Studies on the status, distribution, habitat ecology and strategic planning for conservation of Malabar Pied Hornbill *Anthrococeros coronatus* Central India

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Abstract: The Malabar Pied Hornbill *Anthracoceros coronatus* is one of 10 species of hornbills found in the Indian subcontinent. According to BirdLife International (2015), this species is listed as Near Threatened (Criterion NT C1) due to decreasing trends in its population because of poaching, deforestation and habitat loss and fragmentation. *A. coronatus* prefers deciduous forest and thick canopies with distinct distributional ranges i.e. Western Ghats, Eastern Ghats and some pockets of Satpuda of Central India. Vidarbha is the eastern region of Maharastra state, lies on the northern part of the Deccan Plateau and is adjacent to the Satpuda Hill ranges. Pench Tiger Reserve (PTR-MS), Tadoba-Andheri Tiger Reserve (TATR) and Melghat Tiger Reserve (MTR), plus two proposed tiger reserves and a number of sanctuaries, are located in the Vidarbha region. Vidarbha region supports two broad categories of vegetation, i.e., tropical semi-evergreen and dry deciduous with riverine patches. In PTR-MS, *A. coronatus* was recorded much earlier (Anon. 2000), but in TATR it was first reported in 2001 and in MTR in 2003. Until 2012, not much was known about the distribution, population, food preferences and breeding biology of *A. coronatus* in Vidarbha. A study was conducted to understand the status, distribution and threats to *A. coronatus* in the three tiger reserves of Vidarbha, viz. MTR, TATR, PTR and the contiguous Pench Tiger Reserve in Madhya Pradesh state (PTR-MP) and also some corridors between these protected forests. The present paper presents the findings of the study and focuses on the strategic planning for its conservation. A good population of *A. coronatus* was recorded in PTR-MS and PTR-MP compared to MTR, and the population was lowest in TATR. Seasonal food preferences were also studied with respect to the fruiting phenology of the fruit-bearing trees. Major threats to *A. coronatus* in the study area were found to be illegal tree felling, land encroachments and forest fires. This study also provides

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basic data to the Maharashtra State Forest Department that will help in preparing the management plan for the conservation of *A. coronatus*.

Keywords: Malabar Pied Hornbill, Vidarbha, Central India, Melghat, Pench, Tadoba.

INTRODUCTION

The Malabar Pied Hornbill *Anthracoceros coronatus* is a bird from the eastern Himalayas but now it is a resident species of the wet zone of the Western Ghats (Ali and Ripley 1987) of southern India. It is a resident species in the peninsular hills, from southwest West Bengal and Bihar to North Andhra, the Western Ghats (mainly along the eastern edge), south of South Maharashtra (Ratnagiri) and Sri Lanka (Rasmussen and Anderton 2005). It is a Near Threatened species (Criterion NT C1; BirdLife International 2015) and its population is declining. According to Pande et al. (2003), it is a resident of the Konkan, Malabar and the Western Ghats up to an elevation of 1,000 m asl.

Several hypotheses have been put forward to explain the dispersal of source species from the eastern Himalayas to the Western Ghats. The Satpuda hypothesis (Ali 1949; Hora 1949) envisages the Vindhya-Satpuda range in Central India as a "corridor" for the dispersal of taxa from the Eastern Himalayas to the northern end of the Western Ghats (Shrinivasan and Prashanth 2006). Hora (1949) postulated that the wet-zone species colonized southern India by way of a once continuous corridor of tropical evergreen forests from the eastern Himalayas across the Vindhya-Satpuda range to the Western Ghats of South India (Karanth 2003).

A. coronatus has already been reported from different places of the Satpuda range, including the Satpuda National Park, Pench Tiger Reserve, Madhya Pradesh (Pasha 1997) (PTR-MP), Satpuda Tiger Reserve in Madhya Pradesh (Koeltz 1946), also in Eastern Madhya Pradesh (Jayapal et al. 2005), the Tadoba-Andhari Tiger Reserve in 2001 (Anon. 2009), and the MTR where it was first reported in 2003 (Kasambe and Wadatkar 2006). MTR is an important forest area in the central part of the Satpudas in Maharashtra (MH). Presumably due to defragmentation of this corridor, *A. coronatus* was not reported from MTR until 2003. But after proper protection measures were provided to the forest corridors and the MTR region, habitat for *A. coronatus* became suitable again. A few birds might have migrated from the Satpuda Tiger Reserves in Madhya Pradesh or PTR-MP in search of a suitable habitat. As per the sighting records of *A. coronatus* in MTR from 2003 to 2008, it is clear that the bird has become well established in this area (Wagh et al. 2011).

