International Journal of Ecology and Environmental Sciences 48: 663-669, 2022
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2022.0663

Short Communication

Hornbills: A Flagship Species in Pakke Tiger Reserve, Arunachal Pradesh, India

ANURAG VISHWAKARMA[1], AWADHESH KUMAR[1]* AND MURALI KRISHNA[2]
[1]*Department of Forestry, NERIST (Deemed to be University), Nirjuli-791109, Itanagar, Arunachal Pradesh, India.*
[2]*Amity Institute of Forestry and Wildlife, Amity University, Noida, U.P.*
E-mail: aviwild88@gmail.com; tpileatus@gmail.com; mkchatakonda@amity.edu
***Corresponding author**

ABSTRACT
Flagships species of birds play a pivotal role for promoting avitourism, encouraging people for their conservation and finally maintain ecosystem services. Among the bird species, hornbills are charismatic birds and the main attraction of Arunachal Pradesh due to their large body and unique bill and its significant cultural importance among the tribal society of the state. In this study three hornbill species i.e., Wreathed hornbill (*Rhyticeros undulates*), Oriental pied hornbill (*Anthracoceros albirostris*), and Great Hornbill (*Buceros bicornis*) are documented in and around the forest areas of Pakke Tiger Reserve, Arunachal Pradesh, India. The point count method was used for counting hornbills in the forest area and a total of 57 individuals of three hornbill species were recorded in 26 sampling points. The highest density/km^2 of hornbill was recorded for Wreathed hornbill (21.9±8.9) followed by the Great hornbill (13.4±3.3) and Oriental Pied Hornbill (10.9±2.8). Four roosting sites were recorded. Of these, three sites were in the fringe area of Pakke and one inside the Pakke Tiger Reserve. A total of 150±70 individuals of hornbills were recorded through direct count method in the roosting sites. Darlong village was identified as having highest individuals of Wreathed Hornbill (79±46.7) followed by A2 Village (Wreathed Hornbill: 29.7±9) and Khari camp (Wreathed Hornbill: 20±5) and Langka camp (Oriental Pied Hornbill: 21.8±9.4). The present study described that roosting sites are the most effective and easiest way to watch hornbills by visitors in the Pakke Reserve area.

Key words: Flagship species, Hornbills, Pakke Tiger Reserve, Avitourism, Conservation

INTRODUCTION

Nature provides numerous unique biological species in a particular landscape or habitat. Many species represent their uniqueness by there morphological character, behavior, rarety, or with endemism. Such species are called as flagship species. Flagship species are charismatic to raise environmental awareness among the people (Samways et al. 1995) and rallying points to stimulate conservation awareness and action (Heywood and Watson 1995). They are also crucial in terms of ecology (Nentwing et al. 2004, Walpole and Leader-Williams 2002). Wisely chosen flagship species can positively influence conservation action (Smith and Sutton 2008), but poorly chosen species may have the opposite effect (Bowen-Jones and Entwistle 2002, Barua 2011). Entwistle et al. (2000) pointed out that the loss of flagship species and their habitats may, directly and indirectly, affect the inhabitants of the surrounding.

Avifauna is charismatic and beautiful wildlife in nature. They are easy to watch and capture and record in camera in the wild as they show attractive posture during foraging, breeding, and nesting behaviors. Avifauna is habitat-specific and some can occupy more than one habitat type, however, because of land-use changes, most of the birds have been displaced from their original habitats (Burgess et al. 2002). Any habitat which is selected by bird, it is for their requirements of successful reproduction and survival in the rest of the period (Rodríguez-Estrella 2007). Differences in requirements among bird species have caused specificity on habitat requirements (Buckley and Freckleton 2010).

Flagships species of birds may play a vital role in encouraging people for the conservation of birds as well as promoting avitourism. Avitourism or bird watching is a form of nature or wildlife-based ecotourism that mainly focuses on observing and

identifying birds in their natural habitats (Biggs et al. 2011). Bird watching is a highly significant component within nature based ecotourism. Nowadays avitourism has been confirmed as an efficient tool not only to encourage the conservation of threatened species and their habitats but also to support the livelihood of the local people inhabiting in and around the habitats (Tisdell and Wilson, 2000, Griffin et al. 2017).

