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# HORNBILLS AND ENDEMIC BIRDS

A CONSERVATION STATUS SURVEY ACROSS THE WESTERN GHATS, INDIA

DIVYA MUDAPPA

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nature conservation foundation

The Rufford Small Grants Foundation

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**Cover photographs**

*Front cover:* A male Malabar Pied Hornbill *Anthracoceros coronatus* tosses a fruit of *Putranjiva roxburghii* into its mouth near Dandeli (Photo: Kalyan Varma).

*Back cover:* An Indian Grey Hornbill *Ocyceros birostris* (right); moist forests converted to monoculture *Acacia* plantations in the Western Ghats of Karnataka (left; Photos: Shankar Raman)

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# SUMMARY

The Western Ghats biodiversity hotspot in India is threatened by habitat loss and fragmentation, likely to impact large-bodied, wide-ranging species such as hornbills, as well as endemic species with restricted ranges and specialised requirements. 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 Indian subcontinent), Malabar Grey Hornbill *Ocyceros griseus* (endemic to Western Ghats), and the Great Hornbill *Buceros bicornis*. We also recorded all bird species, especially the 16 restricted-range species. One or more species occurs in each major forest type (tropical dry thorn and deciduous to wet evergreen) in the region. We visited 45 localities across five states: Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. This included 26 Wildlife Sanctuaries, 5 National Parks, 13 Reserved Forests, and one plantation landscape. Across sites, 80 transect surveys of 286.4 km total length were walked.

In total, 631 individual hornbills (412 detections) were recorded across 35 localities. The Malabar Grey Hornbill was most frequent 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) along with key reserved forests (Kottiyoor, New Amarambalam, Vazhachal, Nelliampathy, Goodarickal, Kulathupuzha-Palode). Hornbill densities were estimated in two of the above landscapes. We also recorded 243 bird species, including 11 endemics. We found a positive relationship between distributional range and abundance of endemics and recorded broad patterns of community variation.

The survey also worked to develop awareness about Western Ghats hornbills and a poster was prepared and widely circulated among Forest Department, protected areas, conservation institutions, and individuals. A student project on Malabar Pied Hornbill was carried out as a follow-on. Based on the study and earlier work, tentative recommendations are proposed to Government of India to reinstate the Malabar Pied Hornbill and the two grey hornbills (particularly the former) in Schedule I of the Wildlife (Protection) Act pending wider public consultation.

# 1. 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.

Hornbills are a group of peculiar, large-bodied birds found only in the Old World tropics that have been the focus of much conservation attention. 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 Indian subcontinent), Malabar Grey Hornbill *Ocyceros griseus* (endemic to Western Ghats), and the endangered Great Hornbill *Buceros bicornis*. Besides the two smaller *Ocyceros* species, the larger hornbill species are rare and threatened they have been placed under Schedule I of the Indian Wildlife Protection Act[1]. Past research on hornbills in India has addressed many aspects of hornbill biology such as breeding, nest selection, and diet (Reddy 1988, Kannan 1994, Kannan and James 1997, 2006, Mudappa and Kannan 1997, Mudappa 2000, 2005, Datta 2001, Datta and 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 and 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 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 west 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. It is also among the Global 200 most important ecoregions (Olson and Dinerstein 1998). In addition, it has been recognised as an endemic bird area (Stattersfield *et al.* 1998) with

[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 (addressed later in this report) the Malabar Pied Hornbill *Anthracoceros coronatus* appears to have been omitted from the listing as well as currently (15 August 2008) noted on the website of the Ministry of Environment and Forests, Government of India (http://envfor.nic.in/legis/wildlife/wildlife1.html).

16 species of restricted-range species. One or more species occurs in each major forest type in the region (tropical dry thorn and deciduous to wet evergreen). The Western Ghats has historically been heavily altered due to human impacts on natural landscapes through urbanisation, agriculture, plantations, hydro-electric projects, roads, and deforestation (Nair 1991, 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). Menon and Bawa (1997) estimated that between 1920 and 1990, forest cover in the Western Ghats declined by 40%, resulting in a four-fold increase in the number of fragments and an 83% reduction in size of forest patches. In a 40,000 $km^2$ area of the southern Western Ghats, Jha *et al.* (2000) estimated that one-fourth (25.6%) of the forest cover had been lost over a period of 22 years from 1973 to 1995 giving an annual deforestation rate of 1.16%.

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 $km^2$) of this vegetation is relatively un-fragmented, with 74% of these forests lying outside protected areas (CEPF 2007). In the landscape adjoining forest areas in the Western Ghats, large tracts of plantations are distributed (over 4,500 $km^2$ of tea and coffee plantations alone), which are also often important habitats for wildlife or areas through which many wildlife species move (Raman and 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. Information of the distribution and occurrence of species obtained over these landscapes can be used to design appropriate conservation strategies.

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 assess: (i) distribution of hornbills and endemic birds using field surveys and secondary information, (ii) to identify important hornbill conservation units based on our survey, and (iii) estimate population density of hornbills in some important conservation units to serve as a baseline. The survey covered a number of Protected Areas (Wildlife Sanctuaries and National Parks) and Reserved Forests along the Western Ghats. A larger goal is to identify key areas in the regional landscape for conservation and management of these flagship species and their habitats.

# 2. DETAILS OF THE SURVEY

## 2.1 Study Species

Four hornbill species occur in the Western Ghats: the Malabar Pied Hornbill *Anthracoceros coronatus* and Indian Grey Hornbill *Ocyceros birostris* that are endemic to Indian subcontinent, the Malabar Grey Hornbill *Ocyceros griseus* that is endemic to the Western Ghats, and the Great Hornbill *Buceros bicornis* that is an endangered species listed in Schedule I of India's Wildlife (Protection) Act 1972. In addition, 16 restricted-range bird species including the Malabar Grey Hornbill (Stattersfield *et al.* 1998) are known to occur in the Western Ghats (Table 1). We also kept records of the Malabar Lark *Galerida malabarica* because of its restricted distribution along the Western Ghats (Ali and Ripley 1983, Grimmett *et al.* 1998, Rasmussen and Anderton 2005).

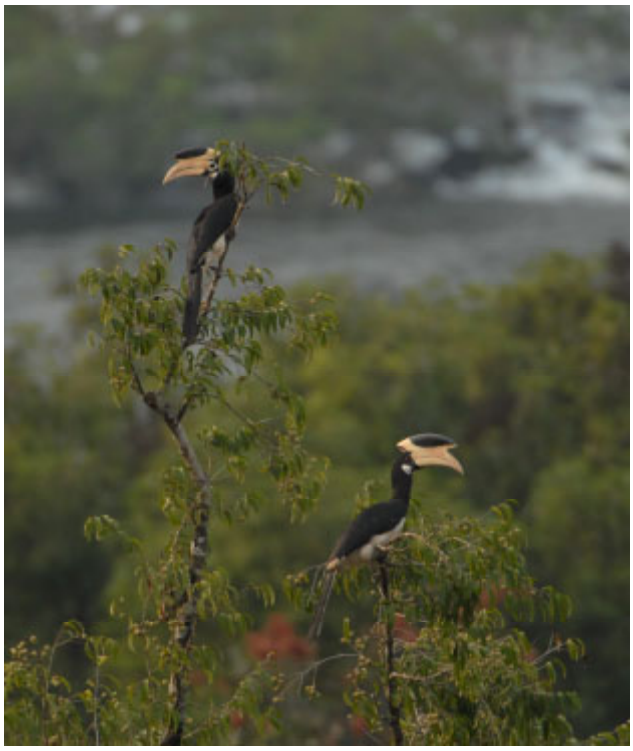
**Table 1.** Hornbills and restricted-range bird species occurring in the Western Ghats.

| Species | Endemism | 2007 IUCN Red List category |
|---|---|---|
| Great Hornbill *Buceros bicornis* | | Near-threatened |
| Malabar Pied Hornbill *Anthracoceros coronatus* | India/Sri Lanka | Near-threatened |
| Indian Grey Hornbill *Ocyceros birostris* | India | Lower concern |
| Malabar Grey Hornbill *Ocyceros griseus* | Western Ghats | Lower concern |
| Malabar Parakeet *Psittacula columboides* | Western Ghats | Lower concern |
| Nilgiri Wood Pigeon *Columba elphinstonii* | Western Ghats | Vulnerable |
| White-bellied Treepie *Dendrocitta leucogastra* | Western Ghats | Lower concern |
| White-bellied Shortwing *Brachypteryx major** | Western Ghats | Vulnerable |
| Black-and-Orange Flycatcher *Ficedula nigrorufa* | Western Ghats | Near-threatened |
| Nilgiri Flycatcher *Eumyias albicaudata* | Western Ghats | Near-threatened |
| White-bellied Blue Flycatcher *Cyornis pallipes* | Western Ghats | Lower concern |
| Grey-headed Bulbul *Pycnonotus priocephalus* | Western Ghats | Lower concern |
| Nilgiri Laughingthrush *Garrulax cachinnans** | Western Ghats | Endangered |
| Wynaad Laughingthrush *Garrulax delesserti* | Western Ghats | Lower concern |
| Grey-breasted Laughingthrush *Garrulax jerdoni** | Western Ghats | Near-threatened |
| Rufous Babbler *Turdoides subrufus* | Western Ghats | Lower concern |
| Crimson-backed Sunbird *Nectarinia minima* | Western Ghats | Lower concern |
| Broad-tailed Grassbird *Schoenicola platyura** | Western Ghats | Vulnerable |
| Nilgiri Pipit *Anthus nilghiriensis** | Western Ghats | Near-threatened |

*Higher-altitude or grassland species not targeted by the survey, but with records maintained if encountered.

Male Malabar Grey Hornbill *Ocyceros griseus* at nest (Photo: Suresh Ganapathiappan)

Male Indian Grey Hornbill *Ocyceros birostris* (Photo: Shankar Raman)



A pair of Malabar Pied Hornbills *Anthracoceros coronatus* with the Kali River in the background (Photo: Kalyan Varma)

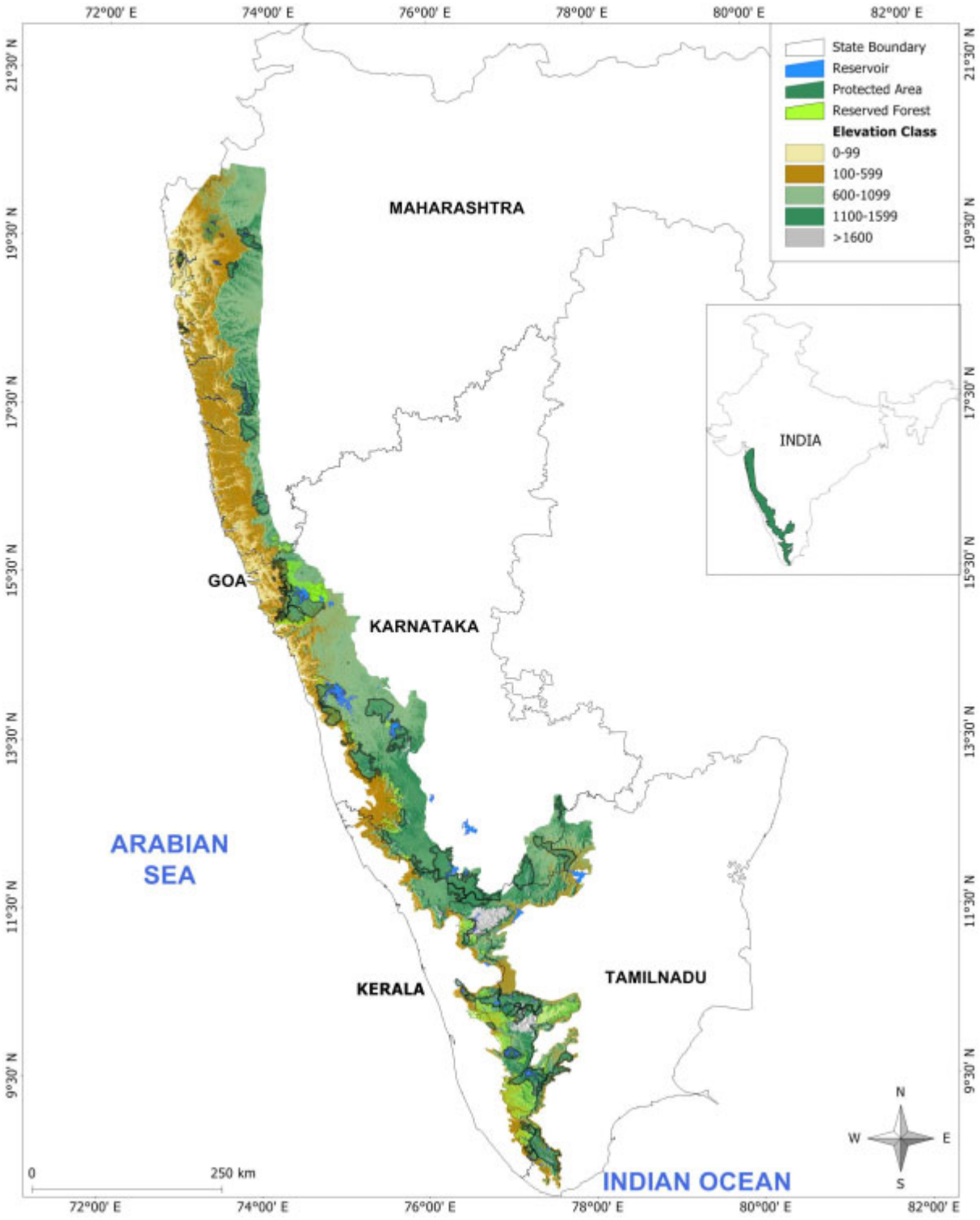
Male Great Hornbill *Buceros bicornis* (Photo: Shankar Raman)

### 2.2. Study region: Western Ghats

The Western Ghats is a 1,600 km long chain of hills running along the west coast of the Indian Peninsula, from near Kanyakumari at 8° N at the southern end to the river Tapti in the north at 21° N (Map 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, this includes the Sahyadri of Maharashtra and Goa, the hills of Uttara and Dakhsina 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 chain of hills is interrupted by the 30 km wide Palghat Gap at around 11° N, and a few other minor breaks along its length (e.g., Shencottah pass at around 9° N, altitude 160 m). Most of the hills over 1,500 m above mean sea level in the Western Ghats are found towards the south, between 8° and 13° N. This includes peaks such as Anaimudi (2,695 m) in the Anamalai hills, Doddabetta (2,637 m) in the Nilgiri hills, Vandaravu (2,554 m) and Kodaikanal (2,328 m) in the Palni hills, and Agasthyamalai (1,868 m) in the Agasthyamalai range of hills. The region south of the Palghat Gap, is often called the southern Western Ghats.

The rocks and soils of the Western Ghats relate to the region's tectonic history. North of Goa from around 16° N the major geological formation is the Deccan traps overlying Archaean rocks. The Deccan Traps had little influence, however, on the regions south of Goa, which are dominated by the Dharwar system of ancient metamorphic rocks up to about Mangalore (13° N), and pre-Cambrian crystalline rocks further south. In the southern Western Ghats, these are principally charnockites, with Khondalites (gneiss and schists with sillimanite and garnet) dominating south of 9° N (Pascal 1988). The major soils found on the Western Ghats are red soils, laterites, black soils, and humid soils such as the peat bogs of the Nilgiri (Subramanyam and Nayar 1974, Nair and Daniel 1986).

The Western Ghats has a tropical climate that shows pronounced variation along north-south, east-west, and altitudinal gradients. Although, the region receives an average annual rainfall of 2,500 mm, this may vary depending on locality by an order of magnitude from less than 500 mm (in the eastern rain-shadow areas) to nearly 7,500 mm (on the western aspect). The distribution of rainfall across the year also varies from south to north. The southern end of the Ghats has a short dry season (2 – 5 months) as it receives rain from the southwest (June – September) and northeast (October – January) monsoons. The northern reaches have a longer dry season (5 – 8 months), receiving rain mostly during the southwest monsoon. The average annual rainfall in the evergreen forests ranges from around 2,000 to 7,500 mm depending on the locality (Pascal 1988).




**Map 1.** The Western Ghats hill range of India showing protected areas and reserved forests.

Temperatures average 20°C in the south and 24°C in the north (Nair and Daniel 1986). The annual mean temperature varies from around 29°C at sea level to around 15°C at 2,400 m altitude. Temperatures are often lower during the monsoon months (Pascal 1988). Mist is frequent, particularly above 1,000 m altitude during the monsoons. The southwest monsoon season is characterised by heavy thundershowers

punctuated by clear days and strong winds, the latter causing much uprooting of vegetation through tree falls. Heavy rainfall during the northeast monsoon is largely precipitated as a consequence of cyclonic storms forming around atmospheric depressions in the Bay of Bengal. Exposed and leeward slopes also face moderate drying effects due to wind.

Several major rivers originate in the Western Ghats and drain towards the east, including the Godavari, Krishna, Cauvery, and Tambiraparani. Smaller, more torrential streams and rivers, such as the Kali, Netravati, Sharavathy, Periyar, and Pamba, drain the Ghats from the steeper Western escarpments into the Arabian Sea in the west. These rivers are a major lifeline for millions of people in the plains and foothills being critical for agriculture as well as power generation.

*Vegetation*

A comprehensive account of vegetation in the Western Ghats is beyond the scope of this report and is available in other publications (e.g., Champion and Seth 1968, Subramanyam and Nayar 1974, Puri *et al.* 1983). Over 4,000 plant species are known from the Western Ghats, of which around 1,500 species (c. 35%) are endemic to this region (Nair and Daniel 1986). Kumar *et al*. (2004) report that of the 490 tree species found in low- and mid-elevation forests, 308 species (63%) in 58 genera are endemic, with 42 of these being monotypic.

The pronounced north-south, altitudinal, and moisture gradients create an impressive diversity of vegetation types. This includes tropical dry thorn forest (including degraded deciduous formations), dry deciduous forest, moist deciduous forest, dry evergreen, semi-evergreen, and wet evergreen in the lowland and middle elevations and the unique shola-grassland habitat at higher elevations (Subramanyam and Nayar 1974, Nair 1991, Ramesh 2001). A number of other unique formations occur at specific localities including bamboo and *Ochlandra* reed brakes, cane brakes, lateritic scrub and *Myristica* swamps (Nair 1991).

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 and 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. Above 1,800 m the evergreen forest becomes a unique, stunted montane formation called shola that alternates with natural high altitude grasslands. The shola-grassland ecosystem is characteristic of the higher reaches of the Nilgiri, Palni, and Anamalai hills, in particular.

The tropical wet evergreen forests of the southern 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. These wet

evergreen forest types are also referred to as tropical rainforests here. The wet evergreen forests of the plains and low elevations are characterised by the occurrence of dipterocarps such as *Dipterocarpus indicus*, *D. bourdillonii*, and *Vateria indica*. Other characteristic species include *Hopea parviflora*, *Kingiodendron pinnatum*, *Humboldtia brunonis*, and *Poeciloneuron indicum*. At least four types of medium-elevation wet-evergreen forests are recognised by Pascal (1988), with an important type in the southern Western Ghats being the *Cullenia exarillata-Mesua ferrea-Palaquium ellipticum* type. Among the various wet evergreen forest types in the Western Ghats, the *Cullenia – Mesua – Palaquium* type is the one with the highest plant endemism (43.4%, Pascal 1988). This evergreen forest type occurs chiefly south of 12° N (limit of *Cullenia* distribution). This type has a lower elevational limit of 600 – 700 m and extends up to about 1,400 m. After a transition zone between 1,400 m and 1,600 m, this type is replaced by the *Schefflera spp. – Meliosma arnottiana – Gordonia obtusa* high elevation wet evergreen forest / shola (Pascal 1988).

