



Conservation Action Plan for Hornbills of Bhutan (2023-2033)



“Ensuring Healthy Forests and Happy Hornbills”

Nature Conservation Division
Department of Forests and Park Services
Ministry of Energy and Natural Resources
Royal Government of Bhutan

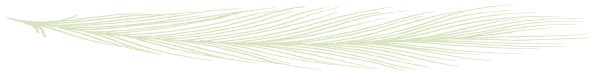
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(July 2023-June 2034)

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Photo credits:

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Royal Government of Bhutan
Ministry of Energy and Natural Resources

Department of Forests and Park Services



PREFACE

Conservation Action Plan for Hornbills of Bhutan is a comprehensive strategy developed by the Department of Forests and Park Services to conserve the hornbill species in Bhutan. Five species of Hornbills are recorded in the country. Hornbill is an iconic bird considered as a flagship species for forest conservation and also forms part of the Bhutanese culture. However, the hornbill population in Bhutan is projected to decline due to various threats such as habitat loss, competition for food resources, hunting, and anthropogenic disturbances.

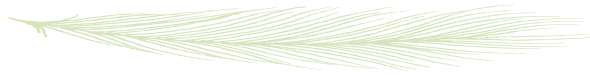
The Hornbill Conservation Action Plan outlines various strategies and actions that will be undertaken to conserve hornbills in Bhutan. These include habitat conservation and management, anti-poaching measures, awareness and education programmes, research and monitoring, and capacity building of local communities. The Conservation Action Plan for Hornbills has been developed with inputs from Ugyen Wangchuck Institute for Forestry Research and Training (UWIFoRT), National Parks, Wildlife Sanctuaries and Forest Divisions under guidance of the Nature Conservation Division.

This plan represents a significant step towards the conservation of hornbills in Bhutan and is a testament to the commitment of the Royal Government of Bhutan to protect its biodiversity. The success of this plan depends on the active participation of all stakeholders, including local communities, and their willingness to work towards the common goal of protecting and conserving hornbills in Bhutan. Therefore, I urge the conservation partners of Bhutan such as the Bhutan for Life, WWF Bhutan, Bhutan Foundation, RSPN Bhutan, Bhutan Trust Fund for Environmental Conservation, Bhutan Ecological Society, Bhutan Birdlife Society, Royal Society for Protection of Nature, Global Environment Facility, United Nations Environment Programme, Hornbill Research Foundation and Birdlife International to help realize these funding requirements. I also request all stakeholders to render their support in implementing the actions on the group.

Lastly, I express my heartfelt appreciation to NCD and UWIFoRT for the coordination and the action planning team for formulating this action plan, and wish everyone good luck for the successful implementation of the proposed actions.

Tashi Delek

Lobzang Dorji
Director



ACKNOWLEDGEMENT

We would like to express our sincere appreciation and gratitude to all involved in developing the Conservation Action Plan for Hornbills in Bhutan. Your commitment, expertise, and hard work have resulted in a comprehensive and well-researched plan that will undoubtedly contribute to the conservation and protection of hornbill species in Bhutan.

We would like to acknowledge the efforts of the conservationists and other stakeholders who contributed their time and knowledge to this plan. Your dedication and collaboration have been instrumental in the success of this project.

Furthermore, we would like to extend our thanks to the organizations and individuals who provided financial and logistical support for this initiative. We would like to thank Bhutan for Life for generous financial support. Without your generosity, this project would not have been possible.

Lastly, we would like to recognize the local communities that have been involved in the conservation efforts of hornbills. Your participation and commitment to protecting these magnificent birds are crucial in ensuring their survival for generations to come.

Once again, we express our deepest appreciation to all those who have contributed to the Conservation Action Plan for Hornbills in Bhutan. Your dedication to conservation is inspiring and essential to the continued existence of these remarkable birds.

(Nature Conservation Division)



EXECUTIVE SUMMARY

Bhutan is situated in the region of eastern Himalayan biodiversity hotspot and she encompasses different ecological zones that provisions suitable habitats for various species of flora and fauna to thrive. A total of 762 bird species have been recorded in the country till date, many of which are globally threatened.

Out of diverse avian species, Hornbills are charismatic bird species and are known for their distinctive appearance with large beaks, unique breeding, and adaptation behaviors. Presently, 54 species of hornbills have been recorded globally, out of which 33 species are found in Asia. As for Bhutan, it is home to five species of hornbills with three species listed under Vulnerable category, one species as Near Threatened, and one species as Least Concerned category of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

This action plan identified threats such as habitat fragmentation and loss, depletion of food resources, hunting and poaching, diseases, and disturbances on nesting sites impacting the hornbills of Bhutan, with overall threat ranked in **Medium** category through Miradi Threat Ranking process. If unaddressed, these threats will significantly trigger a decline in hornbill populations in Bhutan. Therefore, this document outlines the conservation goal and strategic objectives as follows;

Goal: By 2033, Hornbill habitats are sustainably managed and conservation secured for the threatened hornbills in partnership with local communities.

Objective 1: Secure suitable habitats to support thriving population of Hornbills in Bhutan

Objective 2: Engage local communities and stakeholders in Hornbill conservation through awareness and integrated conservation development programs

Objective 3: Increase science-based information on ecology, habitat, threats, and conservation status of hornbills in Bhutan

This action plan aims to sustainably manage and conserve the threatened hornbills and their habitats by involving local communities through proper awareness and integrated conservation-development programmes. It also intends to increase science-based information on ecology, habitats, and threats of hornbills in Bhutan so that we can prioritize conservation actions and make timely interventions.

The action plan outlines the budget requirement of Nu. 180.00 million for implementation of actions for the next ten years. The budget will be sourced from various conservation partners and donors. The Nature Conservation Division and Ugyen Wangchuck Institute for Forestry Research and Training will coordinate the implementation of this plan, in collaboration with relevant stakeholders and field offices. The Forest Monitoring and Information Division of the department will monitor its implementation.

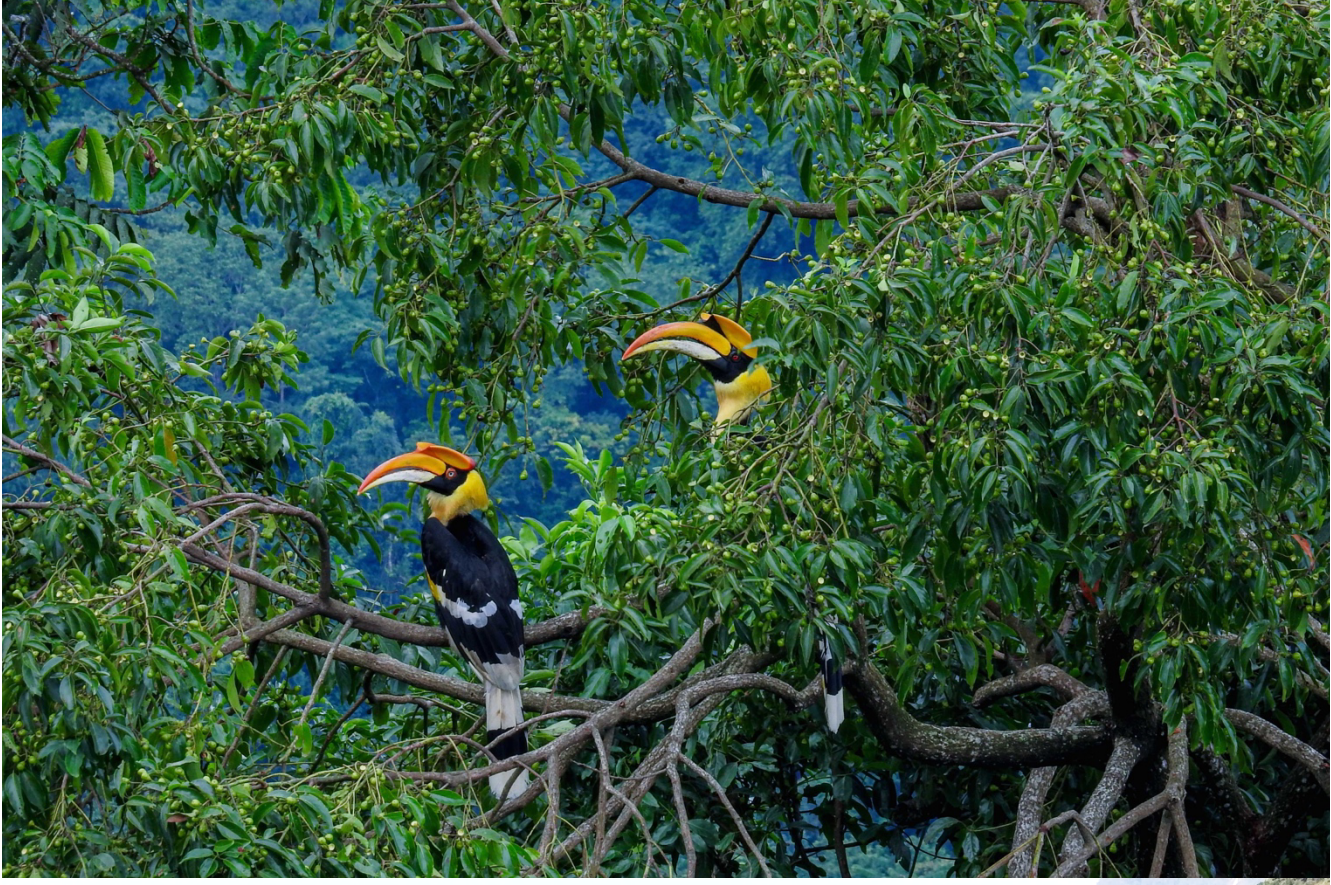




TABLE OF CONTENT

PREFACE..... III

ACKNOWLEDGEMENT..... IV

EXECUTIVE SUMMARY V

TABLE OF CONTENT..... VII

LIST OF FIGURES IX

LIST OF TABLES IX

LIST OF ACRONYMS X

CHAPTER ONE HORNBILLS OF BHUTAN: A STATUS REVIEW 1

1.1. INTRODUCTION 1

1.2. RUFOUS-NECKED HORNBILL 2

 1.2.1. *Distribution*..... 2

 1.2.2. *Population Status* 4

 1.2.3. *Feeding Ecology*..... 4

 1.2.4. *Breeding and Reproduction*..... 5

 1.2.5. *Movement Ecology*..... 6

1.3. GREAT HORNBILL 7

 1.3.1. *Distribution*..... 7

 1.3.2. *Feeding Ecology*..... 8

 1.3.3. *Movement of great hornbill* 9

 1.3.4. *Reproduction* 9

 1.3.5. *Population* 10

1.4. WREATHED HORNBILL 10

 1.4.1. *Occurrence and distribution* 10

 1.4.2. *Nesting and feeding ecology* 12

 1.4.3. *Population* 12

1.5. ORIENTAL PIED HORNBILL..... 12

 1.5.1. *Occurrence and Distribution* 12

 1.5.2. *Feeding and Reproduction* 14

1.6. INDIAN GREY HORNBILL..... 14

 1.6.1. *Distribution*..... 15

 1.6.2. *Population* 15

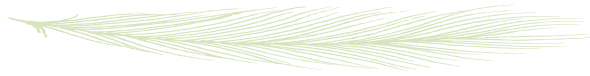
1.7. SOCIO-CULTURAL SIGNIFICANCE OF HORNBILLS..... 16

1.8. RESEARCH AND CONSERVATION STATUS OF HORNBILLS IN BHUTAN 18

CHAPTER TWO THREATS AND CHALLENGES..... 20

2.1. THREATS 20

 2.1.1. *Habitat fragmentation and loss* 21



| | | |
|--|--|-----------|
| 2.1.2. | <i>Depletion of food resources</i> | 22 |
| 2.1.3. | <i>Disturbances on nesting sites</i> | 23 |
| 2.1.4. | <i>Hunting and poaching</i> | 23 |
| 2.1.5. | <i>Diseases</i> | 24 |
| 2.2. | CHALLENGES | 25 |
| 2.2.1. | <i>Climate change</i> | 25 |
| 2.2.2. | <i>Limited scientific information</i> | 26 |
| 2.2.3. | <i>Lack of awareness and weak community engagement</i> | 27 |
| 2.2.4. | <i>Lack of inter-agency collaboration</i> | 27 |
| 2.2.5. | <i>Weak transboundary collaborations</i> | 28 |
| 2.2.6. | <i>Limited resources</i> | 29 |
| CHAPTER THREE ACTION PLAN | | 31 |
| 2.1. | VISION AND GOAL | 31 |
| 2.2. | OBJECTIVES | 31 |
| CHAPTER FOUR PLAN IMPLEMENTATION AND MONITORING | | 42 |
| 4.1. | INSTITUTIONAL ARRANGEMENTS | 42 |
| 4.2. | WORK PLAN AND BUDGET | 42 |
| 4.3. | MONITORING AND EVALUATION | 43 |
| REFERENCES | | 51 |





