Hornbill has been completed from this area (Vijayakumar 2007).

Anamalai—Parambikulam

In the Anamalai–Parambikulam region, hornbill densities were estimated from line transects distributed across three broad strata:

a. Wildlife sanctuaries: Anamalai and Parambikulam Tiger Reserves.
b. Reserved forests: Vazhachal–Sholayar and Malayattur.
c. Rainforest fragments: four forest fragments on private lands in the Valparai plateau.

The 171.64 km of transect survey yielded 462 detections of Malabar Grey Hornbill and 69 detections of the Great Hornbill overall. Detection functions were estimated strata-wise for the Malabar Grey Hornbill; however, due to fewer detections of Great Hornbill, we used a global detection function across strata for estimation of this species. Details of sampling and parameters are provided in Table 2.

The estimated mean density of Malabar Grey Hornbills in reserved forests was 67.4 individuals/km² (Vazhachal–Sholayar, and Malayattur) with a 95% confidence interval (CI) of 40.4–94.4 individuals/km². This appeared to be significantly higher than 95% CI of densities in the wildlife sanctuaries (23.9–33.1 individuals/km²) or rainforest fragments (18.6–33.4 individuals/km²)—the latter two strata thus appearing not to differ significantly from each other (Fig. 5). This was partly because the transect sites within the sanctuaries included some higher altitude areas where hornbills were scarce or absent (see below). Great Hornbills did not show substantial variation across the three strata (Fig. 5) with broad overlap in the 95% CI among sanctuary (1.5–4.4 individuals/ km²), reserved forest (0–4.0 individuals/km²), and fragments (0.6–4.5 individuals/ km²).

A closer look at density estimates from the more intensively-sampled sites within the Anamalai Tiger Reserve and rainforest fragments on the Valparai Plateau indicated patterns of variation within strata (Fig. 6). Within the sanctuary, the mean density of Malabar Grey Hornbill was higher in three sites at middle elevations (700–1,000 m): Anaigundi Shola (42.7 individuals/km²), Karian Shola (48.7 individuals/km²), and Varagaliar–Manamboli–Sheikalmudi complex (40.8 individuals/km²). Malabar Grey Hornbills were scarce or absent (<3 individuals/km²) at the two other sites at higher elevations (>1,300 m, Fig. 6). The Malabar Grey Hornbill densities were broadly similar across the Valparai Plateau fragments (21.5–33.5 individuals/km²). Although the average densities in fragment sites tended to be lower than in the mid-elevation sites within the sanctuary, the 95% CI showed overlap in most cases (Fig. 6). The pattern of Great Hornbill density across sites was similar to that of Malabar Grey Hornbill; the low density and large 95% CI in fragments was possibly due to lower or partial use of fragments by these birds during their wide-ranging movements.

Photo: *Kalyan Varma*

Malabar Grey Hornbill female feeding on *Vitex altissima.*

An important location for Great Hornbills is a roost site in the Valparai Plateau, adjoining forests of the Manamboli range of Anamalai Tiger Reserve, in the Anali estate (Tata Coffee Ltd) and Senthil estate (private ownership). While Anali estate is predominantly under shade-coffee and *Eucalyptus* fuel plantations, Senthil estate has seen recent conversion from rubber and coffee to tea plantations, the latter characterised by little shade. Up to 60 Great Hornbills have been observed to use this roost site every year during the non-breeding season. As the site partly overlaps private tea and coffee estates, it requires the involvement of these private landowners in the protection of roosting trees, reduction of disturbances, and conservation of this important roost site.

Shortcomings of survey

The survey period had to be extended due to various difficulties of logistics including delayed permits, travel, and unpredictable weather patterns. A few of the sites could not be surveyed due to these constraints and as we ran short of time and funds. The survey was too rapid to give a suitable understanding of the current trends in distribution within each of the sites or of seasonal variation and patterns within sites. Among states, Tamil Nadu was poorly covered and requires more field survey in the future. Although some local knowledge is available, of the distribution of many species, the lack of published information and the preponderance of grey literature made it difficult, in many cases, to reliably collate past distribution information as we had expected to do. We were able to establish population baselines only in two regions and for three hornbill species. The survey sites did not adequately represent the distribution of the Indian Grey Hornbill, which is more of a species of the drier zone and eastern aspect of the Ghats.

Key findings and recommendations for future efforts

The results of the occurrence and distribution patterns of the four hornbill species in this survey are broadly concordant with earlier reports (Ali & Ripley 1983) and a more recent survey (Balasubramaniam *et al*. 2004, 2007). However, there has been little systematic effort at estimating abundance or population densities of hornbills in earlier work, and the present survey presents a baseline, across localities, of encounter rates as well as density estimates from select areas of importance.

The importance of moist forests for the Malabar Grey Hornbill and the larger hornbills also stands out. In addition, the Malabar Pied Hornbill appears to prefer lower elevation riverine areas, including many sites outside designated PAs—habitats prone to a range of threats such as encroachments, agriculture, monoculture timber plantations, hydro-electric and irrigation projects, tourism and urban development (e.g., Vazhachal–Athirapilly population along the Chalakudy River threatened by the proposed Athirapilly dam). It is also noted to be an apparently irruptive or dispersive migrant over a wide landscape in Goa (Lainer 2004). Although distributed more widely across localities in central India into Orissa, and in Sri Lanka, the Malabar Pied Hornbill appears to be currently patchily distributed along the Western Ghats with reports indicating declining populations particularly in the southern Western Ghats and Kerala (Sugathan & Varghese 1996; Sashikumar *et al.* 2005; Nameer & Praveen 2006; Praveen & Nameer 2009).

Looking ahead, it is essential to establish baselines through population estimation, discovery and monitoring of nest and roost sites, especially in the sites and landscapes identified as critical for hornbill conservation by this survey. In some of the sites, sizable hornbill populations also occur in reserved forests outside designated protected areas. These require particular attention as these are also subject to greater pressures of hunting and resource extractions. The larger hornbills, particularly the Great Hornbill, are known to be nomadic during the non-breeding season. During these forays, they seem to track fruiting trees in habitats that they do not usually reside in and therefore can be seen in dry deciduous tracts adjoining evergreen forests. Therefore, it becomes necessary for the protection and conservation of areas much larger than their "preferred" or even nesting habitats.

Currently 10% of the land area of the Western Ghats receives some level of protection within 43 wildlife sanctuaries and 13 national parks (Rodgers *et al.* 2002; Kumar *et al.* 2004). Substantial areas of forest and natural vegetation also lie outside existing protected areas as reserved forests, protected forests, private forests, grasslands, and wetlands. Considering just the tropical wet evergreen forests of the Western Ghats, a recent assessment reports that only one-fourth of the total area (15,057 km²) of this forest type is relatively un-fragmented, with 74% lying outside protected areas (CEPF 2007). Information of the distribution and occurrence of species obtained over these landscapes can be used to design appropriate conservation strategies. In the landscape adjoining forest areas in the Western Ghats, large tracts of plantations are distributed (over 4,500 km² of tea and coffee plantations alone), which are also often important habitats for wildlife, or areas through which many wildlife species move (Raman & Mudappa 2003; Kumar *et al.* 2004; Raman 2006; Bali *et al.* 2007). In recent times, there has been increasing interest worldwide in the conservation value of countryside landscapes within and around existing conservation reserves. There is a need to promote hornbill conservation and the use of native shade trees among plantation owners, possibly linking with conservation incentive/certification schemes.

Line transects appear to be a useful and easily applicable method for monitoring hornbill populations (Raman & Mudappa 2003; Gale & Thongaree 2006). Besides monitoring by biologists—trained amateurs, volunteers, and forest department staff need to be involved in hornbill monitoring as successfully demonstrated in Kerala (Praveen & Nameer 2009). There is a need to develop a management and action plan for monitoring, protection, and conservation of critical hornbill populations. This has to be developed by a committee consisting of local forest department, NGOs, local people, and a field/conservation biologist acting as a facilitator. At a number of locations we found low awareness of hornbill species occurrence or abundance, even among forest staff in protected areas. Conservation education and awareness thus need to go hand-in-hand with all protection and conservation efforts.

Acknowledgements

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Photo: *Kalyan Varma*

Malabar Grey Hornbill male.

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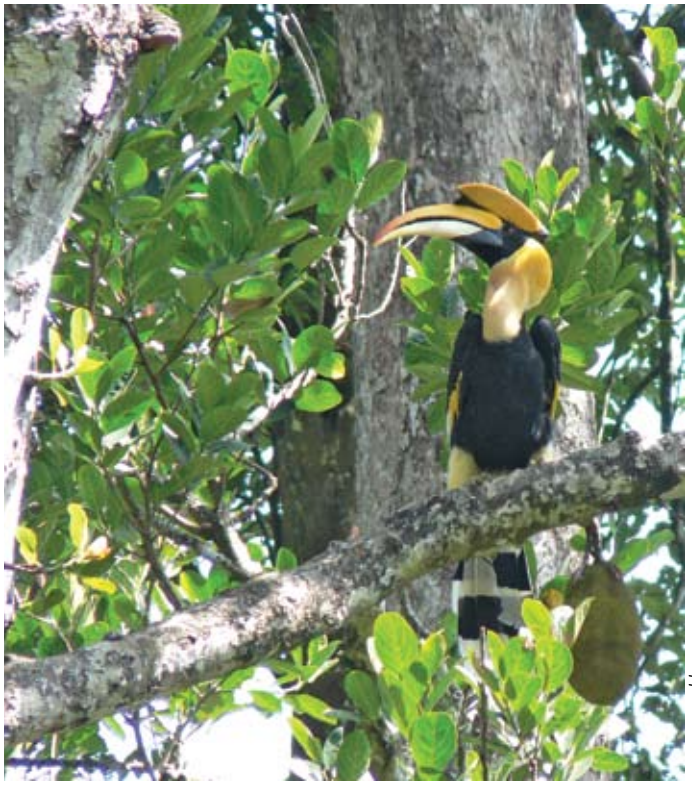

Photo: *Mudappa & Raman*

Great Hornbill male.

APPENDIX

Details and locations of transects surveyed at various sites along the Western Ghats (GA—Goa, MH—Maharashtra, KE—Kerala, KA—Karnataka, TN—Tamil Nadu).

State	Place	Date	Habitat*	Place	Tno	Start (N°)	(E°)	End (N°)	(E°)	Length (km)
GA	Bondla	08.02.2005	XDF	Through forest trail to orchard	1	15.43483	74.10067	15.43420	74.10527	1.83
GA	Bondla	08.02.2005	XDF	Behind canteen into forest	2	15.43662	74.10431	15.44337	74.11265	1.74
GA	Bondla	09.02.2005	XDF	Uphill	3	15.43624	74.10033	15.42782	74.10391	2.18
GA	Mollem	10.02.2005	MDF	Near RO into MDF	4	15.37582	74.23635	15.38110	74.24231	1.96
GA	Mollem	11.02.2005	MDF	Khas-Kond towards Old Surla trail	5	15.41047	74.21070	15.41055	74.21783	3.54
GA	Mollem	11.02.2005	SEF	Khas-Kond towards Tambdi Surla	6	15.42057	74.21080	15.43918	74.25275	7.72
GA	Mollem	12.02.2005	SEF	Mudco Bungalow to Tambdi Surla	7	15.41840	74.26756	15.41497	74.20872	1.86
GA	Mollem	12.02.2005	MDF	Mudco Bungalow to Tambdi Surla	8	15.41497	74.20872	15.43918	74.25275	1.10
GA	Mollem	13.02.2005	MDF	Dudhsagar road	9	15.34129	74.25221	15.33665	74.25941	1.89
GA	Madei	14.02.2005	MDF	Nanorem–Vainguinim–border	10	15.58281	74.21738			0.85
GA	Madei	14.02.2005	SEF	Nanorem–Vainguinim–border	11			15.57673	74.25016	3.27
GA	Madei	15.02.2005	MDF	Satorem to Derodem	12	15.61436	74.21510	15.61334	74.22242	1.19
GA	Cotigao	18.02.2005	SEF	Cusquem (Kuske) transect	13	15.01788	74.21239	15.02626	74.21632	2.12
GA	Cotigao	18.02.2005	SEF	Nadquem Keri route	14	14.98322	74.22384			1.88
GA	Netravali	19.02.2005	WEF	Salginim kuccha road	15	15.01988	74.24185	15.01466	74.24582	1.12
GA	Cotigao	20.02.2005	MDF+SEF	Endrem to Zambolem	16	14.95530	74.19593	14.94598	74.19808	1.55
MH	Tansa	02.04.2005	DDF	Savardo nala	1	19.53873	73.28320	19.53332	73.27786	1.41
MH	Kalsubai	04.04.2005	SEF	Kothale, on Tolar Khind	2	19.40751	73.81431	19.40333	73.81123	1.04
MH	Bhima	05.04.2005	HEF	Bakadevi to Veer waterhole	3	19.07792	73.53838	19.08165	73.54791	1.76
MH	Bhima	06.04.2005	HEF	Kotlun-Gupt Bhima-Bhima temple	4	19.05831	73.54447	19.06159	73.54154	2.55
MH	Borivili	07.04.2005	DDF	Bhoot bungalow road	5	19.18600	72.92090	19.19669	72.92160	2.04
MH	Tungar	08.04.2005	XDF	Tungareshwar Ashram road	6	19.41933	72.91130	19.42068	72.91670	1.68
MH	Matheran	13.04.2005	HEF	To Panorama viewpoint	7	19.00418	73.28510	19.01869	73.27960	2.20
MH	Phansad	14.04.2005	DTF	Chikalgan waterhole trail	8	18.44830	72.92979	18.45466	72.92541	3.01
MH	Mahabaleswar	15.04.2005	HEF	Gotinera to Jannimatha	9	17.90398	73.67551	17.90795	73.67084	1.56
MH	Koyna	18.04.2005	DTDE	Tambi to Maruti mandir	10	17.67228	73.74529	17.67181	73.73714	3.84
MH	Koyna	19.04.2005	WEF	Kusawade	11	17.64550	73.74269	17.65121	73.73046	2.01
MH	Koyna	20.04.2005	DTDE	Rohine camp	12	17.53232	73.77124	17.53353	73.76459	1.41
MH	Koyna	21.04.2005	WEF	Kurunjawade	13	17.54084	73.75740	17.53972	73.74837	1.39
MH	Radhanagari	23.04.2005	DTDE	Idarganj ridge top trail	14	16.36899	73.99578	16.35026	73.97145	2.95
MH	Radhanagari	24.04.2005	WEF	Dajipur Savrai Sada to Patacha Dang	15	16.47481	73.88975	16.48219	73.88245	21.68
KE	Vazhachal	09.02.2006	WEF	Mud road to Adichalthotti + Vazhachal rd	1	10.29142	76.81499	10.28371	76.80479	3.49
KE	Vazhachal	10.02.2006	WEF	Ambalapara towards Meenchalali	2	10.32521	76.73257	10.33386	76.72245	1.95
KE	Vazhachal	11.02.2006	WEF	Poringalkuthu to Orukomban	3	10.32418	76.64621	10.33194	76.63884	1.16
KE	Vazhachal	15.02.2006	WEF	Sheikalmudi–Mudiyankundru trail	4	10.33357	76.83002	10.33765	76.82821	1.07
KE	Vazhachal	16.02.2006	WEF	Melmadu to Ambalapara	5	10.34127	76.76520	10.33287	76.76474	1.29
KE	Nelliampathy	21.02.2006	WEF	Towards Anaimada through Minampara Estate	6	10.54201	76.70195	10.53720	76.70927	1.21
KE	Nelliampathy	22.02.2006	WEF	Mud road–Nemmara KFRI cane stand 1991	7	10.54374	76.67671	10.54766	76.68159	1.14
KE	Peechi	23.02.2006	DDF	Peechi behind pavilion	8	10.53538	76.37744	10.53048	76.37177	1.04
KE	Chimmony	25.02.2006	LEF	Thottapara trail	9	10.42553	76.46398	10.42474	76.47103	1.34
KE	Periyar	26.03.2006	MDF	Mullakudi road	10	9.58243	77.22203	9.57366	77.22580	1.47
KE	Periyar	28.03.2006	MDF	Anjuruli road	11	9.58524	77.16228	9.57760	77.16402	1.21

APPENDIX

Details and locations of transects surveyed at various sites along the Western Ghats (GA—Goa, MH—Maharashtra, KE—Kerala, KA—Karnataka, TN—Tamil Nadu).