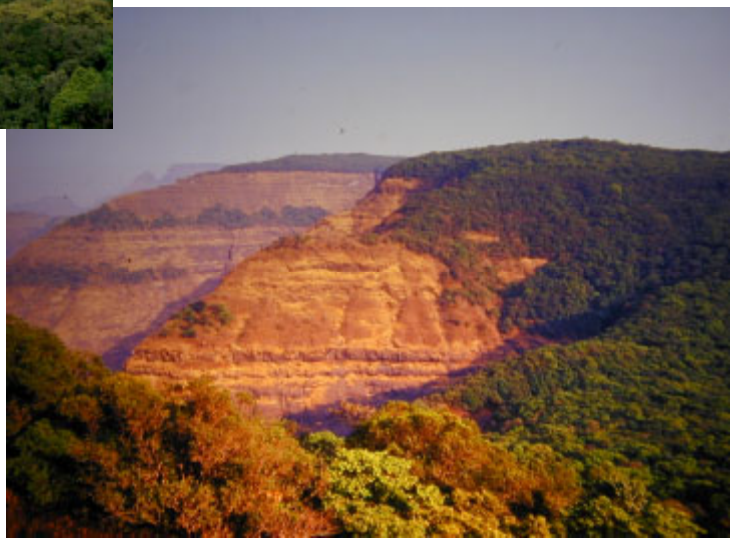
Dry Deciduous Forest

Moist Deciduous Forest

Riverine Forest
(Photo: Kalyan Varma)

Semi-evergreen Forest

Wet evergreen Forest



Sahyadri or Northern
Wet Evergreen Forest

*Fauna*

Animal groups too are characterised by high diversity and endemism, particularly among the lower vertebrates. Nearly 10% (245 species) of the fishes found in India occur in the Western Ghats, of which 42% are endemic (Kumar *et al.* 2004). Of the 215 species of amphibians known from India, at least 120 are now known from the Western Ghats. Nearly three-fourths of these 120 species are typically found in tropical rainforests (Johnsingh 2001). Two groups of amphibians are prominent for their high degree of endemism: the limbless caecilians (14 species of the 17 known from India) and rhacophorid tree frogs (83%). Among reptiles, around 480 species are known from India, of which 197 are known from the Western Ghats. Notable endemism is seen among the burrowing urolpeltid snakes (32 species in Western Ghats), which are confined almost entirely to the Western Ghats and Sri Lanka. Mammalian diversity is relatively low in the Western Ghats. Of the 400 species of Indian mammals, approximately 125 species are known from the Western Ghats. Twelve species, including 2 genera, *Latidens* (bat) and *Platacanthomys* (rodent), are unique to the Western Ghats (Kumar *et al.* 2004).

The avifauna of the Western Ghats includes a little over 500 bird species (Ali and Ripley 1983). A comprehensive recent review of the diversity, natural history, and biogeography of the Western Ghats avifauna is available in the work of Daniels (1997) and only some salient aspects are mentioned here. Of the 507 bird species reported from the Western Ghats, about 360 species are terrestrial (Daniels 1997). A large part of the diversity consists of widespread species that typically occur in the dry and moist deciduous forests and dry thorn forests. The tropical evergreen forests contain fewer species but a greater proportion of endemic and restricted-range species than similar rainforests in northeastern India. Moist forests, particularly tropical evergreen rainforest in the southern Western Ghats, is a major habitat for about 100 species of birds, including 14 endemic species (Malabar Parakeet, Nilgiri Wood Pigeon, Malabar Grey Hornbill, Grey-headed Bulbul, White-bellied Treepie, Wynaad Laughingthrush, Grey-breasted Laughingthrush, Nilgiri Laughingthrush, Rufous Babbler, Black-and-Orange Flycatcher, Nilgiri Flycatcher, White-bellied Blue Flycatcher, White-bellied Shortwing, Crimson-backed Sunbird). Two other restricted range-species that occur in high-altitude grasslands in this region are the Nilgiri Pipit and Broad-tailed Grassbird). The Malabar Lark is restricted to grassy hills and open scrub from plains to c. 2000 m along the Western Ghats. Six endemic species that are mostly montane forest birds (Wynaad Laughingthrush, Nilgiri Laughingthrush, Black-and-Orange Flycatcher, Nilgiri Flycatcher, White-bellied Shortwing, Nilgiri Pipit) are restricted largely to the Western Ghats south of southern Karnataka.

## 2.3. Survey localities and effort

We visited 45 localities across the five states along the Western Ghats: Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. This included 26 Wildlife Sanctuaries, 5

National Parks, 13 Reserved Forests, and one plantation landscape. Logistics limited 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 2). In addition, 15 line transects in Tamil Nadu were repeatedly surveyed five times each (for a total distance of 150.7 km). Besides around 211 hours spent on transect surveys, we spent substantially more time (around 80 days of field time) in various sites excluding Tamil Nadu. As we worked out of a field research station in the Anamalai hills, our presence there has been nearly continuous over the last few years, and it was the base we returned to in-between visits to other surveyed sites.

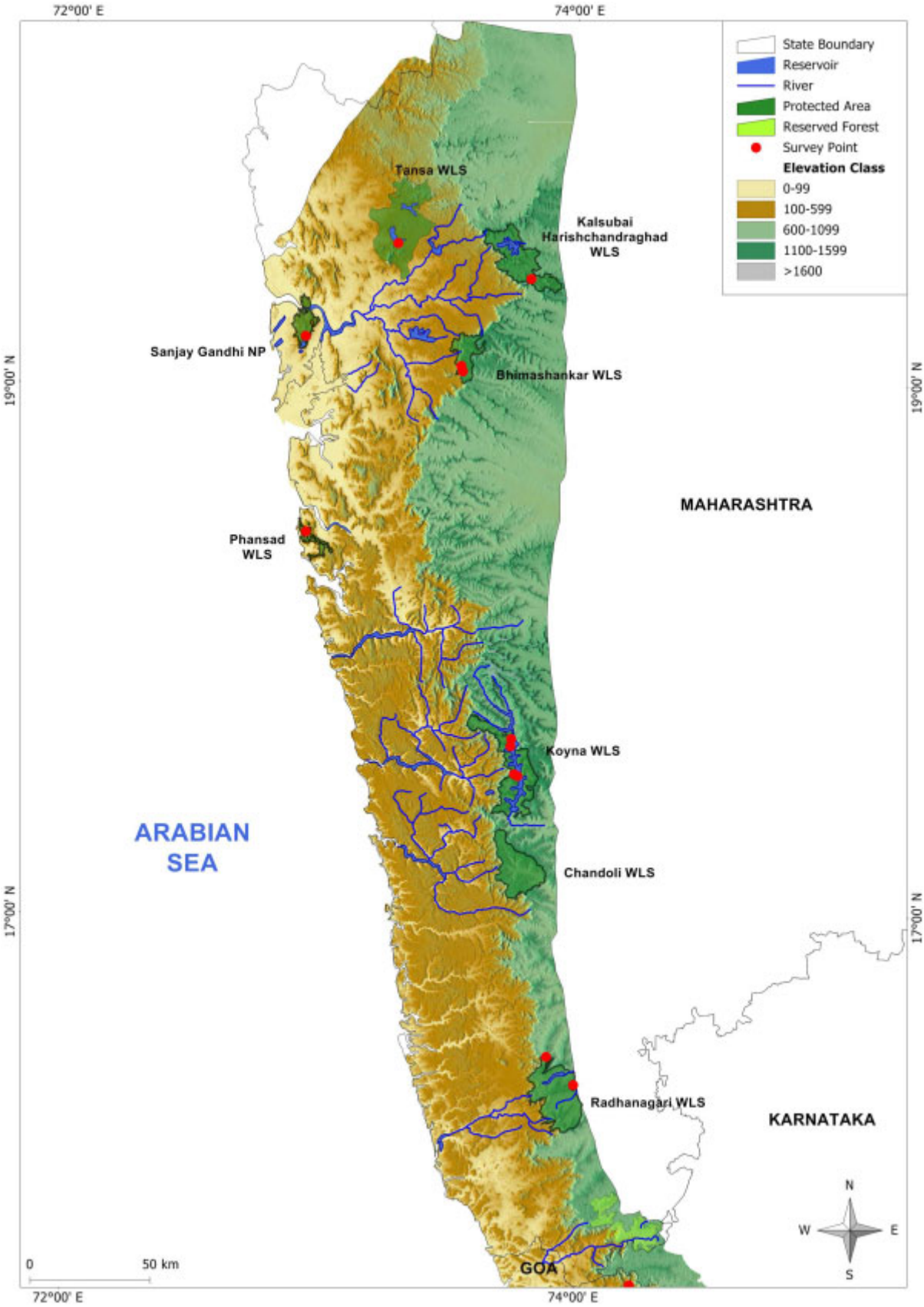
To examine broad habitat affiliations, we also categorised the transects into four major habitat types: dry forests (dry thorn and deciduous forests, including degraded formations), moist forests (moist deciduous and semi-evergreen forests), wet forests (primarily tropical wet evergreen forest) and Sahyadri 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. The locations of the sampled transects across the states are provided in the following maps (Maps 2-6).

**Table 2.** Localities visited and effort in sites where transect survey was carried out.

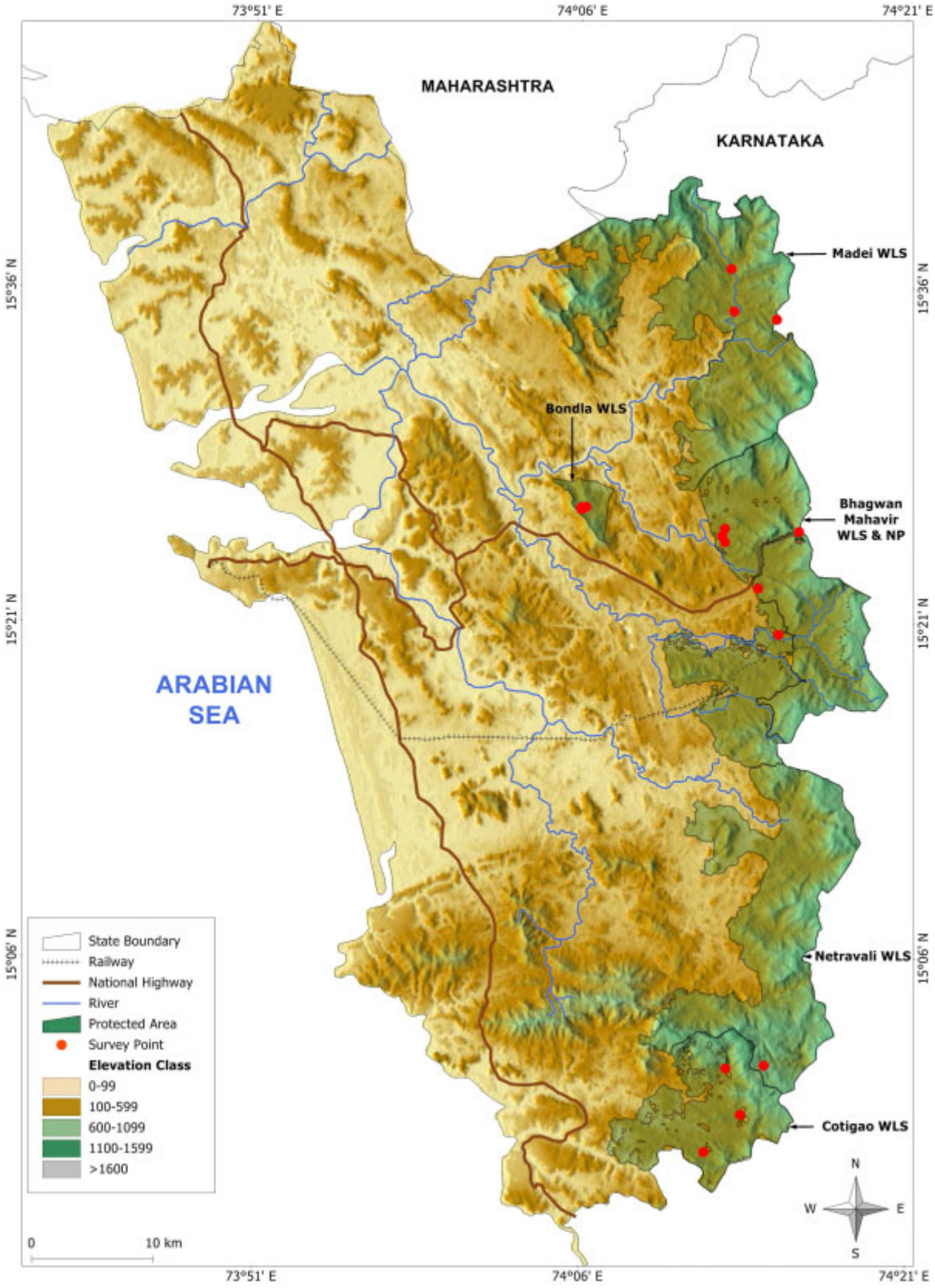
| State | Site | Transects | Duration (min) | Length (km) |
|---|---|---|---|---|
| Maharashtra | Amboli RF | - | | |
| | Bhimashankar WS | 2 | 223 | 4.31 |
| | Borivili NP | 1 | 60 | 2.04 |
| | Kalsubai-Harishchandragad WS | 1 | 45 | 1.04 |
| | Koyna WS | 4 | 383 | 8.65 |
| | Lonavla RF | - | | |
| | 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 | - | + | - |

| State | Site | Transects | Duration (min) | Length (km) |
|---|---|---|---|---|
| | 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** |

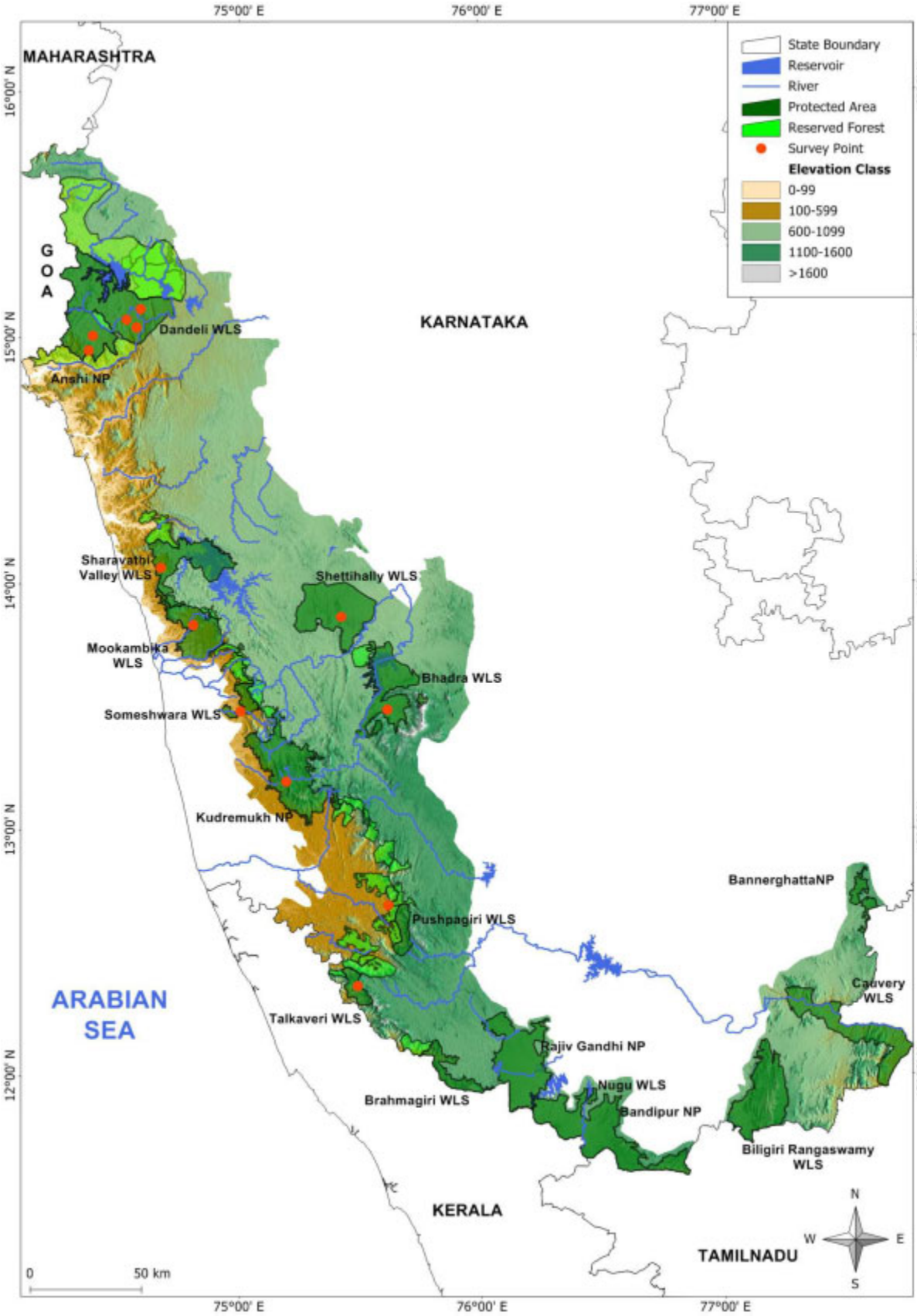
WS—Wildlife Sanctuary, NP—National Park, TR—Tiger Reserve, RF—Reserved Forest, +—visited briefly.