LIST OF FIGURES

| | |
|---|----|
| Figure 1: A group of wreathed hornbills resting on a tree..... | 1 |
| Figure 2: Habitat suitability map of rufous-necked hornbill based on its current distribution..... | 3 |
| Figure 3: Rufous-necked hornbill (R: Female; L: Male)..... | 4 |
| Figure 4: R: A male rufous-necked hornbill on its nest cavity; L: Hornbill foods..... | 6 |
| Figure 5: Habitat suitability map of great hornbill based on its current distribution. | 7 |
| Figure 6: A pair of great hornbills perching on a tree branch..... | 8 |
| Figure 7: Habitat suitability map of wreathed hornbill based on its current distribution..... | 11 |
| Figure 8: A pair of wreathed hornbills. | 11 |
| Figure 9: Habitat suitability map of oriental pied hornbill based on its current distribution | 13 |
| Figure 10: A pair of oriental pied hornbills | 13 |
| Figure 11: Indian grey hornbill..... | 15 |
| Figure 12: Snippet depicting the use of hornbill parts by local people | 16 |
| Figure 13: A male great hornbill feeding the female in nest cavity | 17 |
| Figure 14: Researchers from DoFPS tagging a rufous-necked hornbill..... | 18 |
| Figure 15: Hornbill habitat along the Mangde chhu..... | 21 |
| Figure 16: Rufous-necked hornbill feeding on wild fruits | 22 |
| Figure 17: Ideal habitat of Hornbill in Royal Manas National Park..... | 24 |
| Figure 18: Nesting site of Great hornbill | 26 |
| Figure 19: Hornbill food..... | 29 |
| Figure 20: Conceptual model for Hornbill conservation..... | 30 |
| Figure 21: Wreathed hornbill perching on the tree..... | 32 |
| Figure 22: A pair of great hornbill sharing the meal | 34 |
| Figure 23: A male rufous-necked hornbill..... | 36 |
| Figure 24: Oriental pied hornbill perching on a branch | 43 |

LIST OF TABLES

| | |
|---|----|
| Table 1: Threats to conservation of hornbills in Bhutan | 20 |
| Table 2: Implementation plan and budget outlay | 37 |
| Table 3: Logical framework for plan implementation..... | 44 |



LIST OF ACRONYMS

| | |
|----------|--|
| BC: | Biological Corridor |
| BFL: | Bhutan for Life |
| CFO: | Chief Forestry Officer |
| CITES: | Convention on International Trade in Endangered Species of Wild Flora and Fauna |
| DFO: | Divisional Forest Office |
| DoFPS: | Department of Forests and Park Services |
| FD: | Forest Division |
| FMID: | Forest Monitoring and Information Division |
| FNCA: | Forest and Nature Conservation Act |
| GH: | Great Hornbill |
| HWC: | Human-wildlife conflict |
| IUCN: | International Union for Conservation of Nature |
| IGH: | Indian Grey Hornbill |
| JDNP: | Jigme Dorji National Park |
| JKSNR: | Jigme Khesar Strict Nature Reserve |
| JSWNP: | Jigme Singye Wangchuck National Park |
| JWS: | Jomotshangkha Wildlife Sanctuary |
| m.a.s.l: | Meters above sea level |
| MCP: | Minimum Convex Polygon |
| NCD: | Nature Conservation Division |
| PAs: | Protected Areas |
| PNP: | Phrumsengla National Park |
| PWS: | Phibsoo Wildlife Sanctuary |
| RNH: | Rufous-necked Hornbill |
| RMNP: | Royal Manas National Park |
| RSPN: | Royal Society for Protection of Nature |
| RGoB: | Royal Government of Bhutan |
| SMART: | Spatial Monitoring and Reporting Tool |
| TraMCA: | Transboundary Manas Conservation Area |
| UWIFoRT: | Ugyen Wangchuck Institute for Forestry Research and Training |
| WH: | Wreathed Hornbill |
| WWF: | World Wildlife Fund |



CHAPTER ONE

HORNBILLS OF BHUTAN: A STATUS REVIEW

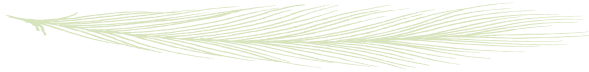
1.1. Introduction

Hornbills are among the largest and most significant bird species found in Asia and Africa's tropical forests (Sun *et al.*, 2019). They occur across sub-Saharan Africa, through India and southern Asia, and the Sunda shelf islands of Indonesia (Magaret & Timothy, 2007). Belonging to the Bucerotidae family, globally there are 62 hornbill species; 32 in Asia and 30 in Africa. Of them, 26 are Globally threatened or Near Threatened with extinction, while all other species are listed as Least Concern in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN Hornbill Specialist Group, 2023).

Hornbills are the most fascinating species in terms of plumage and body size. The most unique and distinctive feature of the hornbills is the heavy and large bill which assists in fighting, preening, constructing the nest, and catching prey (Vishwakarma, Kumar, & Krishna, 2022). They give loud, distinctive calls, and are noisy in flight (Magaret & Timothy G., 2007). 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, 2001).



Figure 1: A group of wreathed hornbills resting on a tree.



Hornbills are omnivorous, feeding on fruits and small animals like insects (Poonswad *et al.*, 1998). With wild fruits forming a major protein of their diet, they perform a significant function as seed dispersers, allowing the regeneration of their important food plants and contributing to the diversity of tropical forests. They are, therefore, excellent indicators of forest conditions (Sherub and Singh, 2020; Suttidate, 2022) and have been dubbed as the ‘Farmers of the forests’ (Kitamura, 2011).

The behaviors of hornbills have fascinated naturalists, ornithologists, and other biologists. Hornbills exhibit a unique nesting behavior. Most of the hornbill species are monogamous breeders and nest in natural cavities in trees and sometimes cliffs (Poonswad, *et al.*, 2005). But unlike other groups of birds, the female bird seals the entrance, leaving only a narrow slit through which she and her chicks receive food from her mate (Magaret & Timothy G., 2007). The only exception are the ground hornbills that use excavated earth banks, open snags, or tree crotches.

In Bhutan, five species of hornbills are recorded, of which three are globally threatened. The hornbills in Bhutan are usually found in the broadleaved forest ecosystems. The five species of hornbills found in Bhutan are 1) rufous-necked hornbill, 2) great hornbill, 3) wreathed hornbill, 4) oriental pied hornbill, and 5) Indian grey hornbill.

1.2. Rufous-necked Hornbill

Rufous-necked Hornbill (RNH) (*Aceros nipalensis* – Hodgson, 1829) is a conspicuous bird under the family Bucerotidae, distinguished by its large bill with black grooved upper mandible, scarlet gular pouch, blue orbital skin, white wing tips on the flight, and white band terminal tail. The male has a rufous head, neck, and underparts while the female has a black head and body. Juveniles are like adult males, but their necks are brown. Call or song is short, repeated, monosyllabic bark, and higher pitched unlike great hornbill.

1.2.1. Distribution

Globally RNH is known to occur in Bhutan, Northeast India including Darjeeling, Yunnan in south China, Laos, Myanmar, Western Thailand, and Vietnam (BirdLife International, 2020). RNH is said to have returned to Nepal after 200 years of disappearance where a pair was photographed at Sim Dhap of Suryodaya Municipality under Ilam district in eastern Nepal (Sanjib Chowdary, 2023). In Vietnam it is reported to be almost extinct due to habitat loss and hunting pressure including most parts of Thailand.

Within the South Asian region, Bhutan provides a safe home for this magnificent bird. They inhabit the temperate cool broadleaved forests and sub-tropical evergreen forests across southern Bhutan. They are usually found in the mature, dense, evergreen, and broadleaved forest edges of forest clearing, open, and grooves of large fruit trees (Inskipp *et al.*, 2019 and Spierenburg, 2005) and require diverse old-growth forests for feeding and nesting (Raman & Mudappa, 2003).

The protected areas and conservation regimes such as the national parks, wildlife sanctuaries, and biological corridors (BC) in southern Bhutan constitute a significant in-situ conservation sites with viable population of RNH in Bhutan (Penjor, 2010; Dorji, 2013; Sherub, 2017; BirdLife International, 2020). The protected areas include the National Parks of Royal Manas (RMNP), Jigme Singye Wangchuck (JSWNP), and Phrumsengla (PNP) and Wildlife Sanctuaries of Jomotsangkha (JWS), Phibsoo (PWS), and Bumdeling (BWS), and the Jigme Khesar Strict Nature Reserve (JKSNR) besides the BC Nos. 1, 3, 4, 5, 6, and 7. The application of SMART patrolling in conservation recorded RNH at elevation as high as 2678 m.a.s.l, observed at the *Baleng* top falling within BC 4 by the field staff of Zhemgang Forest Division in December 2021. Amongst the districts, the RNH is recorded in Samtse, Haa, Chukha, Dagana, Tsirang, Sarpang, Wangdue Phodrang, Zhemgang, Pemagatshel, Mongar, Trashigang, Trashiyangtse, Trongsa, and Samdrup Jonkhar.

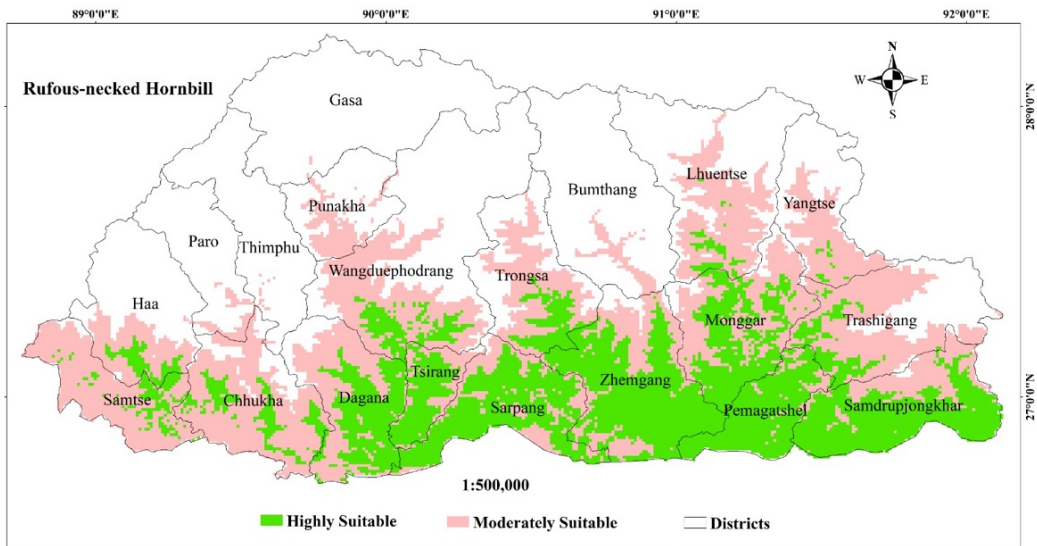


Figure 2: Habitat suitability map of rufous-necked hornbill based on its current distribution.



Figure 3: Rufous-necked hornbill (R: Female; L: Male)

1.2.2. Population Status

Rufous-necked hornbill is categorized as Vulnerable in the IUCN Red List of Threatened Species due to the drastic decline in its population owing to habitat destruction and trafficking (BirdLife International, 2020). It is listed under Appendices I & II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In Bhutan, RNH is considered as an endangered species and protected under Schedule II of the Forest and Nature Conservation Act (FNCA, 2023).