State	Place	Date	Habitat*	Place	Tno	Start (N°)	(E°)	End (N°)	(E°)	Length (km)
KE	Parambikulam	31.03.2006	LEF	Orukomban-Mudhuvarchal Road	12	10.38340	76.62411	10.39175	76.61870	1.21
KE	Goodrickal	04.04.2006	WEF	Chendamarakokka	13	9.45408	77.13031	9.45323	77.13374	1.22
KE	Silent valley	21.05.2006	WEF	Sairandhri	14	11.08443	76.46723	11.08509	76.45470	1.94
KE	Wayanad	23.05.2006	DDF	Ambukuthi vayal to Ayamangalam patch	15	11.66158	76.38345	11.65527	76.39286	1.41
KE	Aralam	24.05.2006	LEF	Uruppukunnu watchtower towards Parriputhode	16	11.95304	75.82525	11.96095	75.81708	1.34
KE	Malayattur	26.05.2006	LEF	Thalumkundam road tow Ernakulamkudi	17	10.21748	76.69526	10.22378	76.68397	1.47
KA	Anshi	12.10.2005	WEF	Trek route 1 near ANC	1	15.00978	74.38722	15.01992	74.38924	1.41
KA	Anshi	13.10.2005	WEF	Kadra viewpoint road	2	14.95057	74.37236	14.94625	74.38763	2.75
KA	Dandeli	15.10.2005	MDF	Shiroli-Mandurli road core area	3	15.11701	74.58702	15.13173	74.57415	3.32
KA	Dandeli	16.10.2005	MDF	Gund-Vagali trail	4	15.07548	74.52791	15.08078	74.53759	1.68
KA	Dandeli	17.10.2005	WEF+ MDF	Kanchikallgudda viewpoint	5	15.04442	74.57093	15.02829	74.58039	2.96
KA	Talacauvery	06.05.2006	WEF	Talacauvery–Munrod tract	6	12.36608	75.48985	12.35531	75.48366	1.61
KA	Subrahmanya	07.05.2006	MDF	On Bisle Ghat Road	7	12.69387	75.61631	12.69395	75.62751	2.10
KA	Kudremukh	09.05.2006	WEF	From Bhadra river Kurinjal trail	8	13.19841	75.19506	13.20068	75.18714	1.34
KA	Someshwara	10.05.2006	MDF	From Sitanadi Nature Camp, Ikkodlu trail	9	13.48405	75.00561	13.46975	74.99970	1.59
KA	Mookambika	11.05.2006	MDF	Kothalamukki game road	10	13.83462	74.81025	13.83612	74.81436	1.41
KA	Sharavati	12.05.2006	WEF	Aedigudda-Nagavalli	11	14.06653	74.67269	14.07806	74.66906	1.47
KA	Shettihalli	13.05.2006	MDF	Anigeri trail	12	13.86593	75.42367	13.86396	75.41346	1.34
KA	Bhadra	14.05.2006	MDF	Kesave-Madla road	13	13.49044	75.61447	13.50683	75.61393	1.44
TN	Anamalai	02.09.2005	WEF	Sheikalmudi-Palaganar-Manamboli	1	10.32703	76.84983	10.33714	76.85175	1.28
TN	Anamalai	03.09.2005	WEF	Koomatti-Manamboli	2	10.40161	76.87666			1.66
TN	Anamalai	04.09.2005	WEF	Kumati-Varagaliar trek shed	3	10.40235	76.87916	10.40175	76.88884	1.42
TN	Anamalai	04.10.2005	WEF	Manamboli elephant transect	4	10.34827	76.89783			2.58
TN	Anamalai	2005–2006	WEF	Korangumudi	5	10.31412	76.91214	10.30872	76.90361	1.83
TN	Anamalai	2005–2006	WEF	Pannimade+	6	10.29677	76.89227			1.20
TN	Anamalai	2005–2006	WEF	Puthuthottam	7	10.33383	76.96735	10.33511	76.96461	2.45
TN	Anamalai	2005–2006	WEF	Tata Finlay	8	10.34755	76.93382	10.34705	76.93352	1.15
TN	Anamalai	2005–2006	WEF	Anaigundi	9	10.42175	76.83122			2.17
TN	Anamalai	2005–2006	WEF	Andiparai	10	10.39060	76.99438	10.40000	76.99117	2.08
TN	Anamalai	2005–2006	WEF	Karian Shola 1	11	10.47045	76.84110	10.49023	76.83065	2.85
TN	Anamalai	2005–2006	WEF	Karian Shola 2	12	10.46388	76.83660			2.85
TN	Anamalai	2005–2006	WEF	Iyerpadi	13	10.37308	76.99138	10.36070	76.99738	2.08
TN	Anamalai	2005–2006	WEF	Akkamalai	14	10.32815	77.02172	10.34570	77.02008	1.94
TN	Anamalai	2005–2006	WEF	Iyerpadi Church	15	10.36935	76.97515	10.37232	76.98078	1.70
TN	Anamalai	2005–2006	WEF	Varagaliar	16	10.42007	76.86811	10.71155	76.88231	2.11
TN	Anamalai	2005–2006	WEF	Banathiar	17	10.40335	76.87857	10.41370	76.88023	2.05
TN	Anamalai	2005–2006	WEF	Manamboli	18	10.34827	76.89783			1.80
TN	Anamalai	2005–2006	WEF	Sheikalmudi	19	10.32707	76.84982	10.33793	76.85755	1.87

* DDF—Dry deciduous forest, DTF—Dry thorn forest, DTDE—Dry thorn and degraded deciduous dry evergreen forest, XDF—Mixed deciduous forest, MDF—Moist deciduous forest, SEF—Semi-evergreen forest, LEF—low elevation wet evergreen forest, HEF—Sahyadri or northern wet evergreen forest, WEF—Wet evergreen forest. +—Location approximate.

Conservation of birds of the Andaman & Nicobar Islands

Lalitha Vijayan

Vijayan, L. 2009. Conservation of birds of the Andaman & Nicobar Islands. *Indian Birds* 5 (4): 103–107.
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Abstract

The Andaman and Nicobar Islands have a rich variety of flora and fauna with many rare and endemic species. Realising the importance of the need for conservation of the biodiversity of this fragile island ecosystem, the Salim Ali Centre for Ornithology and Natural History undertook several studies with a focus on birds and their habitats. An overview of these studies, a summary of the results, and conservation perspectives are presented here. A total of 288 avian spp., including subspecies, are recorded from these islands. Five species were studied in detail, namely Nicobar Megapode *Megapodius nicobariensis*, Narcondam Hornbill *Aceros narcondami*, Andaman Teal *Anas albogularis*, Andaman Crake *Rallina canningi*, and Edible-nest Swiftlet *Collocalia fuciphaga*, and species-specific measures for the conservation of these birds, and their habitats, were recommended.

Introduction

Andaman and Nicobar Islands, one of the major island archipelagos of India, are well known for their rich biodiversity (Saldanha 1989; Vijayan *et al.* 2000; Jayaraj & Andrews 2005). However, island communities are a most vulnerable biota, and island ecosystems are not only very fragile, but also harbour a higher proportion of endemics with greater chances of extinction (Castellata *et al.* 2000)—because of rarity, inbreeding, natural calamities, introduced species, and so on (Brooks *et al.* 1997). Forest birds, especially those on islands, are more threatened (Stattersfield *et al.* 1998; BirdLife International 2001). Saldanha (1988) has reviewed the studies conducted in the Andaman and Nicobar Islands. The Zoological Survey of India and the Bombay Natural History society have been conducting faunal surveys on these islands. However, detailed ecological studies were few and hence the Salim Ali Centre for Ornithology and Natural History (SACON) undertook several studies with a focus on the conservation of birds and their habitats. Ravi Sankaran and I initiated these studies. An overview of the studies on the birds of these islands, especially by SACON and the conservation issues are presented here.

Study area and methods

The Andaman and Nicobar Islands (6°45′N—13°41′N 92°12′E—93°57′E), in the Bay of Bengal, are spread over 8,249 km^2, comprising the Andaman Islands (6,408 km^2), and Nicobar Islands (1841 km^2). Jayaraj & Andrews (2005), and Andrews *et al.* (2006) have presented the latest details regarding biodiversity, and the state of the environment, respectively, of these islands.

SACON started preliminary surveys of the birds of these islands in 1992, as a priority area for research and conservation. Status surveys were conducted, following strip transects and stratified sample counts, for the birds in general and especially for a few target species namely, Nicobar Megapode *Megapodius nicobariensis*, Andaman Teal *Anas (gibberifrons) albogularis*, Narcondam Hornbill *Aceros narcondami*, Edible-nest Swiftlet *Collocalia fuciphaga*, and Andaman Crake *Rallina canningi*. Status and distribution of some of the species, especially the endemics, and also ecology of the target species were studied following standard methods (Pettingill 1985; Bibby *et al.* 1992). Studies of target species covered different seasons, except for the Narcondam Hornbill. Habitat characterisation of the Andaman Islands, and identification of high bird diversity areas were done by bird counts and using remote sensing and GIS techniques following Roy *et al.* (1986), Prasad *et al.* (1998), and IIRS (2003). The consequences of the tsunami of December 2004 on the Nicobar Megapodes was assessed in 2005, and a study is under way on the restoration of the affected areas. The impact of nest collection of Edible-nest Swiftlets was studied by monitoring the nesting colonies in caves and was followed up by developing a programme for in-situ and ex-situ conservation of this species (Sankaran1998a; Anon. 2008), which is being continued in collaboration with the Forest Department of Andaman and Nicobar Islands.

Results & Discussion

Initially, a review of the status and distribution of avian taxa was prepared by Sankaran & Vijayan (1993), which listed a total of about 274 including 106 endemics. However, all did not accept status of a few taxa. During our surveys from 1992 to 1998, only a few species were observed due to the following reasons: 1) more emphasis was given to resident and endemic species, and 2) many sub-species could not be differentiated without catching them and taking various morphometric measurements During these surveys we found that seven endemic taxa were very common in Andamans—Green Imperial Pigeon *Ducula aenea andamanica*, Red-breasted Parakeet *Psittacula alexandri abbotti*, Black-naped Oriole *Oriolus chinensis andamanensis*, Racket-tailed Drongo *Dicrurus paradiseus otiosus*, Asian Fairy-Bluebird *Irena puella andamanica*, Asian Glossy Starling *Aplonis panayensis tytleri*, and Red-whiskered Bulbul *Pycnonotus jocosus whistleri*, of which the last two occur also on Nicobar (Vijayan 1999). The Andaman Dark Serpent Eagle *Spilornis elgini*, a near-threatened species, but also cited as one of the rare birds of the world (Mountfort 1988), was rather common during this survey. Ten species were added

(Vijayan *et al.* 2000) to the existing list for these islands (Sankaran & Vijayan 1993) and during 2003–2004 we added three more (Vijayan *et al.* 2005; Mamannan & Vijayan 2009), while Yahya & Zarri (2002a) added another, taking the list to 288. Studies in the Nicobar Islands have revealed the status of several endemic birds and suggestions for developing a protected area network have been proposed (Sankaran 1995, 1997, 1998b). Many endemics were rare and we could not gather enough data to determine their status. Three species on the islands were found assessed to be of immediate conservation concern and were chosen for detailed studies—Nicobar Megapode, Narcondam Hornbill, and Andaman Teal (Vijayan 1993).

The avifauna of the Andaman Islands shows greater affinity to that of south-east Asia and mainland India, than with that of Nicobar Islands (Vijayan *et al.* 2005). Endemic species preferred moist forests and Andaman Cuckoo-Dove *Macropygia rufipennis*, Andaman Hawk-Owl *Ninox a. affinis* and Andaman Crake were rare; the last species being recorded for the first time from North and Little Andaman (Vijayan *et al.* 2005). SACON's landscape ecology study has generated biological richness maps, with areas of different grades, for each major island group; Little Andaman showed a third of its area as having very high priority, followed by South Andaman (Vijayan *et al.* 2005).

Nicobar Megapode

The Nicobar Megapode has two sub-species: *M. n. nicobariensis* inhabits the Nancowry group of islands north of Sombrero Channel, mainly Nancowry, Teressa and Bomboka, and *M .n. abbotti*, the Great Nicobar group of islands, mainly Great Nicobar**.** **The** population of the former was estimated at 1,200–2,100 and of the latter between 3400 and 6000 (Sankaran 1995). Sankaran & Sivakumar (1999), Sivakumar (2000), and Vijayan *et al.* (2000) studied its ecology. This species is a primitive mound-nester of the littoral forest (Ali & Ripley 1987), mainly restricting itself to within 100 m of the beach. The populations showed declines in many islands where the coastal forests were destroyed or disturbed and the species is threatened (vulnerable) under IUCN criteria (BirdLife International 2001, 2008). The present status, after tsunami, reveals a decline of about 70%, as the littoral forest has been heavily destroyed (Sankaran 2005; Sivakumar 2007).

Narcondam Hornbill

This species has a highly restricted range (6.82 km^2) on Narcondam Island in North Andaman. Its population was estimated at 330–360 in 1998 (Sankaran 1998c), showing a decline from the 1972 record of 400 (Hussain 1984). It is threatened (vulnerable) under IUCN category (BirdLife International 2008). Sankaran (1998c), and Vijayan *et al.* (2000) documented its altitudinal distribution, nests, and population structure . Breeding birds were over four years old and constituted around 46–53% of the population. A majority (88%) of the nests was below 200 m altitude while the younger non-breeding birds occupied elevations >300 m. The nests were located in holes on the trunk or broken branches of large trees. Birds fed on a wide variety of fruits and invertebrates and occasionally small reptiles.

Another short-term study was carried out between January and March 2003 on roosting and nesting by Vivek & Vijayan (2003). Their population estimate was 320–340 birds, which was similar to that of the earlier study but differed from the 432 of Yahya & Zarri (2002b), . These birds used mature undisturbed forests with large trees for nesting and roosting. Additional information was obtained on roosting and pre-nesting activities.

Photo: *Pankaj Sekhsaria*

A megapode on the banks of the Galathea River at South Bay, Great Nicobar Island (2002).

Adult birds roosted in pairs on large trees at elevations of <255 m, and juveniles, in small flocks of three to seven, on a branch of a tree located at higher elevations.

Andaman Teal

The Andaman Teal is restricted to the Andaman Islands and it has long been considered globally endangered at the sub-species level (Green 1992). Green (1992) designated the Andaman Teal as 'vulnerable' or 'doubtfully vulnerable', and Vijayan (1996), Green (1996), and Anon. (2001) categorized it 'endangered', at sub-species level. This taxon has been raised to full species status as *Anas albogularis* by Rasmussen & Anderton (2005). However, BirdLife International (2001, 2008) has not recognised this, and continues to list it as sub-species. This species is the only threatened endemic duck in India, with the exception of the Pink-headed Duck *Rhodonessa caryophyllacea*, which is believed to be extinct. The Andaman Teal inhabits freshwater streams, ponds, swamps and brackish water swamps, tidal creeks and estuaries (Ali & Ripley 1987). A detailed study on this species during 1995–1998 estimated its population at 500–600 (Vijayan *et al.* 2000), and later studies, during 2003–2004 also found these estimates valid (Vijayan *et al.* 2006). However, fluctuation in numbers was very high because of local movements, and the counts were not simultaneous, hence it was difficult to get a realistic population estimate. Ecology of this species showed differential use of habitats at different times. Nesting pools were 20–50 cm deep, mainly brackish, and located in coastal areas, 50–100 m from the hightide line. The nest was a platform of grass or reed mat, 20–35 cm above water, among the reeds, and 20–50 cm from open water (Vijayan *et al.* 2000, 2006; Vijayan 2006).

Edible-nest Swiftlet

The Edible-nest Swiftlet, a cave dwelling species, ranges from the Andaman and Nicobar Islands through Indonesia to the Philippines—the endemic race on the islands being *C. f. inexpectata*. Its population showed declines due to indiscriminate and unrestricted nest collections as the nests are made of its saliva, and the main ingredient of 'bird-nest soup' (Sankaran1998a; Sankaran 2001). Subsequently, a programme was developed in 2002 for in-situ and ex-situ conservation, the latter using the White-bellied Swiftlet *C. esculenta* as a foster parent. It has been progressing well; the chicks of the Edible-nest Swiftlet foster-reared by the White-bellied Swiftlet have come back for nesting; artificial houses are also found to be used by them for nesting, showing the suitability of this programme for farming this species for its sustainable use and conservation (Sankaran & Manchi 2008; Anon. 2008). They also found that in-situ conservation has paid dividends, as protection provided to the caves has helped in substantially increasing the population of the Edible-nest Swiftlet at the selected sites.

Andaman Crake

The Andaman Crake is rare and endemic to the Andaman Islands. So little is known about its ecology and biology that BirdLife International (2001) listed it as 'data deficient'. Hence, a detailed study was carried out during 2004–2007 with status surveys on various islands and ecological studies at two locations, but mainly at Pathilevel, North Andaman (Vijayan & Ezhilarasi 2007; Ezhilarasi 2009). Its population could not be estimated as we had problems in sighting the bird and assessing the distance of calls. The mean encounter rate of this bird was low, 0.29 bird/ point. Smaller islands had lower abundance, but it was higher on larger islands, especially in South, Middle and North Andaman. The study shows that the bird is a habitat specialist of moist forests with clumped distribution showing preference for semi-evergreen and evergreen forests. Its nest is cup-shaped, made up of leaves and twigs, located mostly on the ground, between the buttresses of trees, within 200 m of the forest's edge and near water. Although the population could not be estimated, taking into consideration its low encounter rate, the IUCN criteria such as the restricted range of distribution and a fragmented population with declining locations, area of occurrence estimated to be <5,000 km2 (around 4,000 km2), area of occupancy of around 700 km2, this species is recommended to be considered 'Vulnerable' under 'threatened' category (Vijayan & Ezhilarasi 2007). At present BirdLife International (2008) has listed it as 'near threatened'.

Conservation issues and suggestions

Habitat loss or degradation, hunting, and introduced species are the major threats to birds on these islands, as they are to all the threatened birds of Asia, mainly because 80% are forest species, especially of lowland tropical forests) 30% have a restricted range of distribution as on the islands (BirdLife International 2001; Riley 2002) where habitat changes affect the species much more than on the mainland (Brooks *et al.* 1997). Habitat loss, in many parts of the world, is mainly due to human interferences (Castellatta *et al.*2000). The population problem (mainly because of the settlers from mainland India) has been identified as one of the root causes for habitat changes and other related problems with the development of the area (Davidar *et al.* 1995, 1996; Vijayan 1996,; Sankaran 1997; Vijayan *et al.* 2005). The Forest Survey of India reports of 1999 and 2005 have shown a decrease of 1.5% and 8.6% of forests during 1994–1998 and 1999–2003 respectively, in the Andaman Islands, which are attributed to encroachment by settlers (FSI 1999, 2005). However, there is hope in the future—with the stopping of commercial forestry (logging) operations, removal of encroachments, and habitat restoration (Vijayan *et al.*2006).

The most immediate threat in the Nicobars is the proposal to make Great Nicobar a free port and to create a dry dock and refueling base for international shipping at the mouth of the Galathea River (Vijayan *et al.* 2000). Sankaran (1997) had suggested developing a protected area network for the Nicobar Islands. The 2004 tsunami created havoc, much more in the Nicobars, but natural regeneration along with habitat restoration could improve the situation (Sivakumar 2007).

Data deficient, threatened, and near threatened species, especially endemic, should be given higher priority for research and conservation. Andaman and Nicobar Islands form two of the 218 Endemic Bird Areas of the world with 18 endemic species (Stattersfield *et al.* 1998) and with the addition of the new species, Nicobar Scops-owl *Otus alius* (Rasmussen 1999), now there are 19. Four species are common to both the Andaman and Nicobar groups of islands. Rasmussen & Anderton (2005) have given full species status to the Andaman Teal and their list shows 20 endemics in Andaman and eight in Nicobar. According to BirdLife International (2008), of the 19 endemics, four are threatened, one data deficient, and 11 near-threatened. Nicobar Scops-owl is data deficient, and Nicobar Sparrowhawk *Accipiter butleri* and Nicobar Bulbul *Hypsipetes nicobariensis* are the two threatened taxa on Nicobar Island, which are not studied. Many other species also require detailed surveys during different seasons, concentrating on their specific habitats, in order to assess their status. BirdLife International (2001) has documented that more than 80% of the threatened birds in Asia require population status for monitoring. Meaningful conservation measures can be suggested only after understanding the ecological requirements of these species (Vijayan 1996).

Although an ecological study of the Andaman Teal was conducted for two years, evaluating its habitat requirements, an estimate of such available habitats and movement patterns need to be worked out immediately and site-specific action needed to save this species from extinction (Vijayan 2006; Vijayan *et al*. 2006). The ecology of the Narcondam Hornbill, although partly studied during one breeding season, has yet to be studied intensively (Sankaran 1998c; Vijayan *et al*. 2000; Vivek & Vijayan 2003). The Andaman Crake has a low nesting success, and its fledgling success could not be recorded. Its population is naturally fragmented and there has been a loss of the species from many localities due to habitat loss and degradation. Considering all these factors, management regimes should ensure that adequate protection is given to this species, especially during its breeding season, and full protection of the crucial areas from any kind of human and related disturbances, especially in the larger islands (Vijayan & Ezhilarasi 2007). Some of the above areas are partly or fully protected and many others are near human settlements. Vijayan & Sankaran (2001) have already proposed the southern part of Rutland Island be declared an Andaman Teal Sanctuary. The habitat of this Crake in the localities without full protection may be declared as Sanctuaries or Conservation Areas, delineating the boundaries depending on the status of the land and feasibility. Islam & Rahmani (2004) have listed 19 sites in the Andaman and Nicobar Islands as Important Bird Areas and conservation actions are needed for these and other species-specific sites.