Though this species was regularly spotted by bird watchers,

forest officers and locals in the study area, actual status, distribution, habitat, food preferences, roosting sites, nesting sites and threats of *A. coronatus* were not known, even though such basic data is essential for the conservation of *A. coronatus* and its habitat. So with these 'key thoughts' the authors and their team started the present study on *A. coronatus*.

In this study, the current status of the *A. coronatus* was evaluated in the three selected tiger reserves of Vidarbha (MS) and Pench Tiger Reserve in MP (PTR-MP). Abundance of *A. coronatus* was studied in relation to its habitat, food preferences, roosting and nesting sites.

The study also aims to develop local awareness about the species and train local forest department staff in monitoring and providing better protective measures. The present paper focuses on the status, distribution, ecology and strategic planning for conservation of *A. coronatus* in Vidarbha region, Central India.

MATERIALS AND METHODS

To understand the status and distribution of *A. coronatus* in MTR, and PTR-MS, PTR-MP and TATR more than 13 visits were undertaken from January 2010 to March 2013 to various parts of the study area, covering all major habitat types and all seasons of the year (breeding and non-breeding seasons). Also, we conducted several interviews with locals, tribes, forest staff and bird watchers from time to time to obtain information about the present status of the *A. coronatus* by showing them the pictures, making them listen to the recorded bird calls and sometimes by showing actual birds in the wild.

Point transects were primarily conducted to monitor population of *A. coronatus* in evergreen and riverine forests of the tiger reserves. During field visits in the non-breeding season, the observers walked the points and encountered the hornbills.

Data of fruit-bearing plants used by Malabar Pied Hornbill for foraging in MTR, PTR-MS and TATR was collected. Observations were taken with telescope (15 x 60 Nikon) and binoculars (10 x 50 Nikon) and photographs were taken using a Nikon D90, D5000 Camera with 70-300 mm and 80-400 mm, zoom lenses. Locations of sightings of the species were recorded using a Garmin GPS unit.

Available literature related to the species was referenced, compiled and analyzed. Data on sightings of *A. coronatus* in Vidarbha were collected.

Study area

In Central India, Vidarbha is the eastern region of the Maharashtra. Madhya Pradesh (MP) lies on the northern part of the Deccan Plateau and is adjacent to the Satpuda Hill ranges. PTR, TATR and MTR, along

with the two proposed tiger reserves and number of sanctuaries, are located in Vidarbha.

Forests in Vidarbha occupy about 31.60% of the total area of Maharashtra state forest. The forest types found in the area are classified as Sub-tropical Hill Forest, Tropical Moist Deciduous Forest and Lush Green Deciduous Forest (Champian and Seth 1968).

Vidarbha has three main seasons, a wet monsoon and post-monsoon from June to September, cool dry winter from October to February and the hot dry season from March until the onset of the rains. Temperature of Vidarbha ranges from a minimum of 12 - 25^{o}C to a maximum of 30-48^{o}C, with the relative humidity varying from 10 - 15% to 60 - 95%. Annual precipitation is 1,700 mm and about 90% of the precipitation is in the four months from June to September.

The Indian subcontinent hosts about 1,295 bird species (Grimmett et al. 2009), of which more than 550 species have been reported from Maharashtra State. In Vidarbha, a total of 417 bird species has been reported (Anon. 2009).

Two hornbill species are found in all the Tiger Reserves in the study area, viz., Malabar Pied Hornbill *A. coronatus* and the Indian Grey Hornbill *Ocycerous birostris:* both are endemic to the Indian subcontinent. Of these, *A. coronatus* has been recorded only from the protected areas while the Indian Grey Hornbill has been recorded in both the protected and non-protected forest areas. The latter species is also found in the agricultural and urban areas of Vidarbha. However in this study we documented the status, distribution and habitat of only *A. coronatus*, due to their minimal abundance as compared to Indian Grey Hornbill in the four Tiger Reserves, three of Vidarbha (MS) and the forth in MP (Figure 1).