Studies from three sites estimated an average density of 5.75 individuals of RNH per square kilometer in Thailand (Jornburom *et al.*, 2010 and Jinamoy *et al.*, 2013) while two conservation areas estimated an average density of 6.51 birds per square kilometer in India (Naniwadekar and Datta, 2013 and Shukla *et al.*, 2016). The yearly declining population of existing RNH is equivalent to 7000 - 10000 mature individuals (Birdlife International, 2020). The population status of RNH is not known in Bhutan but it is expected to be stable.

1.2.3. Feeding Ecology

RNH is an omnivorous, consuming fruits, insects, crustaceans, small birds and mammals as protein supplements. The food consumed were categorized into figs, non-fig fruits, insects and animals. They consumed fruits such as nutmegs, pears, and figs, but also rely on fruiting plant species of Annonaceae, Lauraceae, and Myristicaceae families. It is known to eat crabs, beetles, cicadas, lizards, earthworms, frogs, and bird chicks, picking these from the leaf litter, nearby creeks, and from the trunks and branches of large trees (BirdLife International, 2020; Ouithavon, 1999).



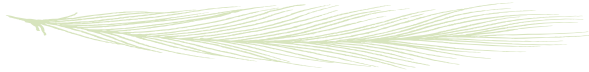
The primary food plants during the non-breeding season in Arunachal Pradesh were *Canarium strictum*, *Prunus ceylanica*, *Ficus drupacea*, *Ficus altissima*, *Ficus geniculata*, *Machilus duthiei*, and *Beilschmiedia assamica*. A significant frugivore, fruits of 21 plant species have been recorded in its diet in India, 17 in Thailand, and 35 in Bhutan, however in Thailand, almost 22% of its diet was comprised of the animal matter: crabs, snakes, cicadas, and amphibians (BirdLife International, 2020).

In Bhutan, species belonging to 20 families dominated by Lauraceae and Anacardiaceae were recorded in their diets. Additionally, 13 animal species such as crabs, bird chicks, beetles, caterpillars, and even small mammals like squirrels and rats were recorded in the diet (UWICER, 2017 in BirdLife International, 2020). The main food consumed during the breeding season (nest site observation made during 2017 in JSWNP and RMNP) comprised both fruits, food, and animals. It was found that RNH consumed fruit food of 17 species belonging to families of Lauraceae, Meliaceae, and Moraceae in high quantities. The most frequently consumed species were *Beilschmiedia assamica*, *Persea gamblei*, *Aleodaphne owdenii*, *Cryptocarya amygdalina*, and *Aphanamixis polystachya* of non-fig fruits, while *Ficus benghalensis* and *Ficus hirta* constitute fig fruit food. Beetles, caterpillars, cicadas, bird chicks, wasps' larvae, crabs, and gliding squirrels constituted animal food (UWICER 2017 in BirdLife International 2020; Dorji, 2018 unpublished report).

1.2.4. Breeding and Reproduction

The RNH requires diverse old-growth forests for feeding and nesting (Raman & Mudappa, 2003). The nesting season in India and Bhutan begins in April, while in Thailand it commences in January with the duration of the nesting period ranging between 105-152 days. Tall and large trees are required for breeding; nests have been recorded in *Cleistocalyx nervosum* in Thailand and in *Terminalia myriocarpa*, *Altingia excelsa*, and *Syzygium* spp. in Arunachal Pradesh. *Shorea robusta* and *Schima wallichii* were also recorded as nest trees in Buxa Tiger Reserve (TR). In Buxa TR, North Bengal, nest entry occurred between the end of March to the first week of May. The nesting cycle ranged from 99 to 121 days, with chicks fleeing between mid-July and August (BirdLife International, 2020).

RNH nests in Bhutan were found in different types of tree species having large diameter and tall heights of *Altingia excelsa*, *Schima khasiana*, *Terminalia myriocarpa*, *Choerospondias axillaris*, *Castanopsis tribuloides*, and *Toona ciliata* (UWICER, 2017 and Dorji, 2013). The incarceration of female RNH commences from the second week of April to first week of May. The female emergence



and chicks' fledging were observed from the last week of July to first week of August in Bhutan. The female emergence from the nest occurred before or on the same day as the chick fledging. Clutch size of 1-2 chicks was raised by each breeding pair. The average breeding period observed by researchers in JSWNP was 104 days (Dorji, 2018 unpublished report).



Figure 4: R: A male rufous-necked hornbill on its nest cavity; L: Hornbill foods

1.2.5. Movement Ecology

Generally, the species is considered sedentary and territorial, but there is some evidence of seasonal movements in search of patchily distributed fruit resources (Tifong *et al.* 2007). The home range size of three individuals tracked by radio telemetry was approximately doubled during the non-breeding season when compared with the breeding season; around 12-16 km² versus 6 km² (Tifong *et al.* 2007). As the male is entirely responsible for feeding the female within the nest cavity during the breeding season, its foraging distance is greatly restricted.

The home range of RNH estimated applying the Minimum Convex Polygon (MCP) and Kernel Density Estimators (KDE) in Bhutan ranged from 16.83 - 5733 per square kilometer. The size of home range doubled during non-breeding for one breeding male while others showed totally reduced home range possibly due to the abundance of food resources in the given area (Kinley et al, 2022). The stable population of rufous-necked hornbills in Bhutan has the potential as a source population for the eastern Himalayas based on the GPS based biologging studies conducted since 2017, in Bhutan (Sherub *et al.*, 2022).

1.3. Great hornbill

Great hornbill (GH) *Buceros bicornis* Linnaeus, 1758 also known as the concave-casqued hornbill, great Indian hornbill or great pied hornbill is a large colorful bird with 95-120 cm long, 150-178 cm wingspan and weight of 2 to 4 kg. The most prominent feature of the hornbill is a very large bill with bright yellow and black colored horny growth known as the casque. The body is mostly black with white neck, wing coverts and flight feathers. Female is smaller than male and has bluish-white iris instead of red. The back of the casque is reddish in female, whereas the underside of the front and back of the casques is black in male.

1.3.1. Distribution

The GH is widely distributed across India, Nepal, Bhutan, China, Bangladesh, Myanmar, Thailand, Laos, Vietnam, Cambodia, Malaysia and Indonesia. In Bhutan, great hornbill is fairly common and it has 2% of the area of Bhutan potential habitat suitable for the hornbills in the southern region to elevation below 3000 m.a.s.l (Nir Kumar Puri et al., 2022). Currently GH is recorded from Samdrup Jongkhar, Pemagatshel, Trashigang, Monggar, Zhemgang, Trongsa, Sarpang, Tsirang, Dagana, Wangdiphodrang, Chukha and Samtse Dzongkhags.

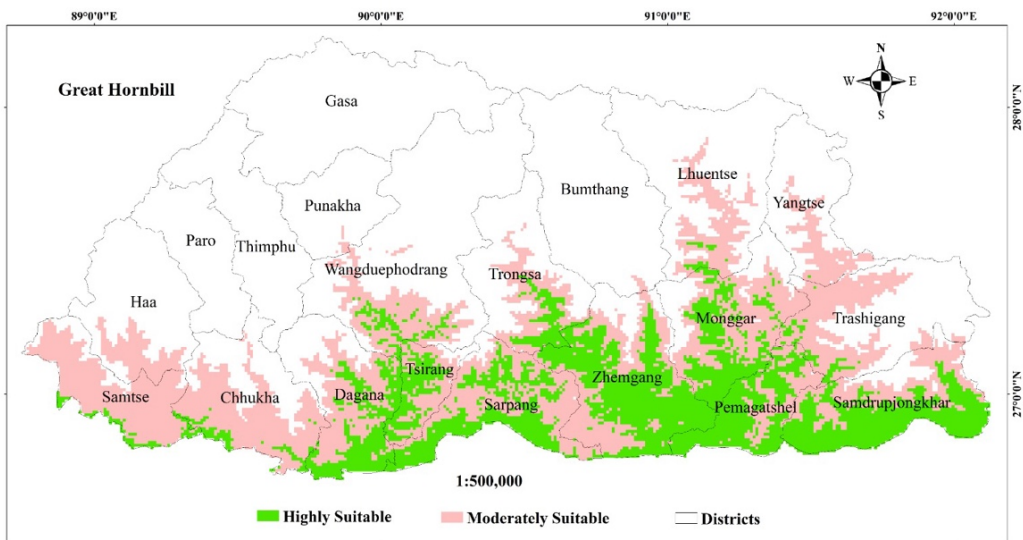
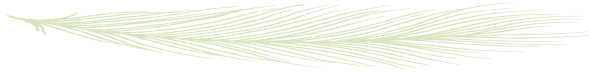


Figure 5: Habitat suitability map of great hornbill based on its current distribution.

GH are mainly found in wet evergreen and mixed deciduous broadleaved forests, rich in large nest cavities and fruit trees suitable for foraging, feeding, breeding, and nesting. They are known to



inhabit mostly in the altitude range of 600 to 2000 m.a.s.l. Their home range varies from less than four square kilometers during the breeding season to fifteen square kilometers in the non-breeding season (Poonswad and Tsuji, 2008 as cited in Khanal, 2018). This species is most prevalent in unlogged forests since its abundance tends to be correlated with the density of large trees in the habitat, which are necessary for nesting (Datta, 1998).

1.3.2. Feeding Ecology

GH are omnivorous and predominantly frugivorous, they feed upon both lipid- and sugar-rich fruits, which are essential for them as a primary source of energy, especially during their breeding season when the energy needs are significantly higher for both the parents and young. They occasionally feed on insects, crabs, small lizards, amphibians, birds, and small mammals. The feeding can take place at any time of the day and depends on the foraging abilities of individuals (Khanal, 2018). They obtain water entirely from their diet of fruits and they are major seed dispersers, which ensures healthy regeneration in the forest. Some of the most preferred fruit tree species include *Ficus* spp., *Polyalthia* sp., and *Elaeagnus* sp. (Kaur, 2015). Figs comprise a major part of their diet, some of the most frequently consumed fig species include *Ficus auriculata*, *F. hederacea*, *F. hirta*, and *F. macrocarpa*, and other fruit trees such as *Cryptocarya amygdalina*, *Aglaia perviridis*, and *A. korthalsii* fruits are also frequently consumed (JSWNP, 2018).



Figure 6: A pair of rufous-necked hornbills perching on a tree branch



1.3.3. Movement of great hornbill

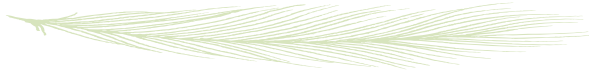
The movement of hornbills are determined by availability of fruit trees, nesting sites, and threats or disturbances. They stay close to their nesting locations for the duration of their three-month nesting season, frequently visiting nesting sites and feeding the sealed female. After the chicks are fledged, they roam in flocks as a socializing process, and it's during this time that they choose their next breeding partner for young male and female. They team up following "casque-butting" maneuvers performed in midair by young male competitors.

The hornbills seem to be partitioning food resources during the non-breeding season. The GH, *Buceros*, is known to depend more on or consume more fig fruits than other hornbill species because they grow year-round in lowland forests in relatively high densities. Their home range is also smaller than that of other hornbill species (A. Datta, et al-2003). The radio tracked male during the breeding season in Khao Yai National Park in Thailand, daily movement was about 4 -14 km and throughout the entire breeding season covers about 7km on an average.

Generally, GH are largely sedentary moving in small areas and during non-breeding season they range widely. However, in Bhutan, there is not enough data on ranging patterns and ecological movement.