Population of the Edible-nest Swiftlet was found to decline because of the unsustainable harvesting for trade (Sankaran 1998a). Recent studies have shown that nests could be utilised without much adverse effect on the population if protection is provided and collected in a planned manner and also through farming as in many south Asian countries.

Hunting or poaching occurs even in protected areas mostly because of the inadequate facilities with the Forest Department and lack of awareness in the local communities, which should be addressed with all seriousness (Vijayan & Sankaran 2001; Vijayan *et al*. 2005, 2006). Suggestions for the conservation of the avifauna and biodiversity of these islands, resulting from various studies, should be discussed and implemented to maintain these ecologically sensitive and still pristine areas of our country.

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— *In memoriam* —

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Observations on Rufous-necked *Aceros nipalensis* and Austen's Brown *Anorrhinus austeni* Hornbills in Arunachal Pradesh: natural history, conservation status, and threats

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In 1997–1998, Ravi Sankaran had spent three months studying the most interesting, and intriguing, hornbill species found in India, with the smallest global range—the Narcondam Hornbill Aceros narcondami *—restricted to a 6 km² island of the Andaman Islands archipelago. While others before him had spent time on the island and made observations, his were the first systematic and meticulously collected data of a study carried out throughout the breeding season, on a large number of nests. Unfortunately, he never wrote up the work as a publication, but he put his research to good use for conservation action and managed to get the goats that were affecting the regeneration of many hornbill food plants, removed from the island. My paper, in this memorial issue, is about my limited observations on two of the lesser-known, and threatened hornbills of north-eastern India.*

Abstract

Among the five species of hornbills that occur in north-eastern India, the least studied are the endangered Rufous-necked Hornbill *Aceros nipalensis*, and the Brown Hornbill *Anorrhinus austeni*[1], which has a restricted distribution in India. Based on field surveys conducted in Namdapha National Park, and several forest divisions in eastern Arunachal Pradesh, during 1996–1999 and 2002–2004, I present information on their distribution and relative abundance. I also present some information on diet, flock sizes, canopy levels used, breeding biology, and nesting records for both these species.

Introduction

India is home to nine species of hornbills (Bucerotidae). Apart from the Great Hornbill *Buceros bicornis*, and Oriental Pied Hornbill *Anthracoceros albirostris*, which also occur in other parts of India, three species—Wreathed *Aceros undulatus*, Rufous-necked *A. nipalensis*, and Austen's Brown *Anorrhinus austeni* Hornbills—occur in north-eastern India.

Collar *et al.* (1994) listed ten globally threatened hornbill species, of which two occur in India, the Rufous-necked, and the Narcondam *A. narcondami* Hornbills, while three —Malabar Grey *Ocyceros griseus*, Malabar Pied *A. coronatus*, and Austen's Brown Hornbills—are listed as 'near threatened'. All these species also have restricted distributions.

Among the species occurring in north-eastern India, the Rufous-necked Hornbill is listed as 'vulnerable' by IUCN (2006), while the Great and Austen's Brown Hornbills are listed as 'near threatened' IUCN (2006). The two main factors that affect Austen's Brown and Rufous-necked Hornbills in north-eastern India are hunting and habitat loss.

The two *Aceros* species are more widely distributed within north-eastern India than the smaller, co-operatively breeding, Austen's Brown Hornbill, which is restricted to upper Assam and eastern Arunachal Pradesh, south of River Brahmaputra. The current distribution of Austen's Brown Hornbill is inadequately known and the factors responsible for its localised occurrence within north-eastern India, and its present rarity, would be interesting to determine. It is uncommon in deciduous forest and locally common in evergreen forest (Ali & Ripley 1987), and was reported to be very common, about 80 years ago, in the plains of eastern Assam (Baker 1927). Chowdhury (2000) provides sighting records in various small reserve forest patches in eastern Assam, Manipur, and Nagaland. Pawar & Birand (2001) have also reported its occurrence in the Barail Range.

Hunting of all hornbill species, by most tribal communities, is a major threat, and a primary cause for hornbill decline in many areas. The breeding biology, nest site selection, diet, and roosting patterns of the Great, Wreathed, and Oriental Pied Hornbills, and their functional role as seed dispersers have been studied in Arunachal Pradesh (Datta 2001; Datta & Rawat 2003, 2004). However, there is limited information on the natural history, breeding biology, and diet of the Rufous-necked and Austen's Brown Hornbills, in India, apart from anecdotal observations that breeding occurs between March and June (Ali & Ripley 1987), although there have been long-term studies in Thailand (Poonswad 1995; Poonswad *et al.* 1987, 1988, 1998; Poonswad & Tsuji 1994; Chimchome *et al.* 1998).

In this paper, I present information on diet, flock size, habitat use, distribution, and nesting of Rufous-necked and Austen's Brown Hornbills, collected between 1996 and 2004 in eastern Arunachal Pradesh. The threats to these species, due to current habitat loss, and hunting practices, are also outlined and discussed.

[1] Rasmussen & Anderton (2005) place it in the genus *Ptilolaemus*.

Photo: *Aparajita Datta*

A male Rufous-necked Hornbill *Aceros nipalensis* (about 2 years old) in Namdapha National Park.

Survey areas

Namdapha National Park (Namdapha NP; 27°23′–27°39′N 96°15′–96°58′E): located in eastern Arunachal Pradesh, Changlang district, comprises an area of 1985 km², with a wide altitudinal variation from 200 m to over 4500 m at Dapha Bum, the highest point in the park. The variety of habitats found here, ranging from temperate, subtropical, and tropical rain forests, has facilitated the presence of a diverse and rich fauna. The Kamlang Wildlife Sanctuary borders it on the north. To the south and south-east lie high mountain ranges and the international border with Myanmar. There are many small streams and rivers that drain into the Noa-dihing, a tributary of the Brahmaputra, flowing east to west through the park. It is contiguous with reserve forests and sanctuaries to the south and west. Towards the eastern boundary there are community forests in Vijaynagar circle (637 km²). The area is populated by a number of communities: *Singpho*, *Tangsa*, *Chakma*, and others, to the west of the park, and *Lisu* and *Nepali*, to the east (Datta 2007).

Kamlang Wildlife Sanctuary (Kamlang WS; 786 km²; 27°40′N–28°0′N 96°20′E–96°55′E): lies to the north of Namdapha NP, in Lohit district. It has steep mountainous terrain, and is criss-crossed by numerous rivers and streams, with some high altitude lakes. The altitude varies from 550 m to 4200 m. The floral and faunal species composition is believed to be similar to that of Namdapha NP, although no research has been undertaken here. To the south of Kamlang WS, are lowland forests under the Namsai Forest Division with several reserve forests (RF)—Turung, Kamlang, Tengapani, Manabum, and unclassed state forests (USF). The main tribal communities here are the *Miju Mishmi*, and the *Khampti* in the lower areas of the district.

Jairampur Forest Division (Jairampur FD; 27°–27°40′N 95°–97°E): comprises seven RF areas that are interspersed with patches of community forests, cultivation, and villages. The area covered by the reserve forests is 307 km². These forests were operated for timber, mainly for hollong *Dipterocarpus macrocarpus*, and mekai *Shorea assamica*, till 1996, when timber extraction was banned, although some extraction occurred up to 2000. The remaining areas are USF, where villagers practice shifting cultivation. The legal status of USF areas is not defined. They are simply designated as any forest that is not included in RFs and village forest reserves. There is no specific legal provision granting rights and concessions to local people for collection from, or use of, these forests, yet it is a customary tradition and fulfils local people's needs. None of them are notified. There is no land tenure system and the government does not have any rights over USF / community land. Parts of the RFs here are almost undisturbed forests, especially towards the Myanmar border. The area has tropical evergreen forests, dominated by the two commercially important dipterocarp species. The area has 28 villages, with an estimated population of *c.* 6000. The main tribe here

Photo: *Rohit Naniwadekar*

Austen's Brown Hornbill *Anorrhinus austeni* in logged forest in eastern Arunachal.

is the *Tangsa*, which is divided into numerous clans and sub-tribes. ***Deomali Forest Division*** (Deomali FD; 305 km^2; 26°55'N–27°15'N 95°10'–95°40'E): in Tirap district. Comprises USF, and five village forest reserves (VFR; 368 km^2). Most of the area lies in the Patkai Hills, with hilly and undulating terrain, with altitude ranging from 140 m to 1,410 m. The rivers flow from south to north; and drain into the Brahmaputra in Assam. The forest types in the area include tropical wet evergreen dipterocarp forests, semi-evergreen forests, wet bamboo brakes, and pioneer Euphorbiaceae scrub. The main tribes here are the *Nocte* and *Wancho* that inhabit the north-eastern and southern parts, respectively, of the district. There are 63 villages here with 5,178 houses and 26,360 people. Village sizes are comparatively large ranging from 24 to 149 households. Tirap district has the highest population density in the state with an increase from 36 per km^2 in 1991 to 42 per km^2 in 2001. Livestock holdings are also relatively high. The main occupation here is agriculture, most of the land in the upper *Nocte* and *Wancho* areas is under *jhum* cultivation, and many areas are severely degraded, as fallow cycles are short. Until the Supreme Court ban in 1996, timber extraction, primarily of two dipterocarp species, was carried out extensively in the lower areas. Tea estates have also come up in this district over the past 15 years.

Methods

Relative abundance of hornbills was assessed by walking trails in the forests of Rima and Pangsu RFs in Jairampur FD (April and November 2002), Changlang district, while Miao RF was visited for four days in April 2002. Turung and Kamlang RF, near Kamlang WS, and Mopaya VFR in Deomali FD, were also visited in April 2002. Rains, and the lack of field guides prevented access and exploration inside Kamlang WS. During several field visits to Namdapha NP (1996–2004), all sightings of Rufous-necked and the Brown Hornbills were recorded. Distances walked, and effort put in (in terms of days spent walking/searching), were recorded to obtain a crude estimate of relative abundance. Encounter rates (numbers per km) of hornbills are compared between Namdapha (a protected area) and the RF/USF areas (unprotected). On sighting one of the target species, the flock size, flock composition, canopy level, activity, if feeding, the food species, locality, and habitat type were recorded.

Fig. 1. Map showing survey areas in Namdapha National Park (green line depicts park boundary) and Jairampur, Deomali, Lohit FD. Villages/towns visited during the survey are marked as circles, while other locations/camps inside Namdapha are marked with squares. The yellow line depicts the international boundary with Myanmar.

A total of 74 days were spent (walks, active searches) in Namdapha NP, over several years (April 1996, November 1997, November 1998, March 1999, October 1999, December 2002–January 2003, October 2003, and April–May 2004). Short surveys were also carried out in RFs towards the south-western part of the park in Miao Reserve Forest (RF), Pangsu and Rima RFs, Jairampur FD in April–May 2002 and, November 2002. Forests near Kamlang Wildlife Sanctuary (WS) and adjoining RFs in Lohit district and, Deomali in Tirap district were also visited in April–May 2002 (Table 1). Additional information from Khonsa FD in Tirap district, visited in 1997, is also provided. Information about Rufous-necked Hornbill distribution is also presented from Eagle Nest WS, Doimara RF, Papum RF, and community forests in East, and West Kameng districts in western Arunachal Pradesh. Fig. 1 depicts the forest areas, and some of the villages visited during the field surveys in eastern Arunachal.

Results

Distribution and sighting records

Rufous-necked Hornbill: The species is vulnerable, although not critically endangered, but faces high risk of extinction in the wild in the medium-term future (IUCN 2009). It is rare in most parts of its global range, though in Bhutan it is more common. In India, populations are mainly found in Arunachal Pradesh, although it is also reported from Sikkim, and northern Bengal, in the eastern Himalaya.

It is rare in most parts of north-eastern India due to hunting and habitat loss—its status being better only in some protected areas of Arunachal Pradesh. In eastern Arunachal Pradesh, its status is better in Namdapha NP and in forests above 800 m elevation, and in western Arunachal Pradesh in East, and West Kameng districts around Eagle Nest WS and in higher areas of Papum and Doimara RF in Khellong Forest Division. It also occurs in Mehao WS (Dibang Valley district), and Tale WS (Lower Subansiri district), although it is relatively uncommon. In Namdapha NP, it is commonly sighted even at lower elevations (200–900 m). It is heavily hunted by several tribes (*Nishi*, *Wancho*, *Tangsa*, *Mishmi*, *Adi*, and *Apatani*), especially in higher elevation sub-tropical evergreen forests, where the Great and Wreathed Hornbills are less commonly seen. Forest loss is possibly a lesser threat for this species, because the condition and extent of forests at higher elevations are relatively better than in the foothills; hunting may be a more serious proximate threat to this species.

I had 101 sightings of Rufous-necked Hornbills between 1996 and 2004 (Table 1). Most were sighted in Namdapha NP (91 sightings), while seven sightings were in RFs (Rima RF, Pangsu RF in Jairampur Forest Division in eastern Arunachal, and Doimara and Papum RF, Khellong Forest Division, western Arunachal), and three in community forests (also designated as USFs in Arunachal) in the Vijaynagar area, Changlang district.

Austen's Brown Hornbill: Its global range is north-eastern India, Myanmar, Thailand, Laos, Vietnam, and southern China. Its distribution in India is restricted to eastern Arunachal Pradesh and Assam. According to Ali & Ripley (1987) it may occur or have occurred in Manipur and Nagaland; more recently, Chowdhury (2000) has reported its occurrence in these two states. It has been sighted from areas in Upper Assam in Joypur RF (Kashmira Kakati, *pers. comm.*), Tinsukia district, in the Cachar Hills (Pawar & Birand 2001), and from several other RFs in upper Assam (Chowdhury 2000).

I had a total of 31 sightings of Austen's Brown Hornbill over several visits between 1996 and 2004 (Table 1). Calls were heard in Mopaya Village Forest Reserve, Deomali Forest Division. Only

two sightings were in Miao RF, while the rest were in Namdapha. The species is also present in Jairampur FD, as was evident from skulls and heads seen with hunters in the villages. Although it was not sighted in Kamlang WS and adjoining reserve forests in Lohit district, reports from local villagers suggest that it may occur there and is possibly the western-most distribution limit of this species. Earlier reports of this hornbill in Arunachal Pradesh were only from Namdapha (Singh 1995).

Relative abundance

Relative abundance of hornbills was obtained from trail walks in the survey areas. In trails walks between 1996 and 1999 (total distance 357 km, pooled over several visits, which includes 112 km walked from Deban to Vijaynagar), we counted 162 and 123 individuals of Rufous-necked and Austen's Brown Hornbills, respectively, with an average encounter rate of 0.32/km (± 0.49) for Rufous-necked, and 0.39/km (± 0.27) for Austen's Brown Hornbill.

In field surveys between 2002 and 2004 (total distance 326 km, which includes 230 km (two walks from Mpen/Deban to Vijaynagar), we counted 55 Rufous-necked, and 29 Austen's Brown Hornbills, with an average encounter rate of 0.28/km (± 0.32) and 0.29/km (± 0.29), respectively.

There appears to be a considerable difference between the breeding and non-breeding season in numbers of both species seen in the low- and mid-elevation forests (200–1000 m) (Fig. 1), with consistently fewer sightings and numbers in the non-breeding season (winter) for both species. However, this could also be due to the fact that most of the survey effort, in the breeding season (all years), was in the Deban–Haldibari–Hornbill–Ranijheel area, while in the non-breeding season, more effort was along the main Noa-dihing valley on the way to Gandhigram–Vijaynagar. On the other hand, the Wreathed Hornbill, which is known to make long-distance movements, is seen in the area in large flocks in the non-breeding season (winter) (Table 1).

Encounter rates of hornbills were considerably lower in reserve and community forests in Jairampur, Deomali, and Lohit FDs (total distance walked, 133 km, in April–May 2002). Three species, Rufous-necked, Austen's Brown, and Oriental Pied Hornbills were sighted; calls of Great, and Austen's Brown Hornbills were heard once. There were three sightings of seven birds [Brown, Rufous-necked and Wreathed hornbill]. The Rufous-necked hornbill was very rare in adjoining reserve and community forests it (0.004 birds/km ± 0.01). However, much of the survey in the reserve and community forests was in low-elevation forest, where Rufous-necked Hornbills generally do not occur. Austen's Brown Hornbill encounter rates were also low (0.2 birds/km ± 0.6).

An additional 116 km (15 days) were walked in Jairampur FD in November 2002 during a survey for the leaf deer (Datta *et al.* 2003), during which all hornbill sightings were noted. Two species—Wreathed and Rufous-necked Hornbills—were sighted, a total of 27 individuals from 10 sightings.

Table 1. Hornbill records in areas surveyed between 1996 and 2004 (effort in terms of days spent and distances walked) in eastern Arunachal Pradesh

Area	Year	Days spent	Locations	Effort (km walked)	Number (species)	Sightings/calls (total numbers seen)
Namdapha NP	April 1996	3	Deban-Bulbulia, 17-19 mile MV road	37	2 (RNH, BH)	7 (24), 1 call
Namdapha NP	November 1997	3	Deban-Bulbulia, 17-19 mile MV road	37	3 (RNH, BH, WH)	8 (54)
Namdapha NP/ Vijaynagar USF	November 1998	9	Deban-Vijaynagar	112	2 (RNH, WH)	24 (143)
Namdapha NP	March 1999	15	Deban-Firmbase (various trails)	126	4 (RNH, BH, WH, GH)	85 (248), 4 calls
Namdapha NP	October 1999	3	Deban-Hornbill, 17-19 mile MV road, Deban-Mpen	41	3 (BH, WH, GH)	13 (42)
Namdapha NP	December 2002	10	Deban-80 mile	102	1 (WH)	2 (23)
Vijaynagar USF	December 2002	15	80 mile -Gandhigram-Vijaynagar	28	2 (RNH, WH)	8 (32)
Namdapha NP	April 2003	7	Deban-Bulbulia, 17-19 mile MV road	ca. 40	3 (BH, GH, RNH)	14 (23+)
Namdapha NP	October 2003	7	Mpen- Gandhigram	128	1 (RNH)	2 (9)
Namdapha NP	April 2004	7	Deban-Ranijheel, 17-22 mile MV road	ca. 56	3 (BH, GH, RNH)	22 (55)
Jairampur FD	November 1998	1	Hongkap RF	14	None	—
Jairampur FD	April 2002	4	Rima, Pangsu and Miao RF	59	2 (BH, RNH)	2 (5)
Jairampur FD	November 2002	15	Nampong-Rima-Putok-Changlai-Tengpum	116	2 (RNH, WH)	10 (27)
*Kamlang WS & Namsai FD	May 2002	4	Kamlang WS, Turung & Kamlang RF	34	None	—
Deomali FD, Joypur RF	April 2002	5	Mopaya VFR, Joypur RF	40	3 (BH, GH, OPH)	1(2), 3 calls

Poor weather hampered fieldwork and only the edge of the sanctuary was visited (about 7 km along the trail to Glao lake from Wakro). Most time spent in areas near Wakro town and Turung RF.
Abbreviations: BH=Austen's Brown Hornbill; GH=Great Hornbill; OPH=Oriental Pied Hornbill; RNH=Rufous-necked Hornbill; WH=Wreathed Hornbill.