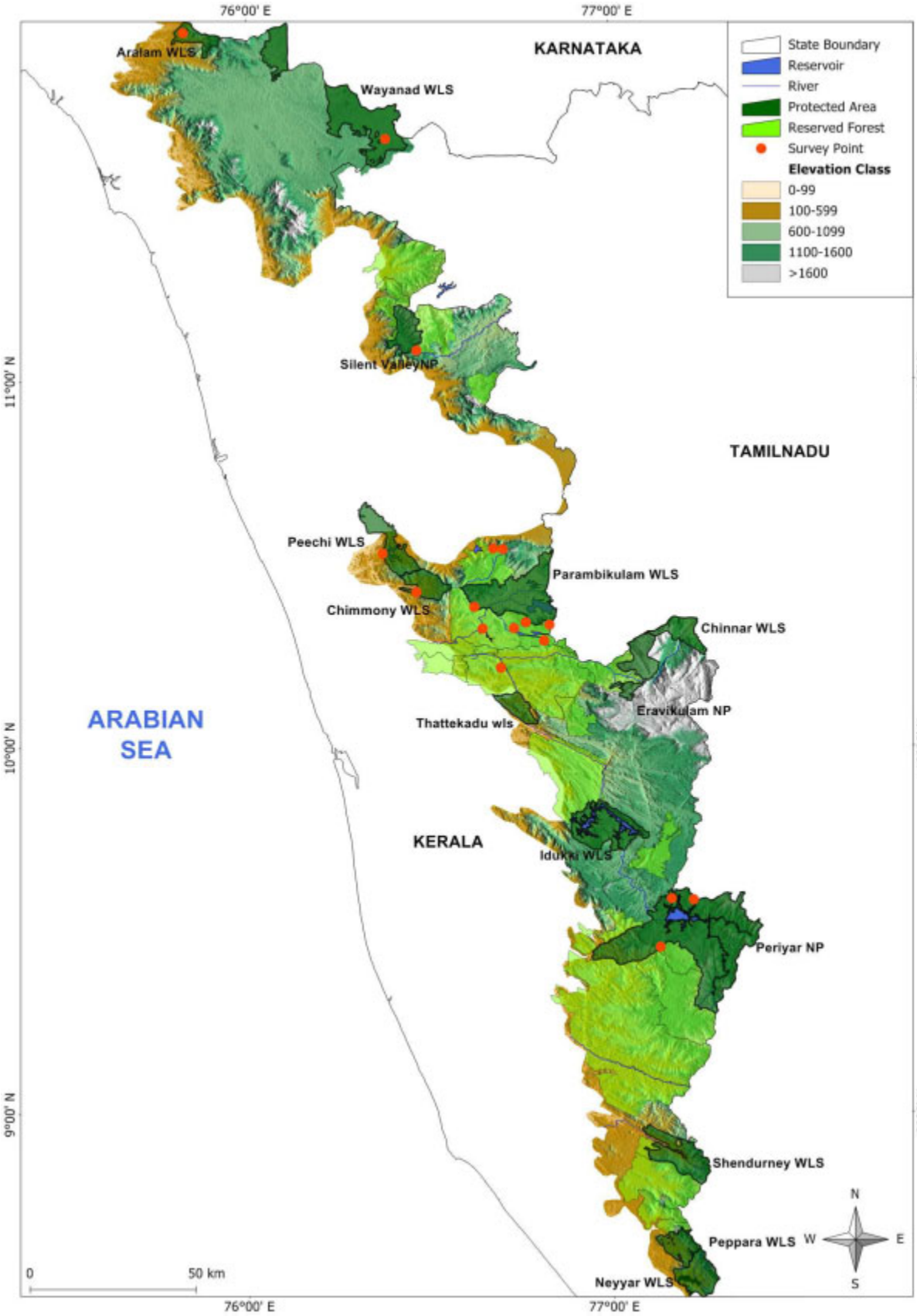

**Map 2.** Map of the Western Ghats along Maharashtra indicating protected areas and survey and transect locations.



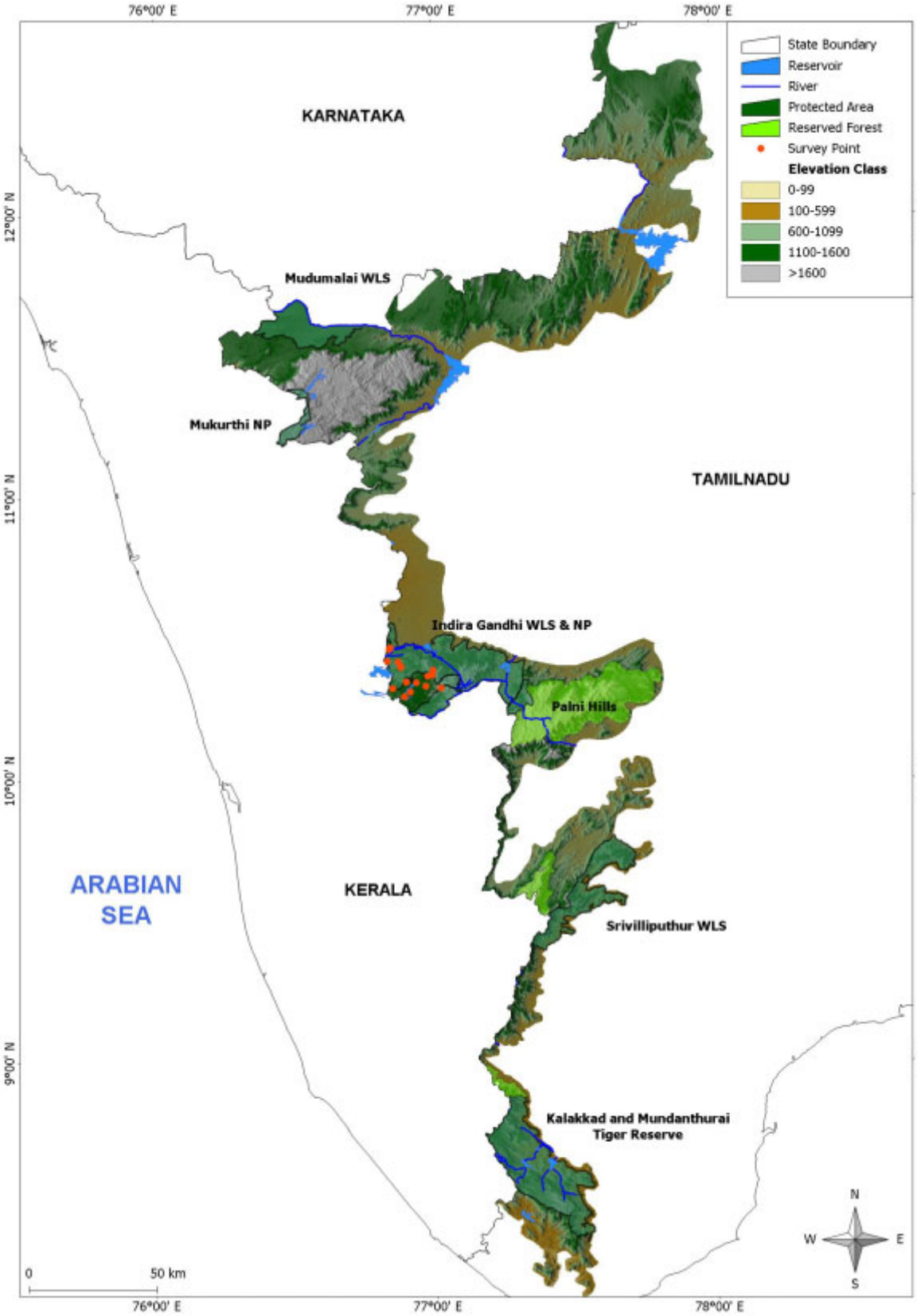

**Map 3.** Map of the Western Ghats along Goa indicating protected areas and survey and transect locations.




**Map 4.** Map of the Western Ghats along Karnataka indicating protected areas and survey and transect locations.




**Map 5.** Map of the Western Ghats along Kerala indicating protected areas and survey and transect locations.




**Map 6.** Map of the Western Ghats along Tamil Nadu indicating protected areas and survey locations.

# 3. HORNBILLS

In total, 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 in only 2 locations (12 individuals) along the Western Ghats in this survey.

### 3.1. State-wise summary

*Maharashtra*

All four hornbill species were recorded in Maharashtra (33 detections comprising 45 individuals). Malabar Grey Hornbills (14 detections numbering 15 individuals) were seen in Amboli, Phansad, and Radhanagari, Great Hornbills (9 detections, 18 individuals) in Amboli, Radhanagari, and in Mahabaleshwar (latter seen by Tanya Balcar and Bob Stewart, personal communication), whereas Malabar Pied Hornbills (4 detections, 5 individuals) were recorded only in Amboli and Phansad during the survey. The Indian Grey Hornbill (6 detections, 7 individuals) were 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 in 103 detections). The Indian Grey Hornbill was detected thrice in Dandeli WS (5 individuals). The Malabar Grey Hornbill was most widespread, being detected a total of 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 6 detections (7 individuals) of Great Hornbill, 3 from Dandeli and 3 from Mookambika.

*Kerala*

Three hornbill species (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 (5 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, Tekkadi, 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 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, respectively (exact numbers are not provided as many are counts over repeatedly-surveyed transects or locations).

### 3.2. Species-wise summary

*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 above sea level. The records range from southern Maharashtra (Radhanagari and Amboli) to the southernmost sites in the Western Ghats. Relatively higher numbers were encountered in Radhanagari, Anamalai hills (Indira Gandhi and Parambikulam Wildlife Sanctuaries and Vazhachal Reserved Forests), and Periyar during the survey.

*Malabar Pied Hornbill*

Recorded in 10 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 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.

*Indian Grey Hornbill*

This species, more typical and widely distributed across the plateaux and plains of India than the Western Ghats, was noted only in a few peripheral localities or the foothills during this survey. During the 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).

### 3.3. 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 (Figure 1). It is clear that the Indian Grey Hornbill is restricted to dry forests, although

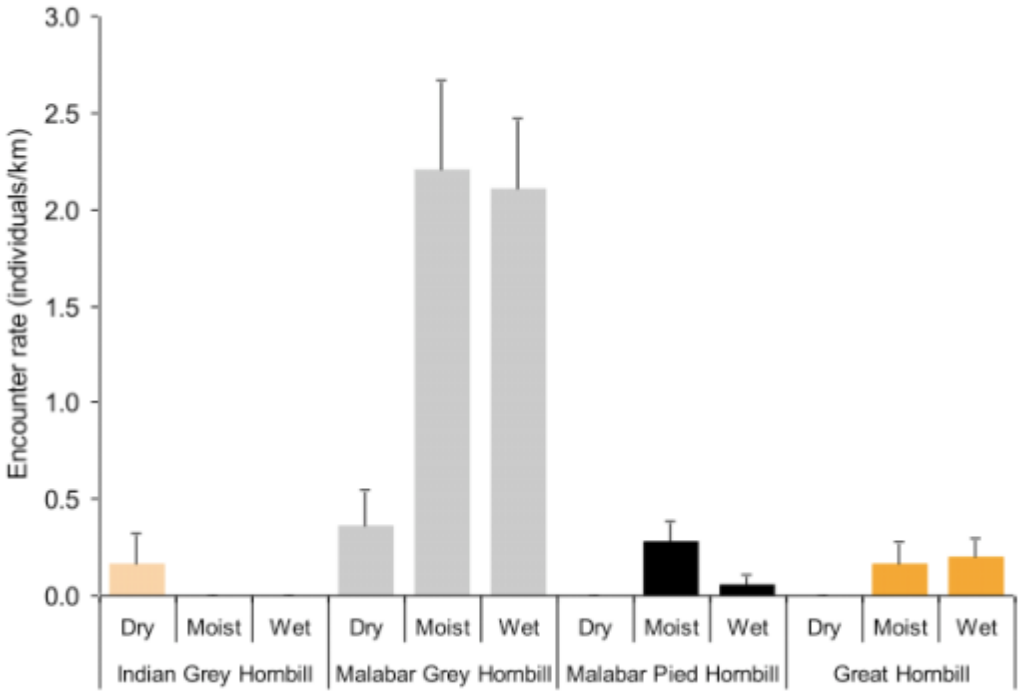



**Figure 1.** Encounter rates of hornbill species in three broadly categorised vegetation types in the Western Ghats (vertical bars represent standard errors).

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).

### 3.4. Identifying important hornbill conservation landscapes

Compiling the occurrence data from our survey and the work of Balasubramanian (2004) presents a picture of hornbill occurrence in relation to altitude and area of contiguous habitat within protected areas (PA) where the hornbill species occurred (Figure 2). As seen from this figure, the two smaller *Ocyceros* hornbills are seen across a wider range of sites in terms of contiguous PA area 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 protected areas at least larger than 20 km$^2$. It must be noted, however, that this analysis excludes areas of forest that may adjoin PAs but without 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.

To identify important hornbill conservation landscapes we used the existing information on number of hornbill species and their abundance (encounter rates/density) within sites factoring in other variables that are likely to be relevant to

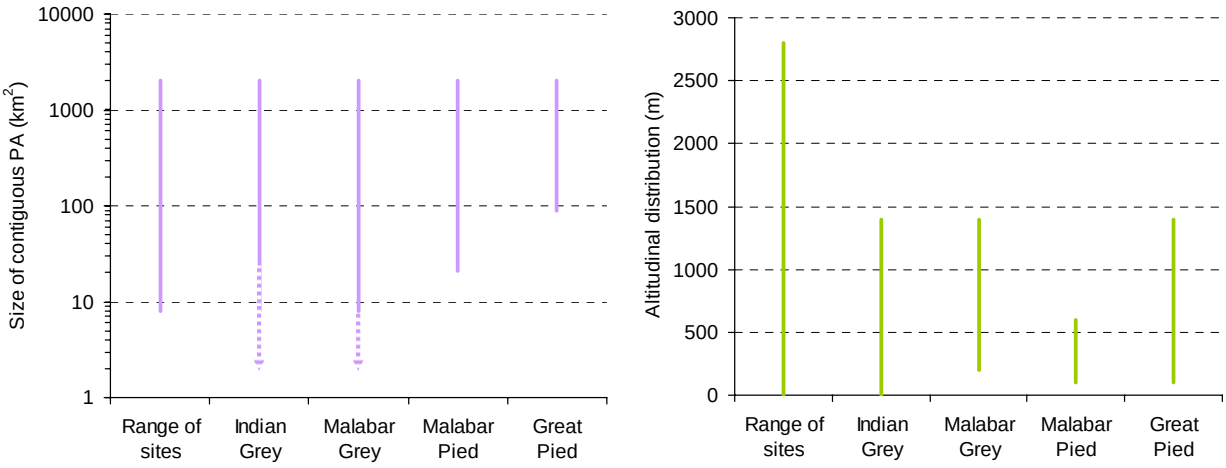



**Figure 2.** Distribution of range of sites surveyed and individual hornbill species in relation to size of contiguous protected area and altitude. Dashed lines indicate records from outside the survey.

the conservation of these large and wide-ranging birds. This included landscapes with a large area (at least 500 $km^2$) mostly under a (core) of contiguous protected areas with or without relatively suitable buffer habitats (Reserved Forests/eco-friendly plantations with tree cover). We also rated habitat status using a number of criteria used to assess sites across the Western Ghats in a related conservation assessment (CEPF 2007), which included an assessment of the identity and intensity of current and future threats to these areas. Based on this we arrived at the shortlist provided below.

*Important hornbill conservation units*

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):

1) **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.

2) **Anamalai-Parambikulam-Vazhachal:** Again a region with all four species of hornbills, this region appears significant particularly in terms of conservation of the *Great Hornbill*. Population densities estimated in and around the Indira Gandhi Wildlife Sanctuary 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).

3) **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) requires better documentation. The region

adjoins the Mysore plateau to the north that appears to be an area where Indian Grey Hornbills are still relatively frequent.

4) **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. Limited time could be devoted during the present survey, however, earlier reports (Balasubramanian 2004) and sight records of flocks (up to 32, H. N. Kumara and Sushma Rao, *in litt*.) indicate its potential.

5) **Neyyar-Peppara-KMTR:** A large contiguous tract of over 400 km$^2$ 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 WS and Tenmala reserved forests.

6) **Crucial Reserved Forests:** Some key Reserved Forest (RF) areas in the southern region, especially those adjoining protected areas, appear important for hornbill conservation:
    a. **Kottiyoor RF** (adjoining Aralam/Brahmagiri WS)
    b. **New Amarambalam RF** (adjoining Silent Valley NP)
    c. **Vazhachal and Nelliampathy RFs** (adjoining Anamalai-Parambikulam)
    d. **Goodarickal RF** (adjoining Periyar TR)
    e. **Kulathupuzha-Palode RFs** (adjoining Peppara-KMTR)

### 3.4. Population density estimation in important hornbill conservation landscapes

We aimed to assess key areas for conservation of hornbills, with an emphasis on areas important for the larger, threatened species, by documenting occurrence of the species as well as population estimation from line transects. Based on hornbill observations and encounter rates (especially of the two larger species) during the survey and reports in earlier literature, we identified landscapes as being potentially important hornbill conservation landscapes (previous section). Among these, 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 it 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 (se$D$) was calculated using standard error of cluster density (se$C$) and standard error of average cluster size (se$F$) using Goodman's (1960) formula: $(\text{se}D)^2 = C^2(\text{se}F)^2 + F^2(\text{se}C)^2 - (\text{se}C)^2(\text{se}F)^2$. 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.

*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 was in Mollem National Park and Wildlife Sanctuary (range = 0.13/km to 1.61/km across 6 transects), with high encounter rates in Madei Widlife Sanctuary, Goa (0/km to 0.84/km across 3 transects), and Dandeli Wildlife Sanctuary, Karnataka (0/km to 0.6/km across 3 transects).

We were able to obtain initial density estimates of Malabar Grey and Malabar Pied Hornbills from the transect data in this region (Figure 3). We obtained 56 detections of Malabar Grey Hornbills and estimated a density of 9.4 individuals per km$^2$ (95% confidence interval: 6.1 to 14.4 individuals/km$^2$). We obtained 11 detections of Malabar Pied Hornbills and estimated a density of 1.3 individuals per km$^2$ (95% CI: 0.5 to 3.0 individuals/ km$^2$). It would be worthwhile to establish a system of transects for

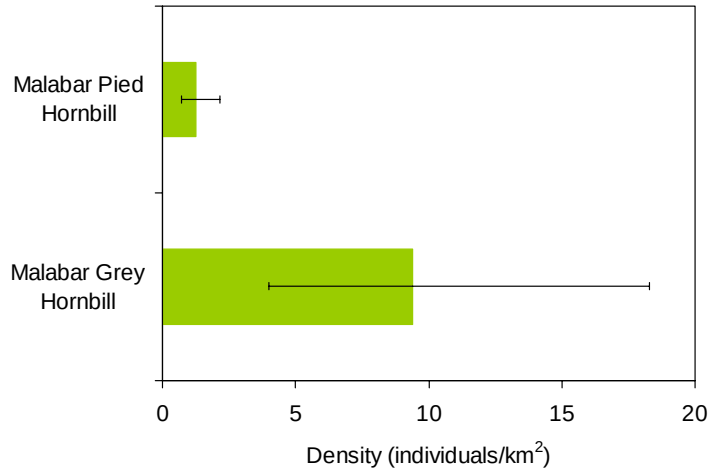



**Figure 3.** Density of two hornbill species in the Dandeli-Goa region (error bars are 95% confidence intervals).

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 evening counts at different roosts, we counted 30 individuals at one roost site (Kali main bridge, 14 Oct 2005), 21 at another (Kali old bridge, 17 Oct 2005), and 24 individuals in Ganeshgudi. Based on these results, we felt the need for an intensive study and encouraged a student project, since completed (see Section 5.6.).

*Anamalai-Parambikulam*

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

(a) Wildlife Sanctuaries: Indira Gandhi and Parambikulam Wildlife Sanctuaries
(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 this species. Details of sampling and parameters are provided in Table 3.