1.3.4. Reproduction

Great hornbill like all other Asian hornbills in general have peculiar nesting and reproduction behavior, requires old growth primary forest with tree cavities for nesting. They are secondary cavity nesters and use cavities excavated by other birds or cavities resulted from fungal decomposition. GH usually nest on larger and elongated cavities than other hornbills (Datta & Rawat, 2004). They are considered monogamous, and partner selection by females and their compatibility is considered so important as females have to depend on a partner for food during the entire nesting period (HRF, 2017). Once they paired up, the couple starts courtship by late January (Feb or early March in captive) (R & Williams, 1986) characterized by vocalization, regurgitation, approach, offering food, billing & biting, allopreening and nest investigation, likely serve a pair bonding (Corinne P. Kozlowski, Bauman, & Asa, 2015). Once the suitable nest cavity is selected, the partner starts sealing/plastering the cavity with mud, fecal matter & fruit pulp and the female gets completely sealed inside the cavity before egg laying. Nest opening is sealed keeping only a narrow slit through which male passes food for her and until chicks fledge. Female enters the nest usually in mid-late



March, lays eggs and incubates inside the cavity. The nesting cycle of GH ranges from 110-129 days. Towards the end of the nesting period, females and the young simultaneously break out of the nest (Mudappa, 2000) by late July or early August (Sherub & Tshering, 2019). Both male and female then feed the nestling for a few days until they are capable of coming out and flying. While in incubation, the female undergoes a complete molt in the nest shedding feathers of the wings and tail. GH are reported to be nesting mostly on *Tetrameles nudiflora* and on other species such as *Ailanthus grandis*, *Alseodaphne semecarpifolia*, *Terminalia* sp., *Lagerstroemia lanceolata*, *Bombax ceiba*, etc.

1.3.5. Population

The current estimated population of GH is 13,000 to 27,000 mature individuals worldwide. Although the GH has a wide range of distribution, its population decline rate is estimated at the band of 30-49% over three generations. The GH is listed as Vulnerable by IUCN, owing to the declining population, mostly driven by habitat loss and degradation. In Bhutan, the population status of the bird is not known but encounter rate (ER) for the GH by trail walk in JWS found out to be 0.8 (Gyeltshen, 2018 *unpublish document*).

1.4. Wreathed hornbill

Wreathed hornbill (*Rhyticeros undulatus*) is one of the five species of hornbills found in Bhutan. Belonging to the family of Bucerotidae, it is also called Bar-pouched wreathed hornbill due to its distinctive blue-black band on its lower throat sac. It is a large hornbill ranging its length between 84 – 117 cm (Male 100-117 cm; female 84-98 cm) and weighing between 1360-3650g (Male 2043-3650 g; female 1360-2685g). While both sexes are black with snow-white tails, the male has a yellow face and throat patch, and the female has a red patch of skin around the eye and a blue throat patch. They are usually seen in pairs or medium-sized flocks, flying between fruiting trees. They give loud hoarse trumpeting croaks, often while in flight. As with many other large hornbills, wings create a powerful thrumming when flying. The bird is a highly social species that usually lives in flocks of up to 10 birds.

1.4.1. Occurrence and distribution

At the global scale, the species occurs in south-east Asia from southern Bhutan, Bangladesh and north-east India east to Cambodia, Laos and Vietnam, and south through Malaysia and Thailand to Indonesia (Sumatra, Borneo, Java, Bali and several nearby islands) and Brunei (BirdLife





International, 2018). In Bhutan, the species has been recorded in most of the southern districts such as Samtse, Dagana, Sarpang, Tsirang, Trongsa, Pemagatshel, and Samdrup Jongkhar and protected areas such as JSWNP, PWS, JWS, and RMNP. Across its range, the species occurs in extensive primary rainforest, mainly in the lowlands but has been recorded to 2,560 m elevation. (Poonswad et al. 2013, Kemp and Boesman 2018). In Bhutan a flock in flight was observed at 2800 m.a.s.l (Dung Dung Neysa, Wangdiphodrang, 2021).

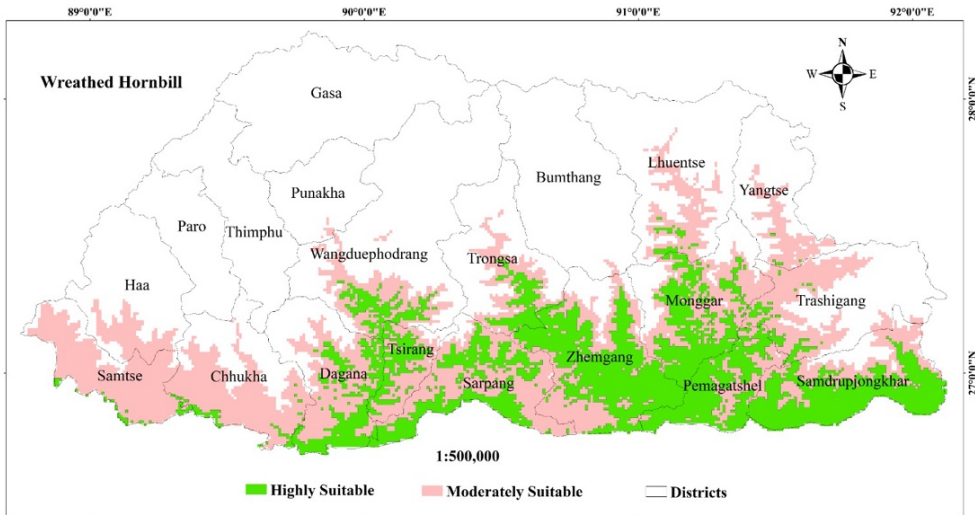
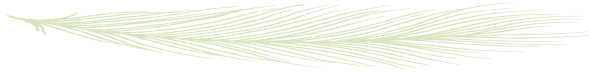


Figure 7: Habitat suitability map of wreathed hornbill based on its current distribution.



Figure 8: A pair of wreathed hornbills.



1.4.2. Nesting and feeding ecology

There is very limited study on the wreathed hornbills in Bhutan. Therefore, information on feeding ecology, reproduction, and movement ecology are very limited. A study conducted in the JWS (Gyeltshen, 2018) found that nests of the wreathed hornbill were found both in open as well as dense forest. Nests are placed in natural cavities high up in tall trees and the same cavity is used throughout successive breeding seasons (Kemp and Boesman 2018). During the breeding season, the female is responsible for incubating the eggs and caring for the young while the male helps by bringing food for the female and young ones.

Wreathed hornbill consumes more drupaceous fruits than other hornbill species and also occasionally eats small animals like insects, crabs, snails and reptiles, particularly during the breeding season, and are, therefore, omnivorous. In Bhutan, wreathed hornbills are known to feed on 9 species of fig fruits and 14 species of non-fig fruits (Gyeltshen, 2018).

1.4.3. Population

According to the BirdLife International (2018), the total population in the world is unknown and the population size tends to be decreasing due to habitat loss and illegal hunting. The wreathed hornbill is a monogamous species, with pairs forming lifelong bonds. It has been listed as Vulnerable on the IUCN Red List since 2018. In Bhutan, the population of the bird is not known.

1.5. Oriental pied hornbill

The Oriental pied hornbill (*Anthracoceros albirostris*) is a medium-sized, pied hornbill, a large canopy-dwelling bird belonging to the family Bucerotidae. A small black-and-white hornbill with a whitish-yellow bill and “helmet.” Primarily black, but with a white belly, facial patch, and wing and tail edges. Sexes are similar, but males have a much larger “helmet” than the female.

1.5.1. Occurrence and Distribution

Oriental pied hornbill is a widespread resident in northern South Asia. In Bhutan the bird is distributed mainly in the southern districts of Samtse, Dagana, Sarpang, and Samdrup Jongkhar. The sighting of the hornbill is very common in places such as Manas, Sarpang, Lhamoizingkha, Gelephu, Phibsoo, Jomotsangkha, Samrang, Samtse. While the species is found in its natural habitat of the





subtropical or tropical moist lowland forests, it is very tolerant to human habitation as compared to other hornbills. Therefore, the species can be found in forest edge, open, moist deciduous and evergreen forests, riverine forest, secondary, logged forests and even gardens and agricultural fields (BirdLife International, 2020). The species shows a preference for secondary growth, river-margin forests (Datta 1998) and does not depend on primary forest habitat even for breeding (Poonswad et al. 2013). It occurs in the coastal lowlands and extends inland up to 700 m elevation.

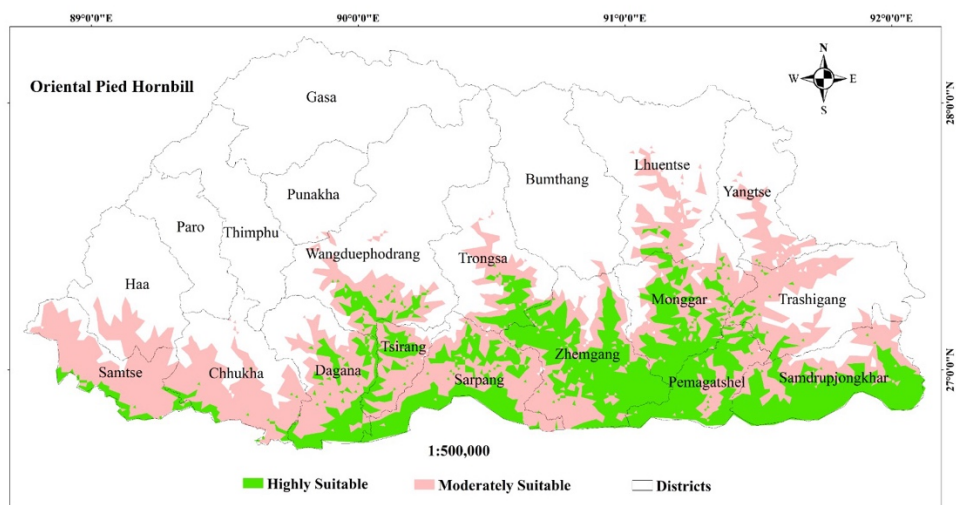
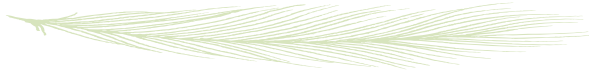


Figure 9: Habitat suitability map of oriental pied hornbill based on its current distribution



Figure 10: A pair of oriental pied hornbills



1.5.2. Feeding and Reproduction

Like any other hornbills, the oriental pied hornbills are also omnivorous and the diet species are figs, wild fruits, berries, large insects, small birds, lizards, frogs and fish are their primary food. Protein-rich and lipid-rich fruits and small animals are their favorite food during the breeding season.

The breeding season of these oriental pied hornbill species is during February to April in mainland Asia. These birds are monogamous and territorial. The nest is usually found up to a height of 30 m often in *Dipterocarpus* or *Cleistocalyx* in Thailand (Poonswad et al. 2013) and on *Tetrameles nudiflora* in north-east India (Datta 2001). They usually use the same nest site year after year. After mating, the female does nest preparation and lays 1- 4 eggs with the incubation period ranging from 25-33 days. The male feeds the chicks and female and the nestling period takes 41- 64 days.

The oriental pied hornbill is a non-migrant sedentary bird. They take a movement for breeding and feeding within their range and juveniles may also move to new locations within the range.

There is no estimated population for oriental pied hornbill and the overall population trend of these species is considered to be stable. The species is therefore, under the Least Concern category of the IUCN Red List and no specific research is carried out in Bhutan. However, due to their co-occurrence with other hornbills, conservation efforts are equally carried out.

1.6. Indian grey hornbill

The Indian grey hornbill (*Ocyrceros birostris*) is a species of hornbill found in the Indian subcontinent and it is a bird native to India, Sri Lanka and parts of Southeast Asia. It is a medium-sized bird with a grey body, black wingtips and characteristic yellow bill. The Indian grey hornbill is a medium-sized bird with males about 50-60 cm in length. It has a black head and neck, with a wide white stripe extending from the beak to the back of the head. The back and wings are grey, while the tail is greyish brown. This species has a distinctive call, consisting of large, hoarse notes. The Indian grey hornbill is an omnivore that eats fruit, insects and small vertebrates. It is usually seen in pairs or small groups and is known to form strong, long-lasting relationships with its partners. This species is listed as Least Concern in the IUCN Red List.



1.6.1. Distribution

The Indian grey hornbill is a hornbill species that is virtually ubiquitous across the entire Indian subcontinent, according to BirdLife International (2020). It occurs throughout India, with the exception of the northeastern region and higher elevations of the Himalaya, as well as in the northeastern parts of Pakistan, Nepal, and Bangladesh. The species lives in a wide variety of environments, including savannah, dry deciduous forests, and urban settings. In contrast to other hornbills that prefer forests, it favors dry plains, foothills, and open habitats BirdLife International (2020).