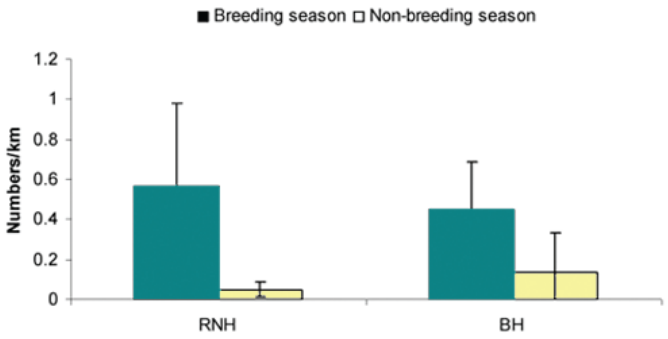

Fig. 2. Mean (± SD) Encounter rates (nos/km) of two hornbill species in breeding (n = 313, effort: 246 km), and non-breeding season (n = 55, effort: 437 km) in the Namdapha National Park.

Flock sizes

Rufous-necked Hornbills were mainly seen in pairs (45% of sightings). Only 3% of sightings were of birds in bigger flocks (> 10 birds), mostly at large fruiting trees. Austen's Brown Hornbill was mostly seen in flocks comprising more than three birds (70% of sightings). The maximum flock size was 15. There were only four sightings each, of single birds, and of pairs.

The mean flock size of the Rufous-necked Hornbill was 2.36 birds in the breeding season, while the modal and median flock size was one (n = 85 sightings). The mean, median, and modal flock size was two in the non-breeding season (n = 15 sightings). The maximum flock size seen was 19 birds in the breeding season, and 7 in the non-breeding season.

The mean flock size of Austen's Brown Hornbill was six birds in both the breeding (n =22), and non-breeding seasons (n = 5). The median and modal flock size was four in the breeding season, while in the non-breeding season median and modal flock size was two and one respectively.

Use of canopy levels

Austen's Brown Hornbill used all canopy layers equally, while Rufous-necked Hornbills were mostly sighted in the upper canopy layer (71% of sightings) (Fig. 3). This difference in the use of canopy levels is probably related to their diet and foraging strategy. While the Rufous-necked Hornbill is largely a resident (possibly territorial) frugivore feeding on canopy fruits, Austen's Brown Hornbill is more omnivorous in its diet (Poonswad *et al.* 1986), feeding much more on animal matter, which probably reflects in its use of all canopy layers.

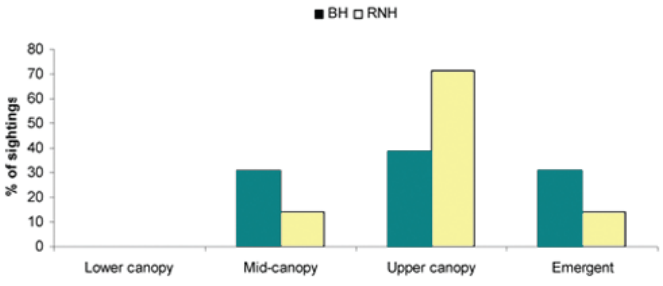

Fig. 3. Use of canopy levels by the two hornbill species in Namdapha National Park, Arunachal Pradesh. n=13 sightings for BH, 59 sightings for RNH.

Diet

Limited observations on the diet of the two species were made during walks. In addition, regurgitated seeds, dropped below two nests each, of both hornbill species, were recorded. Sixteen species were recorded in the diet of the two hornbills, 11 non-fig fruit species, and five fig species (Table 2).

The Rufous-necked Hornbill is largely frugivorous, feeding mainly on berries, drupes, and capsular fruits of primary forest species belonging to Lauraceae, Meliaceae, Myristicaceae, Annonaceae, and figs (Moraceae). No animal matter was recorded in its diet in these limited observations; however more detailed studies in Thailand suggest that it also consumes animal matter, especially crabs (Chimchome *et al.* 1998). Based on 33 feeding observations, the diet of the Rufous-necked Hornbill was made up of figs and non-fig fruits. 51% observations were on fig fruits (four species), and 48% on five species of non-fig fruits. Apart from this, regurgitated seeds of four non-fig fruit species were recorded below fruiting and perch trees visited by Rufous-necked Hornbills. From an old nest, several other species in the diet of these birds—*Horsfieldia kingii*, *Polyalthia simiarum*, and beetle remains—were deciphered. At two active nests in 2004, five non-fig fruit species were recorded.

Austen's Brown Hornbills were recorded feeding on figs and ripe fruits of *Beilshmedia* sp. during six sightings. They were also observed in April 2002, delivering fruits of five species at an active nest. There were regurgitated seeds of *Polyalthia simiarum*, *Dysoxylum binectariferum*, *Aglaia* sp., *Horsfieldia kingii*, and of some Lauraceae species, apart from defecations of fig seeds below the nest. Austen's Brown Hornbill is supposed to have a mixed diet, but is largely insectivorous. Apart from berries, drupes, capsular fruits of primary forest species—Lauraceae, Meliaceae, Annonaceae and figs (Moraceae)—they are reported to consume arthropods, mollusks, and small vertebrates (Poonswad *et al.* 1986, 1998).

Breeding season & nesting records

Rufous-necked Hornbill: The breeding season of the Rufous-necked Hornbill in Namdapha NP commences in late April, much later than that of Great, Wreathed, and Oriental Pied Hornbills further west in Pakke NP, where nesting commences by early- to mid-March in most years (Datta 2001; Datta & Rawat 2004).

In March 1999, I spent 15 days in Namdapha NP, searching for active hornbill nests in the Deban–Haldibari–Hornbill–Bulbulia–Ranijheel–Firmbase area. No active nest trees could be located. It is likely that nesting of Rufous-necked and Austen's Brown Hornbills had not commenced in mid- to late-March, because the former were sighted in pairs till the end of March, and courtship feeding was observed during the second and third weeks of March. An old nest of the Rufous-necked Hornbill, in community forests near Kathang village (10 km from Deban) outside Namdapha NP, was located with the help of a *Miju Mishmi* village headman. The nest had apparently been discovered two years ago and was used the previous year, as evident from old feathers, seeds, and seedlings of the hornbill's regular food plants. The nest was on a *Terminalia myriocarpa* (Hollock) tree, adjacent to a *jhum* field. The village headman also informed that Rufous-necked Hornbills do not start nesting till April. However, there was no nesting on this tree when it was subsequently checked in April and May that year.

I was also shown an old nest of a Rufous-necked Hornbill in community forests near Pakke-ke-Sangh village, by a *Nishi* hunter, at 1,500 m (East Kameng district) on an *Altingia excelsa* (Jutuli) tree in January 2000. Pakke-ke-Sangh village was accessed on foot from Seijusa (Pakke WS), over a two-day trek (*ca.* 83 km).

Table 2. Food species of Rufous-necked Hornbill and Austen's Brown hornbill in eastern Arunachal Pradesh.

Tree species	Family	*Peak fruiting period	Fruit type & color of ripe fruit	Observation method & season
Polyalthia simiarum (Kari)	Annonaceae	May to June & Dec-Feb (both seasons)	Lipid-rich drupaceous carpel, black	Regurgitated seeds below nest tree
Dysoxylum binectariferum (Banderdima)	Meliaceae	March-April (breeding)	Multi-seeded arillate capsular fruit, aril black	Nest trees and trail walk
Chisocheton paniculatus (Banderdima)	Meliaceae	May-June (breeding)	Multi-seeded arillate capsular fruit, aril orange-white	Nest trees and trail walk
Horsfieldia kingii (Ramtamul)	Myristicaceae	Feb-March (breeding)	Single-seeded capsular fruit	Regurgitated seeds below nest tree
Aglaia sp.	Meliaceae	Feb-April (breeding)	Multi-seeded arillate capsular fruit, orange-red	Regurgitated seeds below nest tree
Beilshmedia sp.	Lauraceae	Oct-Nov (non-breeding)	Lipid-rich fleshy drupe, black	Trail walk, regurgitated seeds below fruit and perch trees
Cryptocarya sp.	Lauraceae	May-July (breeding)	Lipid-rich fleshy drupe, black	At nest
Canarium resiniferum (Kaladhuna)	Burseraceae	Nov-Dec (non-breeding)	Lipid-rich fleshy drupe, black	Trail walk
Cinnamommum cecidodaphne (Gonsorai)	Lauraceae	Nov-Dec (non-breeding)	Lipid-rich fleshy drupe, black	Trail walk
Hovenia acerba (Chetiabola)	Rhamnaceae	March? (breeding)	Drupe	Trail walk
Unidentified species	Meliaceae	March (breeding)	Multi-seeded arillate capsular fruit	Perch tree
**Platea latifolia*	Icacinaceae	Nov-Dec (non-breeding)	Lipid-rich fleshy drupe, black	—
Ficus macclellandi	Moraceae	Available in both seasons	Fig (syconia), bright yellow	Trail walk (April)
Ficus altissima	Moraceae	Available in both seasons	Fig (syconia), red	Trail walk
Ficus hookeri	Moraceae	Available in both seasons	Fig (syconia), reddish-black	Trail walk (November)
Ficus sp.1	Moraceae	Not known	Fig (syconia)	Trail walk
Ficus sp.2	Moraceae	Not known	Fig (syconia)	Trail walk

* Not recorded as food species in Namdapha but fruit characteristics indicate it is a hornbill food species. Recorded in Wreathed hornbills' diet in non-breeding season in western Arunachal.

Intensive searches for nests were carried out again in Namdapha in March–April 2004. However, during this period, most sightings were of birds in pairs, indicating that most birds had still not commenced nesting. Despite the abundance of suitable cavities, most birds had not started nesting even by the last week of April. Two active nests were located in the third week of April, in Namdapha. One was located on a *Terminalia myriocarpa* tree near Hornbill camp on 26 April 2004. It had probably been active since a week. Another was found on a steep slope, downhill from the 19th mile (of the Miao–Vijaynagar road), on 24 April 2004. It was located on a tall, emergent *A. excelsa*.

Subsequently, in May 2004, another nest was located in Miao RF (Akhi Nathany, *pers. comm.*). The Rufous-necked Hornbill appears to be resident and territorial (mostly sighted in pairs in particular localities), and the breeding season is between April and July / August. Unfortunately, these nests could not be monitored throughout the breeding cycle, as it coincides with the period of heavy rains in the area and both these nests were difficult to access in the monsoon. Thus, there is neither any information on the exact exit dates from the nest nor whether the nests were even successful.

Austen's Brown Hornbill: During intensive nest searches inside Namdapha in March 1999, no nests of this species could be located. The birds were mostly sighted in flocks. During the survey in Jairampur FD in 2002, a flock was sighted visiting and feeding at an active nest in Miao RF. A nest of Austen's Brown Hornbill was shown to me by a *Wancho* youth on 21 April 2002 in Miao RF. The nest cavity was located on an *Ailanthus grandis* (Borpat) tree, approximately 1 km from Miao township, on a steep hillside, near a perennial stream (about 60 m uphill from the stream). The youth had noticed a flock of noisy birds, and subsequently discovered the nest, while cutting and burning his *jhum* field in 2001. According to him, they had nested successfully in 2001. The cavity was at about 23 m, while the height of the nest tree was about 30 m. The shape of the cavity was oval-elongated and the cavity was located on a primary branch. The hole was south-facing. The nest had a flock of four birds, which were making feeding visits. One was possibly the adult male, and the other three were

helpers. The local youth who showed me the nest had not seen Austen's Brown Hornbills before, though he was familiar with other hornbill species in the area. On a subsequent nest watch of two hours on 28 April 2002, I again observed four birds, each taking turns in feeding 2–3 food items, several times during a visit. In a second visit, about an hour later, different individuals fed the female, and chicks 8–9 times. The chicks (possibly three) had already hatched, as they could be heard calling from inside. This is the first recent recorded instance and evidence of Austen's Brown Hornbill breeding in the wild in India.

This nest tree was also active in 2003; however in the breeding season of 2004, the birds did not nest on this tree, possibly due to increased human activity and disturbance in the vicinity of the nest. One additional nest of this species was located in Miao RF (305 m) in May 2004, which was again found to be active in 2006, 2007, and in 2008. Despite intensive searches within the Haldibari–Bulbulia area, no active nest could be found. Austen's Brown Hornbill is reported to be a monogamous, territorial, and co-operative breeder. In Thailand, its breeding season is from February to April (Poonswad *et al.* 1987). From our limited observations, it appears that its breeding season in north-eastern India commences in mid-April, and is over by June–July.

Table 3. Structural characteristics of nest sites of two hornbill species in Arunachal Pradesh

Parameters	Austen's Brown Hornbill N = 1	Rufous-necked Hornbill N = 2
Tree density (per ha) (trees ≥ 25 cm GBH)	NR	410 ± 56.56
Nest tree height (m)	30	34 ± 6
Nest tree GBH (cm)	> 400	708.5 ± 27.5
Emergence (m)	20	22.5 ± 7.5
Height of cavity from ground (m)	23	19 ± 3
Height of first branch (m)	NR	18 ± 8
Girth at cavity (cm)	NR	NR
Cavity length (cm)	NR	NR
Cavity width (cm)	NR	NR
Distance to habitation (m)	500	1500 ± 0.0
Distance to road (m)	700	6000 ± 4000
Distance to river (m)	1000	2500 ± 500
Altitude (m)	200	1100 ± 300

Nest tree species

The nest tree species used by these two hornbill species were all large emergent trees such as *Terminalia myriocarpa*, *Ailanthus grandis* and *Altingia excelsa*. Other potential nest tree species (all

Photo: *Aparajita Datta*

A male Rufous-necked Hornbill (about 2-years old) in Namdapha National Park.

The tail feathers of the Great Hornbill are highly valued for use in traditional headdresses by the *Wancho* in eastern Arunachal; in 1997, a single tail feather cost Rs 600/- and were hard to obtain as the Great Hornbill appears to be locally extinct or very rare in parts of Tirap district. The tail feathers are kept carefully wrapped in banana leaves, Konnu village, Upper Wancho area, November 1997.

emergents) in the area are *Dipterocarpus macrocarpus* (Hollong) and *Shorea assamica* (Mekai). *Tetrameles nudiflora* (Bhelu) is the most common nesting tree (emergent softwood species) used by hornbills in the foothill forests in western Arunachal. However, the species does not seem to occur in eastern Arunachal (some were seen in lowland forests in Assam). *T. nudiflora* was not observed in the Mehao WS (Dibang Valley district) or in Namdapha NP, even in relatively lower elevation foothill forests. In Namdapha NP, *A. excelsa*, *T. myriocarpa*, *A. grandis* and two dipterocarp species, *S. assamica* and *D. assamicu*s are the common emergent species, and may be more important nest tree species for hornbills.

In all, four nests of Rufous-necked Hornbill have been recorded, two each on *T. myriocarpa* and *A. excelsa*. Overlap in nesting habitat between the Rufous-necked Hornbill and the other hornbill species is largely precluded, since it generally occurs in higher elevation forests, from 800 m to above 1500 m, though in Namdapha NP, they are also sighted at similar elevations as Great, Wreathed and Austen's Brown Hornbills. Great Hornbills are reported up to 1,200 m and though Wreathed Hornbills do occur up to 2,000 m, they are more common at lower elevations and are often seasonal visitors at higher elevation forests of Namdapha NP, Tale WS, and other community forest areas in Lower Subansiri and East Kameng districts (A. Datta, *unpubl. data*).

Photos: *Aparajita Datta*

Heads/beaks of three species of hornbills (RNH, WH, GH) displayed in household in a Tangsa village, eastern Arunachal.

Table 3 lists the parameter values of some nest trees found, of the two species.

Height and size of trees as well as commonness in the habitat are important factors in nest tree selection (Datta & Rawat 2004). Studies on Asian hornbills, across many sites, have revealed that generally hornbills chose large emergent trees with cavities high up on the tree compared to randomly located trees (Kinnaird & O'Brien 2007). While in some areas, hornbill species choose a few particular softwood species, in others the main nest tree species were hardwoods (Thailand and some areas in SE Asia), and Poonswad (1995) contends that this is probably because such trees last longer and can be used by nesting hornbills for a long time, given their durability, once cavities form on them. On the other hand, it is also likely that softwood species like *T. nudiflora* that rot easily, are likely to form cavities. In southern India, hornbills did not show a preference for any particular species (Mudappa & Kannan 1997).

Proximate structural characteristics (tallness, emergence, softwood, easy cavity formation due to woodpecker / barbet activity or breakage of branch) of some tree species determine whether they are used or not. However, hornbills will ultimately select trees based on availability or commonness of a particular species that meets the structural characteristics (Datta & Rawat 2004).

My observations indicate that hornbills do nest in logged and degraded forest, though these attempts are often unsuccessful, mainly due to anthropogenic disturbances. Hornbills may be able to nest successfully even in such marginal habitats, if further degradation of, or disturbance at, the nest site (especially in the breeding season) is prevented. Given the limited availability of suitable nesting trees and the fact that hornbills nest in such marginal habitats, it is necessary to widen the scope of conservation plans for hornbills to include forests outside the existing protected area network, which forms more than 70% of the forest area of Arunachal Pradesh (Datta & Rawat 2004; Kinnaird & O'Brien 2007).

Conservation threats

Most of Arunachal Pradesh is hilly with inaccessible terrain and has low human population densities. The foothill lowland habitat, where most hornbills' nesting occurs, is threatened by habitat loss and degradation due to logging and land clearing for settlements and agriculture (Datta & Rawat 2004). Logging also has led to the creation of roads and greater accessibility, which has been followed by creation of settlements and greater incidence of human activities such as hunting and collection of fuelwood and

Head of a young Rufous-necked Hornbill seen with an Apatani hunter in Tale Wildlife Sanctuary, Lower Subansiri district.

forest products that create additional disturbance (Datta 1998). Logging was banned in 1996, though logging has restarted now in several forest divisions. However, although logging does result in reduced abundance of hornbills, several studies have shown that hornbills are able to persist in logged forests (Johns 1987, 1989; Datta 1998).