Melghat Tiger Reserve (MTR)

MTR (20^{o} 51' - 21^{o} 46' N 76^{o} 38' - 77^{o} 33' E) is located in the Maharashtra state of India. The MTR is a part of the Satpuda Range of hills in Central India and is spread over an area of 3,970 km^2 in the Amravati and Akola districts of Maharashtra. Out of this, 2,100 km^2 area is protected under MTR, which includes five protected areas under unified control namely, Gugamal National Park, Melghat Sanctuary (the buffer zone), Narnala Wildlife Sanctuary, Wan Wildlife Sanctuary and Ambabarwa Wildlife Sanctuary (Figure 1A). MTR has the Southern Tropical Dry Deciduous type of forest but in some parts the forest is semi-evergreen, starting from the west side of Chikhaldara and spreading up to Kolkhas, Kund, Koha and the Koktoo area. Sipna and Dolar are the major rivers flowing through MTR, providing riverine habitat for *A. coronatus*. MTR experiences a tropical climate, with temperatures ranging between 13oC and 22oC during winter and between 23^{o}C and 45^{o}C during summer. The annual rainfall ranges between 1,000 mm and 2,250 mm.

Pench Tiger Reserve, Maharashtra (PTR-MS) and Madhya Pradesh PTR (MP)

Both parts of Pench Tiger Reserve in Madhya Pradesh and in Maharashtra derive their name from the Pench River, which meanders along their central lines. PTR-MS is situated along the northern boundary of Nagpur district, adjoining Seoni and Chindwara districts of Madhya Pradesh. PTR-MS lies between 21° 40' 15" to 21° 43' 10" N and 79° 04' 10" to 79° 24' 50" E. It is located in the southern lower ridges of the Satpuda hill ranges, which form the catchment area of the Pench River. The total area of the PTR-MS core is about 257.26 km^2 and the buffer zone is 483.96 km^2. The forest type of the PTR-MS is Tropical Dry Deciduous (Figure 1B).

PTR-MP is situated in the districts of Seoni and Chindwara of Madhya Pradesh close to the border of PTR-MS. This Tiger Reserve covers an area of 757.920 km^2 and lies between 21° 38' to 21° 50' 30" N and 79° 09' to 79° 22' 03" E. The forest is Tropical Dry Deciduous and Semi-evergreen (Figure 1C).

Tadoba-Andhari Tiger Reserve (TATR)

TATR covers an area of about 625.40 km^2 in Chandrapur district of Maharashtra state. The habitat in TATR consists of Southern Tropical Dry Deciduous Forest interspersed with several large meadows. The forest is dominated by Teak *Tectona grandis* and bamboo *Dendrocalamus strictus* and lies between 21° 23' 23" N and 79° 26' 05" E. (Figure 1D). The reserve gets its name from Andheri River, which flows through the reserve and finally joins the Wainganga River.

RESULTS AND DISCUSSION

The present study found *A. coronatus* in the four Tiger Reserves i.e. MTR, PTR-MS, PTR-MP and TATR in Central India, and identified its prime habitats, food preferences and threats. It was observed that the dry deciduous forest was used for foraging, and the riverine forest was used for foraging and nesting.

A. coronatus was first reported in MTR in 2003 (Wagh et al. 2011) but now its presence is well established in this area. As per the sightings given in Table 1, *A. coronatus* was found almost throughout the year in the study area and this indicates that *A. coronatus* is not a passage migrant or vagrant to MTR. Out of the nine sightings from MTR, three sightings were reported from the core area and six sightings from the Melghat Sanctuary part of the MTR that covers approximately 50% of the MTR. Though most part of MTR has the Southern Tropical Dry Deciduous type of forest, some parts of the forest are semi-evergreen, starting from the western side of Chikhaldara hill-station and spreading

up to Kolkaj, Kund, Koha, Koktu, and Gularghat. Canopies of large ancient fig trees, like *Ficus benghalensis* and other *Ficus* species are also available in many of parts of this area.