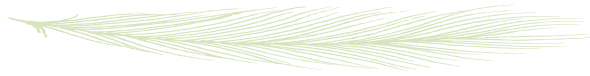
The Indian grey hornbill was first recorded in Bhutan on 13th April 2023 (Mr. Chubzang Tangbi). This species was observed in Gelephu under Sarpang dzongkhag, on *Bombax ceiba* tree near Mouthangchhu (lat 26.862478; long 90.499105). Grey hornbill may be using the forests of the foothills in Bhutan.

1.6.2. Population

According to the BirdLife International (2020), the global population of Indian grey hornbill is not yet quantified but the world population tends to be stable, widespread in the entire Indian subcontinent and most commonly seen.



Figure 11: Indian grey hornbill



1.7. Socio-cultural Significance of Hornbills

Ecologically all hornbills are considered as the “farmers of the forest” or sometimes the “gardeners of the forest” due to its seed dispersal behavior in augmenting the forest regeneration. For instance, the median and maximum seed dispersal distance by the wreathed hornbill was 1.35 km and 11 km respectively exhibiting intraspecific variation in seed dispersal patterns across sexes and breeding and non-breeding male hornbills (Naniwadekar, 2019). Therefore, the presence of hornbills in the forest serves as an important indicator of healthy forest ecosystems.



Figure 12: Snippet depicting the use of hornbill parts by local people

The hornbills are also important species in traditional socio-economic practices. In some areas, hornbills such as RNH, GH, and WH are hunted and their parts are used in ceremonies and rituals. In other areas, its feathers are used in traditional dress and decoration. In some places, its feathers are also believed to have medicinal and magical properties. Hornbill beaks are preserved as antique decorations within homes while curved hornbill pairs are used as logos for the conferences. Hornbill based ecotourism ventures within the hornbill hotspots can boost local economy and sustain local livelihoods such as in Malaysia, which is famously called as the land of hornbills.

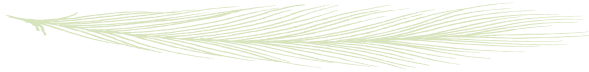


Majority of the hornbill species are monogamous and the hornbill pairs are considered as faithful birds. The faithful male hornbill tirelessly searches for food to feed the female and chicks on time from the start of nest sealing until the fledgling of chicks. Local people especially amongst married couples' joke and tease each other saying “don't act like a *Luchu* (Rufous-necked hornbill)” which literally translates to “don't be jealous.” It is also believed that RNH received its barking voice from the Lord Buddha as the bird came late to receive blessings when all other animals in the forest were given an identical voice each to communicate with each other (Lopen Sangay Tenzin (38), a monk at Kadam Goenpa in Mongar, in Birdlife International, 2020).

Hornbills are respected and honored by their human neighbors. They are revered as sacred and noble birds because they are known to live a simple life with love and faithfulness with their partners displaying the monogamous nature of relationship. The hornbills are said to be displaying majestic characteristics like when they eat, flock, sleep, etc. People love hornbills as they do not destroy agricultural crops except feeding on some fruits like that of *Pyrus pyrifolia* (Asian Pear) observed at Tshochen under Lhuentse district and tree tomato (*Cyphomandra betaceum*) at Ligsarbee in Tsamang, Mongar.



Figure 13: A male great hornbill feeding the female in nest cavity



1.8. Research and conservation status of hornbills in Bhutan

Conservation of natural resources has been deeply ingrained in Bhutanese way of life since time immemorial, and over the course of time, our strong conservation policies have helped further strengthen the conservation of our diverse ecosystems with their rich flora and fauna. The FNCA 2023 protects the hornbills by listing them under Schedule II species. The law also prohibits killing or capturing of wildlife of any species, thereby ensuring hornbills are not killed for food or trophies or put under captivity as pets. Hornbills are also used as a key species for protected area zoning, and identifying important conservation areas in Bhutan. It is also reflected under the species conservation actions of the Biodiversity Strategy and Action Plans (BSAP, 2014) and Biodiversity Rules and Regulations of Bhutan (BRRB, 2023).

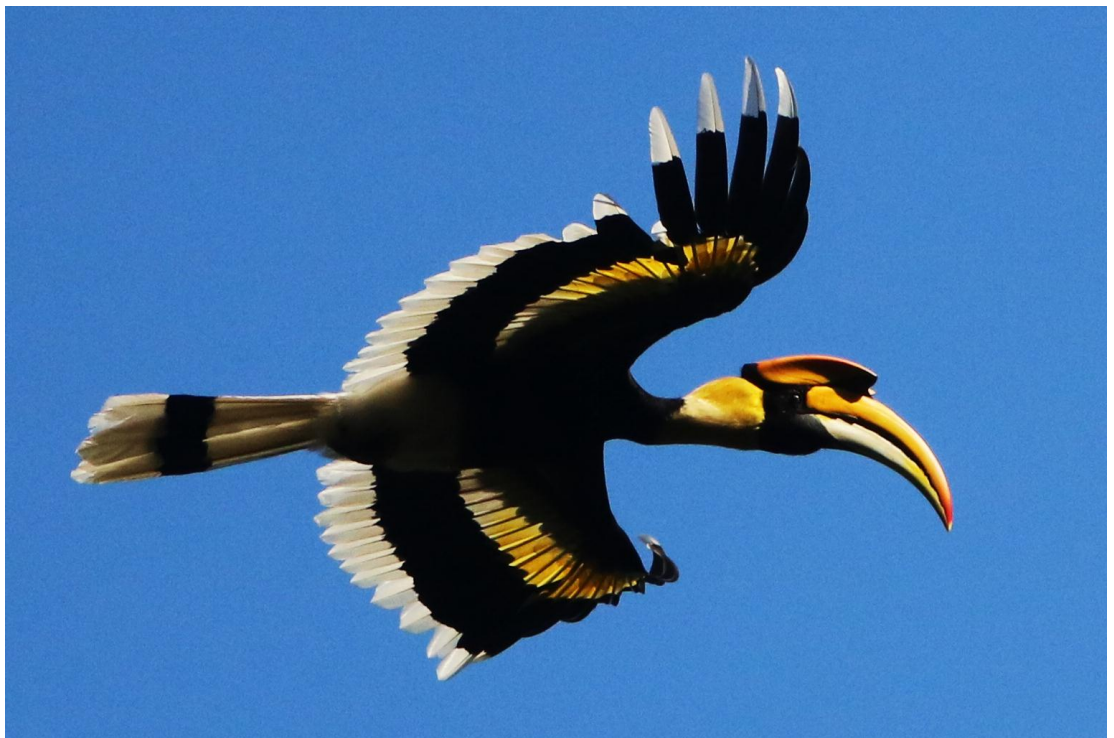


Figure 14: Researchers from DoFPS tagging a rufous-necked hornbill

Hornbill conservation and research works are limited in Bhutan and were mostly conducted by individuals by availing smaller conservation grants at individual level. Restricted to smaller areas and protected areas, the studies mostly covered the RNH and were mostly focused on habitat and conservation status including diet explorations within JSWNP in central Bhutan (Dorji, 2013, 2018;



Sherub, 2017). At the institution level, The Ugyen Wangchuck Institute for Forestry Research and Training leads the research works on the hornbills and has been mostly focused on the RNH. The first biologing of RNH study was conducted in PNP and within the Lingmethang Forest Management Unit under Mongar Forest Division including the diet source and habitat preference study (UWICER, 2017) through the funding support of the Conservation Leadership Programme based in the USA. Currently, the implementation of the Rufous-necked Hornbill conservation works at UWIFoRT is supported by the Bhutan for Life and the Max Planck Institute for Animal Behavior and in recent times, the institute conducted research on RNH diet source and movement ecology through GPS biologing (Sherub, Kinley, and Rinchen, 2022). The only sympatric hornbill study covering three vulnerable hornbills was conducted in South eastern Bhutan under JWS in 2018 (Gyeltshen, 2018). As for the two least concerned hornbill species, no studies were conducted, except for the anecdotal documentation of the species by the rangers and bird lovers.



CHAPTER TWO THREATS AND CHALLENGES

2.1. Threats

The habitat of hornbills in Bhutan are mostly in pristine forests and bird population are also perceived to be stable. However, with modern socio-economic development programmes at the peak, both habitats and bird are faced with some threats. Five key threats were identified during the focussed group discussion for further analysis as threat analysis forms an integral part of conservation action planning and management. Threat analysis and ranking was done using the Miradi threat ranking principle, the various threats identified were ranked based on a score of three dimensions of scope, severity and irreversibility using 4 points absolute scale of Low, Medium, High and Very High culminating into an overall threat rating.

The overall threat assessment for the hornbills in Bhutan was ranked **Medium** (Table 1). Of the five threats identified, habitat fragmentation and loss, and depletion of food resources were ranked in medium category while the disturbances on nesting sites, hunting and poaching, and diseases were all ranked in Low category.

Table 1: Threats to conservation of hornbills in Bhutan

| Threats/Targets | Objective 1: Secure suitable habitat to support thriving population of hornbills in Bhutan. | Objective 2: Engage local communities and stakeholders in Hornbill conservation through awareness and integrated conservation development programs. | Objective 3: : Increase science-based information on ecology, habitat, threats, and conservation status of hornbills in Bhutan. | Summary Threat Rating | |
|--------------------------------|---|---|---|-----------------------|--------|
| Habitat fragmentation and loss | Medium | | Medium | Medium | |
| Disturbances on nesting sites | | Low | Low | Low | |
| Depletion of food resources | Medium | Medium | Medium | Medium | |
| Hunting and poaching | | Low | Low | Low | |
| Disease | Low | | Low | Low | |
| Summary Target Ratings: | Medium | Low | Medium | Overall Rating | Medium |



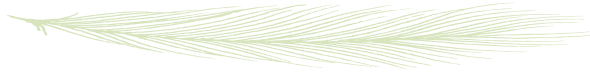
2.1.1. *Habitat fragmentation and loss*

Across its range in Asia, habitat loss is the most significant threat to the hornbills. As many as fourteen of the 32 species are severely affected for their survival by habitat loss. In South-East Asia, study showed that deforestation between 2000 and 2012 has led to the decline of habitat for many hornbill species; Rhinoceros Hornbill habitat declined by 43.8%, Wrinkled Hornbill habitat declined by 62%, Great Hornbill habitat declined by 26% and Wreathed Hornbill habitat declined by 32.8% (Tracewski et al. 2016). The time period for the dataset studied was considered 3 generation lengths for hornbill species, so the rate of habitat loss for these species is alarming.

Threat analysis and ranking exercise found that habitat loss is one of the major threats to hornbill conservation in Bhutan. In Bhutan, the rate of deforestation is not as alarming like South-east Asian countries, however, many anthropogenic actions are triggering habitat loss. Harvesting of timber for rural and commercial use causes some damage to the hornbill habitats. Across the suitable habitats of RNH, there are 643 km² (79,070 hectares) community forests and annual harvesting of timber from the community forests are expected to disturb the hornbill habitat. Harvesting of large trees and nesting trees results in the birds being unable to find suitable nesting sites.



Figure 15: Hornbill habitat along the Mangde chhu



Forests are lost through illegal felling of trees, and land conversion mainly for housing and agricultural developments, from small-scale agriculture to large-scale plantations. Because of its exceptionally large home range, the species requires extensive undisturbed forest and is unable to persist in areas where lowland forest has been reduced to small fragments (Chang et al. 2013). Installation of electric transmission lines also results in felling of trees in long tracks, posing threat to the hornbills. The Vulnerable hornbills such as RNH, GH, and WH depend on large fruiting trees for feeding and nesting so they are especially susceptible to deforestation and habitat degradation through logging, infrastructural development and clearance for agriculture. Furthermore, viable populations require vast tracks of forest to survive, exacerbating its susceptibility to habitat fragmentation.


2.1.2. Depletion of food resources

Hornbills are primary frugivores and the forests they inhabit should have abundant palatable fruit trees. Moreover, hornbills have an interesting nesting behaviour, which involves the female imprisoning herself within a large tree cavity (Poonswad, 1993), with the male bird feeding the female. The hornbills also have long nesting cycles lasting four to five months so abundance of food resources is vital for their breeding success. Any depletion of food resources will result in threatening the survival of this globally threatened species.