Hunting of hornbills during the breeding season is taboo in many areas, but is carried out during the winter from November to February (non-breeding season). There is a great demand for hornbill casques, meat, fat and feathers all over Arunachal, particularly among certain tribes, and these are either sold or bartered in exchange for goods (Datta 1998, 2002). Hornbills have become virtually extinct, or very rare, in many areas in eastern and central Arunachal (Datta 2002). Apart from the Rufous-necked Hornbill, which frequents forests above 800 m, all other species are largely restricted to lowland forests, the extent of which is fast declining.

Rufous-necked Hornbill: This species is among the ten globally threatened hornbills. It is believed to be extinct in Nepal and is also near extinction in Vietnam (IUCN 2009). Its current global distribution is north-eastern India (primarily in Arunachal Pradesh), Bhutan, Myanmar, northern and western Thailand, southern China, northern Laos, and Vietnam. Its presence in Cambodia is unconfirmed. The species occurs in hill evergreen forest from 600 m to 2200 m. Hunting is the primary threat to the Rufous-necked Hornbill in Arunachal Pradesh. This is the only hornbill species found at higher altitudes (>1,000–2,000 m), and is targeted extensively by hunters in the survey areas. In western Arunachal, it is hunted by *Nishi, Adi* and *Apatani*, and by the *Wancho*, *Tangsa*, *Miju Mishmi* and *Lisu* in eastern Arunachal—and these tribes have distinct names for the species (Table 4). In 1997, I recorded 32 Rufous-necked Hornbill heads on display (hunted over several years) in a single household in Pongchau, a *Wancho* village in Tirap district. 61% of all hornbill heads seen in 35 households, across 17 villages, were of the Rufous-necked Hornbill (Datta 2002).

Austen's Brown Hornbill: It is probably the most threatened of the hornbills in north-eastern India, in terms of total population in India, because of a naturally restricted and localised range. Its habitat is mostly dense evergreen forest and it is restricted to below 1,000 m. Lowland and foothill forests are the most vulnerable to logging, conversion to tea estates, settlements, and clearing for agriculture. There has been extensive habitat loss/modification (especially in upper Assam and Tirap district). Hunting of this species occurs, by the *Tangsa* and *Wancho*, but much less than that of other hornbill species because of its smaller size and lack of spectacular striking plumage. In eastern Arunachal, local knowledge of Austen's Brown Hornbill is sketchy. While some villages and tribes, *Lisu*, *Tangsa* and some *Wancho*, were aware of this species and knew its habits, in some nearby localities, people were not aware of it. Common names for these species are given by *Tangsa*, *Lisu*, *Khampti* and the *Miju Mishmi*. The species is most commonly sighted in Namdapha NP in low-elevation evergreen forest in the Deban–Haldibari–Bulbulia area and seen further up till the 58th mile on the Miao–Vijaynagar Road. The best place for these two hornbill species is Namdapha NP.

Photo: *Aparajita Datta*

Heads/beaks of three species of hornbills (RNH, WH, BH) displayed in household in a Tangsa village, eastern Arunachal.

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Photo: *Aparajita Datta*

Wreathed Hornbills at a communal roost in Pakke, western Arunachal.

Predators of swiftlets and their nests in the Andaman & Nicobar Islands

Shirish Manchi & Ravi Sankaran

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The Andaman and Nicobar Islands are inhabited by two species of swiftlets: the echolocating Edible-nest Swiftlet *Aerodramus fuciphagus inexpectatus* and the non-echolocating Glossy Swiftlet *Collocalia esculenta affinis*. Both taxa are endemic to the islands where they habitually nest and roost inside caves, crevices and rock shelters (Sankaran 1998, 2001; Koon & Cranbrook 2002; Naguyen *et al*. 2002). In addition, the Glossy Swiftlet also roosts and nests in man-made structures like buildings, houses, jetties and bridges. Edible-nest Swiftlets, under enormous pressure from the bird's-nest trade, have become endangered in the archipelago, having faced an estimated population decline of up to 80% in a decade (Lau & Melville 1994; Sankaran 1995, 1998, 2001). Some colonies of the Glossy Swiftlet are also exploited despite the low proportion of saliva used in their nest construction, which reduces the market value of the nests.

Nest-site selection by swiftlets is believed to be primarily based on avoidance of predation. Nest safety is likely to be influenced by the specialised search strategies of the potential predators (Cody 1983; Martin 1995). This means that documenting nest predators is of great interest in understanding the nest-site selection of the species and the benefits of their adaptations towards it.

Swiftlets are adapted to nest on walls and ceilings, both in complete darkness as well as in poorly lit zones of caves. Echolocation appears to be a strategy of the members of genus *Aerodramus* that enables them to roost and nest in the dark zones of caves, free from visually orienting predators or competitors (Fenton 1975; Medway & Pye 1977). Despite this, swiftlets are not without depredators.

Our study of these species in the Andaman and Nicobar Islands spans almost 13 years, from 1997 to 2009. During this time, we have observed several instances of predation of nests, eggs, nestlings and adult swiftlets. Across the distributional ranges of these swiftlets, their predators include both vertebrates (e.g., owls, raptors, snakes, geckoes, bats, cats, and rats), and invertebrates (e.g., cockroaches, lice, flies, giant crickets, and centipedes), (Sankaran 1998; Koon & Cranbrook 2002; Naguyen *et al*. 2002). In our study, with the species conformed as predators of swiftlets, some potential predators were also observed inside caves. Our observations on the potential predator species and the species conformed as predators of swiftlets and their nests are summarised in Table 1. We could not confirm whether the potential predators indeed depredated nests of adult swiftlets.

Table 1. Predators of swiftlets and their nests in the Andaman & Nicobar Islands

Species	Description
Brown-Hawk Owl *Ninox scutulata obscura*	Individuals were observed hunting both species of swiftlets in the cave openings of Chalis-ek and Interview islands, in North & Middle Andaman, while the birds entered or exited from the caves at dusk and dawn, during May and June of each year from 2001 to 2008. In May 2005 an individual was also seen roosting just bellow the Edible-nest Swiftlet colony on the man-made scaffolding inside the cave at Interview Island.
*Besra *Accipiter virgatus*	According to the nest collectors, Besras were recorded hunting swiftlets near the cave openings and also in the dim-lit zones inside the cave in North & Middle Andaman and Baratang Island, round the year.
Large-billed Crow *Corvus macrorhynchos*	In the morning of 19 March 2007, a Large-billed Crow, while in flight, was observed preying on the breeding colony of Glossy Swiftlets, under Panighat bridge in North & Middle Andaman Island.
*Red-tailed trinket snake *Gonyosoma oxycephalum*	A known bird predator (Whitaker & Captain 2004), this species was found near cave openings and inside caves, close to the swiftlet breeding colonies, at Chalis-ek North Andaman and Interview Island, during the breeding season of the swiftlets in February 2002, May 2005, May 2007 and January 2009 (Fig. 1). We did not directly observe predation.
*Reticulated python *Python reticulatus*	A common visitor to the caves, it is known to prey on swiftlets in other regions (Koon & Cranbrook 2002), but we did not observe predation. During the survey in 1997 an individual was encountered in a cave on Great Nicobar.
*King cobra *Ophiophagus hannah*	The species was observed resting in the crevice inside the cave at Bartang Island. We believe that King Cobra can be a potential predator of the swiftlets or the bats inside the cave.
*Vipers *Trimeresurus* (unidentified sp.)	During the survey in 1997, inside the caves at Pambuka and Pagget islands, vipers were seen resting near the swiftlet colony, most probably for hunting the adults approaching nests and also flying from the nests. These species were never observed predating on the swiftlets or their nests.

Table 1. Predators of swiftlets and their nests in the Andaman & Nicobar Islands

Species	Description
*Sea snake (unidentified sp.)	During the survey in 1997, sea snakes were seen resting under the swiftlet colony in the coastal caves in Nicobar Islands. They were presumed to be predating on the fallen chicks or eggs. Predation was never observed.
*Lizards (unidentified spp.)	Geckos from south-eastern Asia were recorded predating on swiftlets eggs in houses. In the cave at Interview Island we recorded a lizard moving in the Edible-nest Swiftlet colony. We did not observe any type of predation of the swiftlets by the lizard.
Crabs (unidentified spp.)	Different species of crabs were found predating on fallen swiftlet chicks and also scavenging on dead ones. During the survey in 1997 crabs were observed inside most of the coastal caves in Andaman and Nicobar Islands. Under Mayabunder jetty, in February 2007, an individual was observed predating on a Glossy Swiftlet chick that had fallen from the nest.
Spider (Order: Arachinida)	At Great Nicobar a Glossy Swiftlet was caught in a spider's web; the spider took almost three days to finish sucking it dry (Manish Chandi, Per. comm.; Fig. 2). In another instance, during June 2006, an adult Edible-nest Swiftlet was observed caught in a spider's web within 200 m of the nearest cave on Interview Island.
Ants (Order: Hymenoptera)	Red ants are one of the major predators of eggs and chicks inside caves. In almost all the caves on Interview Island and Chalis-ek ants were seen attacking newly hatched chicks (Fig. 3) and also feeding on the material inside the eggs by making a hole in the egg.
Cockroaches (unidentified spp.)	Not a conventional predator, cockroaches inside caves reduced the breeding success of Edible-nest Swiftlets by feeding on their nests. In the several caves on Interview Island this incidence was observed. There is a cave on Interview Island called Cockroach cave because of their high number and rate of nest predation.
*Crickets (unidentified spp.)	Giant crickets in south-eastern Asia are known predators of swiftlets. Crickets were also encountered in the caves at Baratang Islands during the survey in 2007, but were never observed predating on the swiftlets.
Domestic cat	During cyclonic weather of April, May and June in 2004, 2005, and 2006, in front of the police station at Mayabunder, North and Middle Andaman, when Glossy Swiftlets foraged close to the tar road, a domestic cat was observed hunting them by hitting them with its forelimb.
*Rats (unidentified spp.)	Rats are present in most caves of the Andaman and Nicobar Islands. Rats were recorded predating on swiftlets in south-eastern Asian countries but we never observed them predating on swiftlets. Rats were observed feeding on the edible nests fallen on the ground, in the cave at Interview Island.

Note: * Potential predators of the swiftlets.

Predation can affect the population of the colonial breeders like Edible-nest Swiftlet, as it was proved in one of the caves under continuous observation. The population of the Edible-nest Swiftlet was recorded using the roost count method (Medway 1969). Predators like Brown-Hawk Owl *Ninox scutulata obscura* and the Red-tailed trinket snake *Gonyosoma oxycephalum* were observed predating on adult individuals of both species of swiftlets inside the cave on Interview Island, using a man-made wooden scaffolding set up to study the breeding biology of the species. Despite its successful breeding seasons the population of the Edible-nest Swiftlets declined between 2000 and 2004. But after the removal of the scaffolding, used by predators to launch an attack inside the cave, the population in 2005 started rising again (Fig. 1).

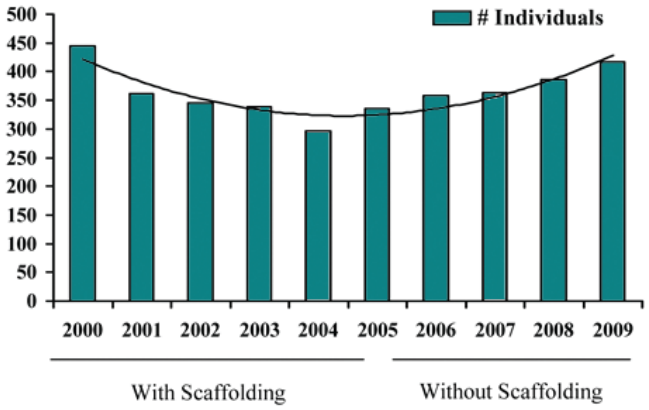

Fig. 1. Population of the Edible-nest Swiftlets in the cave at Interview Island Wildlife Sanctuary, during the existence, and after removal, of the man-made scaffolding causing heavy predation.

Photo: *Shirish Manchi*

Fig. 1. Red-tailed trinket snake *Gonyosoma oxycephalum* resting just below the swiftlet colony in the cave at Interview Island.

Photo: *Manish Chandi*

Glossy Swiftlet *Collocalia esculenta* caught in the spider web at Great Nicobar.

Photo: *Shirish Manchi*

Red ant attack on the freshly hatched chicks of Edible-nest Swiftlet *Aerodramus fuciphagus* in the cave at Interview Island.

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— Ravi and the camel —

This was in January 1999 when I went to Jaisalmer with a friend to visit another friend. In the middle of the desert, like some lunatic mirage, I saw this man with a luxuriant moustache wearing a hat and smoking a pipe while perched on a camel! I had met Ravi several times before and like anyone else would be, was delighted to see him again. He immediately took it onto himself to teach me and Swapna the art of riding a camel. After several hours of training he had to leave us as he was invited for lunch at a village some 3km away. He decided to go on camel back. After a couple of hours we saw him return, hurriedly (the camel was racing back) and get into a jeep and speed off in the same direction that he came from. We were puzzled but later learnt that it was the camel who was in a hurry and not him and this was the story: After he left us, he prodded and poked the camel into taking him to the village and the beast would not relent. The camel took a step at a time, stopping here and there to eat a morsel of some vegetation, with long halts to simply observe the countryside. An impatient Ravi in the meanwhile kept prodding and managed to get the camel to move a bit at a time. This went on for more than an hour till they finally reached the boundary of the village and the camel decided to move even slower and observe the countryside more keenly. Ravi who was very hungry and at the end of his patience prodded again - this time the camel turned around with gusto, and with energy never seen in a camel before, raced back 3 km with a stunned Ravi stuck to his back (and the pipe still stuck in Ravi's mouth)! A scene straight out of Tintin! But this is what I always remember Ravi as- a total clown – lovable, full of life and fun!

– Shomita Mukherjee
on Facebook, January 20, 2009

(Post No. 3: <http://www.facebook.com/topic.php?uid=59602514000&topic=6400> downloaded on 25 September 2009)

Ravi Sankaran's ornithological contribution

Asad R. Rahmani

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It is very difficult to write about a person who leaves this world at the prime of his career. We can only foresee his future contribution to science from the published work that he left behind, and what he would have done if he had had a full life. Ravi Sankaran's sudden death on 17 January 2009, at a young age of 46, has left a large vacuum in the Indian ornithological world. As a person who was associated with him since the start of his career in March 1985, and having spoken to him about his 'grand plan' for the Salim Ali Centre for Ornithology & Natural History (SACON), where he was the Director, on 16 January 2009, I feel privileged to write about Ravi's contribution to Indian ornithology.

Ravi joined the Bombay Natural History Society (BNHS) on 25 March 1985, and commenced working with me in the Endangered Species Project—I was in-charge of the fieldwork on the Great Indian Bustard *Ardeotis nigriceps* and florican (Otididae) species. On 1 April 1985 we went to Karera Bustard Sanctuary in Madhya Pradesh, where we had a field station, and after that we went for a one-month survey of the Bengal Florican *Houbaropsis bengalensis* in the Uttar Pradesh *terai* and the Assam valley. We saw our first Bengal Florican on 14 April 1985 in Kowaghati grassland of the Sathiana range, and he saw his first Lesser Florican *Sypheotides indica*, with me, in July 1985, in Sailana Florican Sanctuary in Ratlam district. These two species 'hooked' him for the rest of his life. Although after joining SACON in 1992 he studied many other species, particularly in the Andaman & Nicobar Islands, his first 'love' was floricans. Whenever we would meet, we would talk of them.

From 1985 to 1990, we carried out extensive surveys in Rajasthan, Madhya Pradesh, Uttar Pradesh, Gujarat, and Maharashtra, in search of Great Indian Bustard and Lesser Florican. His name first appeared in our report *The Bengal Florican: Status and ecology, Annual Report 1986-87*, (Rahmani, A. R, Narayan, G., Sankaran, R. Rosalind, L. 1988). His first independent popular article was *Sitting by a desert waterhole* (Sankaran 1986), which was based on our field visit to Sudasari enclosure in the Desert National Park where we spent some wonderful days, watching bustards and other birds, sitting in a cramped 3x3 m hide.

Ravi was a keen observer, a good writer and a good photographer. Besides working for his PhD thesis on the Bengal Florican in Dudwa and Lesser Florican in Sailana, he was interested in all natural history subjects. He told me many interesting observations and the conservation problems of his study areas. As he was still doing fieldwork, we did not have sufficient data to write scientific papers, but I encouraged him to write popular articles. In 1987, he wrote three popular articles on bustard and floricans in *Sanctuary Asia*, *Frontline*, and *Hornbill*. Our first scientific publication, albeit a short note, was about an observation made in the Sam enclosure in the Desert National Park, when we saw a Large Grey Shrike *Lanius meridionalis* methodically removing ticks from a camel (Sankaran & Rahmani 1987). Our next short note was on the unusual nesting of the Purple Sunbird *Cinnyris asiatica* (Rahmani & Sankaran 1990). Ravi was also co-author of a short note on the Black Drongo *Dicrurus macrocercus* eating a bird (D'Silva *et al*. 1990). This observation was made in Karera Bustard Sanctuary in 1988. Through these initial short notes, Ravi learnt the value of good observations, and publishing them in journals and magazines.

Under the Florican Project, we wrote many annual reports from 1987 to 1989, and the final report in 1990—but as these reports are grey literature, I will not mention them in detail (Please see Pittie 2009, for a list of Ravi's publications). The first major paper of this project, with Ravi as its first author, was published in *JBNHS* (Sankaran *et al*. 1992). That year we also published a status paper on the Bengal Florican (Rahmani *et al*. 1992). These two papers, and also his popular articles, laid the foundation for Ravi's ornithological work for the next 20 years. During the Florican Project, while Ravi, Goutam, and Lima did most of the fieldwork, I went through the published literature on these two rare birds, and pinpointed areas that required surveys. Through our joint efforts, we highlighted the deteriorating status of these birds, and also suggested conservation initiatives that were required to protect them. To gather data on the status of the Lesser Florican, Ravi conducted extensive surveys in western Madhya Pradesh, eastern Rajasthan, and Gujarat, visiting *vidis* or *bheeds*, as the grasslands are called in the local language, interacting with local people, and officials. We were helped by the earlier survey work of Paul Goriup and Z. J. Karpowicz (1985). However, Ravi found many more *bheeds* in Madhya Pradesh and Rajasthan where the Lesser Florican is found in the monsoon. He also established *Florican Watch*, involving local people. Despite his extremely busy fieldwork schedule, and distance (by 1992 Ravi had shifted to Coimbatore), Ravi made it a point to visit Lesser Florican areas every monsoon. If some people now protect floricans, it is only due to Ravi's untiring work.