A. coronatus was reported much earlier in PTR-MS, but during our surveys we recorded a total of 12 individuals at four different sites, i.e. Ambakhori, Totladoh, Kantra-Utar Nala and Sillari Gate (Table 2). Maximum numbers were sighted at Ambakhori when they were calling. PTR-MS forest is of the semi-evergreen and dry deciduous types, with Teak and Salai *Shorea robusta* dominanting the habitat with dense canopy, and excellent meadows. Fruiting plant species like *Ficus* are the dominant in this area. The Pench River passes through the midline of PTR-MS, creating many evergreen riverine patches along its edges and these patches act as the potential sites for the roosting and nesting of *A. coronatus*. *A. coronatus* prefers figs as food in PTR-MS but sometimes they were also found feeding on small mammals like squirrels and bats. Two nesting sites were also recorded, at Ranidoh and Sillari Gate in PTR-MS.

PTR-MP and PTR-MS are contiguous forest areas, but divided administratively into two different states. During our survey as per the sightings and reports of the local forest department staff, a total of 13 individuals of *A. coronatus* were recorded at Karmajhari, Raiyakasa, Boda Nala and Turia Gate in the PTR (MP) (Table 3). Most of the forest type in PTR-MP is similar to PTR-MS but *Ficus* species and Kusum trees *Schleichera oleosa* are dominant here. Three nests were reported, at Raiyakasa, Sitaghati and Boda-Nala areas in PTR-MP.

TATR is one of the best managed Tiger Reserves in Maharashtra State. *A. coronatus* was reported for the first time in TATR in 2001 at Mohurli gate area and, during our surveys, we recorded only five individuals of *A. coronatus* in TATR at Mohurli, Kolsa, Jamani and Navegaon (Table 4), and of these four sites, Mohurli is a regular roosting site for *A. coronatus*. No nest was found in TATR during the study period.

Food preference

A. coronatus are both fruit and flesh-eaters. They are far-ranging in their search for food and drop the seeds of the fruits they eat as they go, dispersing them over a wide area. They are thus important seed dispersers for the forest, acting as an agent of forest regeneration, at the same time controlling large-sized insects and other small animals. As such, they can be regarded as indicators of high moist forest, ensuring the continuance of forest health and species richness (Balasubramanian et al. 2004).

For food preferences and feeding habits, *A. coronatus* was studied in different seasons in the four Tiger Reserves of the study area by walking along transect lines or by direct searches during our field visits, and observations about the foraging habits were noted down (Table 5). In MTR, *A. coronatus* was seen foraging on the fruits of 10 fruit-plant

species namely, *F. benghalensis, F. religiosa, F. racemosa, F. infectoria, F. virega, Syzygium cumini, Adina cordifolia, Schleichera oleosa, Phoenix sylvestris* and *Grewia tiliifolia.*

Ficus species fruits were found as a major food source of *A. coronatus* in MTR. Regarding the food preference of *A. coronatus* in MTR, it was noted that during summer, *A. coronatus* dispersed towards the hilly region of a famous hill-station in Vidarbha, Chikhaldara, and preferred the fruits of *Ficus* species *i.e. F. benghalensis, F. religiosa, F. racemosa* and two non-*Ficus* species *i.e. P. sylvestris* and *S. cumini*. The relatively open riverine habitats on the banks of the River Sipna also provide important roosting site for *A. coronatus* in MTR.

During food preference studies in the non-breeding and breeding period in both PTR-MS and PTR-MP, *A. coronatus* were observed to feed on fruits of *S. cumini, F. benghalensis, F. religiosa, F. racemosa, F. infectoria, Adina cordifolia, Schleichera oleosa*, and *G. tiliifolia*.

A. coronatus was seen feeding on small mammals like Three-striped Palm Squirrel *Funambulus palmarium* and Short-nosed Fruit-eating Bat *Cynopterus sphinx* during the breeding season (K. Thomare pers. comm.).