**Table 3.** 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.

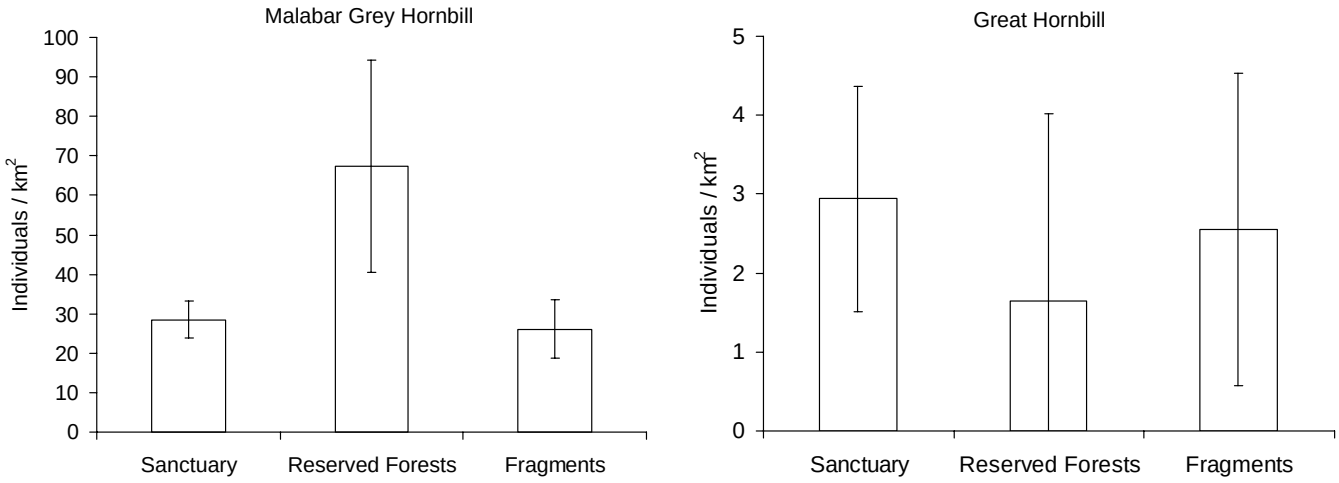



**Figure 4.** Hornbill densities in Wildlife Sanctuaries (Indira Gandhi and Parambikulam), Reserved Forests, and rainforest fragments in the Anamalai Hills and Valparai plateau. Vertical bars are 95% confidence intervals.

The estimated mean density of Malabar Grey Hornbills in Reserved Forests was 67.4 individuals/km$^2$ (Vazhachal-Sholayar and Malayattur) with a 95% confidence interval of 40.4 to 94.4 individuals/km$^2$. This appeared to be significantly higher than 95% CI of densities in the wildlife sanctuaries (23.9 to 33.1 individuals/km$^2$) or rainforest fragments (18.6 to 33.4 individuals/km$^2$)—the latter two strata thus appearing to not differ significantly from each other (Figure 4). 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 (Figure 4) with broad overlap in the 95% CI among sanctuary (1.5 to 4.4 individuals/ km$^2$), Reserved Forest (0 to 4.0 individuals/km$^2$), and fragments (0.6 to 4.5 individuals/ km$^2$).

A closer look at density estimates from the more intensively-sampled sites within the Indira Gandhi Wildlife Sanctuary and rainforest fragments on the Valparai plateau indicated patterns of variation within strata (Figure 5). Within the sanctuary, the mean density of Malabar Grey Hornbill was higher in three sites at middle elevations (700 to 1000 m): Anaigundi shola (42.7 individuals/km$^2$), Karian Shola (48.7 individuals/km$^2$), and Varagaliar-Manamboli-Sheikalmudi complex (40.8 individuals/km$^2$). Malabar Grey Hornbills were scarce or absent (<3 individuals/km$^2$) at the two other sites at higher elevations (>1300 m, Figure 5). The Malabar Grey Hornbill densities were broadly similar across the Valparai plateau fragments (21.5 to 33.5 individuals/km$^2$). 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 (Figure 5). 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.

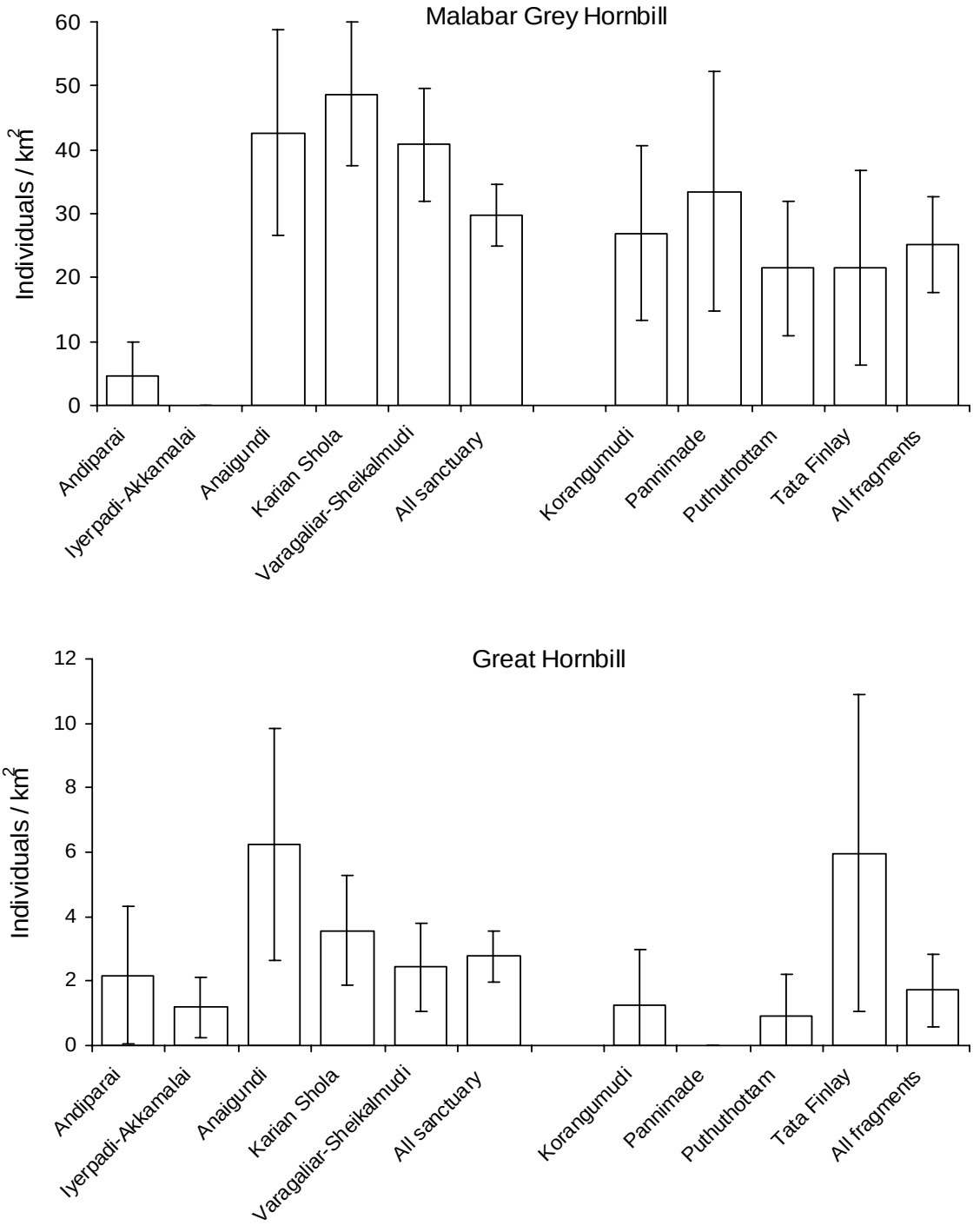



**Figure 5.** Hornbill densities across sites within the Indira Gandhi Wildlife Sanctuary and rainforest fragments in the Valparai plateau. Vertical bars represent 95% confidence intervals.

# 4. ENDEMICS AND BIRD COMMUNITY

### 4.1. Endemic species occurrence and distribution

In total, we recorded 243 bird species among around 8000 records during the survey (**Annexure**). This included 1803 detections (individuals and flocks) of 11 endemic species including the Malabar Grey Hornbill. The most widespread among these were the Crimson-backed Sunbird, White-cheeked Barbet, Malabar Grey Hornbill, and White-bellied Blue Flycatcher. The least widespread were Malabar Lark, Nilgiri Flycatcher, Nilgiri Wood Pigeon, and Wynaad Laughingthrush; whereas Rufous Babbler, Malabar Parakeet, and Grey-headed Bulbul were intermediate (Table 4).

There appeared to be a strong relationship between the abundance of endemic species and their distribution across sites in the Western Ghats. The relative distribution of a species (measured as a percentage of 45 survey localities) appeared logarithmically related to the relative abundance of the species (measured as the percentage of detections out of total detections) during the survey ($R^2$ = 0.82, Figure 6).

**Table 4.** Number of localities and detections of focal endemic species during the survey.

| Species | Localities | | Detections | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Grey-headed Bulbul | 17 | 37.8 | 98 | 5.4 |
| Malabar Lark | 4 | 8.9 | 4 | 0.2 |
| Malabar Grey Hornbill | 33 | 73.3 | 277 | 15.4 |
| Malabar Parakeet | 24 | 53.3 | 129 | 7.2 |
| Nilgiri Flycatcher | 4 | 8.9 | 7 | 0.4 |
| Nilgiri Wood Pigeon | 7 | 15.6 | 57 | 3.2 |
| Rufous Babbler | 17 | 37.8 | 33 | 1.8 |
| White-cheeked Barbet | 38 | 84.4 | 321 | 17.8 |
| Crimson-backed Sunbird | 36 | 80.0 | 747 | 41.4 |
| White-bellied Blue Flycatcher | 32 | 71.1 | 118 | 6.5 |
| Wynaad Laughingthrush | 8 | 17.8 | 12 | 0.7 |
| **Total** | **45** | | **1803** | |

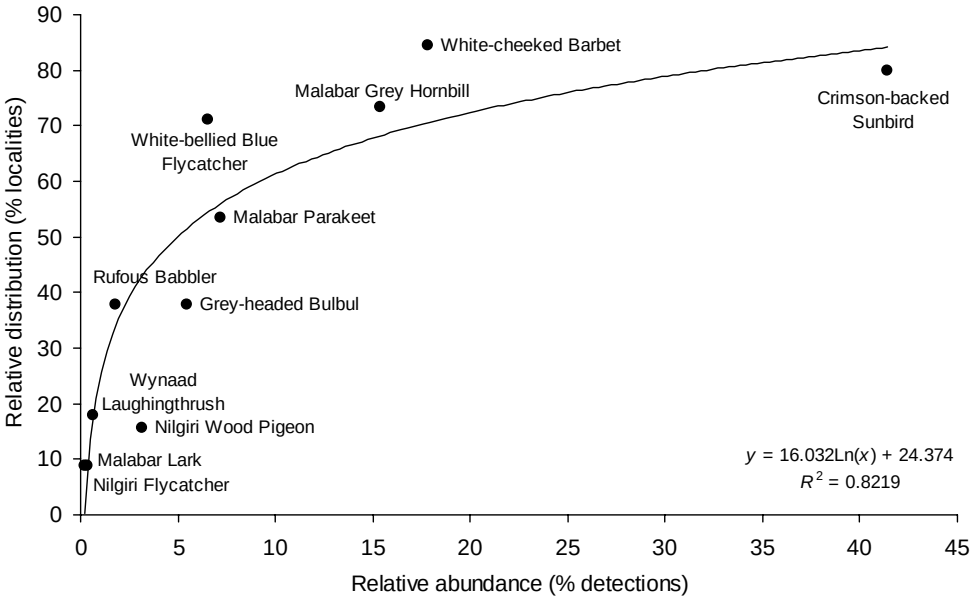



**Figure 6.** Relationship between relative distribution and abundance of endemic bird species in the Western Ghats.

### 4.2. State-wise summary

*Maharashtra*

The survey across 12 sites in Maharashtra resulted in observation of a total of 160 bird species, including eight endemic species. The number of endemic species recorded tended to increase from the drier sites in the North to sites with moister forests, particularly in the South. Thus, no endemics were recorded during the survey in Tansa WS, Tungareshwar WS, and Borivili NP. Two to four endemic species were recorded in Kalsubai Harishchandragad WS, Lonavla RF, Matheran RF, and Mahabaleshwar RF. A higher number of endemic species were seen in Koyna WS and Bhimashankar WS (5 each), Amboli RF (6), and Radhanagari WS (7). Among endemics other than the Malabar Grey Hornbill, the following observation records were obtained in the State:

i) Malabar Crested Lark was recorded in Amboli, Radhanagari, Bhimashankar, and Kalsubai, with a sizable population appearing resident in Radhanagari.

ii) Nilgiri Wood Pigeon was recorded in Bhimashankar, Koyna, Mahabaleshwar, Matheran, and Radhanagari, with the maximum number (38) seen in Koyna, where a sizable population appears to exist. Encounters and calls heard in Bhimashankar and Mahabaleshwar, suggested that the species may be relatively frequent there as well.

iii) Barring the three sites where no endemics were observed, White-cheeked Barbet and Crimson-backed Sunbird were recorded in all other sites (the former was not observed in Phansad).

iv) Malabar Parakeet was recorded only in Koyna.

v) Rufous Babbler was recorded in Amboli and Radhanagari.

vi) White-bellied Blue Flycatcher was seen in evergreen forests in Koyna, Radhanagari, Amboli, Bhimashankar, and Mahabaleshwar.

*Goa*

We recorded 123 bird species during the survey across five protected areas in Goa and nearby areas including seven endemic species. Among the six endemics recorded besides the Malabar Grey Hornbill:

i) The White-cheeked Barbet and Crimson-backed Sunbird were most widely distributed, being recorded frequently in all sites.
ii) The Grey-headed Bulbul and White-bellied Blue Flycatcher were recorded in Mollem, Madei, Cotigao, and Netravali. Mollem and Madei seem to be particularly important strongholds for the Grey-headed Bulbul.
iii) The Malabar Parakeet was recorded in Cotigao, Netravali, and Mollem.
iv) The Rufous Babbler was recorded only in Netravali.

*Karnataka*

We recorded 135 bird species including eight endemics during the survey across 13 sites in Karnataka. Besides the Malabar Grey Hornbill, the other seven endemics included:

i) Three widely distributed species recorded across sites: the White-cheeked Barbet (except Ganeshgui-Castlerock and Makut), Crimson-backed Sunbird (except Ganeshgudi-Castlerock and Makut), and White-bellied Blue Flycatcher (except Bhadra). These species are very likely to occur in all survey sites and the above absences were probably due to chance and short duration of the survey.
ii) Malabar Parakeets were detected in Anshi, Bhadra, Brahmagiri, Dandeli, Kudremukh, Mookambika, Shettihalli, and Subrahmanya.
iii) Rufous Babblers were recorded in Bhadra, Kudremukh, Sharavati, and Talacauvery.
iv) Grey-headed Bulbuls were recorded in Bhadra, Brahmagiri, Kudremukh, Mookambika, Someshwara, and Subrahmanya.
v) Nilgiri Wood Pigeon was recorded from Kudremukh.

*Kerala*

In total, 181 bird species including 9 endemics were recorded across 14 sites in Kerala. The highest number of endemics (9 species) was recorded in Vazhachal followed by 8 species in Goodrickal, Malayattur, Nelliampathy, New Amarambalam, and Parambikulam. Among the endemics, besides the Malabar Grey Hornbill, we recorded the eight species as described below.

i) Two species appeared to be widespread across all sites with absences possibly due to chance and short survey effort: White-cheeked Barbets (except in Nadugani) and Crimson-backed Sunbird (except in Aralam, Nadugani, Tekkadi).
ii) Grey-headed Bulbul was recorded from Chimmony, Malayattur, New Amarambalam, Parambikulam, Silent Valley, Vazhachal

iii) Malabar Parakeet was recorded from all sites except Peechi, Nadugani, and Wayanad.
iv) Nilgiri Flycatcher was recorded from Goodrickal, Nelliampathy, and Vazhachal.
v) Rufous Babbler was recorded from Aralam, Goodrickal, Malayattur, Nelliampathy, New Amarambalam, Parambikulam, Periyar, Tekkadi RF, and Vazhachal.
vi) White-bellied Blue Flycatcher was recorded from Aralam, Chimmony, Goodrickal, Malayattur, Nelliampathy, New Amarambalam, Parambikulam, Periyar, Silent Valley, and Vazhachal.
vii) Wynaad Laughingthrush was recorded from Goodrickal, Malayattur, Nelliampathy, New Amarambalam, Parambikulam, Periyar, and Vazhachal.

*Tamil Nadu*

Our observations from the Indira Gandhi Wildlife Sanctuary and earlier work in Kalakad-Mundanthurai Tiger Reserve indicate the occurrence of all endemic species listed in Table 1, except the Nilgiri Laughingthrush (the latter was commonly observed in a number of locations visited in the Nilgiris outside the survey period). Data on relative abundance of these species is available in earlier reports and publications; here, we only note the occurrence of all but one of the endemic species in these two important protected areas in the southern Western Ghats of Tamil Nadu.

### 4.3. Species-wise summary

We obtained over 1800 detections of the endemic and restricted-range species across sites during the survey (Table 5); of these, over 1500 detections were on transects. Records of Malabar Grey Hornbill were discussed earlier; a summary for other species is provided below.

*Malabar Parakeet*

This species was recorded from the southernmost sites up to Koyna (17.7°N) in Maharashtra during this survey. On transects, we obtained 107 detections of this species. Among these transects, the highest encounter rates (detections/km) were obtained in Periyar (12.2, 7.5), Vazhachal (5.2), Indira Gandhi Wildlife Sanctuary (4.7), and Shettihalli (4.5). Among the remaining sites, encounter rates higher than 2 detections/km were obtained mainly in transects in Kerala and Tamil Nadu, with the exception of single transects in Cotigao in Goa (2.4) and Koyna in Maharashtra (2.8).

*Grey-headed Bulbul*

This was recorded from Vazhachal, Malayattur, and Indira Gandhi Wildlife Sanctuary in the south up to Madei Wildlife Sanctuary in Goa in the north. Over two-thirds of 92 detections on transects were from wildlife sanctuaries in the state of Goa (Mollem, Madei, Netravali, and Cotigao). The transects with the highest encounter rates

(detections/km) included Mollem (12.8, 7.0), Netravali (8.0), Madei (7.0, 3.4), Kudremukh (6.0), Vazhachal (4.3, 3), Cotigao (3), and Mookambika (2.8).

*Nilgiri Flycatcher*

A species more typical of higher altitudes, this species was not frequently encountered during this survey. Our records were mainly from altitudes above 900 m in Nelliampathy, Vazhachal, Indira Gandhi Wildlife Sanctuary, and Goodrickal in the states of Tamil Nadu and Kerala.

*Nilgiri Wood Pigeon*

Although recorded from as far south as Kalakad-Mundanthurai Tiger Reserve in Tamil Nadu, we recorded this species during the survey mainly in Maharashtra from Radhanagari to Bhimashankar. Of 49 detections on transect, encounter rates (detections/km) varied across sites being highest in Koyna (9.0, 9.3, and 1.0 on different transects), followed by Mahabaleshwar (3.9), Bhimashankar (1.2), Matheran (0.5), and Radhanagari (0.2).

*Rufous Babbler*

This species was recorded from the southernmost sites up to Amboli and Radhanagari in Maharashtra. Being more of a forest-edge species, we obtained only few 11 detections of this babbler on transects with encounter rates as follows: Periyar (2.7), Parambikulam (1.7), Nelliampathy (0.8), Bhadra (0.7), Talacauvery (0.6), Indira Gandhi Wildlife Sanctuary (0.6), and Vazhachal (0.3).