In 1991, Ravi was awarded a PhD for his thesis on "Some aspects of the breeding behaviour of the Lesser Florican *Sypheitides indica* (J. F.Miller) and the Bengal Florican *Houbaropsis bengalensis* (Gmelin)", by Mumbai University. This was the culmination of his work under the Endangered Species Project. Although he did not publish many major papers from his thesis, some short notes came out in *JBNHS* on the breeding behaviour of the two florican species (Sankaran 1996a, 1996b). His paper on the relation between bustard body size and display type (Sankaran 1997), is a very interesting piece of work wherein Ravi shows a direct correlation between body size and display type in the bustard family. "The small bustards have aerial displays, with the smallest of these having a jumping display, those species with increased body size having flight displays, and beyond this body size, all bustards have ground displays". Ravi's analysis showed that the Bengal Florican and the Black-bellied Bustard *Eupodotis melanogaster* (of Africa) are at the size threshold beyond which all bustard species have ground displays. In his other

noteworthy paper (Sankaran 1994) Ravi re-analysed the ringing and recovery data of Dharmakumarsinhji (1950), and based on his own data proved that male Lesser Floricans do not return to the same territories year after year—their arrival depends on the rainfall pattern of the area and, they show disperse lek type with small male territories while females have large range. He did not find site fidelity from year to year, but strong site fidelity within a season. This behaviour should be expected from a species that moves for breeding to the semi-arid grasslands of north-western India, where the rainfall pattern varies from year to year—so if a male florican has a strong site-fidelity for display, in some years it may land up in the area with very little rainfall (and females). Therefore it has to shift breeding areas every year and selects areas with good over-all rainfall. However, the Bengal Florican, which lives in more stable grasslands of the *terai* and the Brahmaputra plains, with regular rainfall, shows strong site fidelity.

From 1993, Ravi's main work shifted to Andaman & Nicobar Islands, where he subsequently spent 15 years and made a long-lasting impact on its people and also on Andaman ornithology. His initial studies were in collaboration with Dr Lalitha Vijayan, as principal investigator, but soon he was the principal investigator of other projects. Lalitha and Ravi worked on a major project funded by the Ministry of Environment and Forests titled, '*A study on the ecology, status and conservation perspectives of certain rare endemic avifauna of the Andaman and Nicobar Islands*' (2000). Twenty species of birds are considered 'rare' on the Andaman Islands, of which the SACON team intensively studied the Andaman Teal *Anas albogularis*, now considered a full species by Rasmussen & Anderton (2005), Andaman Banded Crake *Rallina canningi*, Narcondam Hornbill *Aceros narcondami*, and Nicobar Megapode *Megapodius nicobariensis*.

Before Ravi's work on the Narcondam Hornbill, there were six visits by various ornithologists, mainly to collect specimen of this species or to study its ecology. Among his various studies, I consider his work on the Narcondam Hornbill unique, mainly due to its wonderful interpretation of field results. Unfortunately, this study has not been published in any peer-reviewed journal, although the results are given in the final report of the project from where I quote some highlights. The following description is also based on discussions with Ravi while I was collecting information for my IBA book.

The Narcondam Hornbill shows the greatest degree of endemicity of any of India's avifauna, being confined to only 7.5 km^2 of volcanic island. Its population varies between 330–360 individuals, of which 30–45 hornbills the policemen posted there, poach every year. The total breeding population is between 68–85 pairs. On this volcanic island (700 m asl), nearly 60% of the nests are found below 100 m, and 29% between 100–200 m—and no nest was located above 400 m. Therefore, despite the rugged terrain, most of the nesting sites are accessible to people. The age of the hornbills can be assessed by counting the rings on their casques. Its not always easy to see the rings, but nevertheless a valuable tool to study the age structure of hornbills. A bird with a single ring was considered to be a year old, two rings as two years, and so on. Ravi studied 17 nests, and found that barring three, in all the nests, males were older than the females. Narcondam Hornbills mature at about four years of age, and start forming pairs, and nest when they are about five years old. That males were older than females could indicate that either the latter are short lived compared to males or they prefer older mates. Another very interesting observation, made by Ravi, was on the age-class distribution of Narcondam Hornbill at different altitudes. He found that most of the younger birds, non-breeders mainly, were found above 300 m msl. This was consistent with the presence of all nests below 300 m msl, and could be indicative of age segregation to reduce pressure on resources.

The most interesting result of this study, which Ravi discussed with me in great detail, is the impact of goats introduced in 1974 or 1976 on the tiny Narcondam Island. As Myanmar was claiming the Narcondam Island as its territory—it is closer to Myanmar than to India—the Indian Government established a police post on Narcondam in 1969, and brought in policemen from Uttar Pradesh. Being from the mainland, they were not used to seafood, though abundant all around in the form of fish, crabs, lobster, etc. So, to provide fresh meat, goats were in brought in 1976. Over the years, the goat numbers crossed over 400, forming a sizable feral population. In the late 1980s and early 1990s, on the recommendations of the Ministry of Environment and Forests, the A&N administration removed some goats to satisfy the MoEF directive. During his study in 1998, Ravi found 135 –150 goats in the police camp of 50 acres, and estimated about 200 feral animals. He was shocked to notice a complete lack of vegetative regeneration, "there is virtually no herb and shrub layer, and more importantly no saplings of trees". As the island is volcanic in origin, with very high rainfall, the roots of trees hold the soil and boulders together. Hornbills nest in old trees with hollows and holes. Due to heavy rains and storms, many old trees fall every year. Once the canopy opens, new trees come up. However, if regeneration were not taking place due to domestic and feral goats, there would not be any replacement of dead and fallen trees. During his study, Ravi found that there was no dearth of nesting holes, but if regeneration of new trees does not take place and if the population of goats is not curtailed, in another 7–8 decades, there would not be many old trees left to provide nesting sites for the Narcondam Hornbill. Ravi also found that the police outpost, including houses, plantation, and kitchen gardens, already occupies about 50 acres. About 12 large trees are felled every year for fuel. All this has a great ecological impact on the long-term survival of this unique species found nowhere else in the world.

Another remarkable study for which the ornithological fraternity will remember Ravi is that of the Nicobar Megapode. Out of the 22 species of megapodes in the world, one species is found in the Nicobar group of islands. Megapodes are unique among birds as they incubate their eggs in mounds of rotting leaves, or geothermally (by the sun) heated burrows. Various species of megapodes are distributed from Nicobar Island to Australia, New Guinea, Indonesia, the Philippines, and numerous islands of the Pacific. Many species of megapodes have been studied, but detailed studies were not done on the Nicobar Megapode. This gap was ably filled by Ravi Sankaran's six-years study, 1992–1994, and 2005–2008, of the species. Ravi, and his student, K. Sivakumar, now a faculty of the Wildlife Institute of India (WII), lived in extremely primitive conditions on Great Nicobar Island to study the ecology and behaviour of this elusive bird. They surveyed 16 islands, ranging from 213 km^2 to 1.2 km^2. Ravi walked the coastline of all the 16 islands, covering nearly 687 km, and intensively surveyed 65 transects of 114 km. If you have such an intensive study, the results are expected to be good. It is a pleasure to read the results of this study in their final report (Vijayan & Sankaran 2000). The results of this study were also published in good papers (Sankaran 1995; Sivakumar & Sankaran 2003, 2005a–b) Preliminary results where published in *Zoologische Verhandelingen, Leiden* (Sankaran & Sivakumar 1999). Ravi also guided Sivakumar for his PhD on Nicobar Megapode (Sivakumar 2000). They have written many technical reports, not easily available to people (Pittie 2009). Sivakumar and Ravi read a paper "*Incubation mounds and mound use patterns in the Nicobar*

Megapode…" at the First Pan Asian Ornithological Congress, 1996, the proceedings of which were never published.

After the tsunami in 2004, Ravi conducted a survey and found a total devastation of Megapodes nesting mounds on many small islands. However, he was also hopeful that if the birds were left alone, they would return and recreate the mounds. Ravi was very worried about the amount of funds poured into Andaman & Nicobar Islands in the name of tsunami relief, and the type of corrupt people who generally follow these funds. On some islands, more ecological damage was done in the name of tsunami relief than the tsunami itself!

Ravi's study on the Edible-nest swiftlet is another masterpiece. It involved basic biological work in extremely trying field conditions, understanding the conservation problems, realising the impossibility of physically protecting the nest caves on discrete islands with the limited capacity of the forest department, and knowing the potential of benefiting the local people by sustainably harvesting nests of this species. Although I have not seen nesting colonies of Edible-nest Swiftlet, I have been following Ravi and his student's work for the last decade or more. After Ravi explained to me how sustainable harvesting of nests of this species would help in its protection, I fully backed him and SACON in their request to the Government of India to de-list it from Schedule I to Schedule IV to enable the sustainable harvesting and export of its nests. Perhaps the last report submitted by Ravi, along with his student, Manchi Shirish Sheshnarayan, was to the Government of India and the Andaman & Nicobar state Government (Sankaran & Sheshnarayan 2008).

I think a little background on this issue would help the readers fully appreciate Ravi Sankaran's brilliant approach to conservation of the Edible-nest Swiftlet. The following description is based on the final report *A Study on the Ecology, Status and Conservation Perspectives of Certain Rare Endemic Avifauna of the Andaman and Nicobar Islands*' (Vijayan & Sankaran 2000) his recent papers, his letters to the Government of India, and my discussion with Ravi, and his student Manchi Shirish Sheshnarayan, who has submitted a thesis on Edible-nest and Glossy swiftlets (sadly after Ravi's demise).

Four species of swiftlets are found in India: the Himalayan Swiftlet *Aerodramus brevirostris* in the Himalayas and north-eastern India; the Indian Edible-nest Swiftlet *Aerodramus unicolor*, found in the Western Ghats, Sri Lanka and coastal islands; the Edible-nest Swiftlet *Aerodramus fuciphagus*, and the Glossy or White-bellied Swiftlet *Collacalia esculenta*, the last two found only on the Andaman & Nicobar Islands in India, but widespread in South-east Asia. None of the species is globally threatened, although some populations are under threat due to unsustainable harvests of their nests by poachers.

The four species of swiftlets make nests using their saliva and feathers, vegetable matter, small leaves, and twigs—collected in flight. The Edible-nest Swiftlet is unique as it makes a nest of pure saliva, with none or very little impurity. In the 16th century the Chinese discovered the cuisine value of the nests and since then the species has been over-exploited all over its range. Other species are also exploited but their nests are of inferior quality, as they have impurities like feathers, feces, leaves, etc. Harvesting of nests of Edible-nest Swiftlets started in the 18th century in Andaman & Nicobar Islands where it was mainly an unregulated activity (Sankaran 1998). The Indian Edible-nest Swiftlet nests in the rocky caves and grottos of the Western Ghats and coastal islands such as Vengurla Rocks off the Malvan coast in Maharashtra, and Pigeon Islands off the coast of North Kanara (Ali & Ripley 1987). Its nest is full of 'impurities' such as feathers, moss, lichens, but nevertheless it is exploited in some areas. Due to over-exploitation of nests of this species in the Vengurla Rocks and resultant protests by activists, all the species of swiftlets were brought under Schedule I of the Wildlife Protection Act, nearly ten years ago.

During his study of the avifauna of the Andaman & Nicobar Islands, Ravi Sankaran became interested in the fate of Edible-nest Swiftlet. In his 1997 survey Ravi found 6,631 breeding pairs in 291 caves (Sankaran 1998)—all the colonies were over-exploited, and nests collected irrespective of whether they contained eggs or chicks. At Port Blair, a kilogram of nests (70–125 nests) fetches between Rs 15,000 and Rs 20,000, sometimes more. He also found that it is extremely difficult to protect nesting colonies on remote islands and in remote caves—with the latter's approaches sometimes known only to poachers. He found population declines of the Edible-nest Swiftlet as evidenced from diminishing nest yields. Ravi saw an opportunity in this dire situation—instead of trying to curtail nest collection, why not regulate it and let the local people earn some additional income? Nests can be harvested after the chicks have fledged and flown away. This involves no killing and allows nests to be harvested year after year, as birds build new nests every year. In order to give scientific support to his plan, first a proper study had to be done on the Edible-nest Swiftlet and also the Glossy Swiftlet. With the collaboration of the Department of Environment and Forests, Andaman & Nicobar Islands, SACON started a study in 2001 in 29 caves. Intensive data collection took place from 2004 to 2007.

Photo: *Pankaj Sekhsaria*

A megapode nest in the coastal forests Great Nicobar Island (2002).

Edible-nest Swiftlets breed and roost in dark caves as they navigate in darkness by echolocation. However the Glossy Swiftlet does not echolocate and builds nests near cave openings and even in old buildings, and under bridges. In order to engineer better *ex-situ* swiftlet houses with a view to sustainable harvesting, Ravi and his student studied nest site characteristics in 29 caves—rock texture, rock contour, inclination of walls, micro-meteorological parameters (temperature and humidity), nest orientation, and predatory pressures.

As the two species nest almost at the same time, and also feed on dipterous, hymenopterous, and hemipterous insects, caught in the air, eggs of Edible-nest Swiftlets can be transferred to Glossy Swiftlet nests to increase the population of the former, and also to develop new nesting colonies for management and sustainable harvest. Both the species raise multiple-broods, sometimes nesting four times in a year, so it was also necessary to find out which is the best time to harvest the abandoned nests without unnecessarily disturbing the birds.

During the last six to seven years Ravi had developed a team of local people who were ready to start a cooperative society, with strict rules and regulations, for the sustainable harvesting of Edible-nest Swiftlet nests. They had even collected about 28 kg of nests. But the problem was that the nests could not be exported out of the country, as the species was in Schedule I of The Indian Wildlife (Protection) Act, 1972. We both had numerous meetings in the Ministry of Environment and Forests, Government of India, to remove Edible-nest Swiftlet from Schedule I. Finally, the Standing Committee of the National Board for Wildlife took this bold decision on 17 July 2009—sadly after Ravi's death. However, Ravi has left a very robust plan with the Department of Environment and Forests, Andaman & Nicobar Islands, which, if properly implemented, will be first of its kind, with an out-of-box approach to conservation.

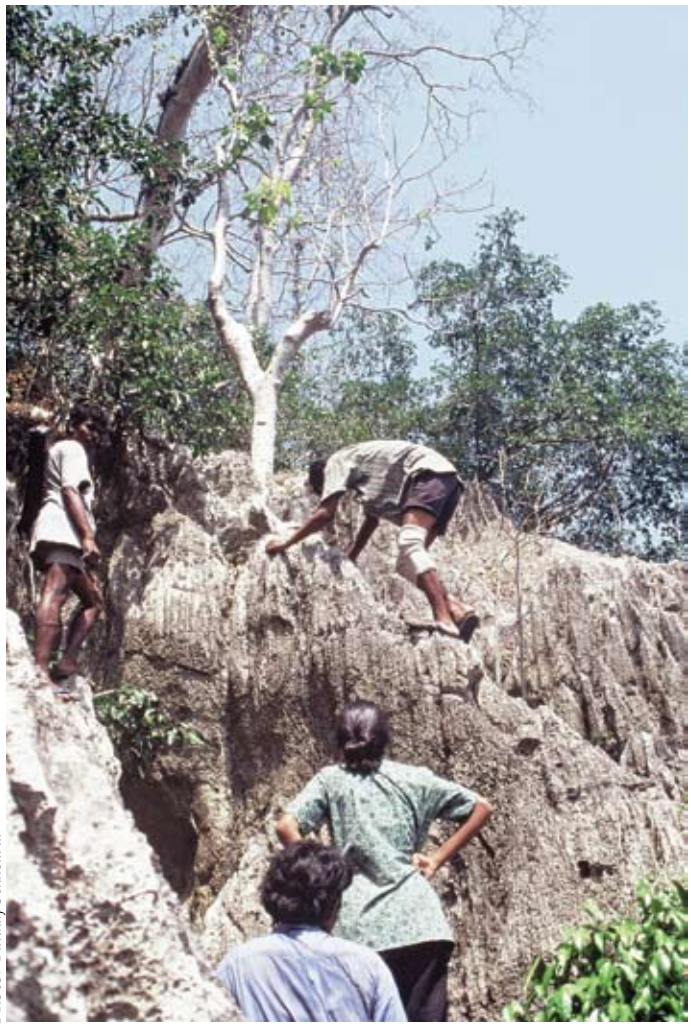

Photo: *Pankaj Sekhsaria*

Climbing the rocky Challis Ek complex. Ravi (with strapped knees) and his wife Deepa (hands of hips)

According to this plan, local people will be involved in the protection of nesting caves, and nests will be harvested only after the breeding season is over. Nest harvest will be strictly regulated through cooperative societies (on different islands or groups of islands), and exported under government supervision. New Edible-nest Swiftlet colonies will be developed by foster parenting, i.e., replacing eggs of Glossy Swiftlets with eggs of Edible-nest Swiftlets, and wherever necessary, structural changes will be made in houses to provide suitable substratum for nesting and also to maintain the micro-climate of the artificial nesting colonies (light, humidity, and temperature). The scientific background for doing this is already available through the studies done by Ravi and his student. Fortunately, the administrative support of the Andaman & Nicobar government is also available.

If the population of Edible-nest Swiftlet increases, and local people benefit from benign harvest of its nests, we have only Ravi Sankaran to thank for his foresight, planning, and scientific approach in solving this conservation problem. In the Indian conservation scenario, full of bleeding heart animal right activists, we have to listen to people like Ravi Sankaran for their ecological wisdom, and species-specific conservation planning.

Ravi was a good teacher, always looking for quality students, whom he found in Sivakumar and Manchi Shirish Sheshnarayan. They have not disappointed him. Ravi has also inspired many students—some willing to continue his work on the Lesser Florican, Nicobar Megapode, Narcondam Hornbill, and Edible-nest Swiftlet.

Modern, objective, and scientific thinking were Ravi Sankaran's forte. In many conservation approaches he was ahead of his time. I have seen his growth from being a pure field biologist interested only in the ecology, behaviour, and conservation of a species, into a practical conservationist—where involvement of people, particularly local communities, became a defining paradigm for him. Besides his approach to conservation of Edible-nest Swiftlet, lately, he was also involved in a major project *Strengthening community conservation efforts in Nagaland: a programme to impart technical support on biodiversity conservation and livelihood options to communities*. It is a collaborative programme between the Nagaland Empowerment of People through Economic Development, Kohima (NEPED), and SACON, funded by Sir Dorabji Tata Trust, Mumbai. He was executing this project in collaboration with some other organisations such as Kalpavriksh, Pune; Ecosystems India, Guwahati; Aranayak, Assam; ATREE, Bangalore; and Nature Conservation Foundation, Mysore. The aim of the project is "To develop mechanisms by which the existing community conservation efforts in Nagaland are strengthened, expanded and lead to livelihood benefits since some local communities have by their own volition set aside areas within their village lands for the preservation of wildlife. The approach will be that of training a core group of individuals from different tribes who will facilitate a resource group with expertise in biodiversity conservation and livelihood options." Fortunately, SACON has taken responsibility to complete this project.

In a research career of 23 years, Ravi wrote 21 full papers, 12 short notes in peer-reviewed journals, nine scientific articles in magazines and 37 project reports. Most of these reports are

available in the libraries of BNHS and SACON. A bibliography was published by Pittie (2009).