TATR is composed of mixed forest types, with bamboo and Teak as the dominant vegetation. *Ficus* species are uncommon and hence *A. coronatus* preferred the fruits of *F. benghalensis, F. religiosa, F. racemosa, Adina cordifolia, S. cumini* and *Zizyphus mauritiana*.

Riverine evergreen habitats in MTR, PTR-MS and PTR-MP provide important roosting sites for *A. coronatus*. They mainly roosted in the foliage of tree species like *Terminalia arjuna* and *A. cordifolia*.

In the four selected Tiger Reserves of Central India, a total of 54 individuals of *A. coronatus* were reported, 27 from MTR, 12 from PTR-MS, 10 from PTR-MP and five from TATR (Tables 1-4). The maximum number was found in MTR and lowest in TATR, but since MTR covers about 50% of the total study area, PTR-MS covers 18%, PTR-MP covers 18% and TATR covers 15%.

In MTR *A. coronatus* was found almost throughout the year in the study area. This indicates that it is not a passage migrant or vagrant to the study area. Most of the sightings from MTR were reported from the central part of the Reserve, i.e. Gularghat, Dharghad, Koktu, Dhakana, Kund, Bander Kahu, Kolkhas, Chourakund and Raipur, and these areas covered approximately 50% of the MTR. Crowns of large old trees like *Ficus* species were seen in most of the area.

We also noted *A. coronatus* in and around Chikhaldara in the month of April, May and June, where there are several ancient *F. benghalensis* and *P. sylvestris* trees around Chikhaldara, the famous hill-station in Vidarbha. April to June is the fruiting period of *F. benghalensis* and *P. sylvestris* in Chikhaldara region and hence most of the time the hornbills were found to be feeding on these fruits.

Presence of juveniles with adults confirms their breeding status in this region, although only a single nest hole was located in MTR. The lack of nesting record from MTR could be due to of the difficulty in locating nests, which could in turn be due to the vastness of the area and hilly terrain.

CONCLUSIONS

As per the observations, abundance of *A. coronatus* is much lower in all the Tiger Reserves of the study area as compared to the Western Ghats, and even their sightings are scarce.

From the above data, we assume that the abundance of *A. coronatus* could be dependent on the type of vegetation, availability of riverine habitat, temperature, availability of food and size of the area.

During the survey, most of the sightings were recorded from Protected Areas (core and buffer zones) and no sightings were recorded from the corridors in between these Tiger Reserves.

This could be due to degraded habitat, low number of old plants, low *Ficus* species dominance, discontinuous forest patches, heavy anthropogenic pressure and/or failure in nesting.

No poaching or illegal hunting of hornbills by locals or tribes was observed during the survey in all the Tiger Reserves of the study area. There are reports of *A. coronatus* being hunted by tribals in Dandeli forest of Western Ghats for medicinal purpose (Vijaykumar et al. 2011).

No natural predators of the *A. coronatus* have been observed during the study period. Clear felling by locals in buffer zones for agriculture expansion, intentional forest fires and old trees falling due to heavy rain and storms were recorded to be the major threats to the habitat of *A. coronatus*.

This study also provides the basic data to the Maharashtra State Forest Department, which will help to prepare the management plan for the conservation of *A. coronatus*.

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Table 1. Sightings of Malabar Pied Hornbills *A. coronatus* in Melghat Tiger Reserve.

SN	Area	Location	Altitude (m asl)	No. of birds
1	Kolkaj	21° 29' 49" N 77° 12' 30" E	422	3
2	Bujrukpadaw	21° 32' 52" N 77° 14' 12" E	463	4
3	Semadoh	21° 34' 52" N 77° 16' 12" E	538	2
4	Raipur	21° 34' 52" N 77° 16' 12" E	538	2
5	Chourakund	21° 32' 45" N 77° 06' 39" E	385	1
6	Banderkahu	21° 27' 21" N 77° 16' 14" E	550	2
7	Chikhaldara	21° 21' 42" N 77° 22' 26" E	1,067	7
8	Koktu	21° 19' 14" N 77° 02' 42" E	531	4
9	Gularghat	21° 15' 31" N 77° 00' 52" E	585	2

Table 2. Sightings of Malabar Pied Hornbill *A. coronatus* in Pench Tiger Reserve, Maharastra state (PTR-MS).