The conservation work on birds of the northeast Indian forest have focused particularly on the hornbill species. In India, the northeast region has the highest diversity of hornbill species. Hornbill belongs to family Bucerotidae and comprises of a total 54 species globally (Kemp 2001). They show substantial variation in body size ranging from Black dwarf hornbill (*Horizocerus hartlaubi*), the smallest species (99.1 g and 32 cm or 1 ft 1 in) in length to the largest species Southern ground hornbill (*Bucorvus leadbeateri)* which has maximum weight and length of 6.3 kg and 180 cm or (5 ft 11 in) across the wings respectively (Kemp and Kemp 1980, Kemp 2001, Dunning 2008). Out of the nine hornbill species reported from India, five are found in the northeast (i.e., Wreathed hornbill (*Rhyticeros undulatus*), Brown hornbill (*Anorrhinusaus austeni*), Rufous-necked hornbill (*Aceros nipalensis*) Oriental pied hornbill (*Anthracoceros albirostris*) and Great hornbill (*Buceros bicornis*). Of these five species, three species (i.e., *Rhyticeros undulates, Anorrhinus austeni and Aceros nipalensis*) are endemic to northeast India showing their biogeographical affinity with South-east Asia. The Great hornbill occurs in north, north-east, and south India, apart from Nepal, Bhutan, and Bangladesh.

Hornbills are the most fascinating species in terms of plumage, body size and the most unique distinctive features of the hornbills is the heavy and large bill which assists in fighting, preening, constructing the nest, and catching prey. These species are omnivorous, feeding on fruits and small animals like insects (Poonswad et al. 1998) make them vital for preservation and conservation of tropical forest. Most of the hornbill species are monogamous breeders and nest in natural cavities in trees and sometimes cliffs (Poonswad et al. 2005). Hornbills are diurnal in habit and mostly traveling in pairs or small groups. The present study aimed to estimate the population and conservation status of hornbills for the promotion of avitourism in this region.

STUDY ARE AND METHODS

Pakke Wildlife Sanctuary and Tiger Reserve (hereafter PTR), located in the Pakke Kessang district, lies in the eastern Himalayan region of Arunachal Pradesh, India (26° 85' 49'' N to 27° 81' 69'' N; 92° 83' 69'' E to 93° 80' 99'' E) and covers an area of 861.95 km^2 (Fig. 1). Seijosa is headquarter of PTR, situated at distance of 60 km from Tezpur on National Highway (NH-52). The sanctuary is naturally surrounded by rivers on 3 sides and shares a common boundary with Nameri National Park, in Assam on its fourth side. PTR is divided in to two management zones viz., buffer zone (75 km^2) and core zone (786.95 km^2). It receives an average annual rainfall of 2545 mm. The mean annual maximum temperature is 28°C and the minimum is 19°C. Average relative humidity is 84%. The altitudinal variation ranges from 100 to 2040 m asl. PTR harbors different types of vegetation, viz., tropical evergreen forests, tropical semi-evergreen forests, and subtropical forests (Champion and Seth 1968) and accounting of about 234 woody species of flowering plants (angiosperms). Nyishi, is the predominant tribe, which constitute a larger segment of human population along with Nepalies, Kulibengalies and Bodo tribes in the fringe of the PTR.

Pakke is famous for its four resident hornbill species: Wreathed hornbill, Rufous-necked hornbill, Oriental pied hornbill and Great hornbill (Datta 1998). The area has great biological significance due to the richness of its flora and fauna, as a result of its location at the Oriental and the Indo-Malayan realm, and has been considered as one of the hot-spots for biodiversity (Myers 1991), particularly for hornbills conservation. This Tiger Reserve has won India Biodiversity Award 2016 in the category of 'Conservation of threatened species for its Hornbill Nest Adoption Programme'. Various nature camps and elephant safari area are the great attraction to tourists in the area.

Estimation of hornbills in forest

The point count distance sampling method was used to estimate the hornbills inside the Tiger Reserve.