Long walks in the rain in Sailana, sitting for an entire day in cramped and damp hides to watch the display of the Lesser Florican, perching on a 20 m *machan* in Sathiana grassland in Dudwa to study the behaviour of the Bengal Florican, all gave Ravi the initial strength to become one of the finest field biologists of India. His inquisitiveness to learn, incisive questioning ability, writing and speaking skills further added to his character, including his signature pipe!

I think the best tribute to Ravi Sankaran by us would be to see that the Lesser Florican continues to display in the grassland of Sailana, chicks come out from the nest mounds of Nicobar Megapodes, the goats of Narcondam Island are totally removed, a nest harvesting cooperative systems is put in place to benefit local people and the Edible-nest Swiftlet, and people of Nagaland manage more biodiversity areas for the benefit of wildlife and their welfare.

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I want to thank Aasheesh Pittie for asking me to write this article on Ravi Sankaran. I want to thank Rajeshwari (Deepa), Ravi's wife, who gave me strength to write this paper. I also want to thank P. A. Azeez, Director-in-Charge of SACON for providing me unpublished documents, and Ravi's two students K. Sivakumar, and Manchi Shirish Shesnarayanan for going through the manuscript.

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Photo: *Pankaj Sekhsaria*

Ravi Sankaran

Edible-nest Swiftlet *Collocalia fuciphaga*: extinction by protection

Pankaj Sekhsaria

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Prologue

This piece was written sometime in 2004, and included detailed inputs from discussions the author had with Dr Ravi Sankaran. Tragically, Dr Sankaran passed away in January 2009, after suffering a massive heart attack.

It was reported on 18 August 2009 that Dr Sankaran's efforts to de-list the Edible-nest Swiftlet had finally been de-listed, raising hopes that the project he had initiated for the conservation for the birds in the Islands would have a fair chance of being implemented. ['Selling bird's nest soup to save this bird: there's a change in law.' Tuesday, Aug 18, 2009 at 0354 hrs New Delhi: http://www.indianexpress.com/news/selling-birds-nest-soup-to-save-this-bird-theres-a-change-in-law/503342/0.]

Introduction

The path to hell, for humans, it is said, is paved with good intentions. For a little bird in the Andaman & Nicobar Islands, the Edible-nest Swiftlet *Collacalia fuciphaga*, the path to extinction, it would seem, too has being paved with similar good intentions. Being listed in Schedule I of the Indian Wildlife (Protection) Act, 1972 (WLPA), is the ultimate recognition of the endangered status of any creature in India

A nest of saliva

It also means that the highest degree of protection will be accorded to the species, and this is exactly what has happened in the case of the Edible-nest Swiftlet too. Herein lies the ultimate paradox, and probably the seeds of an unfolding tragedy. At the crux of the matter is the nest of the bird that is made entirely of its own saliva. The final product is a beautiful white 'half-cup', roughly six centimeters across with an average weight of 10 gm.

Photo: *Pankaj Sekhsaria*

Edible-nest Swiftlet's saliva nest.

This is indeed a fascinating biological quirk, but one for which the bird has had to pay a heavy price. Since the 16th century, when the nest of the bird is reported to have become an important part of Chinese cuisine and pharmacy, its been heavily exploited across its range. While there is little modern scientific evaluation or validation of the efficacy or efficiency of the nest, consumption has been immense. A TRAFFIC International publication of 1994 estimated that about nine million nests, weighing nearly 76 tons, were being imported into China annually. Not surprisingly then, the wholly edible white nest was and continues to be one of the world's most expensive animal products, pegged sometime back at US $ 2,620-4,060 per kg in retail markets in the South-east Asian countries.

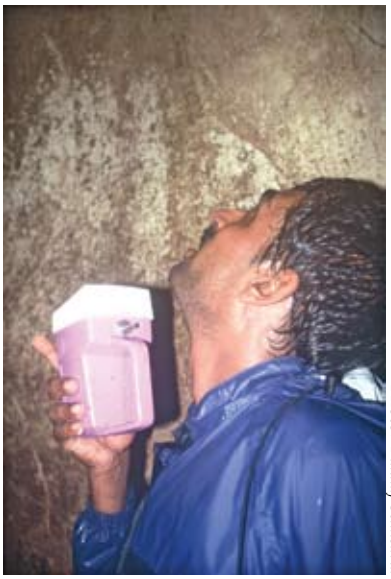

Photo: *Pankaj Sekhsaria*

Ravi inside a cave during the monsoon.

It is well known that a part of the international trade was being fed by the extraction of nests that takes place from the Andaman & Nicobar Islands, but authentic information only started coming in 1995, when the first studies were initiated by ornithologist, Dr. Ravi Sankaran, of the Salim Ali Centre for Ornithology and Natural History (SACON). He initiated a laborious and painstaking process of locating the nesting sites and enumerating the nests and birds. Detailed surveys were conducted on the islands between March 1995 and early 1997, where he visited a total of 385 caves (325 in the Andamans). The outcome was two pioneering reports. The first published in 1995 dealt with the Nicobars and the second, in 1998, presented a complete picture of the situation in the entire archipelago.

A threatened population

Sankaran's studies estimated that the total breeding population on the islands was about 6,700 breeding pairs. He reported that at least 94% of the caves were being exploited for the bird's nest, and that less than 1% of the breeding population was being allowed to successfully fledge as the nests were being harvested for the market

before the nesting could be completed. Sankaran estimated that the Edible-nest Swiftlet had experienced a whopping 80% decline in its population, placing it in the critically threatened category (IUCN criteria A1c). This was primarily due to indiscriminate and unrestricted nest collection from the wild, leading him to the further conclusion that if this was not dealt with urgently the bird would soon be extinct in the Andaman & Nicobar Islands.

He initially advocated strict protection, but changed his stand when he realised that protection, in the conventional sense, would not work. He also learnt of the ingenious house ranching methods developed by the Indonesians for managing swiftlets.

House ranching

It was estimated that nearly 65,000 kg of nests were being produced in Indonesia annually, from colonies of the Edible-nest Swiftlet that reside within human habitation: a total of 5.5 million birds and their nests, in houses and rooms of human habitations, optimally managed by humans. "Thus, while swiftlet populations in caves will continue to decline, or become extinct, due to collection pressures," Sankaran concluded, "the species will survive because there are hundreds of thousands of birds that reside within human habitation, all optimally managed".

Nest collectors, he started to advocate, would have to be empowered to harvest nests within the rigid framework of strictly scientifically harvesting regimes. This would have to be complimented in the 'Indonesian way', with a realistic long-term strategy that would include both in-situ and ex-situ conservation programmes, i.e., house ranching, both based on the economic importance of the species and using this importance to organise local communities to conserve the species.

In 1999, his recommendation took the form of an innovative initiative that was launched jointly by the Wildlife Circle of the Department of Environment and Forests, Andaman and Nicobar Islands, and SACON. The final aim of the initiative was to ensure protection of the nests in the wild so that eggs would be available for the house ranching ex situ component. The project took off well. Protection accorded to a complex of 28 caves on Challis Ek in North Andaman Island, and one cave on Interview Island Wildlife Sanctuary, saw over 3,000 chicks being fledged, a growth of over 25% in the population of the swiftlets at these sites. A team of local people, who were earlier nest collectors, were now being motivated towards protection, and subsequently, sustainable harvesting.

The law becomes the hurdle

Just as phase one was taking off, the law came into the picture, and in October 2003 the Edible-nest Swiftlet was put onto Schedule I of the Wildlife Act. This meant that there could be no activity that involved use of, or trade in the nest of the bird—the primary premise on which Sankaran's initiative had been based. The entire project was dealt a set back and in spite of continued efforts, over the years, to have the swiftlet removed from Schedule I, it continues to be listed there.

Admittedly there are genuine concerns about the de-listing of a species and the implications of an act of this kind. The biggest fear is of setting a precedent that could be misused by vested interests. In this case however, the recommendations are based on solid, detailed, and pioneering scientific studies of nearly a decade, and were in turn backed with a wealth of international information and experience. "Its more like apiculture," would be Sankaran's argument, "where bees are reared for their honey. House ranching of swiftlets cannot be likened to the farming of animals for skin or meat". The implication of not delisting the bird is that the conservation initiative is bound to fail, while harvesting from the wild would continue unabated. The consequences of this would be the local extinction of the bird in the Andaman & Nicobar Islands—a predicament that was summed up with stunning simplicity by J. C. Daniel of the Bombay Natural History Society. Speaking during the concluding session of the International Seminar to commemorate the centenary Journal of the Bombay Natural History Society in Mumbai in November 2003, he spoke of the fate of the Edible-nest Swiflet if corrective action was not taken at the earliest: extinction by protection—the ultimate oxymoron.

Photo: *Pankaj Sekhsaria*

Ravi with his field staff and wife Deepa at the Edible-nest Swiftlet Camp, Challis Ek, North Andaman Island. (Challis Ek translates as '41'—which is the number of caves in this cave complex where the swiftlets are found). At extreme left is Alex, Ravi's man Friday. They worked together for a vey long time and, like was Ravi's way of working, they also became close family friends.

The inimitable Ravi Sankaran I knew

Ashish Chandola

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He was junior in age, but we got along very well, since we first met at Manas Tiger Reserve, Assam, in 1984. That we shared in common a fondness for many things became evident at that first meeting. Of these, the fondness for feathered, spotted, and furry creatures, and a few common friends, endured the test of time.

Looking back on the three decades, and more, that I had known Ravi, today, I too feel like many of his more recent friends who have been posting comments on his page on Facebook—all of us wish we had been able to interact with Ravi for a longer period of time! I quote: *"hey Ravi, keep forgetting that you are not there any more, miss you, want to argue/laugh with you and ask you stuff, get your crazy advice, hear your insults…no one's written for a long time here, but we remember you…Aparajita"* (21st May 2009; Facebook).

It is said that we must move on…that life goes on, moves on. The shock ebbs but not the tugging sorrow, which will remain a part of this life for all time to come.

He hid from my camera, but not from my company. I hardly have any photos of him, but memories and stories abound—of *bhindi* for breakfast, lunch, and dinner; of the black cobra that I had trapped in his insect net, unaware that a hole in the net had positioned the snake within a comfortable striking distance of my arm!

At his field station at Sailana, I recollect so well, how Ravi never failed to delight in the charming call of the Rain Quail *Coturnix coromandelica* as it reverberated—picked up by one male bird and then another, across their grassland habitat, as it turned green, with the advent of the monsoon rains. I was there to film the Lesser Florican *Sypheotides indica* at the start of its breeding season, and Ravi had embarked on his first major project of studying the breeding biology of this rare, elusive, and enigmatic bird, which included counting how many times a minute, the male bird leapt up in its crazy, carefree display.

Ravi had started his career under the uncompromising gaze, and the demanding tutelage, of Dr Asad Rahmani. . When we met at Manas Tiger Reserve in Assam, Dr Rahmani, accompanied by Usha, and Ganden, was driving a battered old project jeep of the Bombay Natural History Society (BNHS) across India—quite unmindful of its bent chassis—surveying bustard and florican habitat.

Ravi traveled in the back of the jeep, a lanky, dark lad with a shock of unruly hair, quite unconcerned that his occasional *beedi* smoking was frowned upon! The forest department folks at Manas promptly told me that the "boy" accompanying the party must be to look after the luggage and keep the *gaadi* clean! They also told me that he had a very big flute with him, and played it well!

Years later, when I related this story to Ravi he just grinned his usual grin, and was lost in a cloud of aromatic smoke as he fired up the pipe whipped out from his pocket, complete with Erinmore Flake tobacco, all the way from Denmark, to which he had now graduated!

Manas has the Bengal Florican *Houbaropsis bengalensis*, and I had volunteered to show Dr Rahmani and party some of the grasslands where we knew the birds were present. When we assembled at Mathangudi bungalow in the morning, Ravi spoke too soon. He hardly knew his birds then and to cut a long story short, he promptly misidentified a dove as it landed in a nearby tree, calling it a shikra! This put him at the receiving end of a thorough dressing down delivered by Dr Rahmani.

This was just the beginning as Dr Rahmani again ticked Ravi off when he plucked the flower of a ground orchid and brought it for the party to see. The comment from Dr Rahmani went somewhat like this: "Why did you pluck it? It could be the last specimen of its kind. You must check before you destroy things". I believe that such lessons learnt from a perfectionist, must surely have ingrained in Ravi the habit of double-checking facts, and not speaking too soon—lessons perhaps, that contributed in no small measure to his achievements as a scientist in later years.

It is indeed hard to forget the oversized flute, though I never did get to hear him playing it. To me now, it is a symbol that this chap did every thing on a grand scale!

It was at Sailana though, that Ravi promised to get me some honey of the big bees that make their hives in amongst the sheltered crannies of rocky outcrops. He never did get the honey, and right till our last meeting, a few months back, accused me of making his younger days "miserable" by reminding him about that unfulfilled promise!

As *bhindi* was our staple at Sailana, fantasizing about honey and good food was hardly surprising. And just down the road lived the former ruler of the area, in his regal residence. Though the old fort had been beaten down in brilliance by time and fate, the Sailana Raja had a formidable reputation as a master cook. So when we were invited to the fort there was much anticipation of exotic victuals like *pakoras*—and though the tea did not quite turn out that way, we were shown the huge and varied collection of the most unbelievable cacti, which Raja *sahib* had gathered with care, and was most passionate about. This was most fascinating.

Ravi went through a phase when he took brilliant photographs, and some of the very best of the Lesser Florican that I have seen. He was generous and handed the originals around, and the originals of some of his favorites never got returned to him. At Karera he decided to photograph a common Indian fox *Vulpes bengalensis* that had denned in the middle of the village road between the two ruts in which the local bus and other vehicles ran. He borrowed my canvas hide and set this up in a depression near the den. Next morning, while it was still dark, he took a cycle, which he hid in a ditch close to the hide, and positioned himself for photography.

Karera is one of the hottest places on Earth, as far as I am concerned, and temperatures reach well over 40ºC by 0830 hrs. When we next saw Ravi, around 1000 hrs, bathed in sweat, there was disgust writ all over his face. No, the fox had not come to the

den. When he could not bear the stifling heat inside the hide any longer Ravi had got out only to see the fox sitting by the bicycle watching the hide!

The BNHS has always consisted of a bunch of the most brilliant, dedicated, and colourful characters, and Ali Hassan, the famed bird-catcher was all of this, and more! When I finally caught up with him at Karera, he was forever bragging about his ability to catch *any* bird, however big or small (after having recently failed to trap the Great Indian Bustard *Ardeotis nigriceps* in spite of several attempts!), and when we tried to get rid of him by asking him to catch the Common Myna *Acridotheres tristis* feeding on the ground nearby, he *did* turn up with it in his hand in about an hour's time, much to our disgust!

Mehboob, Ali Hassan's son and assistant, was very good at wielding a stout stick as a weapon, and the skills to show off had been passed down from father to son in full measure! To shut Mehboob up and to save us from the disturbing sight, and whirring sound of his lethal stick as he twirled it over his head and side, passing it from one hand to the other with frightening precision, Ravi jumped into a well and dared Mehboob to do the same. Mehboob was too frightened even to look into the depths of the well let alone jump in, and was so respectful of Ravi's amazing feat that he actually became quite shy of showing off his stick craft!

Ravi's penchant, and sheer fascination for jumping into wells became legendary, earning him much respect from village folk, colleagues, and friends. I believe he finally gave up this sport of jumping into wells after he jumped into one where the water depth was far less than what he'd envisaged! But then, he never did talk about that one!

Being stuck down in a well is no fun for any length of time however cool the water may be! So, to beat the Karera heat Ravi found a fast drying 'drainage' near the asbestos roofed 'hut' that served as the BNHS field station. And to this we would retreat to while away the hottest part of the day. Water flowed under the sand and into a fair size pool and as we could never sit idle we took to catching fish. Not for the pot, but just a few to feed the bright eyed little mongoose that visited camp in the mornings. And then we caught this flat 'thing' with a ridged back and eyes on top of its head - obviously a bottom feeder but something about it seemed charming. Ravi suggested that it could possibly be the only one of its kind and promptly let it go. Dr Rahmani would have been pleased to hear that comment—but he was sitting in front of a large desert cooler back at the field station!

Shanthi and I discovered that our apartment in Chennai was very close to where Ravi's parents lived, when Ravi turned up at our doorstep one evening, with Simba and Kali, two boxers that belonged to his father, in tow. These visits were to become a regular feature, as were Simba's loud protest barks if Ravi stayed on for a third glass of beer! Ravi's pleadings, "please Simba, just half a glass…", would have little effect. Simba would claw the tiled floor in a furious digging motion and demonstrated to us that vitrified tiles were *not* scratch proof after all! Dogs were Ravi's great love, and an answer to many things. We guessed that Ravi's wife Deepa, had brought up the topic of having children when we received a frantic call from Ravi asking us to find him a fox terrier, as that would surely distract Deepa!! When their daughter Yamini, was born, the deeply caring, affectionate, and proud father in Ravi emerged, which to many of his friends, was quite a revelation!

Both Deepa, and Ravi loved riding horses, and according to some friends who were eyewitnesses, Ravi even smoked his pipe with relaxed ease while riding a camel. Shomita Mukherjee has a good story of Ravi riding a reluctant camel to lunch in a village 3 km away from their camp, and how he nearly missed out on the good meal! This is posted on Dr Ravi Sankaran's page on Facebook and is a good read. There are other stories too which this writer would love to quote from but feels strongly are best read in the Facebook pages on the Internet [http://www.facebook.com/pages/Dr-Ravi-Sankaran/59602514000].

Anything for a good laugh was something Ravi lived by. We met up in Mumbai at the Taj, where a cousin sister of my wife Shanthi, was a well-known and senior member of the staff. Ravi insisted that we do a *tonga* ride around the Taj, much to our amusement, and the cousin's embarrassment, who dreaded being seen by her colleagues. She was totally perplexed by Ravi!

He met us at Port Blair airport when Shanthi and I visited the Andamans over Christmas and New Year in 2001–2002. He took us straight to the jetty and helped us board the d*ungi* that would take us across the open sea to Havelock Island where friends were already in the midst of a major party. When Shanthi, a vegetarian, realised that the main party ingredient, a huge pig, was all trussed up at one end of the *dungi*, and traveling with us, she was not amused, but Ravi was, and very much so!

As if that was not enough, as the *dungi* pulled away from the jetty Ravi shouted out the details of discomforts caused by seasickness. But then Ravi was like that—he made light of things that would send others into a major depression and people around benefited from his outlook. His sister, Deepa, took a long time to forgive Ravi for dancing a gig singing, "Its broken! Its broken!", when her favorite porcelain vase fell on the floor and shattered! That was Ravi!

The sea was rough and we were thoroughly drenched by the spray. What was amazing, and in fact mesmerizing, was to experience the skills of the Karen boatmen as they took such a small craft across the open sea, braving huge waves, and yet staying a steady course without any visible effort or concern. And we were grateful that we did not suffer the perils of seasickness in spite of the dread that Ravi tried to instill in us!