*White-cheeked Barbet*

Besides a few low elevation drier forest sites in Maharashtra (Tansa, Tungareshwar, Borivili, and Phansad), this widespread species was recorded at or in sites close to all other survey sites. We obtained 285 detections of this species on transects, with 10 transects providing encounter rates higher than 5 detections/km: Nelliampathy (16.6 and 5.3), Bhadra (10.4), Koyna (10.0), Peechi (9.6), Sharavati (8.8), Shettihalli (8.2), Netravali (7.1), Chimmony (6.7), and Bhimashankar (6.3).

*Crimson-backed Sunbird*

Similar to the White-cheeked Barbet, this was another widespread species seen across all sites barring a few dry low elevation sites in Maharashtra. This was the most frequently detected endemic species on transects (732 detections) with encounter rates higher than 10/km in 22 transects: Netravali (23.2), Mollem (11.3 – 19.2), Bhadra (18.0), Madei (17.6, 10.9), Bhimashankar (10.6), Bondla (12.1 – 13.8), Chimmony (16.4), Cotigao (10.4), Koyna (9.5, 14.2), Mahabaleshwar (13.5), Nelliampathy (14.0), and Vazhachal (10.8 – 14.6).

**Table 5.** Occurrence of endemics and restricted-range species across survey sites.

| SITE | GHB | MBL | MGH | MBP | NLF | NWP | RFB | WCB | CBS | WBF | WLT | Number of species | Number of detections |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Maharashtra** | | | | | | | | | | | | | |
| AMBOLI | | 1 | 6 | | | | 2 | 2 | 2 | 1 | | 6 | 14 |
| BHIMA | | 1 | | | | 3 | | 24 | 38 | 7 | | 5 | 73 |
| BORIVILI | | | | | | | | | | | | 0 | 0 |
| KALSUBAI | | 1 | | | | | | 7 | 6 | | | 3 | 14 |
| KOYNA | | | | 15 | | 38 | | 50 | 70 | 16 | | 5 | 189 |
| LONAVLA | | | | | | | | 4 | 1 | | | 2 | 5 |
| MAHABALESWAR | | | | | | 6 | | 5 | 22 | 4 | | 4 | 37 |
| MATHERAN | | | | | | 2 | | 9 | 1 | | | 3 | 12 |
| PHANSAD | | | 5 | | | | | | 1 | | | 2 | 6 |
| RADHANAGARI | | 1 | 3 | | | 5 | 2 | 22 | 29 | 3 | | 7 | 65 |
| TANSA | | | | | | | | | | | | 0 | 0 |
| TUNGAR | | | | | | | | | | | | 0 | 0 |
| **Total** | | **4** | **14** | **15** | | **54** | **4** | **123** | **170** | **31** | | **8** | **415** |
| **Goa** | | | | | | | | | | | | | |
| BONDLA | | | 8 | | | | | 3 | 68 | | | 3 | 79 |
| COTIGAO | 12 | | 12 | 5 | | | | 11 | 24 | 3 | | 6 | 67 |
| MADEI | 19 | | 20 | | | | | 9 | 46 | 2 | | 5 | 96 |
| MOLLEM | 19 | | 18 | 9 | | | | 7 | 112 | 1 | | 6 | 166 |
| NETRAVALI | 10 | | 1 | 1 | | | 1 | 9 | 27 | 1 | | 7 | 50 |
| **Total** | **60** | | **59** | **15** | | | **1** | **39** | **277** | **7** | | **7** | **458** |
| **Karnataka** | | | | | | | | | | | | | |
| ANSHI | | | 5 | 2 | | | | 1 | 7 | 6 | | 5 | 21 |
| BHADRA | 1 | | 1 | 2 | | | 2 | 15 | 24 | | | 6 | 45 |
| BRAHMAGIRI | 1 | | 2 | 1 | | | | 2 | 2 | 1 | | 6 | 9 |
| DANDELI | | | 14 | 5 | | | | 4 | 25 | 6 | | 5 | 54 |
| G'GUDI-C'ROCK | | | 2 | | | | | | | 1 | | 2 | 3 |
| KUDREMUKH | 8 | | 8 | 1 | | 2 | 1 | 1 | 4 | 3 | | 8 | 28 |
| MAKUT | | | 7 | | | | | | | 1 | | 2 | 8 |
| MOOKAMBIKA | 4 | | 9 | 4 | | | | 5 | 10 | 6 | | 6 | 38 |
| SHARAVATI | | | 10 | | | | 1 | 10 | 4 | 6 | | 5 | 31 |
| SHETTIHALLI | | | 4 | 6 | | | | 11 | 7 | 3 | | 5 | 31 |
| SOMESHWARA | 1 | | 11 | | | | | 4 | 11 | 5 | | 5 | 32 |
| SUBRAHMANYA | 2 | | 1 | 2 | | | | 3 | 1 | 2 | | 6 | 11 |
| TALACAUVERY | | | 3 | | | | 1 | 4 | 6 | 2 | | 5 | 16 |
| **Total** | **17** | | **77** | **23** | | **2** | **5** | **60** | **101** | **42** | | **8** | **327** |
| **Kerala** | | | | | | | | | | | | | |
| ARALAM | | | 6 | 1 | | | 1 | 3 | | 4 | | 5 | 15 |
| CHIMMONY | 2 | | 12 | 2 | | | | 10 | 23 | 1 | | 6 | 50 |
| GOODRICKAL | | | 8 | 7 | 3 | | 4 | 11 | 14 | 9 | 2 | 8 | 58 |
| MALAYATTUR | 1 | | 10 | 6 | | | 1 | 4 | 2 | 2 | 2 | 8 | 28 |
| NADUGANI | | | 1 | | | | | | | | | 1 | 1 |
| NELLIAMPATHY | | | 10 | 9 | 1 | | 3 | 24 | 24 | 2 | 1 | 8 | 74 |
| NEW AMARAMBALAM | 1 | | 2 | 1 | | | 1 | 1 | 1 | 1 | 1 | 8 | 9 |
| PARAMBIKULAM | 2 | | 5 | 5 | | | 2 | 4 | 11 | 3 | 1 | 8 | 33 |
| PEECHI | | | | | | | | 9 | | | | 1 | 9 |
| PERIYAR | | | 15 | 21 | | | 4 | 11 | 12 | 4 | 2 | 7 | 69 |
| SILENT VALLEY | 1 | | | 3 | | | | 2 | 2 | 2 | | 5 | 10 |
| TEKKADI RF | | | 1 | 1 | | | 1 | 1 | | | | 4 | 4 |
| VAZHACHAL | 13 | | 48 | 8 | 2 | | 4 | 10 | 88 | 2 | 2 | 9 | 177 |
| WAYANAD | | | | | | | | 6 | 8 | | | 2 | 14 |
| **Total** | **20** | | **118** | **64** | **6** | | **21** | **96** | **185** | **30** | **11** | **9** | **551** |
| **Tamil Nadu** | | | | | | | | | | | | | |
| IGWLS | 1 | | 9 | 12 | 1 | 1 | 2 | 3 | 14 | 8 | 1 | 10 | 52 |
| **All sites total** | **98** | **4** | **277** | **129** | **7** | **57** | **33** | **321** | **747** | **118** | **12** | **11** | **1803** |

*Species codes:* GHB=Grey-headed Bulbul, MBL=Malabar Lark, MGH = Malabar grey Hornbill, MBP = Malabar Parakeet, NLF=Nilgiri Flycatcher, NWP=Nilgiri Wood Pigeon, RFB=Rufous Babbler, WCB=White-cheeked Barbet, CBS=Crimson-backed Sunbird, WBF=White-bellied Blue Flycatcher, WLT= Wynaad Laughingthrush.

*White-bellied Blue Flycatcher*

This species was recorded from Bhimashankar in Maharashtra in the north to the southernmost sites, primarily in wet evergreen forest. Of 101 detections, the transects with high encounter rates (>2 detections/km) were: Koyna (2.5 – 5.8), Goodrickal (4.9), Sharavati (4.1), Aralam (3.7), Mookambika (3.6), Periyar (3.3), Someshwara (2.5), Bhimashankar (2.4), Shettihalli (2.2), Indira Gandhi Wildlife Sanctuary (2.1), and Dandeli (2.0).

*Wynaad Laughingthrush*

Although the survey covered a large number of sites where this species could occur, it was seen in only a handful of localities in Tamil Nadu and Kerala. Low elevation (300 to 1000 m) wet evergreen forest sites, with interspersed bamboo, in the Goodrickal-Periyar area and in the sanctuaries and Reserved Forests in the Anamalai hills appear particularly suitable sites for this species. Only three detections were obtained on transect with encounter rates (detections/km) as follows: Vazhachal (0.9), Nelliampathy (0.8), and Malayattur (0.7).

### 4.4. Bird diversity across sites

Since survey effort varied substantially across the 45 sites, the diversity of birds seen across these sites (range 6 to 97 species) cannot be directly compared. We therefore restricted the comparisons to 37 sites that were surveyed by a total of 65 line transects. In these 37 sites, we carried out 65 transect surveys of 142.6 km total length. A transect survey typically consisted of a 1-hour count of all bird species encountered (typically over the first 1.5 km), followed by continued survey for hornbills and endemic birds of varying length and duration (depending on trails and logistics). Barring two long transects of 21.7 km length in Radhanagari and 7.7 km in Mollem, the average length of transects was 1.8 km (SE = 0.09, range 0.85 to 3.8 km). Survey of all birds was carried out in all 37 sites in 58 of the 65 transects; in the remaining 7, due to time or logistical constraints, only hornbills and/or endemic birds were recorded.

Across the 58 transects, we detected 86 birds on average (SE = 4), with no statistically significant difference across the four broad forest type categories: dry, moist, wet, and northern wet forests (1-way ANOVA, $F_{3,54} = 0.27$, $P = 0.85$). However, bird species richness (the expected number of species in rarefaction analysis sample of 25 individuals in each transect) showed a significant variation across forest type category ($F_{3,54} = 7.29$, $P < 0.001$). This was due to lower bird richness in the northern wet forests as compared to the other three strata (Tukey post-hoc tests, $P < 0.05$, Figure 7a). Conversely, the number of endemic bird species detected on transects varied significantly across forest type categories ($F_{3,54} = 13.3$, $P < 0.001$), but was lower in the dry forests than in the other three types (Tukey tests, $P < 0.05$, Figure 7b).

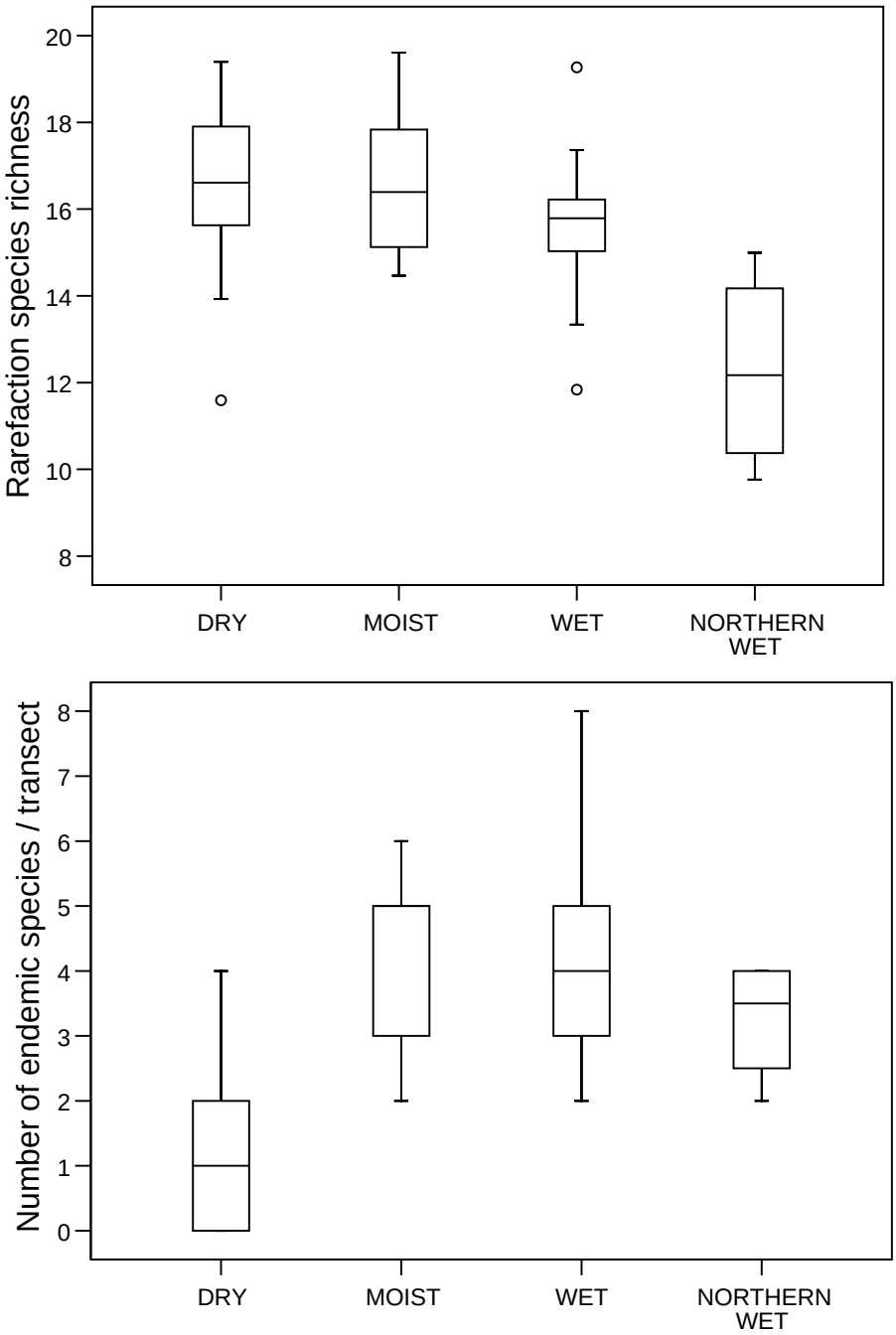



**Figure 7.** Box plots indicating comparative richness of bird species and endemics in transects across forest type categories in the Western Ghats. (a) Upper panel: bird species richness (rarefaction estimate for a standard sample of 25 individuals) and (b) Lower panel: number of endemic bird species detected per transect.

### 4.5. Bird community composition

To see the broad patterns of variation in bird community composition across the transects from 37 sites, we computed a matrix of Bray-Curtis dissimilarities based on the species-abundance data. This was used for a non-metric multi-dimensional scaling (NMDS) ordination of the sites. The analysis (Figure 8) revealed compositional variation that can be interpreted along the two axes in two main ways. The distribution of sites along the x-axis appears to be related to a moisture gradient from dry deciduous and thorn vegetation to tropical wet evergreen forests. On the y-axis, distribution of sites does not appear to be directly related to any single variable. However, among the wet forest sites, sites that were part of the Sahyadri complex of northern Western Ghats appear to separate (Radhanagari and Koyna to Matheran) from the more southerly sites (Goa and further south). It must be noted also that three of the most disturbed forest sites that we sampled—Tansa (Savardo nala), Peechi (near dam site), and Subrahmanya (along Bisle ghat road)—occupy extreme positions on this ordination indicating a possible effect of disturbance on bird community composition amidst the respective types of forest.

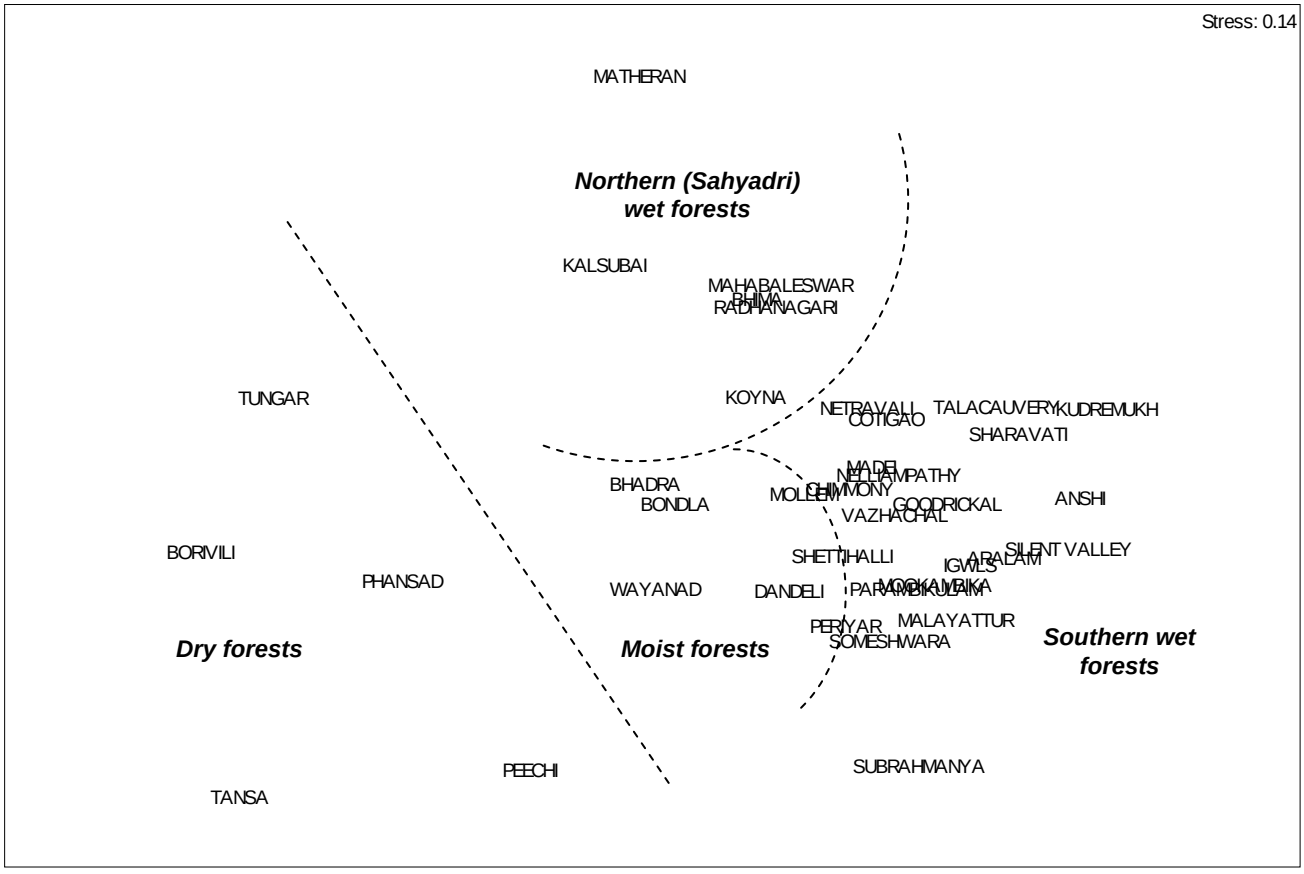



**Figure 8.** Variation in bird species composition across sites illustrated by NMDS ordination. Dashed lines are drawn by eye and are only meant to be indicative.

# 5. CONCLUSIONS, LIMITATIONS, OUTPUTS

### 5.1. Key findings

The results of the occurrence and distribution patterns of the four hornbill species in this survey are broadly concordant with earlier reports (Ali and 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 hornbill 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 be 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 (e.g., Sugathan and Varghese 1996, Sashikumar *et al.* 2005, Nameer and Praveen 2006).