Figure 16: Rufous-necked hornbill feeding on wild fruits





Primary causes of food resource depletion in Bhutan are collection of edible fruits by the local communities. Fruits such as *Parasassafras confertiflora*, *Persea fructifera*, *Artocarrpus lacucha*, *Syzygium cumini*, etc are being collected by local peoples both for personal consumption and sale. Timber extraction for commercial logging and rural house building contributes to the depletion of hornbills' fruits by felling the tree species such as *Phoebe lanceolata*, *Beilschmiedia spp*, *Persea fruitifera*, *Persea odoratissima*. The practice of monoculture plantations on privately registered land can adversely impact fruit tree diversity.

2.1.3. Disturbances on nesting sites

Hornbills require tall and wide-girthed trees are required for nesting. Nest was recorded in *Cleistocalyx nervosum* in Thailand and in *Terminalia myriocarpa*, *Altingia excelsa*, and *Syzygium spp.* in Arunachal Pradesh, India. *Shorea robusta* and *Schima Wallachia* were also recorded as nest trees (Birdlife International, 2020). In Bhutan, nests were recorded in different types of tree species in the cavities of living tree trunks of *Phoebe lanceolata*, *Terminalia myriocarpa*, *Altingia excelsa*, *Castanopsis tribuloides*, *Toona ciliata*, *Ailanthus integrifolia*.

Hornbills can tolerate or survive to a certain degree of human disturbances provided there are enough resources available for nesting and food trees in their habitat. However, the pace of rapid developmental activities such as the construction of roads, high-tension power lines, land use changes, and both commercial and rural timber harvesting in the habitat cause significant threats to the nesting of the bird. Observations from the field indicate that nest trees are felled for timber extraction, and the nesting trees in the private lands are felled for commercial purposes exacerbating unavailability of nesting trees.

2.1.4. Hunting and poaching

Hunting is one of the major threats to wildlife, including hornbills. Across its range, hornbills are hunted for meat or biomaterials such as the beak and feathers for cultural activities (Kinnaird and O'Brien 2007, Kemp and Boesman 2018). Some communities also use the body fat for a purported medical value or to polish guns (Naniwadekar et al. 2016). In Bhutan, the traditional hunting practices for hornbills are minimal with only certain communities using the hornbill biomaterials for religious and cultural practices. Great Hornbill, and Rufous-headed Hornbill are the species impacted by hunting though the threat is classified as low in the threat ranking. The stringent conservation rules make hunting rather very secluded and limited.



Figure 17: Ideal habitat of Hornbill in Royal Manas National Park

Conservation efforts are being made to protect the existing hornbill species and their habitats in the country, and it is imperative to raise awareness and enforce strict laws to prevent further harm to these ecologically important species. Additionally, in order to curb down the minimal existing hunting practices in the country, intensive SMART patrolling and periodic monitoring in the potential threat habitats of hornbills need to be carried out.

2.1.5. Diseases

Although there is not much research on the diseases of Hornbills in Bhutan, like any other living organism, hornbills are vulnerable to diseases that can affect reproductive success, alter behaviors, and cause mortality. Some diseases recorded in neighboring countries include iron storage disease (ISD). ISD was categorized as the cause of death in 58 individual hornbills or 12% of the complete data set including African species (Gamble, 2012). Analysis by Asian hornbill genera against the cases of ISD as a denominator was higher than African hornbills. This assessment has concluded that the more frugivorous Asian hornbill species, specifically in the *Aceros* and *Rhyticeros* genera, indeed should be considered susceptible to ISD (Gamble, 2012).

Hornbills are highly susceptible to pseudotuberculosis, a disease caused by the bacterium *Yersinia pseudotuberculosis* (Galama, King, & Brouwer, 2002). This disease results in very rapid and usually





fatal inflammation of the liver. Contamination of food and water by infected droppings from rodents and wild birds as well as by avian carriers within the collection are likely sources of the bacterium. Several parasites like nematodes, blood-sucking mites, and feather louse were also reported as carriers of diseases in *Buceros bicornis* by EAZA Ex-situ Programme (EEP) institutions (Galama, 1996). As Bhutan shares its border with India, there is transboundary migration, which may increase the risk of disease transmission. Diseases are one of the risks that will always pose huge threats to the hornbill population. So, to maintain the hornbill species and population intact, further research can be conducted to determine the diseases that impact hornbills in our region. Thus, intensive research on diseases of hornbills and their habitat will allow us to take prompt actions and interventions to protect the existing hornbill species.

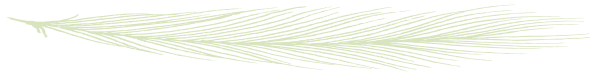
2.2. Challenges

2.2.1. Climate change

Human-induced climate change is regarded as a major threat to biodiversity as it can cause a variety of effects on biodiversity such as fluctuations in breeding and populations, species phenological changes, changes in habitat due to range shifts, and local extinctions. Hornbills are particularly susceptible to climate change impacts owing to their distinctive breeding habits (Pattinson et al., 2022).

Bhutan being located in the Eastern Himalayan biodiversity hotspot, is very vulnerable to climate change. It is evident that snowlines and permanent glaciers in northern Bhutan are receding at a very fast rate, with probable range shift of species and the tree line. The hornbill habitats being mostly in southern Bhutan, the impact of climate change is currently not felt but impacts in the future are probable. Such probable impacts have been modeled for hornbills in India and showed a climatic niche shift of the species towards the west, followed by northwest and northern shifts (Sarkar 2023). The study also reported that the species are expected to lose >40% of their suitable present climatic niche under the SSP 585 scenario in 2081–2100. Researchers monitoring the breeding habits of three hornbill species in the Pakke Tiger Reserve in Arunachal Pradesh for 22 years observed that extreme weather conditions in recent years disrupted the timing of nesting, causing delayed nesting and nest failures (Datta, 2022). With inevitable climate change threats on the rise, it is therefore vital that its impacts are regularly monitored to bring adaptive management practices.





2.2.2. *Limited scientific information*

Science based conservation information is paramount to achieve sustainable species persistence including the hornbills amid the fast developmental changes with escalating anthropogenic threats. The integrated application of combined knowledge and skills is useful for evidence-based conservation action of hornbills and their habitats to safeguard the viable population of hornbill species. In Bhutan the scientific information on hornbills is limited which are attributed to limited financial resources and fewer technical capacity and interested people. Only during the late twenty-first century few people started exploring hornbills that were mostly restricted to the central part of the country focusing only on the habitat and diet source of Rufous-necked hornbills. Few but slowly growing research exists as part of the post graduate program pursued in India and Germany, undergraduate life science studies based at the Sherubtse College, and undergraduate and diploma courses in the College of Natural Resources.

However, the Bhutan for Life project initiated by the WWF office in Bhutan that was instituted under the Royal Patronage of His Majesty the fifth King Jigme Khesar Namgyal Wangchuck and it was a boon to the biodiversity conservation efforts for Bhutan where some in-depth research studies were fielded by the UWIFoRT under the Department of Forests and Park Services. The ever first



Figure 18: Nesting site of Great hornbill



hornbill count in Bhutan was conducted during the year 2022 covering the hornbill habit range, bioglogging of hornbills to determine habitat use and home range, and some basic diet source of hornbills especially RNH which is adaptable for catching was conducted till date by UWIFoRT. Still, we need to do a lot in terms of scientific research that forms a basis for any field interventions to address the anthropogenic threats and maintain healthy habitat to secure a thriving hornbill population.

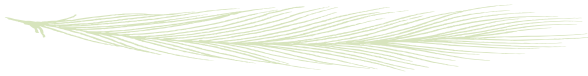
Nevertheless, to ensure sustainable hornbill conservation building the required science-based information through research is necessary to provide information for framing conservation policy frameworks. The Hornbill conservation action planning including the indigenous knowledge systems is a milestone set by HSG to achieve by the end of 2025 where Bhutan is on track and focuses on the Vulnerable species that will guide in building the science-based information in the forefront of securing sustainable hornbill conservation in Bhutan and the region.

2.2.3. Lack of awareness and weak community engagement

Engagement of local communities is considered vital for the success of conservation programmes, and community-based conservation is the future of biodiversity protection. The programme entails an effort to protect biodiversity in which the local community participates as much as possible together with the conservationists and scientists. This holds true for the conservation of hornbills as well. The prime habitats of hornbills in Bhutan connect diverse community groups such as the major settlements and towns with far flung remote villages amidst the thick forests. In many cases, people are not aware of the importance of hornbills in keeping the forests healthy. This has resulted in felling of trees vital for hornbill nesting and feeding. Creating awareness to the local communities of the importance of hornbill conservation will also help reduce hunting practices, if existent. In order to make the local communities and citizens conservation stewards, nature-based programmes that best benefit the needs of the communities should be explored and the participation of local communities, women's groups and youth groups should be promoted.

2.2.4. Lack of inter-agency collaboration

One of the issues in the success of any project or conservation program is due to lack of collaboration and coordination among agencies and different stakeholders right from the planning process to implementation and monitoring. It is one of the challenges in biodiversity conservation initiatives lacking common understanding amongst relevant stakeholders with diverging objectives. Therefore,



inter-agency coordination and collaboration among all the relevant stakeholders is vital for the hornbill conservation as the species plays critical roles in the ecosystem across the landscape. Formation of local groups such as Hornbill Guardian at the gewog community or village level can promote the local stewardship towards conservation of hornbills at the grassroots and improve the local level stakeholder collaboration.

2.2.5. *Weak transboundary collaborations*

Animals and plants do not recognize the political and administrative boundaries that intersect their habitats and move or migrate across boundaries separating regions, countries and even continents. (Chanchani P. *et al.*, 2014). Modern conservation practice has recognized the importance of landscape approaches that seek to combine both protection and sustainable management of biodiversity across a larger area which extends well beyond the political boundaries. Transboundary Manas Conservation areas (TraMCA) between Manas India and Royal Manas, Bhutan is one the successful transboundary conservation initiatives undertaken by Bhutan and India for the landscape level tiger conservation. Through the TraMCA approach the magnificent tiger not only survives but also thrives and inspires the world to step up its efforts to save the animal.





As hornbills predominantly occupy southern foot hills from Samtse in the west to Jomotshangkha in the east all along the Indo-Bhutan boundary, conservation of the species and its habitat at a landscape level encompassing habitat both in India and Bhutan is viewed as crucial. Thus, the initiative of TraMCA collaboration which was initiated a decade ago may be further strengthened and upscaled to include hornbill conservation as transboundary and priority species as hornbills occupy both areas and face similar conservation threats.

2.2.6. Limited resources

According to Hockings et al. (2006), resources are a primary requirement for the successful implementation of the planned programs. Bhutan being a donor dependent country cannot set aside a sustainable budget towards conservation activities for which the capital expenditure requires external funding support (NCD, 2019). Assessment report on protected areas of Bhutan found that management effectiveness is limited by a low level of financial and technical resources resulting in gaps in monitoring and research (MoAF, 2016). Even though there are few studies conducted on hornbill conservation and its nesting habitat through annual monitoring, there is still a need for in depth studies on its ecology and impacts of climate change on its ecosystem. Since, financial resources are limited; carrying out in depth studies remains a challenge. Even in field offices it has been found that frontline staff cannot be provided enough travel allowances and training opportunities on wildlife surveys, monitoring and management (NCD, 2019). Moreover, the conservation funds are project tied and for a short duration, it has impacted continuity of conservation (BNC,2021). Hence, there is a need to incorporate hornbill conservation funds in long term projects.