In the Andamans, Ravi was totally convinced that the long-term survival of the endemic variety of the Edible-nest Swiftlet *Collocalia fuciphaga* could only by secured by cross-parenting, and the participation of nest collectors in protection. He spent much effort and showed how this could and should be done. Shanthi and I made a small video of this and have put it on Ravi's Facebook page for all to see [http://www.facebook.com/pages/Dr-Ravi-Sankaran/59602514000?v=app_2392950137&viewas=0].

Philosopher, Ravi certainly was not! He was grounded in realism. It revealed itself in what he said and in what he did. Donning the role of the devil's advocate came with ease to him, and he did this with much aplomb, drowning out others with his booming voice and extreme stand. To those who knew him well, it was obvious that he was provoking, so as to hear all sides of an argument before winding things down, and reaching an informed conclusion.

Need for flagging concrete around the house was one such debate: Deepa and Ravi had constructed on their farm near Coimbatore, and we had just finished our home at Whitefield, Bangalore. So when he visited us he declared with all the finality he could muster that flagging concrete around the building was a total waste and not needed at all! And then surprised Shanthi by calling all the way from Nagaland to discuss how best it could be done without spending too much money!

To have a chapter of BirdLife International in India was desirable, and not in argument. The big question mark hung over whether the many entities, all swearing allegiance to Indian ornithology, would work in harmony under such an umbrella organization—a situation that few would voice and even fewer confront. The reality of this question, that he posed, was the "cat"

he was pleased to release amongst the "pigeons", and of which he had already told his friends before the meeting started.

Much has been said about Ravi's contribution to science and conservation, his ability for hard work, his administrative skills as Director of SACON when he was so suddenly taken away from us all. At the memorial meeting held at Chennai, speaking eloquently about her mentor, one of Ravi's students elucidated so well Ravi's basic approach—he would constantly hammer in the conservation angle to his students, she told us, and would say, 'What are you going to do with your petty PhDs? What are you going to do for the subject that you are studying, what are you going to give back to the habitat and the people in the area? Think about that.'

For years Ravi had been telling us to make a film on the grasslands, and would talk at length of the importance of these for water conservation, rural India, and wildlife. As much of Gujarat has had a good monsoon this year, Shanthi and I went looking for the Lesser Florican, and were pleased to find a good number jumping in the various grasslands. Ravi had taken a fuzzy photo of a male bird walking through the grass, with neck outstretched, and head plumes pointing forward, a possible threat display, which our common friend and reputed wildlife artist, Carl D'Silva, converted into a remarkable etching on glass that now adorns a space in our home. We were fascinated to see the same posture, assumed by a male bird, just two weeks back, as it moved purposefully forward through short grass, and also managed to record it on video. Looked like it was not too pleased to see a Black Partridge *Francolinus francolinus* too close to its jumping spot!

This once again brought on the emptiness that one feels without the enthusiastic and all effusive presence of Ravi—how pleased he would have been to see the video of the florican with neck outstretched and head plumes pointing forward and even more so, as he had not described this in any detail in any of his published papers, but had only spoken of it in informal forums at the BNHS, at which Carl was also present.

While we were in Gujarat, a friend forwarded us an article that had appeared in the Indian Express on the 18th of August 2009.

"Selling bird's nest soup to save this bird: there's a change in law."

The National Board for Wildlife (NBWL) had finally de-listed the Edible-nest Swiftlet for 3 years, to allow the sustainable harvesting of the bird's nest to help the long-term survival of the species by involving nest collectors in the conservation effort. The proposal had been pending with the NBWL for three years. Ravi's work in the Andamans had been directed exactly towards this. He would have been happy, but would also have insisted that a lot of work remained to be done, and directed some of his students towards the Andamans, if not headed out there himself!

Animals, birds, furry and feathered, smooth, spotted, striped and mottled creatures have lost someone who loved them so very much. Landscapes across the high mountains, flood plains of the Bengal Florican, the grassland and deserts of the Lesser Florican and the bustard all have lost a friend who represented them with passion, aided so well with an authority gained through scientific enquiry. But for me, my dear friend Ajith Kumar's words on Facebook says it all—I copy and paste:

'ltm' said…"Lots of people like me are still grieving in silence, not for the loss to conservation, but for having lost a great friend; no words can express our sorrow…time cannot heal this wound".

Photo: *Ashish Chandola*

Male Lesser Florican *Sypheotides indica* threat display. Glass etching by Carl D'Silva. Collection of Ashish & Shanthi Chandola.

—In the news[1]—

Compiled by Praveen J.

Great Himalayan Bird Count - 2009

After the grand success of "Great Himalayan Bird Count, Winter of 2008", Action and Research for Conservation of Himalayas (ARCH) has announced the dates of this year's counts. "Great Himalayan Bird Count, Winter of 2009" is planned along 36 popular trekking trails situated in the valleys of rivers Tons, Yamuna, Bhagirithi, Bhilingna, Ganga, Mandakini, and Alaknanda, in the Garhwal Himalayas, including Asan, and Jhilmil Jheel Conservation Reserves in Dehradun, and Haridwar districts, respectively. The bird count will start on 7 November 2009 at Dehradun and finish three days later, on 10 November, at the same location. Sixteen groups will undertake 36 different treks of roughly ten kilometers each, during these days. ARCH is encouraging the participation of school children as they strongly feel that young minds should start thinking of conservation as an academic and career pursuit rather than as just another creative pastime. This event will be organized with the support of the forest department of Uttarakhand. For more details on participation and methodology please email *arch.himalayas@yahoo.co.in* or *arch.birdcount@yahoo.in.*

A new 'Bald' Bulbul from Laos

An odd songbird with a bald head, living in a rugged terrain in Laos, has been discovered by scientists of the Wildlife Conservation Society (WCS), and the University of Melbourne, as part of a project funded and managed by the mining company Minerals and Metals Group (MMG). Named Bare-faced Bulbul *Pycnonotus hualon*, because of the lack of feathers on its face and part of its head, it is the only example of a bald songbird in mainland Asia. It is the first new species of bulbul, a family of about 130 spp., described from Asia in over a century. A description of the new species has been published in the July 2009 issue of *Forktail*, the journal of the Oriental Bird Club. The thrush-sized bird is greenish-olive, with a light-coloured breast, a distinctive, featherless, pink face with bluish skin around the eye, extending to the bill, and a narrow line of hair-like feathers down the centre of the crown. The bird seems to be primarily tree dwelling. It was found in an area of sparse forest, on rugged limestone karsts—a little-visited habitat known for unusual wildlife discoveries. This discovery highlights the importance of this region for birds and biodiversity. Fortunately, much of the bird's presumed habitat falls within legally protected areas in Laos. However, quarrying of limestone looms as a potential threat to wildlife in this area, along with conversion of habitat for agriculture *(http://www.birdlife.org).*

From the field

Vivek Tiwari reported an Osprey *Pandion haliaetus* along with other birds like Wedge-tailed Green Pigeon *Treron sphenura*, Sooty Flycatcher *Muscicapa sibirica*, Spotted Forktail *Enicurus maculatus*, Yellow-breasted Greenfinch *Carduelis spinoides*, and Greater Pied Kingfisher *Todiramphus chloris* between 6–8 August 2009 at Sat Tal, Uttarakhand (*DelhiBird*). Mohina Macker and others reported Bridled *Sterna anaethetus* and White-cheeked *S. repressa* Terns near Colaba fishing village, Mumbai on 26 July 2009 (*BirdsofBombay*). A set of coucal photographs taken by Bhaskar Das on 25 August 2009 from the Howrah area, in West Bengal, also showed a sub-adult Lesser Coucal *Centropus bengalensis*. Sumit Sen (Kolkata) believes that this area might hold a good population of Lesser Coucals (*BengalBird*). Anand Arya photographed a Common Redshank *Tringa totanus* with a ring on its right leg. S. Balachandran of BNHS felt that this bird could have been one of several ringed during September 2002 at the Basai wetlands. BNHS puts rings on the right legs of birds during even years, and on the left, during odd (*DelhiBird*). Kiran Srivastava reported a pair of Blue-winged Parakeets *Psittacula columboides* from Sanjay Gandhi National Park, Mumbai, on 9 August 2009—a species not seen often around Mumbai (*BirdsofBombay*). Uma K., and friends reported an Indian Cuckoo *Cuculus micropterus* chick being parented by Black Drongos *Dicrurus macrocercus* at Biligirirangan Hills, southern Karnataka, in June 2009 (*BngBirds*). Dipu Karuthedathu reported a similar observation of a juvenile Brainfever Bird *Hierococcyx varius* among a group of Jungle Babblers *Turdoides striatus* on 16 August 2009 from Shornur, Kerala (*KeralaBirder*). Vivek Tiwari and other delhibirders reported a Common Cuckoo *C. canorus*, presumably on passage, at Sultanpur on 1 August 2009(*DelhiBird*). Vaibhav Deshmukh reported a juvenile Eurasian Hobby *Falco subbuteo* on passage, busy feeding on dragonflies, near Alibag, Maharashtra on 5 August 2009 (*BirdsofBombay*). On 12 July 2009, Gnaneskandan Keshavbharathi reported a sighting of Fulvous Whistling Ducks *Dendrocyna bicolor* at Pallikaranai Marsh near Chennai (*TamilBirds*). Manjula Mathur reported a Rufous-tailed Scrub Robin *Cercotrichas galactotes* at Taal Chhapar on 8 August 2009 (*DelhiBird*). Tulsi R. Subedi reported a large congregation of 240 Indian White-backed Vultures *Gyps bengalensis*, along with one Himalayan Griffon *G. himalayensis*, one Slender-billed *G. tenuirostris*, two Red-headed *Sarcogyps calvus*, and nine Egyptian *Neophron percnopterus* Vultures on a single carcass in Nepal, evoking interest in population recovery of these critically endangered birds (*OrientalBirding*). Anshuman Varma and friends reported Koklass Pheasant *Pucrasia macrolopha*, Blue-throated Flycatcher *Cyornis rubeculoides*, Speckled Piculet *Picumnus innominatus*, and Black-throated Sunbird *Aethopyga saturata* among other birds from a trip to Pangot, Uttarakhand between 26 and 28 June 2009 (*DelhiBird*).

A quest for 'lost' birds

BirdLife International is launching a global bid to try to confirm the continued existence of 47 spp., of birds that have not been seen for up to 184 years. The list of potentially lost birds is a tantalising mix of species ranging from those inhabiting the least visited places on earth—such as remote islands, and parts of the western Himalayas—to those occurring in parts of Europe, and the United States of America. Some of the species high in the list of lost birds are Ivory-billed Woodpecker *Campephilus principalis*, Jamaican Petrel *Pterodroma caribbaea*, Hooded Seedeater *Sporophila melanops*, and our own Himalayan Quail *Galloperdix bicalcarata* and Pink-headed Duck *Rhodonessa caryophyllacea*. History of ornithology has shown that we should not give up on species that are feared to have gone extinct. Species like Cebu Flowerpecker *Dicaeum quadricolor*, and closer to home, Jerdon's Courser *Rhinoptilus bitorquatus* and Forest Owlet *Heteroglaux blewitti*, have been rediscovered at the eleventh hour, just before the last remnants of their habitats were

[1] For the period 15th June–15th August 2009.

destroyed. The announcement of the quest for lost species is being made at the launch of the 21st British Birdwatching Fair at Rutland Water, UK. Cebu Flowerpecker is chosen as the emblem of this year's fair, because it provides hope and inspiration not to give up on a lost species. Philippines Ministry of Tourism has agreed to become the BirdLife Species Champion for this forest jewel. However in India, we continue our quest to get such a species champion for the Jerdon's Courser, which inhabits the scrub jungle in and around Sri Lankamalleswaram Wildlife Sanctuary in Kadapa district, with their numbers reduced to just about 50 birds. Funding from the UK's Darwin Initiative, which helped in studying its population, alternative habitat, and conservation requirements, is nearing its end, and BirdLife International has stepped in to highlight the urgent need for a Species Champion (*http://www.birdlife.org*).

Birders contribute $36 billion to US economy

According to a new report released by the U. S. Fish and Wildlife Service in mid July 2009, birdwatchers contributed a whopping $ 36 billion to the economy of United States in 2006. One out of every five Americans, 48 million people in all, watch birds. The report identifies who birders are, where they live, how avid they are, and what kinds of birds they watch, along with how much they spend on their hobby, and the economic impact of such spending. Participation in bird watching is highest in the northern half of the U.S., with the most number of birders in Montana, Maine, Vermont, Minnesota, and Iowa. The report is an addendum to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. The survey, conducted by the U. S. Fish and Wildlife Service in partnership with state wildlife agencies and national conservation organizations, has become the reference for participation and expenditure information on fish and wildlife recreation in the United States. The survey helps quantify how enjoyment of the outdoors and wildlife contributes to society, and promotes a healthy economy—and further strengthens the Service's commitment to conserve the nation's wildlife for the enjoyment and benefit of its citizens. It would be an interesting idea to start such a survey in India and study the eco-trend of our population (*http://www.citizen-times.com*).

Hundreds of new species being discovered in eastern Himalayas

Over 350 new species, including the world's smallest deer, a "flying frog", an exquisitely coloured bird, and a 100 million-years old gecko have been discovered in the eastern Himalayas, a biological treasure trove that is now threatened by climate change. A decade of research carried out by scientists in remote mountain areas endangered by rising global temperatures brought exciting discoveries such as a bright green frog that uses its red, and long, webbed feet to glide in the air. The beautiful Bugun Liocichla *Liocichla bugunorum*, discovered just a couple of years ago from Eaglenest (Arunachal Pradesh) has catapulted the eastern Himalayas onto all bird conservation maps. One of the other significant findings was not exactly "new" in the classic sense. A 100-million year-old gecko, the oldest fossil gecko species known to science, was discovered in an amber mine in the Hukawng Valley in northern Myanmar. A report entitled *The eastern Himalayas—where worlds collide* by WWF details discoveries made by scientists from various organisations between 1998 and 2008 in a region reaching across Bhutan and north-eastern India to the far north of Myanmar as well as Nepal, and the southern parts of the Tibet Autonomous Region (China). However, the good news of this explosion in species discoveries is tempered by the increasing threats to the Himalaya's cultural and biological diversity. This rugged and remarkable landscape is already seeing direct, measurable impacts from climate change, and risks being lost forever. The report describes more than 350 new spp., discovered, including 244 plants, 16 amphibians, 16 reptiles, 14 fish, two birds, two mammals, and at least 60 new invertebrates. The eastern Himalayas harbor a staggering 10,000 plant, 300 mammal, 977 bird, 176 reptile, 105 amphibian, and 269 freshwater fish species. Historically, the rugged and largely inaccessible landscape of the eastern Himalayas has made biological surveys in the region extremely difficult. As a result, wildlife has remained poorly surveyed with large areas still remaining biologically unexplored. Today, further spp., continue to be unearthed, and many more spp., of amphibians, reptiles, and fish are currently in the process of being officially named by scientists (*http://www.sciencedaily.com*).

— Editorial —

Early this year, when Ravi Sankaran passed away so unexpectedly, all I could think of was how *Indian Birds* could carry forward the memory of this charismatic ornithologist. I wrote to several of his seniors, colleagues, friends, well-wishers, and students, and asked them to write something which they would like to offer for publication 'as a tribute to the memory of Ravi Sankaran', in a special memorial issue of *Indian Birds*. Their response was spontaneous and generous—you have the result in your hands. Of course, given our schedule, some could not send a paper in time, but their work, in the fields of ornithology and conservation, is the type of memorial Ravi would have understood and appreciated.

Shankar Raman heard about our plans and emailed me his wish to contribute a joint paper with Divya! Lalita Vijayan, convalescing from an illness, wrote about SACON's work in the Andaman & Nicobar Islands. Asad R. Rahmani's comprehensive assessment of Ravi's telling contribution to Indian ornithology is the most personal among all the papers, as he revisited memories of Ravi with every word he set down. Shirish Manchi, Ravi's student, was the first to send in his note. Pankaj Sekhsaria sent several pictures, and a note on how our quirky legal system created a paradox for the Edible-nest Swiftlet's survival. Aparajita Datta kept her promise and rushed in her paper in the nick of time. Ashish Chandola's reminiscences touch the heart about a man who delighted in the call of the Rain Quail *Coturnix coromandelica*. Carl D'Silva allowed us to use a picture of his brilliantly rendered glass etching, and Ramki Sreenivasan sent in his brilliant photograph of a displaying male Lesser Florican *Sypheotides indica*.

I would like to thank all of them for making this issue of *Indian Birds* possible.

"*Vivat, crescat, floreat Ornithologia Indiae*." [May Indian Ornithology live, grow and flourish.]
– Ernst Mayr. Rec. Indian Mus. 1952. L (I): 2.

– Aasheesh Pittie

Guidelines to contributors of *Indian Birds*

Indian Birds publishes original peer-reviewed papers, articles and notes about birds and birdwatching with an emphasis on South Asian birds (South Asia: Afghanistan, Bangladesh, Bhutan, India, the Maldives, Myanmar, Nepal, Pakistan and Sri Lanka). We welcome original articles on behaviour, ecology and conservation, counts and censuses (particularly those covering multiple years), annotated checklists, trip reports, book reviews, reviews of audio recordings, letters, announcements, notices, news from the birding world, etc. Authors proposing reviews of published material should first discuss this with the editor. All manuscripts should be easy to read and understand. Manuscripts will be edited for length, content and style, and will be sent to referees when appropriate. The editor will discuss contributions with authors and advise on modifications. Some basic guidelines are given below:

General When a bird species is first mentioned, both the English and scientific name must be given, thereafter the English name only. English and scientific names should follow Manakadan, R., & Pittie, A. 2001. Standardised common and scientific names of the birds of the Indian Subcontinent. *Buceros* 6 (1): i-ix, 1-38. Metric units and their international symbols must be used; dates and times should be of the form 1.i.2005 and 13:45hrs respectively. Numbers one to ten should be written in full, except when used with a measurement abbreviation or higher number, thus: five birds, but 5km and 5-15 birds. Numerals are used for all numbers greater than ten: 12, 120, 1,200 and 12,000.

Preparation and submission of manuscripts These should preferably be sent electronically as an email attachment or mailed on a PC-formatted floppy disk or CD-ROM to the contact addresses given below. The text, tables, figure legends (which must be self-explanatory) and appendices should be combined in one MS Word file. Alternatively, hard copies of typescripts, original maps and diagrams can be sent by mail, but this should be an option of last resort.

Images Photographs, artwork, maps, diagrams, etc. should be digitised and sent either as an email attachment or on CD-ROM. These should be in TIFF and at least 8"x11" in 300dpi resolution. JPEG files must be "maximum" quality, that is, at their minimum compression. Maps should be marked with a scale and north arrow.

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