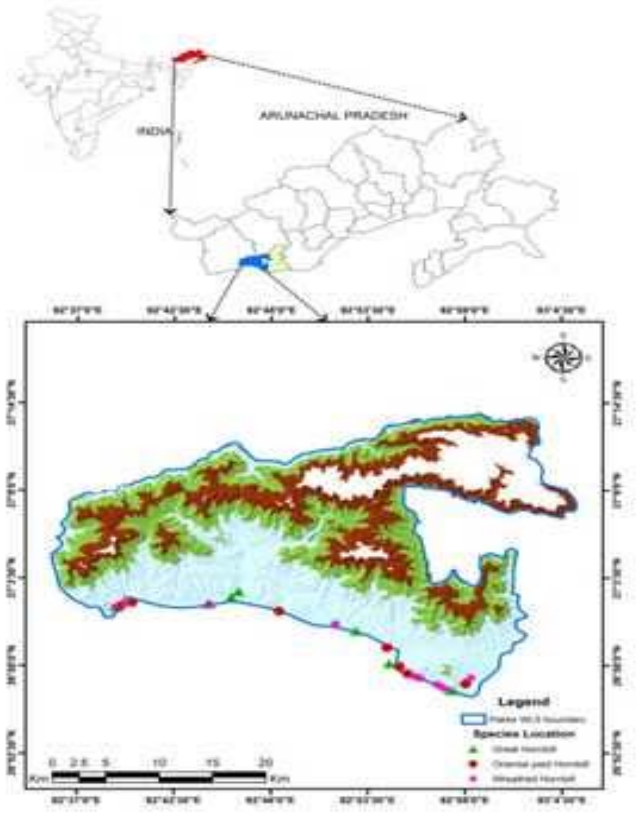

Figure1. Study area

Survey was conducted in buffer area mostly existing forest trails and 500 m interval distance was maintained to avoide recounting of hornbills. Total 117 point stations were laid in the forest trails in which hornbills were recorded in only 26 points stations (Fig. 2). We avoided the call and flying hornbills for recounting biasness. Time spent at each point was 15 minutes followed by five minutes for settlement. The study was conducted from December 2018 to March 2019 in the buffer and the adjacent areas of the PTR to estimate the population of hornbill species and the possibility of wildlife-based tourism.

Estimation of hornbills in a roosting sites

The direct count method was used to estimate hornbills at the roosting sites. The roosting sites were selected after talking to local people, and four sites were found during a survey in which one roosting site is inside the PTR and three sites are in the fringe area of Tiger Reserve (Fig. 2). In our surveys, three Wreathed hornbill's roosting sites and one Oriental Pied Hornbill's roosting site was found. Each roosting site was observed for three months with two hours every week at evening between 16:00 to 17:00 hrs.

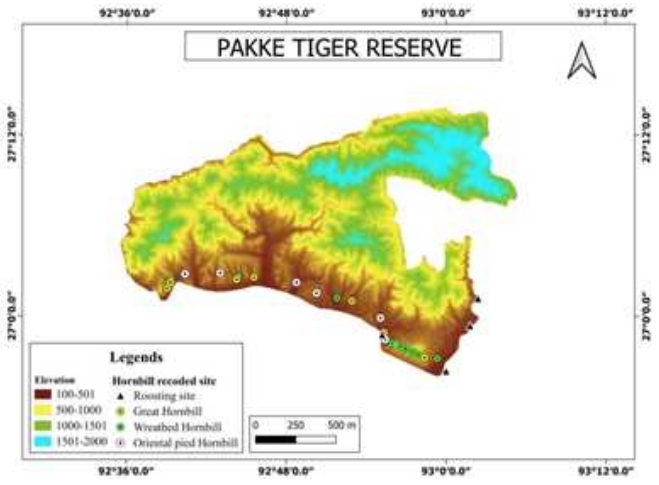

Figure 2. Location of roosting site and sampling points

RESULTS

Population estimation in sampling points

In our study, a total of 117 point count samples were laid in the buffer area of PTR in which three hornbill species (Wreathed hornbill, Oriental Pied hornbill and Great hornbill (Fig. 3)) were recorded in 26 point count samples. A total of 57 individuals of three hornbill species were recorded in 26 sampling points and the highest density of hornbill species was recorded for Wreathed hornbill (21.9 ± 8.9) in eight sampling points, followed by Great hornbill (13.4 ± 3.3) in nine sampling points, and Oriental Pied hornbill (10.9 ± 2.7) in nine sampling points. Similarly, the density of cluster (DS) of hornbills was highest in Wreathed hornbill (7.5 ± 1.4) followed by Oriental Pied hornbill (7.3 ± 1.3) and Great hornbill (6.7 ± 1.3) (Table 1). Similarly, the most abundant hornbill species is the Wreathed hornbill 58% (n = 21), followed by the Oriental Pied hornbill 21% (n = 13) and the Great hornbill 21% (n = 13).