The following sites are identified as important hornbill conservation landscapes in the Western Ghats (in rough order of priority), with the caveat that this is probably not a complete list and that intensive surveys are still required in some of these sites:

1) **Amboli-Goa-Dandeli** (across borders of Maharastra – Goa – Karnataka)
2) **Anamalai-Parambikulam-Vazhachal** (Tamil Nadu – Kerala)
3) **Nilgiris-Wayanad** (Tamil Nadu – Kerala)
4) **Someshwara-Sharavati-Mookambika** (Karnataka)
5) **Neyyar-Peppara-KMTR** ((Tamil Nadu – Kerala)
6) **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** (Kerala), **New Amarambalam RF** (Kerala), **Vazhachal and Nelliampathy RFs** (Kerala), **Goodarickal RF** (Kerala), **Kulathupuzha-Palode RFs** (Kerala).

### 5.2. Shortcomings

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 their 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 that is more of a species of the drier zone and eastern aspect of the Ghats. Since most of the survey was carried out in the altitudinal range of 0-1500 m, we could not survey for the high-altitude endemics of the Western Ghats, although details of the distribution of one species, the White-bellied Shortwing, can be found in Robin and Sukumar (2002) and Robin *et al.* (2006).

### 5.3. Recommendations for future effort

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 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. Hornbills also occur in many plantation areas (especially coffee and cardamom that are grown under shade trees). 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; besides monitoring by trained biologists, possibilities for the involvement of trained amateurs, volunteers, and Forest Department staff in hornbill monitoring needs to be explored. 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.

### 5.4. Reinstating protection status for all Indian hornbills in Wildlife Protection Act

As mentioned in the Introduction, the Wildlife (Protection) Act of India promulgated in 1972 had earlier provided a high protection status for all Indian hornbills by listing the family Bucerotidae in Schedule I of the Act and prohibiting their hunting (Anonymous 1992). However, in the list as it currently stands on the website of India's Ministry of Environment and Forests (http://envfor.nic.in/legis/wildlife/wildlife1.html, accessed 15 August 2008), the two grey hornbills (both *Ocyceros*) have been removed. In what is possibly an oversight, the Malabar Pied Hornbill *Anthracoceros coronatus* appears to have been omitted completely from listing in any of the Schedules as verified from a published source (WPSI 2002) as well as the above website of the Ministry of Environment and Forests, Government of India. This is ironical since the Act as it stands provides a level of protection under Schedule IV for a whole range of other bird species, indeed entire families such as bulbuls (Pycnonotidae), mynas (Sturnidae), and owls (Strigidae) to name a few among a long list.

The Schedules of the Act are currently under review (R. Sankaran, personal communication), although perhaps requiring much wider public participation and feedback. At the time of report preparation, we were unable to find a publicly-available copy of any proposed revised listing of species in the Wildlife Act. In the context of hornbills, their sensitivity to hunting and habitat disturbance and specialised requirements of diverse old-growth forests for feeding and nesting have been amply demonstrated across Asia (see Poonswad and Kemp 1993, and Kinnaird and O'Brien 2007 for a recent synthesis) including India (Reddy 1988, Kannan 1994, Kannan and James 1997, 2006, Mudappa and Kannan 1997, Mudappa 2000, Datta 1998, 2001, Datta and 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 and Soni 2006). In Central Indian forests, their sensitivity to habitat disturbance due to logging has also been reported (Mehta 1998). Even during this survey, we obtained reports of continuing threats of hunting and poaching of nests of hornbills in the Western Ghats.

As a consequence, we would like to propose the following immediate recommendations regarding the listing of hornbills on the Schedules of India's Wildlife (Protection) Act 1972, pending further wider public consultation:

1. Malabar Pied Hornbill *Anthracoceros coronatus* should be clearly and unambiguously listed in Schedule I (Part III: Birds) as this appears to be a threatened species and currently appears to receive little or no recognition. This will bring all large hornbill species occurring within India into Schedule I.

**2.** The Malabar Grey Hornbill *Ocyceros griseus* and the Indian Grey Hornbill *Ocyceros birostris* may also be listed in Schedule I. Wider public consultation may be held to consider their listing in other Schedules instead.

**3.** The common and scientific name of the species listed as Indian Pied Hornbill (*Anthracoceros malabaricus*) may be updated as Oriental Pied Hornbill *Anthracoceros albirostris*, this being the name currently used for the species (Grimmett *et al.* 1998).

### 5.5. Poster


We produced an educational poster on hornbills titled *Hornbills: Feathered Foresters*. We specially commissioned a painting by Maya Ramaswamy, a renowned wildlife artist in India, for this poster depicting the four species of hornbills found in the Western Ghats.

The poster illustrates the differences in the colouration between males and females of the species as well as illustrates all four species in flight to aid in identification. The unique nesting habit of the hornbills is also represented in the poster. Brief information on the vernacular names, distribution, and status of each species is also provided.

The posters were distributed at most of the surveyed sites as well as to many schools, conservation organisations, and other interested agencies and individuals close to many sites in the Western Ghats. The poster continues to be distributed in our study areas as and when required. It is helping to generate awareness about hornbills, their biology, and conservation importance in the region.

### 5.6. Masters' research project on Malabar Pied Hornbill

After our survey at one of the sites, Dandeli, which is now identified as an important hornbill conservation landscape, we encouraged a short study of the species by a student from Pondicherry University. Sneha Vijayakumar conducted the study on the ecology of this species including population counts between December 2006 and May 2007 as part of her Master's dissertation in ecology with funding support from WCS-India Program, under the guidance of Dr Priya Davidar, Pondicherry University. Her study has been crucial in building local awareness about the species, training the local

Forest Department staff in monitoring the species, as well as in recommending a management plan and priority status for the conservation of the Malabar Pied Hornbill, in particular, in this region along with the Wildlife Manager of the Park, Mr. Manoj Kumar. The following outputs have emerged from her work so far:

VIJAYAKUMAR, S. 2007. Status Survey of the Malabar Pied Hornbill (*Anthracoceros coronatus*) in the Dandeli region, North Karnataka. M. S. thesis, Pondicherry University, Pondicherry.

VIJAYAKUMAR, S. & DAVIDAR, P. 2007. Observations on possible social play in the Malabar Pied Hornbill (*Anthracoceros coronatus*) at Dandeli, northern Karnataka. *Indian Birds* **3(6):** 228-230.

### 5.7. Publications and Presentations at Symposia

We presented the preliminary findings of our survey at the Fourth International Hornbill Conference held in South Africa in November 2005. The following paper and poster were presented and have been published in the conference proceedings:

MUDAPPA, D. & RAMAN, T. R. S. 2007. Hornbill populations in important conservation units along the Western Ghats, India. Page 76 in *The Active Management of Hornbills and their Habitats for Conservation*. Edited by A. C. Kemp & M. I. Kemp. CD-ROM Proceedings of the 4th International Hornbill Conference, Mabula Game Lodge, Bela-Bela, South Africa. Naturalists & Nomads, Pretoria.

RAMAN, T. R. S. 2007. Effects of habitat alteration on hornbills and frugivorous birds in tropical rainforests of India. Pages 383-394 in *The Active Management of Hornbills and their Habitats for Conservation*. Edited by A. C. Kemp & M. I. Kemp. CD-ROM Proceedings of the 4th International Hornbill Conference, Mabula Game Lodge, Bela-Bela, South Africa. Naturalists & Nomads, Pretoria.

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# Annexure 1

List of bird species recorded during the survey in various sites and number of detections obtained.

| Species | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | TN | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | |
| Ashy Drongo *Dicrurus leucophaeus* | 5 | 2 | 2 | 2 | 1 | | | 3 | | | | | | | | 1 | | 2 | | | | 3 | | | 1 | | | | | | 1 | | | 2 | | 1 | 1 | | | | | | | 27 |
| Ashy Prinia *Prinia socialis* | | | | | | | | | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | 4 |
| Ashy Woodswallow *Artamus fuscus* | | | | | | | 4 | | | | | | | | | | | | | 1 | 1 | | | | 2 | | | | | | | | | | | | | | | | | | | 8 |
| Asian Brown Flycatcher *Muscicapa dauurica* | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | 1 | | | | | | | | | | | | | | | | | | | 3 |
| Asian Fairy Bluebird *Irena puella* | 1 | 9 | 12 | 9 | 3 | | | 1 | 1 | | 5 | 1 | 5 | 4 | 1 | 4 | 4 | 1 | 2 | 2 | 6 | 3 | | 12 | 1 | 3 | | 3 | 1 | | 18 | | | | | | | | | | | | 6 | 118 |
| Asian Koel *Eudynamys scolopacea* | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | 1 | | 2 | 1 | | | | | | 2 | | 1 | 1 | 1 | | | | 2 | | | 15 |
| Asian Openbill *Anastomus oscitans* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| Asian Palm Swift *Cypsiurus balasiensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Asian Paradise Flycatcher *Terpsiphone paradisi* | 2 | 2 | 6 | 6 | | 1 | | | 1 | | | | | | | 1 | | | 4 | | | | 2 | | 2 | 3 | | | 1 | | | 1 | 1 | 1 | | 1 | 1 | | | 1 | | 1 | 38 |
| Bar-winged Flycatcher-Shrike *Hemipus picatus* | 1 | 1 | | 1 | | | 4 | | 4 | | | 1 | 1 | | 1 | | | | 1 | 3 | 2 | | 1 | | | 1 | 1 | | 1 | 1 | | | | | 1 | | 1 | | | 1 | | | 2 | 30 |
| Baya Weaver *Ploceus philippinus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 |
| Besra *Accipiter virgatus* | | | 2 | 2 | | 1 | | | 2 | 1 | 1 | | | 1 | 1 | | 1 | 1 | 1 | 1 | | | 3 | | 1 | | | | | 3 | | 1 | | | 2 | | | | 1 | | | 2 | 28 |
| Black Baza *Aviceda leuphotes* | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Black Bulbul *Hypsipetes leucocephalus* | | 5 | 2 | 7 | 3 | | | 1 | | | 6 | | 1 | 3 | 1 | | 4 | | | 5 | | | 14 | | | | 3 | | | 2 | | 20 | | 1 | 28 | 2 | 15 | 1 | | 20 | | 1 | | 145 |
| Black Drongo *Dicrurus macrocercus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| Black Eagle *Ictinaetus malayensis* | | | 1 | | | 1 | | | | | | | | | | | | | | 2 | 1 | | 1 | | | | 1 | | 1 | | | | | | 1 | | 1 | | | 1 | | 1 | | 13 |
| Black Ibis *Pseudibis papillosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 |
| Black Kite *Milvus migrans* | | | | | | | 1 | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 4 |
| Black-capped Kingfisher *Halcyon pileata* | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Black-crested Bulbul *Pycnonotus melanicterus* | 3 | 13 | 19 | 9 | | | | 1 | 1 | | | 1 | 3 | 3 | | 8 | 12 | | 2 | 5 | 1 | 1 | | 4 | 1 | 4 | | 4 | | 1 | 13 | | | | | | | | | | | | 3 | 112 |
| Black-crowned Night Heron *Nycticorax nycticorax* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Black-headed Ibis *Threskiornis melanocephalus* | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Black-hooded Oriole *Oriolus xanthornus* | 7 | 2 | | 8 | | | | | 3 | | | | | | | 1 | | | 1 | | | | | | 7 | | | | | | | | 3 | | 6 | | | | 4 | | 1 | | | 43 |
| Black-lored Tit *Parus xanthogenys* | | | | | | | 1 | | 1 | | | | | 1 | | | | | | 4 | | | 2 | 1 | | 1 | | | 2 | 2 | | | | | | 1 | | | | | | 3 | 19 |
| Black-naped Monarch *Hypothymis azurea* | 2 | 3 | 6 | 3 | 1 | | 3 | | 3 | 1 | | | 1 | 6 | 1 | 4 | 3 | | 2 | 4 | 7 | 2 | | 2 | 1 | 1 | 1 | 3 | | 1 | 9 | 3 | 1 | 4 | 2 | 2 | 11 | | 2 | 1 | 3 | 3 | | 2 | 10 | 114 |
| Black-naped Oriole *Oriolus chinensis* | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 3 |
| Black-rumped Flameback *Dinopium benghalense* | 1 | 1 | 1 | 2 | | | 4 | | 2 | | | | | | | 1 | | | | | 1 | | 1 | | 3 | 2 | | 1 | | 1 | | | | 2 | | | | | | | 1 | | | 24 |
| Black-shouldered Kite *Elanus caeruleus* | | | | | | | | | | | | | | | | | 1 | | | 3 | | | | | | | | | | 1 | | | | | 1 | | | | | | | | | | 6 |
| Black-throated Munia *Lonchura kelaarti* | | | | | | | | | | | | | | | | | | | | 1 | | | 2 | | | | | | | | | | | | | | | | | | | | | | 3 |
| Blue-bearded Bee-eater *Nyctyornis athertoni* | | | | | | | | 1 | | | | | 2 | 1 | | 1 | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | | 1 | 8 |
| Blue-capped Rock Thrush *Monticola cinclorhynchus* | 1 | | | | 1 | 1 | | | | | | | | | | | | | | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | 6 |
| Blue-eared Kingfisher *Alcedo meninting* | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| Blue-faced Malkoha *Phaenicophaeus viridirostris* | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 2 |
| Blue-tailed Bee-eater *Merops philippinus* | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |

| Species | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | | TN | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI | DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERYY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW | PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | |
| Blue-winged Leafbird *Chloropsis cochinchinensis* | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 1 | | | | | | | | 3 | | 5 |
| Blyth's Reed Warbler *Acrocephalus dumetorum* | 6 | 5 | 15 | 3 | 3 | | | | | | | | | | | | | 1 | | 2 | 5 | | | 8 | | 1 | 1 | 4 | | | 3 | | | 3 | 1 | 2 | 1 | 1 | 12 | | 2 | | | 1 | | 80 |
| Bonelli's Eagle *Hieraaetus fasciatus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 |
| Booted Eagle *Hieraaetus pennatus* | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | 2 |
| Brahminy Kite *Haliastur indus* | 1 | | | | | 1 | | | 1 | | | | | | | | | | | 1 | 1 | | | 1 | | | 1 | 2 | | | 1 | | | | 2 | | | | | 1 | | | | | 13 |
| Brahminy Starling *Sturnus pagodarum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | 1 | | | | | | | | | 3 |
| Bronzed Drongo *Dicrurus aeneus* | 1 | 2 | 3 | 6 | 2 | 1 | 1 | | 15 | | | 1 | 6 | | | 2 | 2 | | 1 | | 1 | 6 | | 2 | 1 | 5 | 7 | 8 | | 1 | 14 | 2 | | | | 2 | | 1 | | 1 | 1 | | | 5 | 100 |
| Brown Fish Owl *Ketupa zeylonensis* | 1 | | | | | 1 | 1 | | | | | | 1 | | | | | | 1 | | | 1 | | | | | | 1 | 1 | | | | | 2 | | | | | 1 | | 1 | | | 1 | 13 |
| Brown Hawk Owl *Ninox scutulata* | | | | | | | | | | 1 | | | | | | | | | | | 3 | | | | | 1 | | 1 | | | | | | | | | | | | | 1 | | | | | 6 |
| Brown Rock Thrush *Monticola solitarius* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | 3 |
| Brown Shrike *Lanius cristatus* | | | | | | | | | | | | | | | | | | | | | 3 | | | 1 | | | | 2 | | 1 | | | | | | | | | | | | | | 7 |
| Brown-backed Needletail *Hirundapus giganteus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 |
| Brown-breasted Flycatcher *Muscicapa muttui* | 1 | 2 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | | | | | | | | | | | | | 7 |
| Brown-capped Pygmy Woodpecker *Dendrocopos nanus* | 2 | | | | | | | | 1 | | | | | | | | | | | 1 | | | | | 1 | 1 | 2 | 3 | | | | 1 | | | | | | | | | | 1 | | | 13 |
| Brown-cheeked Fulvetta *Alcippe poioicephala* | 5 | 6 | 12 | 11 | 3 | 6 | 4 | 2 | 12 | | 3 | 1 | 3 | 4 | 2 | | | 2 | 6 | 3 | 10 | 7 | | 9 | 1 | | | 3 | 5 | | 17 | | 1 | 7 | | 3 | 10 | 2 | 7 | 2 | 1 | 2 | | 1 | 17 | 190 |
| Brown-headed Barbet *Megalaima zeylanica* | 1 | 1 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 5 | | | | | 9 | | 2 | 5 | | 25 |
| Cattle Egret *Bubulcus ibis* | | 2 | | | 1 | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | 7 |
| Changeable Hawk Eagle *Spizaetus cirrhatus* | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Chestnut-headed Bee-eater *Merops leschenaultii* | | 1 | 1 | 2 | 1 | | | 1 | | | | | 1 | | | 1 | | | | 1 | 2 | | | 2 | | | | | | | 4 | 2 | | | | | | | | | | | | | 19 |
| Chestnut-shouldered Petronia *Petronia xanthocollis* | | 1 | | 3 | | | 4 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 2 | 3 | 1 | 1 | | | | | 3 | | | 19 |
| Chestnut-tailed Starling *Sturnus malabaricus* | 3 | 1 | 1 | 2 | 1 | | | | | | | | | | 1 | 2 | | | | | | | | 1 | | | 1 | 2 | | | | | | | | | | | | | | | | | | 15 |
| Collared Scops Owl *Otus bakkamoena* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | | | | | | | | | | | | | | | 1 | 3 |
| Common Buzzard *Buteo buteo* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Common Flameback *Dinopium javenense* | | | | | | | | 1 | | | | | | | 1 | | | | | 2 | 1 | 1 | | 1 | | 1 | | 3 | | | 3 | | | | | | | | | | | | | 3 | 17 |
| Common Hawk Cuckoo *Hierococcyx varius* | | | | | | | 2 | | | | | | | | | | 1 | | | | | | | | 1 | 1 | 1 | 5 | | | | | | 1 | | | | | | | | | | | 12 |
| Common Hoopoe *Upupa epops* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 |
| Common Iora *Aegithina tiphia* | 3 | 2 | | 2 | 1 | | 7 | 1 | | | | | 1 | | | 1 | | | | 2 | | 1 | | | | 2 | 4 | 2 | 1 | | 1 | 4 | 2 | 2 | 9 | 3 | 17 | 2 | 1 | 1 | 1 | 3 | 2 | 5 | | 83 |
| Common Kingfisher *Alcedo atthis* | | 1 | | | | | 2 | 1 | | | | | 1 | 1 | | 1 | | | | | | | | | | | | | | | | 1 | | | 2 | 1 | | | | | | | | | 11 |
| Common Myna *Acridotheres tristis* | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | 1 | | | 1 | | 1 | | 2 | 1 | 1 | | | | 1 | | | | | 10 |
| Common Rosefinch *Carpodacus erythrinus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | 1 | | | | | | | 1 | | 5 |
| Common Sandpiper *Actitis hypoleucos* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 |
| Common Tailorbird *Orthotomus sutorius* | 4 | 1 | 3 | 2 | | | 8 | 1 | 9 | | | | | | | | | | | 1 | | 1 | | | 1 | | 2 | | | | | 7 | 2 | | 8 | | 5 | 1 | 3 | | 1 | 1 | 2 | 7 | | 70 |
| Common Woodshrike *Tephrodornis pondicerianus* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 1 | 1 | | | | 1 | | 1 | 4 | | 11 |
| Coppersmith Barbet *Megalaima rubricapilla* | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | 3 | 1 | | 1 | | 2 | | | 2 | | | 13 |
| Crested Bunting *Melophus lathami* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | | | 2 |
| Crested Goshawk *Accipiter trivirgatus* | | | | | | | | | | | | | | | | 1 | | 1 | | | | | | 1 | | | | | 1 | | | | 1 | | | | | | | | | | | | | 5 |
| Crested Serpent Eagle *Spilornis cheela* | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 2 | | | | 1 | 1 | | | 1 | | 1 | | 3 | 1 | | 1 | 1 | | | 1 | 2 | | | 1 | 2 | | | | 2 | | | | 1 | 1 | | 1 | 1 | 31 |
| Crested Treeswift *Hemiprocne coronata* | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | 2 |
| Crimson Sunbird *Aethopyga siparaja* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | 2 | | 4 |
| Crimson-backed Sunbird *Nectarinia minima* | 68 | 24 | 46 | 112 | 27 | 7 | 24 | 2 | 25 | | 4 | | 10 | 4 | 7 | 11 | 1 | 6 | | 23 | 14 | 2 | | 24 | 1 | 11 | | 12 | 2 | | 88 | 8 | 2 | 38 | | 6 | 70 | 1 | 22 | 1 | 1 | 29 | | | 14 | 747 |
| Crimson-fronted Barbet *Megalaima rubricapilla* | | 9 | 11 | 7 | 2 | | 1 | 1 | 1 | | | | 3 | 1 | 1 | 4 | | | | 1 | 2 | 2 | 1 | 4 | | 1 | 1 | 10 | | 1 | 9 | 1 | | | | 1 | | 1 | | | | | | | 76 |

| | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | TN | |
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| Species | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI | DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERYY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW | PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | Total |
| Dark-fronted Babbler *Rhopocichla atriceps* | 1 | 6 | 3 | 4 | 1 | | | | 5 | | 1 | 1 | 2 | 1 | 3 | 2 | 1 | | 1 | | 6 | 1 | | 4 | 1 | 1 | | 1 | 1 | | 3 | | | | | 4 | | | | | | | | | 2 | 56 |
| Darter *Anhinga melanogaster* | | | 1 | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| Dollarbird *Eurystomus orientalis* | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 2 | | | | | | | | | | | | | | | 3 |
| Drongo Cuckoo *Surniculus lugubris* | | | | | | | 2 | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 4 |
| Dusky Crag Martin *Hirundo concolor* | | | 1 | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | 1 | | | | | | | | | | | | | | 9 |
| Emerald Dove *Chalcophaps indica* | | | 1 | 1 | 1 | | 1 | | 2 | | | 1 | 2 | | | | 3 | | 1 | 2 | 4 | 4 | | 5 | | 3 | 1 | 2 | 1 | | 2 | | 1 | 2 | | | 7 | 1 | | 1 | 2 | | | 1 | 52 |
| Eurasian Blackbird *Turdus merula* | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 2 | 1 | | 1 | 5 | | 5 | 1 | | 1 | | | | 19 |
| Eurasian Crag Martin *Hirundo rupestris* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Eurasian Golden Oriole *Oriolus oriolus* | 1 | | 1 | | 2 | | | | | | | | | | | | | | | 1 | | 1 | | | | 5 | 2 | | | | | | | | 4 | | | | 5 | | | | | | 22 |
| Eurasian Hobby *Falco subbuteo* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Eurasian Thick-knee *Burhinus oedicnemus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Eurasian Wryneck *Jynx torquilla* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | 1 |
| Forest Wagtail *Dendronanthus indicus* | 1 | 3 | 1 | 2 | 1 | | | | 1 | | | | | | | | | | | 1 | 2 | | | 1 | | 3 | | 3 | | 1 | 2 | | | | | 1 | | | | | | | | | 23 |
| Golden-fronted Chloropsis *Choloropsis aurifrons* | 3 | 2 | 1 | | 1 | | 3 | | | | | | | | 2 | 1 | 1 | | 1 | 1 | 1 | 1 | | | | 1 | 1 | 4 | 1 | | | 1 | | | | | | | | | | 1 | | 2 | 29 |
| Great Cormorant *Phalacrocorax carbo* | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | | | | | 2 |
| Great Hornbill *Buceros bicornis* | | | | | | | | | 3 | | | | 3 | | | | | | | 1 | 6 | | | 2 | | 8 | | 4 | | 1 | 7 | | 2 | | | | | 1 | | | 6 | | | 39 | 83 |
| Great Tit *Parus major* | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | | | | 2 | 4 |
| Great-eared Nightjar *Eurostopodus macrotis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Greater Coucal *Centropus sinensis* | 2 | | 2 | | | | 1 | 1 | | | 1 | | 2 | | | 5 | 1 | 1 | 1 | | 4 | 1 | | | | 1 | 1 | 3 | | | 3 | 1 | 1 | 2 | 1 | 4 | 2 | 1 | | 1 | 1 | 2 | 2 | | 48 |
| Greater Flameback *Chrysocolaptes lucidus* | 3 | 2 | 1 | 4 | 1 | 1 | 2 | | 8 | | 1 | 1 | 1 | 2 | 1 | 2 | | 1 | 2 | 3 | 7 | 3 | | 3 | 1 | 3 | 1 | 3 | | 2 | 6 | 2 | | | | 1 | | | | 1 | 1 | 1 | | 3 | 73 |
| Greater Racket-tailed Drongo *Dicrurus paradiseus* | 4 | 1 | 7 | 7 | 1 | 4 | 4 | 1 | 12 | | | 1 | 3 | | 3 | 7 | 3 | 1 | 5 | 9 | 11 | 7 | | 7 | 1 | 3 | 6 | 10 | 3 | 1 | 11 | 3 | | | 2 | | | | 6 | | 5 | 1 | 11 | 161 |
| Green Bee-eater *Merops orientalis* | | | 2 | | 1 | | 1 | | | | | | 1 | | | | | | | | | | | | | | 1 | | | | | 1 | 2 | | 2 | 4 | | 1 | | | 1 | | | | 17 |
| Green Imperial Pigeon *Ducula aenea* | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | 1 | | | | | | | | | | | | | 3 |
| Green Sandpiper *Tringa ochropus* | | | 1 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| Greenish Leaf Warbler *Phylloscopus trochiloides* | 6 | 5 | 13 | 14 | 5 | 7 | | 1 | 28 | | 1 | | | | | | | | | 6 | 7 | | | 20 | | 6 | 10 | 10 | | | 23 | | | 3 | 3 | 1 | 7 | 2 | 10 | 4 | 1 | 3 | 1 | 2 | 4 | 203 |
| Grey Junglefowl *Gallus sonneratii* | 2 | | 4 | 2 | 1 | 1 | 4 | | | 1 | 1 | 1 | 2 | 2 | | 1 | | 1 | 2 | 1 | 8 | 1 | | 4 | 1 | 2 | | 6 | 1 | | 5 | 1 | 2 | 4 | 1 | 2 | 15 | 3 | 1 | | 5 | 2 | | | | 90 |
| Grey Wagtail *Motacilla cinerea* | | | 1 | 2 | | 1 | | | | | | | | | | | | | | | 4 | | | 1 | | 1 | | 3 | | | | | 2 | | 1 | 3 | | | | 1 | | | | | 20 |
| Grey-bellied Cuckoo *Cacomantis passerinus* | | | 1 | | | | 2 | | | 1 | | | | | 1 | 1 | 1 | | | | | | | | | | 3 | | | | | 1 | 1 | | | 3 | | | | | | | 1 | | 17 |
| Grey-breasted Prinia *Prinia hodgsonii* | | | | | | | 3 | | 1 | | | | | 1 | | | | | | | 1 | 1 | | | | | 1 | | | | 12 | | | | | | | | | | | | 1 | 1 | 22 |
| Grey-headed Bulbul *Pycnonotus priocephalus* | | 12 | 19 | 19 | 10 | | 1 | 1 | | | 8 | | 4 | | | 1 | 2 | | | 2 | | 1 | | | 1 | 2 | | | 1 | | 13 | | | | | | | | | | | | 1 | 98 |
| Grey-headed Fish Eagle *Ichthyophaga ichthyaetus* | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | 1 | 5 |
| Grey-headed Flycatcher *Culicicapa ceylonensis* | | | | | | | 3 | | | | 2 | 1 | | | | | | 4 | | | 3 | | | | | | | 1 | | 8 | | | | | | | | | | | | 2 | 24 |
| Heart-spotted Woodpecker *Hemicircus canente* | 2 | 1 | 2 | 5 | 1 | | 1 | | 3 | | 1 | | 1 | 1 | 1 | | | | 1 | 1 | 3 | 1 | | 1 | 1 | 1 | 1 | 4 | 1 | | | | | | | | | | | 1 | | | | 3 | 38 |
| Hill Myna *Gracula religiosa* | | | | | | | 3 | 2 | 1 | | 1 | 1 | 5 | | 9 | 1 | 2 | 1 | 1 | 4 | 6 | 3 | 1 | 7 | 1 | 5 | 1 | 14 | 1 | 1 | 15 | 1 | | | | | | | | | | | | 3 | 90 |
| House Crow *Corvus splendens* | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | 1 | | 1 | 1 | | | | 2 | 1 | | | | | 9 |
| House Sparrow *Passer domesticus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | 1 | | | | 3 |
| House Swift *Apus affinis* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | | | | | | | | | | | | | | | | 2 |
| Indian Blue Robin *Luscinia brunnea* | | 1 | | | | | | | 2 | | | | | | | | | | | | | | | 2 | | | | 2 | | | 1 | | | | | | | | | | | | | 8 |
| Indian Cormorant *Phalacrocorax fuscicollis* | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Indian Cuckoo *Cuculus micropterus* | | | | | | | 1 | | | | | | | | | | | | | 1 | | | | | | 1 | 2 | | | | | | | | | | | | | | | | | 5 |
| Indian Grey Hornbill *Ocyceros birostris* | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | 6 | | | | | | | | | | 9 |
| Indian Nightjar *Caprimulgus asiaticus* | | 1 | | | | | 1 | | | | | | | | | | | | | | 1 | | | | | 1 | | 1 | | | | | 2 | | | 2 | | | | 1 | 1 | 2 | | | 13 |
| Indian Peafowl *Pavo cristatus* | 1 | 1 | | 1 | | | 6 | | 1 | | 2 | | | | | 2 | | | | | | | | | | | | | | | 2 | | | | 2 | | | | | | | | | | 18 |

| | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | TN | |
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| Species | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI | DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERYY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW | PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | Total |
| Indian Pitta *Pitta brachyura* | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | 2 | | 1 | | | | | | | | | | | | | | | | | | 5 |
| Indian Pond Heron *Ardeola grayii* | | | 1 | 2 | 1 | 1 | | | 1 | | | | | | | | | | | | 4 | 1 | | 1 | | | | | | | 1 | 1 | | | 1 | | | | | | | | | 15 |
| Indian Robin *Saxicoloides fulicata* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | 1 | | 1 | | | | | | 5 |
| Indian Scimitar Babbler *Pomatorhinus horsfieldii* | | 1 | 6 | | 2 | 3 | 1 | 1 | 6 | | | | 2 | 1 | 2 | | | 4 | 7 | | 9 | 2 | | 7 | 1 | 2 | | 5 | 1 | 1 | 6 | 4 | 2 | 5 | | 4 | 19 | 2 | 8 | | 3 | 5 | | | 6 | 128 |
| Indian Swiftlet *Collacalia unicolor* | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | 3 |
| Intermediate Egret *Mesophoyx intermedia* | | | 1 | | | | 1 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| Jerdon's Nightjar *Caprimulgus atripennis* | | 1 | | | | | 1 | | | | | | | | | 1 | | | | | | | | | | 1 | | | | | | | | | | 2 | | | | | 1 | 1 | | | 8 |
| Jungle Babbler *Turdoides striatus* | 6 | | 1 | | | 1 | 2 | | 3 | 1 | | | | | 1 | | 1 | | | 1 | | 1 | | 1 | 1 | 1 | 1 | 3 | 1 | 1 | | 1 | 1 | 1 | 1 | 4 | 3 | 4 | 1 | | 1 | 1 | | 1 | 1 | 47 |
| Jungle Bush Quail *Perdicula asiatica* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | 2 |
| Jungle Myna *Acridotheres fuscus* | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | 2 | | | | 1 | | | 2 | | 1 | | 3 | | | | | 11 |
| Jungle Owlet *Glaucidium radiatum* | | | | | | 1 | 2 | | | 1 | | | | | | | 1 | | | 1 | | | | | | 1 | 1 | 3 | 1 | 1 | | 1 | | 2 | | | | | 1 | | | 1 | 2 | 20 |
| Kestrel *Falco tinnunculus* | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | 2 |
| Large Cuckooshrike *Caracina macei* | | | | | | | | | | | | | | | 1 | 2 | | | | 1 | | | | | | | 4 | 2 | | | | | | | | | | | | 1 | | 3 | | | 14 |
| Large Grey Babbler *Turdoides malcomi* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | 2 |
| Large Woodshrike *Tephrodornis gularis* | 2 | 1 | 1 | 3 | | 1 | 1 | | 5 | | | | | | 1 | 1 | | | | 1 | 1 | 1 | | | 1 | 1 | 2 | 2 | | | 4 | 1 | | | | | | | | | | | 4 | 34 |
| Large-billed Crow *Corvus macrorhynchos* | 1 | 3 | 5 | 2 | 2 | 1 | 3 | | 4 | | 2 | | | 1 | | 2 | 1 | 1 | | 1 | 4 | 1 | | | | 1 | 1 | 4 | | | 3 | 1 | 2 | 2 | 5 | 2 | 3 | 3 | 1 | | | 1 | 2 | 3 | 2 | 70 |
| Large-billed Leaf Warbler *Phylloscopus magnirostris* | | 1 | 1 | | 2 | 2 | | | 2 | | 1 | | 1 | | | 2 | | | | 8 | 9 | | | 12 | | 4 | | 5 | | | 22 | | | | | 1 | | 1 | | | 1 | | | 7 | 82 |
| Laughing Dove *Streptopelia senegalensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | 2 |
| Lesser Adjutant *Leptoptilos javanicus* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 |
| Lesser Coucal *Centropus bengalensis* | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| Lesser Whistling-Duck *Dendrocygna javanica* | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Lesser Yellownape *Picus chlorolophus* | | | | | | 1 | 1 | | 1 | | | | 1 | 3 | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | 1 | 10 |
| Little Cormorant *Phalacrocorax niger* | | | 1 | | | | 1 | | | | | | | | | | | | | 1 | 3 | | | | | 1 | | | | | | | | 1 | | | 1 | | | | | | | | 9 |
| Little Egret *Egretta garzetta* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | | 1 | | | | | | | | 3 |
| Little Grebe *Tachybaptus ruficollis* | | | | | | | | | | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | 4 |
| Little Spiderhunter *Arachnothera longirostra* | 1 | 6 | 4 | 1 | 3 | 1 | 2 | 1 | 1 | | | 1 | 1 | 1 | | | | | 2 | 1 | 3 | 1 | | 3 | 1 | 1 | | 3 | 3 | 1 | 12 | | | | | | | | | | | | 10 | 64 |
| Long-tailed Shrike *Lanius schach* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 | 1 | 2 | 1 | 2 | | 2 | | | | | | 10 |
| Loten's Sunbird *Nectarinia lotenia* | 1 | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | | | | | | | 5 |
| Malabar Grey Hornbill *Ocyceros griseus* | 8 | 12 | 20 | 18 | 1 | 5 | 1 | 2 | 14 | 2 | 8 | 7 | 9 | 10 | 4 | 11 | 1 | 3 | 6 | 12 | 8 | 10 | 1 | 10 | 2 | 5 | | 15 | | 1 | 48 | | 6 | | | | | | | 5 | 3 | | | 9 | 277 |
| Malabar Lark *Galerida malabarica* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | 1 | | | | | | 1 | | | 4 |
| Malabar Parakeet *Psittacula columboides* | | 5 | | 9 | 1 | 2 | 2 | 1 | 5 | | 1 | | 4 | | 6 | | 2 | | 1 | 2 | 7 | 6 | | 9 | 1 | 5 | | 21 | 3 | 1 | 8 | | | | | | 15 | | | | | | 12 | 129 |
| Malabar Pied Hornbill *Anthracoceros coronatus* | | 1 | 5 | 12 | | | 1 | | 7 | 4 | | | 5 | | | | | | | | | | | | | | | | | | 4 | | 3 | | | | | | 1 | | | | | 43 |
| Malabar Trogon *Harpactes fasciatus* | | 1 | 3 | 5 | 1 | 4 | 1 | | 1 | | 1 | | 1 | 2 | 1 | 2 | | 1 | 1 | 1 | 7 | 1 | | 3 | | 1 | | 3 | 1 | | 9 | 1 | | | | | | | | | | | 7 | 59 |
| Malabar Whistling Thrush *Myophonus horsfieldii* | 1 | 3 | 5 | 7 | 2 | 4 | 1 | 2 | 3 | | 4 | 1 | 3 | 6 | 6 | 3 | 2 | 5 | 2 | 6 | 11 | 9 | | 11 | 1 | 6 | | 6 | 5 | 1 | 14 | | 2 | 3 | | | 6 | | 2 | 1 | 1 | 3 | | | 27 | 175 |
| Mottled Wood Owl *Strix ocellata* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 |
| Mountain Hawk Eagle *Spizaetus nipalensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 1 |
| Mountain Imperial Pigeon *Ducula badia* | | 4 | 17 | 7 | 2 | | | 1 | 2 | | 11 | 1 | 16 | 3 | 1 | | 1 | 4 | 3 | 9 | 8 | 4 | 1 | 8 | | 2 | | 10 | 1 | 1 | 5 | | | | | | | | | | | | 3 | 125 |
| Nilgiri Flycatcher *Eumyias albicaudata* | | | | | | | | | | | | | | | | | | | | | 3 | | | 1 | | | | | | | 2 | | | | | | | | | | | | 1 | 7 |
| Nilgiri Wood Pigeon *Columba elphinstonii* | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | 5 | | | 1 | 57 |
| Northern House Martin *Delichon urbica* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Olive-backed Pipit *Anthus hodgsoni* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 |
| Orange-headed Thrush *Zoothera citrina* | 1 | 1 | 8 | 5 | 2 | | 1 | | | | | | 3 | 1 | 4 | 1 | | | 1 | 5 | 6 | 7 | | 7 | 1 | 2 | 2 | 1 | 1 | | 4 | 2 | 1 | 4 | | 2 | 15 | 2 | 4 | 5 | | 10 | | | 3 | 112 |
| Oriental Honey Buzzard *Pernis ptilorhynchus* | | | 1 | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | 2 | | | | 1 | 1 | 1 | | 1 | 1 | | | | 11 |
| Oriental Magpie Robin *Copsychus saularis* | 1 | 2 | | | | | 3 | | 2 | 1 | | | | | 1 | | | | | 1 | | | | 1 | 1 | | 1 | 3 | 1 | 1 | | | 1 | | 3 | | 2 | 1 | 1 | | 1 | 1 | 1 | | | 30 |

| | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | TN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI | DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERYY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | Total |
| Oriental Scops Owl *Otus sunia* | 1 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 2 | | | | 1 | | | 1 | 6 |
| Oriental Turtle Dove *Streptopelia orientalis* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 9 | | 1 | 2 | 1 | 2 | 2 | 1 | 1 | | | 20 |
| Oriental White-Eye *Zosterops palpebrosus* | | | 1 | 1 | 3 | 1 | 4 | 1 | 1 | | 1 | | | 2 | 4 | | | 2 | 1 | | 6 | | | 6 | | | 4 | | | 10 | 5 | 1 | | | | | 5 | | | 1 | 1 | | 4 | 65 |
| Osprey *Pandion haliaetus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 |
| Pacific Swallow *Hirundo tahitica* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 |
| Paddyfield Pipit *Anthus rufulus* | | | | | | | | | | | | | | 1 | | | | 1 | | | 2 | | | | | | | | | | 1 | | | | | | | | | | | | | 5 |
| Pale-billed Flowerpecker *Dicaeum erythrorhynchos* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 6 | 1 | | | | | | 1 | | | 9 |
| Pied Bushchat *Saxicola caprata* | | | | | | | | | | | | | | | | | | 1 | | | 2 | | | 1 | | | | | | | 1 | | | 2 | 2 | 1 | 2 | | | 1 | | | 13 |
| Pied Kingfisher *Ceryle rudis* | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | 3 |
| Plain Flowerpecker *Dicaeum concolor* | 8 | 4 | 13 | 9 | 3 | 1 | 7 | 1 | 19 | | 2 | 1 | 5 | 4 | 5 | 10 | 2 | 7 | 4 | 4 | 12 | 3 | | 15 | 1 | 8 | | 9 | 7 | 1 | 21 | 12 | 2 | | | | 14 | | | | 2 | | | 13 | 229 |
| Plain Prinia *Prinia inornata* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Plum-headed Parakeet *Psittacula cyanocephala* | 2 | 1 | | 1 | | | 12 | | 7 | | | | 1 | | 3 | | | | | 3 | | | | 1 | | 6 | 7 | | 1 | | 1 | | | | 3 | | 1 | | 7 | 1 | 1 | 2 | | 61 |
| Pompadour Pigeon *Treron pompadora* | 1 | 3 | 7 | 5 | 2 | 1 | 1 | | 2 | | | | 1 | | 1 | 1 | | | 1 | 2 | 3 | | | 1 | | 1 | 4 | | | 4 | 2 | 1 | | | 5 | | 2 | 1 | 4 | 1 | | 2 | 59 |
| Puff-throated Babbler *Pellorneum ruficeps* | | 1 | 1 | 1 | 1 | 3 | 5 | | 4 | | 2 | 1 | 1 | 1 | 5 | 4 | 3 | 1 | 3 | 2 | 7 | 5 | 1 | 6 | 1 | 3 | | 8 | 1 | | 3 | 5 | 2 | 7 | | 4 | 15 | 2 | 4 | 3 | 3 | 6 | | 2 | 8 | 135 |
| Purple Sunbird *Nectarinia asiatica* | 5 | | 2 | 9 | | | 2 | | | | | | | | | | | | | | 1 | | | | | 2 | 1 | | | 1 | | 2 | 1 | 6 | 7 | 9 | 4 | 1 | | 2 | 1 | 2 | 7 | 65 |
| Purple-rumped Sunbird *Nectarinia zeylonica* | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | | | | | | 1 | | | | 1 | | | 1 | | | | 7 |
| Red Spurfowl Galloperdix spadicea | 1 | 1 | | | | | | | | 1 | | | 1 | | 1 | | | 1 | | | 5 | 1 | | 2 | | 2 | | 2 | 2 | | 1 | | 1 | 2 | 1 | 5 | 1 | | 1 | 1 | 1 | | | 2 | 37 |
| Red-headed Vulture *Sarcogyps calvus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| Red-rumped Swallow *Hirundo daurica* | | | 1 | 1 | | | 2 | | | | | | | | | | | | | | 2 | | | | | 1 | | | | 1 | | | | | 1 | | | | | | | 1 | 11 |
| Red-vented Bulbul *Pycnonotus cafer* | | | | | | | | 1 | 1 | | | | | | | | | | | | 1 | | | 1 | | 3 | 1 | 1 | | | 1 | | 2 | 4 | 7 | 4 | 1 | | 1 | 1 | 4 | 1 | | 36 |
| Red-wattled Lapwing *Vanellus indicus* | | | | | | | 1 | | 1 | | | | | | | | | 1 | | 1 | | | | | | 1 | | | | | | 1 | | | 2 | 1 | | | 2 | | | | | 11 |
| Red-whiskered Bulbul *Pycnonotus jocosus* | 5 | 3 | 2 | 4 | 5 | | 4 | 1 | | | | | | | 4 | | | 4 | | | 7 | 1 | | 5 | | | 3 | 3 | 1 | 1 | 11 | 2 | 18 | 6 | 10 | 40 | 6 | 11 | 16 | 7 | 13 | | 9 | | 202 |
| Richard's Pipit *Anthus richardi* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 |
| River Tern *Sterna aurantia* | | | | | | | 1 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 2 | | | | | 1 | | | | 5 |
| Rock Pigeon *Columba livia* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | 2 | | | | | | | 4 |
| Rose-ringed Parakeet *Psittacula krameri* | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 3 | | | | | 1 | | 1 | | | 7 |
| Rufous Babbler *Turdoides subrufus* | | | | | 1 | | 2 | | | | 1 | | | 1 | | | | 1 | 1 | | 4 | 1 | | 3 | 1 | 2 | | 4 | | 1 | 4 | | 2 | | | | | | | 2 | | | 2 | 33 |
| Rufous Treepie *Dendrocitta vagabunda* | 1 | 1 | 1 | 3 | | | 1 | | | | | | | | 3 | | 1 | | 1 | 1 | | 1 | | 1 | | 6 | 2 | | | | 1 | | | | 1 | | | | 1 | 1 | 2 | | | 29 |
| Rufous Woodpecker *Celeus brachyurus* | 1 | | | 1 | | | 1 | 1 | 1 | | | | 1 | | | 3 | | | | | 2 | | | | 1 | 1 | 1 | 4 | 1 | | 2 | | | 2 | | | | | 1 | | 1 | | 27 |
| Rufous-bellied Eagle *Hieraaetus kienerii* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 |
| Rusty-tailed Flycatcher *Muscicapa ruficauda* | | | | | | | | | | | | | | | | | | | | 2 | 3 | | | 2 | | 2 | | | | 14 | | | | | | | | | | | | | | 23 |
| Savanna Nightjar *Caprimulgus affinis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | | | 2 |
| Scaly Thrush *Zoothera dauma* | | | | 1 | | | | | | | | | 2 | | 1 | | 1 | | | | | | | 1 | | | | | | | | | | | | | | | | | 1 | | | | 7 |
| Scarlet Minivet *Percrocotus flammeus* | | | | 4 | 2 | 3 | 5 | | 6 | | | 1 | 1 | 1 | | 2 | | 1 | 1 | 2 | 4 | 2 | | 6 | 1 | 3 | 2 | 4 | 1 | | 4 | 1 | 2 | | | 1 | 2 | | | | | | | 10 | 72 |
| Shikra *Accipiter badius* | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | | 4 |
| Short-toed Snake Eagle *Circaetus gallicus* | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| Silver-backed Needletail *Hirundapus cochinchinensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 |
| Small Minivet *Pericrocotus cinnamomeus* | 1 | | | 2 | | | 2 | | 1 | | | | 1 | | | | | | | | | | | | | | 1 | | | | 2 | | | | | 2 | | | | | 1 | | | 13 |
| Speckled Piculet *Picumnus innominatus* | | | | | | | | | | | 1 | | 1 | 1 | | | | | 1 | | 2 | | | | 1 | | | | | | | | | | | | | | | 1 | | 1 | | 9 |
| Spotted Dove *Streptopelia chinensis* | 1 | 1 | 2 | | | | | | 1 | | | | | | | | | | | | | | | 1 | 1 | | 5 | | 1 | 1 | | | | | 2 | 3 | 1 | | | 4 | | 3 | | 1 | 29 |
| Spotted Owlet *Athene brama* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 |
| Sri Lanka Frogmouth *Batrachostomus moniliger* | 3 | | | | | 1 | | | | | | | 1 | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 7 |
| Steppe Eagle *Aquila nipalensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | 1 |

| | Goa | | | | | Karnataka | | | | | | | | | | | | Kerala | | | | | | | | | | | | | | | Maharashtra | | | | | | | | | | | TN | |
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| Species | BONDLA | COTIGAO | MADEI | MOLLEM | NETRAVALI | ANSHI | BHADRA | BRAHMAGIRI | DANDELI | G'GUDI-C'ROCK | KUDREMUKH | MAKUT | MOOKAMBIKA | SHARAVATI | SHETTIHALLI | SOMESHWARA | SUBRAHMANYA | TALACAUVERYY | ARALAM | CHIMMONY | GOODRICKAL | MALAYATTUR | NADUGANI | NELLIAMPATHY | NEW | PARAMBIKULAM | PEECHI | PERIYAR | SILENT VALLEY | TEKKADI RF | VAZHACHAL | WAYANAD | AMBOLI | BHIMA | BORIVILI | KALSUBAI | KOYNA | LONAVLA | MAHABALESWAR | MATHERAN | PHANSAD | RADHANAGARI | TANSA | TUNGAR | IGWLS | Total |
| Stork-billed Kingfisher *Halycon capensis* | | | 1 | | | | | | 1 | | | | | | | 1 | | | 1 | | | | | 1 | | 3 | | | | | | | | | | | | | | | | | | 8 |
| Streak-throated Woodpecker *Picus xanthopygaeus* | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | | | | | | | 2 |
| Sulpur-bellied Leaf Warbler *Phylloascopus griseolus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| Tawny-bellied Babbler *Dumetia hyperythra* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Thick-billed Flowerpecker *Dicaeum agile* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | 2 | 2 | 1 | | 1 | 1 | 1 | 3 | | 14 |
| Tickell's Blue Flycatcer *Cyornis tickelliae* | 1 | | | 2 | 1 | | 7 | | 17 | | | | 1 | | 5 | | 1 | | 1 | | | | | | 1 | 1 | 4 | 6 | | 1 | | 7 | 1 | | 4 | | 2 | | | 1 | 2 | | 1 | 1 | 68 |
| Tickell's Leaf Warbler *Phylloscopus affinis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 |
| Tree Pipit *Anthus trivialis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 |
| Unidentified | 5 | 2 | 1 | 2 | | 4 | | | 7 | 1 | | | 2 | 1 | 4 | | | | | 3 | | | | 3 | | | | 5 | | | 3 | | 1 | 4 | 1 | 3 | 4 | 3 | 2 | 1 | 2 | 5 | 3 | 3 | 3 | 78 |
| Velvet-fronted Nuthatch *Sitta frontalis* | 1 | | 1 | 6 | | | 3 | | 4 | | 1 | | | | 1 | 1 | | | 1 | | 3 | 3 | | 3 | 1 | 2 | | 3 | 2 | | 2 | 5 | | | | | | | | | | | 5 | 48 |
| Verditer Flycatcher *Eumyias thalassina* | | | 1 | | 1 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 3 |
| Vernal Hanging Parrot *Loriculus vernalis* | 4 | 7 | 7 | 10 | 4 | | 5 | 2 | | | 1 | 1 | 2 | | 6 | 5 | 3 | | 3 | 15 | 5 | 2 | | 5 | | 4 | 9 | | 1 | | 35 | 6 | | | | 11 | | | | 1 | 2 | | | 11 | 167 |
| Western Crowned Warbler *Phylloscopus occipitalis* | 1 | | 2 | | 1 | | | | | | | | | | | | | | | | 2 | | | | | | | | | | 2 | | | | | | | | | | | | | 8 |
| White-bellied Blue Flycatcher *Cyornis pallipes* | | 3 | 2 | 1 | 1 | 6 | | 1 | 6 | 1 | 3 | 1 | 6 | 6 | 3 | 5 | 2 | 2 | 4 | 1 | 9 | 2 | | 2 | 1 | 3 | | 4 | 2 | | 2 | | 1 | 7 | | 16 | | 4 | | | 3 | | | 8 | 118 |
| White-bellied Drongo *Dicrurus caerulescens* | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | 2 | 1 | | | | | 1 | | 1 | | 7 |
| White-bellied Sea Eagle *Haliaeetus leucogaster* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| White-bellied Treepie *Dendrocitta leucogastra* | | | | | | | 1 | | | | | | 2 | 1 | | | | | | 1 | 6 | 4 | | 3 | | 2 | | 3 | 1 | 1 | 7 | | | | | | | | | | | 2 | 34 |
| White-bellied Waterhen *Amaurornis pheonicurus* | | 1 | | | | | | | | | | | | | | | | | | | 2 | | | | | 1 | | | | | | | | | 1 | | | | | | | | | 5 |
| White-bellied Woodpecker *Dryocopus javensis* | | 1 | 3 | 2 | | 1 | | | 1 | | | | 1 | | | 1 | 1 | 1 | 2 | | 1 | | | | | 2 | | 2 | | | 1 | | | | | | | | | | | 1 | 21 |
| White-browed Bulbul *Pycnonotus luteolus* | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 6 | | | | | 4 | | | | | 11 |
| White-browed Wagtail *Motacilla maderaspatensis* | | | 1 | | | | 1 | | | | | | | | | | | | | | 5 | | | 1 | | | 1 | 1 | | | 1 | | | | 1 | | | | | | | | | 12 |
| White-cheeked Barbet *Megalaima viridis* | 3 | 11 | 9 | 7 | 9 | 1 | 15 | 2 | 4 | | 1 | | 5 | 10 | 11 | 4 | 3 | 4 | 3 | 10 | 11 | 4 | | 24 | 1 | 4 | 9 | 11 | 2 | 1 | 10 | 6 | 2 | 24 | | 7 | 50 | 4 | 5 | 9 | | 22 | | | 3 | 321 |
| White-eyed Buzzard *Butastur teesa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 |
| White-rumped Munia *Lonchura striata* | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 2 |
| White-rumped Needletail *Zoonavena sylvatica* | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| White-rumped Shama *Copsychus malabaricus* | 1 | | | | | | 7 | 1 | 10 | | | | | | 3 | 1 | | | | | | | | | | | | | | | 1 | | 1 | 2 | | | 11 | | 1 | 3 | 1 | 5 | | 1 | | 49 |
| White-throated Fantail *Rhipidura albicollis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 2 | | | | | | | 3 |
| White-throated Kingfisher *Halcyon smyrnensis* | | 2 | 1 | 1 | 1 | | 1 | | 1 | | | | | 1 | | 2 | 1 | | 1 | | 4 | | | 1 | | 1 | 2 | 2 | | | | | | | | 2 | 3 | 1 | | | 2 | 1 | | 1 | | 32 |
| Wire-tailed Swallow *Hirundo smithii* | | | | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 3 |
| Wood Sandpiper *Tringa glareola* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Woolly-necked Stork *Ciconia episcopus* | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Wynaad Laughingthrush *Garrulax delesserti* | | | | | | | | | | | | | | | | | | | | | 2 | 2 | | 1 | 1 | 1 | | 2 | | | 2 | | | | | | | | | | | | | 1 | 12 |
| Yellow-billed Babbler *Turdoides affinis* | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | 2 |
| Yellow-browed Bulbul *Iole indica* | 4 | 6 | 22 | 27 | 10 | 15 | 1 | 2 | 14 | | 11 | 1 | 4 | 8 | 6 | 4 | 2 | 11 | 7 | 6 | 13 | 5 | 1 | 18 | 1 | 5 | 1 | 5 | 6 | | 35 | 1 | 2 | 4 | | 35 | 3 | 4 | | | 10 | | | 20 | 330 |
| Yellow-crowned Woodpecker *Dendrocopos mahrattensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 2 | | | 3 |
| Yellow-eyed Babbler *Chrysomma sinense* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | 2 |
| Yellow-footed Green Pigeon | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | | | 2 |
| Yellow-wattled Lapwing *Vanellus malabaricus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 |
| Zitting Cisticola *Cisticola juncidis* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 |

# Annexure 2

Details and locations of transects surveyed at various sites along the Western Ghats (GA – Goa, MH – Maharastra, 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 |

| State | Place | Date | Habitat* | Place | Tno | Start (N) | (E) | End (N) | (E) | Length (km) |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 rd 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 |
| 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 |

| State | Place | Date | Habitat* | Place | Tno | Start (N) | (E) | End (N) | (E) | Length (km) |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | IGWLS | 02/09/2005 | WEF | Sheikalmudi-Palaganar-Manamboli | 1 | 10.32703 | 76.84983 | 10.33714 | 76.85175 | 1.28 |
| TN | IGWLS | 03/09/2005 | WEF | Koomatti-Manamboli | 2 | 10.40161 | 76.87666 | | | 1.66 |
| TN | IGWLS | 04/09/2005 | WEF | Kumati-Varagaliar trek shed | 3 | 10.40235 | 76.87916 | 10.40175 | 76.88884 | 1.42 |
| TN | IGWLS | 04/10/2005 | WEF | Manamboli elephant transect | 4 | 10.34827 | 76.89783 | | | 2.58 |
| TN | IGWLS | 2005-2006 | WEF | Korangumudi | 5 | 10.31412 | 76.91214 | 10.30872 | 76.90361 | 1.83 |
| TN | IGWLS | 2005-2006 | WEF | Pannimade[+] | 6 | 10.29677 | 76.89227 | | | 1.20 |
| TN | IGWLS | 2005-2006 | WEF | Puthuthottam | 7 | 10.33383 | 76.96735 | 10.33511 | 76.96461 | 2.45 |
| TN | IGWLS | 2005-2006 | WEF | Tata Finlay | 8 | 10.34755 | 76.93382 | 10.34705 | 76.93352 | 1.15 |
| TN | IGWLS | 2005-2006 | WEF | Anaigundi | 9 | 10.42175 | 76.83122 | | | 2.17 |
| TN | IGWLS | 2005-2006 | WEF | Andiparai | 10 | 10.39060 | 76.99438 | 10.40000 | 76.99117 | 2.08 |
| TN | IGWLS | 2005-2006 | WEF | Karian Shola 1 | 11 | 10.47045 | 76.84110 | 10.49023 | 76.83065 | 2.85 |
| TN | IGWLS | 2005-2006 | WEF | Karian Shola 2 | 12 | 10.46388 | 76.83660 | | | 2.85 |
| TN | IGWLS | 2005-2006 | WEF | Iyerpadi | 13 | 10.37308 | 76.99138 | 10.36070 | 76.99738 | 2.08 |
| TN | IGWLS | 2005-2006 | WEF | Akkamalai | 14 | 10.32815 | 77.02172 | 10.34570 | 77.02008 | 1.94 |
| TN | IGWLS | 2005-2006 | WEF | Iyerpadi Church | 15 | 10.36935 | 76.97515 | 10.37232 | 76.98078 | 1.70 |
| TN | IGWLS | 2005-2006 | WEF | Varagaliar | 16 | 10.42007 | 76.86811 | 10.71155 | 76.88231 | 2.11 |
| TN | IGWLS | 2005-2006 | WEF | Banathiar | 17 | 10.40335 | 76.87857 | 10.41370 | 76.88023 | 2.05 |
| TN | IGWLS | 2005-2006 | WEF | Manamboli | 18 | 10.34827 | 76.89783 | | | 1.80 |
| TN | IGWLS | 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 aproximate.

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