Figure 19: Hornbill food

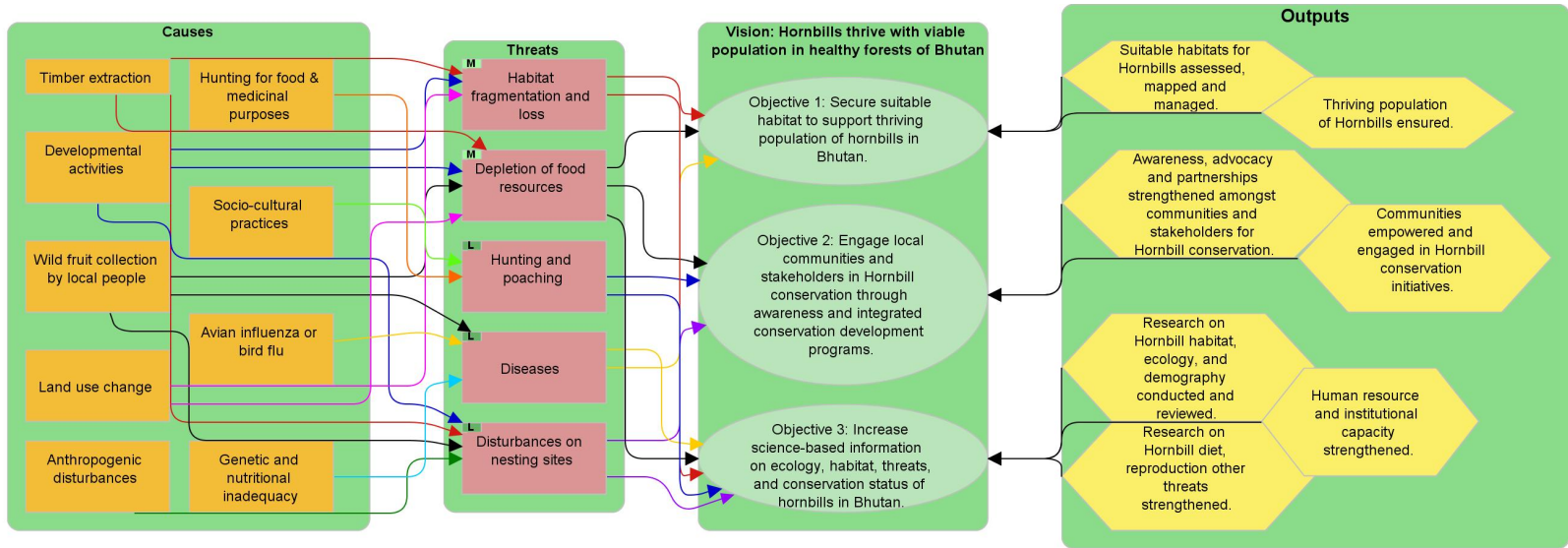


Figure 20: Conceptual model for Hornbill conservation





CHAPTER THREE ACTION PLAN

2.1. Vision and Goal

Vision: Hornbills thrive with viable populations in healthy forests of Bhutan.

Goal: By 2033, Hornbill habitats are sustainably managed and conservation secured for the threatened hornbills in partnership with local communities.

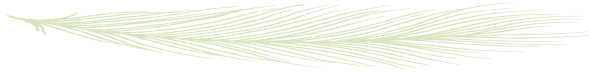
2.2. Objectives

2.2.1. *Objective 1: Secure suitable habitats to support thriving population of Hornbills in Bhutan*

The aim of securing suitable habitats to support the thriving population of the globally threatened hornbills of Bhutan is to conserve and protect the habitats where these birds live, breed and forage. Their habitats are under threat from various human activities such as logging and land use changes. These activities impact the loss of the nesting and foraging sites of hornbills, which can cause population decline and reduce distribution range.

Bhutan has 21 Forest Management Units, 73 Local Forest Management regimes, 839 Community Forest Management regimes and full-scale rural timber allocation regimes. Through these regimes, forests are being cleared for the construction of houses, buildings and other purposes. For 2021 itself, Bhutan has lost 117,635 m³ of trees for the construction of houses and buildings. So far, a total area of 113139.46 (2.94 %) has been cleared for agricultural and infrastructural developments.

Overall, the objective of securing habitats for hornbills in Bhutan is to ensure the survival of hornbills, while also preserving the ecological values associated with these birds. This objective is also important for the long-term conservation of hornbills and the ecosystem they inhabit.



Output 1.1. Suitable habitats for hornbills assessed, mapped and managed

Activity 1.1.1. Assess and map suitable and degraded habitat of hornbills of Bhutan

Activity 1.1.2. Assess season-based availability of food resources for hornbills

Activity 1.1.3. Restore, enrich and manage degraded hornbill habitat through plantation of fruit trees & other suitable species.

Activity 1.1.4. Nest conservation and management

Activity 1.1.5. Develop and implement guidelines on protection of nesting trees and key fruit trees in consultation with relevant stakeholders

Activity 1.1.6. Ensure proper waste management within hornbill habitat

Output 1.2. Thriving population of hornbills ensured.

Activity 1.2.1. Assess distribution pattern of five hornbill species

Activity 1.2.2. Develop Bhutan Hornbill Monitoring Protocol

Activity 1.2.3. Ascertain the population estimate of all five hornbill species

Activity 1.2.4. Conduct Annual Hornbill count

Activity 1.2.5. Conduct periodic SMART patrolling in prime hornbill habitats



Figure 21: Wreathed hornbill perching on the tree



2.2.2. Objective 2: Engage local communities and stakeholders in Hornbill conservation through awareness and integrated conservation development programs

In order to ensure a successful implementation of hornbill conservation program, we will adopt an integrated and inter sectoral linkage approach. It's important to bring different levels of stakeholders on the same board with common shared goals. The local communities on other hand are one of the key stakeholders and they provide the insight of conservation chains. They live within forest fringes and their livelihoods are strongly associated with nature. Thus, the local communities would play an important role in conservation.

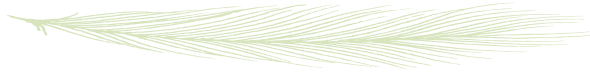
Hornbills which require special habitat of healthy forest have strong association with local communities and the two often overlap resource requirements that ultimately result in threats to hornbills. The threat analysis for hornbills in Bhutan has identified five major threats and all are found to have contributed directly or indirectly by people. Therefore, the objective is set to ensure hornbill conservation by engaging local communities and stakeholders in hornbill conservation programs. As an integrated conservation approach, the local communities will be given awareness on significance of hornbills in the landscape and in collaboration with local communities, various other conservation program will be implemented such as formation of community hornbill guardian & citizen science groups, inter-community & transboundary hornbill conservation exchange program, organize hornbill festival, eco-tourism & support local communities with livelihood programs.

Output 2.1. Awareness, advocacy and partnerships strengthened amongst communities and stakeholders for hornbill conservation

Activity 2.1.1. Design and develop awareness framework and outreach materials for diverse audiences

Activity 2.1.2. Carry out awareness on importance of hornbill conservation to communities

Activity 2.1.3. Instill hornbill conservation mindset in youths of educational institutes



Activity 2.1.4. Strengthen citizen science for hornbill conservation

Activity 2.1.5. Organize community exchange programs on hornbill conservation

Activity 2.1.6. Organize hornbill festival in hornbill rich communities

Activity 2.1.7. Initiate transboundary collaboration on Hornbill conservation

Output 2.2. Communities empowered and engaged in hornbill conservation initiatives

Activity 2.2.1. Form Community Hornbill Guardian groups and train them.

Activity 2.2.2. Hornbill based eco-tourism ventures identified and established by providing required training and resources

Activity 2.2.3. Support plantation of fruit and other commercially viable tree in private land & CFs to reduce pressure on natural forest resources.

Activity 2.2.4. Support rural-livelihood and encourage sustainable land management practices



Figure 22: A pair of great hornbills sharing the meal



2.2.3. Objective 3: Increase science-based information on ecology, habitat, threats, and conservation status of hornbills in Bhutan

Species-based information is critical for securing the conservation of any biological species to provide a foundation for understanding the biology, behavior, ecology, and threats of concern for the species. Hornbills being a flagship species of the sub-tropical forests in Bhutan, scientific information on the bird is very important to prioritize conservation actions. Of the five species of hornbills found in Bhutan, three are globally threatened yet scientific information is limited mostly to the Rufous-necked hornbill, as specified in chapter 1 and 2. Through this objective of increasing science-based information, the action plan has set out actions targeting three outputs each focusing on enhancing information on habitat, ecology, and demography; diet, reproduction and conservation threats; and strengthening human resources and institutional capacity towards achieving the two former outputs.

For example, scientific studies have helped to identify the specific habitat requirements of different hornbill species. Pilgrim et al. (2003) found that the Great hornbill requires large, mature forests with specific tree species for nesting and roosting, and such information has helped protect the specific trees to ensure nesting success. Such information is not available in Bhutan so actions have been set to address these shortcomings.

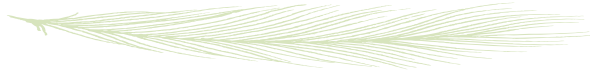
The limited studies are also attributed to limited expertise and limited resources in the country, so this action plan outlines measures to increase human capacity to study and document hornbill conservation initiatives, backed by required field gears and scientific equipment.

Output 3.1. Research on hornbill habitat, ecology, and demography conducted and reviewed

Activity 3.1.1. Review the conservation status and distribution of five hornbill species

Activity 3.1.2. Study on the movement and home-range pattern of three vulnerable hornbills

Activity 3.1.3. Study impact of climate change on hornbill and its habitat



Activity 3.1.4. Study and document social perspectives towards hornbill conservation and socio-cultural significance

Activity 3.1.5. Ascertain genetic diversity of the three hornbills of Bhutan

Output 3.2. Research on hornbill diet, reproduction other threats strengthened

Activity 3.2.1. Study hornbill feeding and foraging behavior

Activity 3.2.2. Determine hornbill breeding biology for all five species

Activity 3.2.3. Assess and monitor anthropogenic threats on hornbill habitats

Activity 3.2.4. Monitor and document phenology for hornbill fruit trees

Activity 3.2.5. Hornbill related zoonotic and fungal disease incidences monitored and reported annually by field offices

Output 3.3. Human resource and institutional capacity strengthened.

Activity 3.3.1. Take part in international hornbill conservation initiatives such as conference, workshops, and trainings

Activity 3.3.2. Train frontline rangers on hornbill survey techniques and monitoring

Activity 3.3.3. Equip field offices with necessary gears for hornbill survey and monitoring



Figure 23: A male rufous-necked hornbill

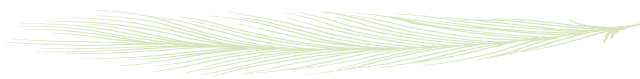
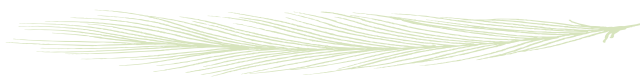
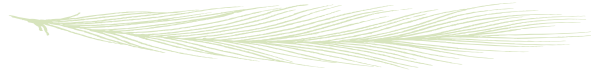


Table 2: Implementation plan and budget outlay

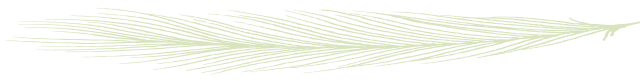
| Sl. No | Objective | Output | Action | Y 1 | Y 2 | Y 3 | Y 4 | Y 5 | Y 6 | Y 7 | Y 8 | Y 9 | Y 10 | Activity Total | | |
|--------|---|---|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|----------------|-----|-----|
| 1 | Secure suitable habitats to support thriving population of Hornbills in Bhutan | <i>Suitable habitats for hornbills assessed, mapped and managed</i> | Assess and map suitable and degraded habitat of hornbills of Bhutan | 1.5 | 1.5 | | | | | | 1.5 | | | 4.5 | | |
| 2 | | | Assess season-based availability of food resources for hornbills | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | | | | 2.5 | |
| 3 | | | Restore, enrich and manage degraded hornbill habitat through plantation of fruit trees & other suitable species. | | | | 2.5 | 2.5 | 2.5 | | | | 2.5 | | | 10 |
| 4 | | | Nest conservation and management | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 5 |
| 5 | | | Develop and implement guidelines on protection of nesting trees and key fruit trees in consultation with relevant stakeholders | 1 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 3 |
| 6 | | | Ensure proper waste management within hornbill habitat | 0.2 | 0.5 | 0.2 | 0.5 | 0.2 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 2.6 |