Population estimation in roosting sites

In the intensive survey of study, four roosting sites were identified and selected for hornbill watch for tourists. Of the 4 roosting sites, three sites are for Wreathed hornbill and one for Oriental Pied hornbill. Based on the direct total count in four roosting sites, population and tourist related data are presented in Table 2. The highest number of Wreathed hornbill

Figure 3. (a) Wreathed Hornbill (*Rhyticeros undulatus*), (b) Flock of Wreathed Honrbill, (c) Great hornbill (*Buceros bicornis*) and (d) Oriental pied hornbill (*Anthracoceros albirostris*)

Table 1. Density of hornbills in sampling points

Name of species	**N (sampling points)**	**n (no. of individuals)**	**DS***	**D***	**Detection probability**	**p value**
Great hornbill	9	2±0.4	6.7±1.3	13.4±3.3	59.4	0.38
Oriental pied hornbill	9	2±0.7	7.3±1.3	10.9±2.7	50.1	0.34
Wreathed hornbill	8	3.3±2.4	7.5±1.4	21.9±8.9	21.1	0.34

*DS=Density of hornbill cluster or flock, **D=Density of hornbill

Table 2 Hornbill roosting sites and their attainment details

Roosting site (Location)	Species	Population (Mean ± sd)	Distance from HQ (Km)	Best time to watch (24 hrs)	Months	How to reach
Darlong (Fringe of PTR)	Wreathed hornbill	79±46.7	2	5:00 to 6:00 hrs & 16:00 to 17:00 hrs	January to March	By walk and vehicle
A-2 Village (Fringe of PTR)	Wreathed hornbill	29.7±9	10	5:00 to 6:00 hrs & 16:00 to 17:00 hrs	January to March	By vehicle
Khari camp (Inside the PTR)	Wreathed hornbill	20±5	12	5:00 to 6:00 hrs & 16:00 to 17:00 hrs	January to March	By vehicle
Langka camp (Fringe of PTR)	Oriental Pied hornbill	21.8±9.4	14	5:00 to 6:00 hrs & 16:00 to 17:00 hrs	January to March	By vehicle

Figure 4. Wreathed Hornbil's roosting site (a) near Khari camp, (b) at Darlong village, (c) at A-2 village and (d) Oriental Pied Hornbill roosting site near Langka camp.

population was recorded in Darlong village which is located within 2 km distance from the PTR headquarter and takes 10-15 minutes walking distance. The best time for watching hornbills at PTR are 05:00 to 06:00 hrs and 16:00 to 17:00 hrs during January to March.

DISCUSSION

The protection of biodiversity depends on the conservation of individual species as well as ecosystem conservation in which the species thrives. Ocampo-Penuela and Winton (2017) uses the avifauna as flagship species for biodiversity conservation. During our suvery 117 points stations were laid in which three Hornbill species were recorded in 26 point stations. Our study reveals the wealthy population of three hornbill species in PTR and their fringe areas which could be the major attraction of tourist. Four roosting sites of two

hornbills (Wreathed hornbill and Oriental Pied hornbill) have been identified and individual hornbill was also recorded inside the PTR of three species (Wreathed Hornbill, Oriental Pied Hornbill and Great Hornbill). The Wreathed hornbill was the most abundant, and Great hornbill and Oriental Pied hornbill were slightly less abundant (Fig. 4). However, the detection probability of all the hornbills are more than 50% and visitors can watch solitary Great hornbill in the forest trail as their roosting was not recorded. Hornbills return to their roosting sites at the same time everyday i.e., between 16:00 to 17:00 hrs and their roosting sites are easily visible and during morning they start moving from around 4:30 to 5:30 hrs.