SN	Area	Location	Altitude (m asl)	No. of birds
1	Ambakhori	21° 41' 10" N 79° 40' 10" E	190	6
2	Tataladoh	21° 42' 15" N 79° 30' 20" E	179	2
3	Kantra-utar Nala	21° 41' 10" N 79° 28' 40" E	184	2
4	Sillari Gate	21° 43' 15" N 79° 24' 50" E	193	2

Table 3. Sightings of Malabar Pied Hornbill *A. coronatus* in Pench Tiger Reserve, Madhya Pradesh state (PTR-MP).

SN	Area	Location	Altitude (m asl)	No. of birds
1	Karmajhari	21° 49' 39" N 79° 18' 89" E	494	2
2	Raiyakasa	21° 48' 50" N 79° 17' 67" E	476	3
3	Boda Nala	21° 45' 98" N 79° 19' 34" E	500	2
4	Turia Gate	21° 43' 47" N 79° 16' 16" E	464	3

Table 4. Sightings of Malabar Pied Hornbill *A. coronatus* in Tadoba-Andheri Tiger Reserve (TATR).

SN	Area	Location	Altitude (m asl)	No. of birds
1	Mohurli	21° 23.23" N 79° 26.05" E	238	2
2	Kolsa	21° 23.23" N 79° 26.05" E	245	1
3	Jamani	21° 23.23" N 79° 26.05" E	224	1
4	Navegaon	21° 23.23" N 79° 26.05" E	256	1

Table 5. Food preference of the Malabar Pied Hornbill *A. coronatus* in the study area.

SN	Plant species	MTR	PTR-MS	PTR-MP	TATR
1	*Ficus benghalensis*	√	√	√	√
2	*Ficus religiosa*	√	√	√	√
3	*Ficus racemosa*	√	√	√	√
4	*Ficus infectoria*	√	√	√	-
5	*Ficus virens*	√	√	√	√
6	*Syzygium cumini*	√	√	√	√
7	*Adina cordifolia*	√	√	√	√
8	*Schleichera oleosa*	√	√	√	-
9	*Grewia tiliifolia*	√	√	√	-
10	*Phoenix sylvestris*	√	-	-	-
11	*Zizyphus mauritiana*	-	-	-	√

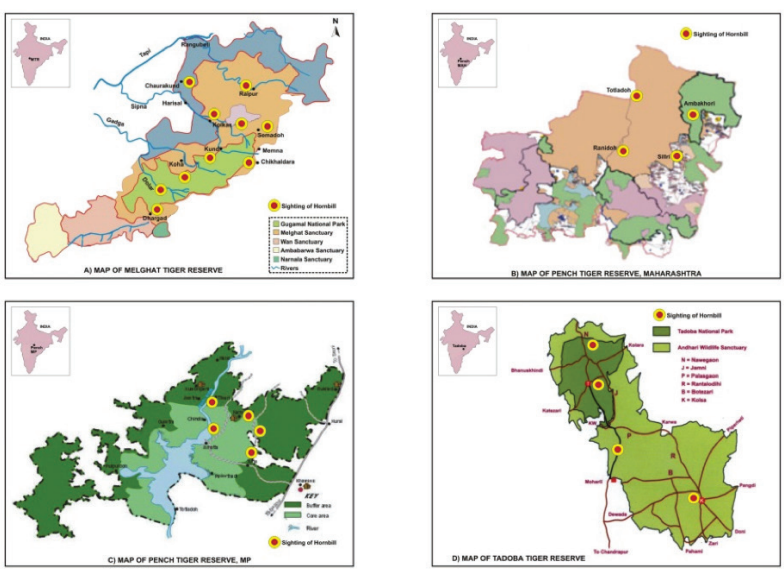

Figure 1. Map of Tiger Reserves in Central India.
[(A) Melghat Tiger Reserve (MTR), (B) Pench Tiger Reserve, Maharashtra state (PTR-MS), (C) Pench Tiger Reserve, Madhya Pradesh state (PTR-MP), (D) Tadoba-Andheri Tiger Reserve (TATR)]