Hornbills are fascinating species with having large bills and feathers and can be easily identified by the large body and harsh sound of their feathers by tourist. Based on our survey, the PTR has a high potential for the sighting of hornbill species for the hornbill lovers. In the present study, we attempt to provide an initial description of the characteristics of hornbill and their population concerning avitourism in Pakke Tiger Reserve, Arunachal Pradesh and to recognize its main constraints and challenges. Ecotourism has been embraced by many livelihood generating options that can raise incomes for local people who inhabit in the fringes to biodiversity-rich areas such as protected areas while supporting to *in-situ* conservation (Biggs et al. 2011). The Costa Rican Tourism Institute estimated that 41% of its 1-billion dollar tourism revenues were gain from tourists who came primarily for bird watching in 1991.

Because ecotourists pay for a variety of services when travelling to nature-based areas (national parks and wildlife sanctuaries) such as payment made to transportation (air, bus, and taxi), hotel, lodges, homestay, restaurants, food suppliers, local guides, entry fee of national parks or wildlife sanctuaries, elephant and jeep safari, riverboat rides, cultural activities. Parks and communities also charge indirect fees by selling of souvenirs to ecotourists such as t-shirts, postcards, books, hand-made crafts like jewelry, woodwork, clothes, tapestries and local food products allow local communities to profit from these goods made directly by them. The selling of these local goods contributes to a significant portion of total tourism revenues by local communities in many developing countries (Wunder and Sayer 2000).

Birdwatching tourists tends to be well educated and many are relatively affluent. They tend to be either: singles or small groups travelling in and acting almost completely independently; or are limited by time or local knowledge and therefore more likely to join a tour. Avifauna is charismatic and beautiful wildlife in nature. They are easy to watch and capture and record in camera in the wild as they show attractive posture during foraging, breeding, and nesting behaviors. Avifauna is habitat-specific and some can occupy more than one habitat type, however, because of land-use changes, most of the birds have been displaced from their original habitats (Burgess et al. 2002). Any habitat which is selected by bird, it is for their requirements of successful reproduction and survival in the rest of the period (Rodríguez-Estrella 2007). Differences in requirements among bird species have caused specificity on habitat requirements (Buckley and Freckleton 2010). The major constraints to the growth of the industry here are: access to many locations and a lack of accommodation and vehicles in many such places; the relatively large traveling distances necessary; the climatic discomforts of rainfall and humidity; and the lack of specialized guides. Hornbills are the main focused species of Pakke Tiger Reserve and for entire Arunachal Pradesh due to its enormous hunting for traditional headgear (Datta 2002, Aiyadurai 2011).

ACKNOWLEDGEMENTS

The authors express their sincere thanks to the PCCF-Wildlife, Itanagar for giving us necessary permission to carry out our research, and Mr. TanaTapi, Divisional Forest Officer, Pakke Tiger Reserve for his valuable logistic support during the fieldwork. We are also grateful to the Director, NERIST and Head, Department of Forestry, NERIST, Arunachal Pradesh for their administrative supports. We thank Mr. Gangaram Chiri, Ms. Dina Brah, and Akangsha Gogoi for helping us during the fieldwork. Finally, we thank NMHS, MoEF & CC, GBPNIHESD, Almora, Uttarakhand for providing financial support to the present study.

Conflict of interest: The authors declare no conflict of interest.

Authors' contributions: All authors contributed equally.

REFERENCES

Aiyadurai, A. 2011. Wildlife hunting and conservation in Northeast India: a need for an interdisciplinary understanding. International Journal of Galliformes Conservation, 2, 61-73.

Barua, M. 2011. Mobilizing metaphors: the popular use of keystone, flagship and umbrella species concepts. Biodiversity and Conservation, 20(7), 1427-1440.

Biggs, D., Turpie, J., Fabricius, C. and Spenceley, A. 2011. The value of avitourism for conservation and job creation-An analysis from South Africa. Conservation and Society, 9(1), 80-90.

Bowen-Jones, E. and Entwistle, A. 2002. Identifying appropriate flagship species: the importance of culture and local contexts. Oryx, 36(2), 189-195.

Buckley, H.L. and Freckleton, R.P. 2010. Understanding the role of species dynamics in abundance–occupancy relationships. Journal of Ecology, 98(3), 645-658.

Burgess, N., Doggart, N. and Lovett, J.C. 2002. The Uluguru Mountains of eastern Tanzania: the effect of forest loss on biodiversity. Oryx, 36(2), 140-152.

Champion, H.G. and Seth, S. K. 1968. A revised survey of the forest types of India. Government of India Press, New Delhi, 404pp.

Datta, A. 1998. Hornbill abundance in unlogged forest, Selectively logged forest and a forest plantation in Arunachal Pradesh. Oryx, 32(4), 285-294.

Datta, A. 2002. Status of hornbills and hunting among tribal communities in eastern Arunachal Pradesh. Unpublished Report. Submitted to the Wildlife Conservation Society, New York and WCS-India Program, Bangalore.

Dunning, J.B.Jr. (Ed.) 2008. CRC Handbook of Avian Body Masses (2nd ed.). CRC Press. ISBN 978-1-4200-6444-5.

Entwistle, A.C., Mickleburgh, S. and Dunstone, N. 2000. Mammal conservation: current contexts and opportunities. Pp. 1-7. In: Entwistle, A.C. and Dunstone, N. (Eds.) Priorities for the Conservation of Mammalian Diversity Has the Panda had its Day? Cambridge, UK:CambridgeUniversity Press.

Griffin, A.S., Tebbich, S. and Bugnyar, T. 2017. Animal cognition in a human-dominated world. Animal Cognition, 20, 1–6. https://doi.org/10.1007/s10071-016-1051-9

Heywood, V.H. and Watson, R.T. (Eds.) 1995. Global Biodiversity Assessment. Cambridge: Cambridge University Press/UNEP.

Kemp, A.C. 2001. Family Bucocerotidae (Hornbills). pp. 436–487. In: del Hoyo, J., Elliott, A. and Jordi, S. (Eds.). Handbook of the Birds of the World. Volume 6, Mousebirds to Hornbills. Barcelona: Lynx Edicions. ISBN 978-84-87334-30-6.

Kemp, A.C. and Kemp, M.I. 1980. The biology of the southern ground hornbill *Bucorvus leadbeateri* (Vigors)(Aves: Bucerotidae). Annals of the Transvaal Museum, 32(4), 65-100.

Myers, N. 1990. The biodiversity challenge: expanded hot-spots analysis. Environmentalist, 10(4), 243-256.

Nentwig, W., Bacher, S., Beierkunlein, C., Brandl, R. and Grabherr, G. 2004. Okologie [Ecology]. Heidelberg, Germany:Spektrum Akademischer Verlag. 344pp.

Ocampo-Peñuela, N. and Winton, R. S. 2017. Economic and conservation potential of birdwatching tourism in post-conflict Colombia. Tropical Conservation Science, 10, 194008291773386.

Poonswad, P., Sukkasem, C., Phataramata, S., Hayeemuida, S., Plongmai, K., Chuailua, P., et al. 2005. Comparison of cavitymodification and community involvement as strategies for hornbill conservation in Thailand. Biological Conservation, 122, 385–393.

Poonswad, P., Tsuji, A., Jirawatkavi, N. and Chimchome, V. 1998. Some aspects of food and feeding ecology of sympatric hornbill species in KhaoYai National Park, Thailand. Pp. 137-157. In: The Asian hornbills: Ecology and Conservation, Thai Studies in Biodiversity, ??????

Rodríguez Estrella, R. 2007. Land use changes affect distributional patterns of desert birds in the Baja California peninsula, Mexico. Diversity and Distributions, 13(6), 877-889.

Samways, M.J., Stork, N.E., Cracraft, J., Eeley, H.A.C., Foster, M., Lund, G. and Hilton Taylor, C. 1995. Scales, planning and approaches to inventoring and monitoring. pp. 475-517. In: Heywood, V.H. and Watson, R.T. (Eds.) Global Biodiversity Assessment, Cambridge, UK: Cambridge University Press.

Smith, A. M. and Sutton, S. G. 2008. The role of a flagship species in the formation of conservation intentions. Human Dimensions of Wildlife, 13(2), 127-140.

Tisdell, C.A. and Wilson, C. 2000. A study of the impact of ecotourism on environmental education and conservation: The case of turtle watching at an Australian site (No. 1741-2016-140666).

Walpole, M.J. and Leader-Williams, N. 2002. Tourism and flagship species in conservation. Biodiversity andConservation, 11, 543–547.

Wunder, S. and Sayer, J. 2000. The economics of deforestation. The example of Ecuador. Palgrave Macmillan, Basingstoke, UK

.

Received: 26th October 2021
Accepted:29th January 2022