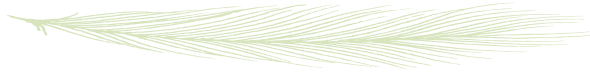
| | | | | | | | | | | | | | | |
|----|--|---|--|--|------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 16 | | | Organize community exchange programs on hornbill conservation | | | 2 | | 1 | | 1 | | 1 | | 5 |
| 17 | | | Organize hornbill festival in hornbill rich communities | | | 1 | | 1 | | 1 | | 1 | | 4 |
| 18 | | | Initiate transboundary collaboration on Hornbill conservation | 0.2 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 2.2 |
| 19 | | Communities empowered and engaged in hornbill conservation initiatives | Form Community Hornbill Guardian groups and train them. | | | 1 | 1 | 1 | | | | | | 3 |
| 20 | | | Hornbill based eco-tourism ventures identified and established by providing required training and resources | | | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 17.5 |
| 21 | | | Support plantation of fruit and other commercially viable tree in private land & CFs to reduce pressure on natural forest resources. | | | | 1 | 1 | 1 | | 0.5 | | 0.5 | 4 |
| 22 | | | Support rural-livelihood and encourage sustainable land management practices | | | | | | | | 2 | 2 | 2 | 6 |
| 23 | Increase science-based information on | | Research on hornbill habitat, ecology, and | Review the conservation status and distribution of five Hornbill species | 0.25 | | | | | | | | 0.2 | 0.2 |



| | | | | | | | | | | | | | | | | | |
|----|---|---|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 24 | ecology, habitat, threats, and conservation status of hornbills in Bhutan | <i>demography conducted and reviewed</i> | Study on the movement and home-range pattern of three vulnerable hornbills | | 3 | 1.5 | 1.5 | | | | | | | | | 6 | |
| 25 | | | Study impact of climate change on hornbill and its habitat | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | 4.5 | |
| 26 | | | Study and document social perspectives towards hornbill conservation and socio-cultural significance | 1 | 1 | | | | | | | | | | | | 2 |
| 27 | | | Ascertain genetic diversity of the three hornbills of Bhutan | | | 3 | 3 | | | | | 2 | | | | | 8 |
| 28 | | | Study hornbill feeding and foraging behavior | 0.5 | 0.5 | 0.5 | | | | | | | | | | | 1.5 |
| 29 | | <i>Research on hornbill diet, reproduction other threats strengthened</i> | Determine hornbill breeding biology for all five species | | | 1.5 | 1.5 | | 1.5 | 1.5 | | | | | | 6 | |
| 30 | | | Assess and monitor anthropogenic threats on hornbill habitats | 0.3 | 0.5 | | | | 0.5 | | | | | 0.5 | | 1.8 | |
| 31 | | | Monitor and document phenology for hornbill fruit trees | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 3.4 | |
| | | | | | | | | | | | | | | | | | |



| | | | | | | | | | | | | | |
|--------------------|---|--|-------------|--------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|--------------|---------------|
| 32 | | Hornbill related zoonotic and fungal disease incidences monitored and reported annually by field offices | 0.25 | 0.25 | | | 0.25 | 0.25 | | | 0.25 | 0.25 | 1.5 |
| 33 | <i>Human resource and institutional capacity strengthened</i> | Take part in international hornbill conservation initiatives such as conference, workshops, and trainings. | 2 | 2 | | 2 | | 2 | | 2 | | 2 | 12 |
| 34 | | Train frontline rangers on hornbill survey techniques and monitoring | | | 1 | 1 | 1 | | | | | | 3 |
| 35 | | Equip field offices with necessary gears for hornbill survey and monitoring | | 5 | 5 | | | 5 | 5 | | | 5 | 25 |
| Grand Total | | | 11.5 | 22.25 | 23.0 | 25.3 | 17.75 | 22.55 | 14.5 | 14.5 | 12.45 | 16.95 | 180.75 |



CHAPTER FOUR PLAN IMPLEMENTATION AND MONITORING

4.1. Institutional arrangements

The DoFPS being the custodian of wildlife and natural resources, will lead the implementation of this conservation action plan. The plan implementation will be coordinated by NCD in collaboration with UWIFoRT and other important stakeholders. However, the majority of the actions will be implemented by the field offices where hornbills are present. Most of the scientific studies and national events will be led by the UWIFoRT, though students from the colleges under the Royal University of Bhutan and other Bhutanese researchers are encouraged to take up research work on the hornbills by securing their own funding. The Forest Monitoring and Information Division (FMID) of the DoFPS will monitor the implementation of the plan.

4.2. Work plan and budget

This conservation action plan is developed for a plan period of ten years from July 2023-June 2033, and covers all the five species of hornbills, though major scientific studies will be targeted towards the vulnerable species. The development of the plan is guided by the National Forest Policy 2011 and the 12th Five Year Plan of the Ministry of Agriculture and Forests, though much of the implementation works will be in the 13th FYP and beyond. The action plan is also guided by the Bhutan for Life conservation milestones that will extend until 2032 and the GEF 7 ecotourism conservation project. Over the next ten years, the Department of Forests and the conservation partners will implement 35 key actions and will incur an estimated cost of Nu. 180.00 million.

Most of the funding for implementation of this conservation action plan are expected to be met from the Bhutan for Life project across the protected areas, and other existing conservation projects such as the GEF & Ecotourism Project in North-eastern Bhutan, WWF funded IKI project in South-western Bhutan. Funding from other donors like WWF Bhutan, BTFEC, UNDP, RSPN, BES, Bhutan Foundation, and other international donors will also be sourced based on locality of implementation. The RGoB will, however, have



a major share of funding through civil service remunerations, institutional setups, and implementation of prioritized activities.

4.3. Monitoring and evaluation

Implementation of the plan will be monitored annually by FMID, NCD and UWIFoRT in collaboration with the field offices. A mid-term review of the plan will be carried towards the end of the five years of plan implementation. Progress will be monitored from periodic reports submitted by the focal persons from the field offices and present to the Department. The logical framework (Table 3) will be used for monitoring and evaluation, using indicators provided. This conservation action plan is a living document and the activities prescribed above are dynamic and should change as per the change of policy, priorities or field situations. The annual monitoring and mid-term review should consider any addition or deletion of actions wherever necessary and relevant.



Figure 24: Oriental pied hornbill perching on a branch

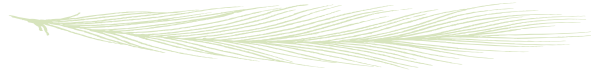
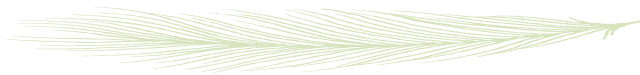
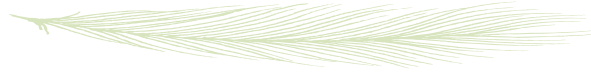


Table 3: Logical framework for plan implementation

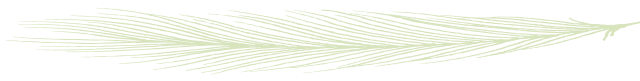
| Sl. No | Objective | Output | Action | Indicator | Means of Verification | Lead | Partners |
|--------|---|---|--|---|-----------------------|-------------|-------------------------------|
| 1 | Secure suitable habitats to support thriving population of Hornbills in Bhutan | <i>Suitable habitats for hornbills assessed, mapped and managed</i> | Assess and map suitable and degraded habitat of hornbills of Bhutan | Suitable & degraded hornbill habitats including nesting locations identified and mapped | Reports | UWIFoRT/NCD | Pas & FDs |
| 2 | | | Assess season-based availability of food resources for Hornbills | Food resources during pre & post breeding period documented | Reports | PAs & FDs | UWIFoRT/NCD |
| 3 | | | Restore and manage degraded hornbill habitat through plantation of fruit trees & other suitable species. | Acreage of degraded hornbill habitats restored/managed | Reports | PAs & FDs | UWIFoRT/NCD |
| 4 | | | Implement nest conservation and management activities | No. of nest improvement piloted in Sarpang and replicated in other critical sites | Reports | UWIFoRT/NCD | Sarpang DFO & other PAs & FDs |



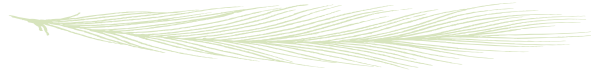
| | | | | | | |
|---|---|--|--|------------|-------------|-----------------------------------|
| 5 | <i>Thriving population of hornbills ensured</i> | Develop and implement guidelines on protection of nesting trees and key fruit trees in consultation with relevant stakeholders | Guidelines developed and implemented | Guidelines | UWIFoRT/NCD | PAs & FDs |
| 6 | | Ensure proper waste management within hornbill habitat | Reduced incidences of solid waste and pollution in prime hornbill habitats; No. of cleaning campaigns, awareness programmes, waste bins. | Reports | PAs & FDs | Communities & Local Gov./Thromdes |
| 7 | | Assess distribution pattern of five hornbill species | Distribution pattern ascertained | Reports | UWIFoRT/NCD | PAs & FDs |
| 8 | | Develop Bhutan hornbill Monitoring Protocol | Protocol developed | Protocols | UWIFoRT/NCD | PAs & FDs |
| 9 | | Ascertain the population estimate of all five hornbill species | Population estimates known for all five species | Reports | UWIFoRT/NCD | PAs & FDs |



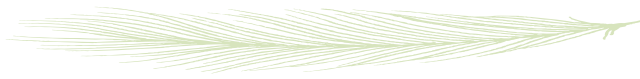
| | | | | | | | |
|----|--|---|---|---|--------------|----------------|---|
| 10 | Engage local communities and stakeholders in Hornbill conservation through awareness and integrated development programs | <i>Awareness, advocacy and partnerships strengthened amongst communities and stakeholders for hornbill conservation</i> | Conduct Annual Hornbill count | Annual count recorded | Reports | UWIFoRT/NCD | PAs & FDs, Hornbill guardian groups, citizen science participants |
| 11 | | | Conduct periodic SMART patrolling in prime hornbill habitats | No. of patrolling conducted | SMART Report | PAs & FDs | Hornbill guardian groups |
| 12 | | | Design and develop awareness framework and outreach materials for diverse audiences | Awareness frameworks and materials developed | Frameworks | UWIFoRT/NCD | PAs & FDs, HSG |
| 13 | | | Carry out awareness on importance of hornbill conservation to communities | No. of awareness programmes conducted | Reports | NCD, PAs & FDs | LGs, Hornbill guardian groups |
| 14 | | | Instill hornbill conservation mindset in youths of educational institutes | Conservation programmes for youths conducted; No. of schools engaged; No. of students participated. | Reports | NCD, PAs & FDs | Schools, teachers, students, monks, |



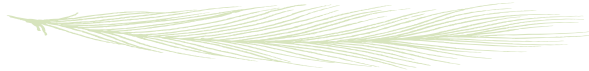
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| 15 | | Strengthen citizen science for hornbill conservation | Citizen science strengthened; No. of participants | Citizen science reports | UWIFoRT/NCD | PAS, FDs, citizen science participants |
| 16 | | Organize community exchange programs on hornbill conservation | No. of exchange programmes conducted | Exchange programme reports | PAs & FDs | Hornbill guardian groups, students, citizen science participants |
| 17 | | Organize Hornbill festival in hornbill rich communities | No. of festival conducted | Festival | DoFPS, Dzongkhag | HSG, PAs, FDs, LGs, citizen science participants, hornbill guardian groups, |
| 18 | | Initiate transboundary collaboration on Hornbill conservation | No. of transboundary conservation programmes held | Reports | DoFPS | HSG, DoFPS, transboundary leaders |
| 19 | <i>Communities empowered and engaged in</i> | Form Community Hornbill Guardian groups and train them. | No. of hornbill guardian groups instituted | Community Groups | PAs & FDs | LGs & communities |



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| 20 | | <i>hornbill conservation initiatives</i> | Hornbill based eco-tourism ventures identified and established by providing required training and resources | No. of Eco-tourism products strengthened or established | Ecotourism products | NCD & UWIFoRT | DoT, ABTO, Dzongkhags, Communities, Youths, LGs |
| 21 | | | Support plantation of fruit and other commercially viable tree in private land & CFs to reduce pressure on natural forest resources. | No. of communities supported with plantations; No. of seedlings provided | Plantation reports | PAs & FDs | LGs, GBCL, Prvt. or local nurseries, CFMGs |
| 22 | | | Support rural-livelihood and encourage sustainable land management practices | Communities supported with sustainable land management practices; Acreage of land managed | Reports | PAs & FDs | Dzongkhags, LGs |
| 23 | Increase science-based information on ecology, habitat, threats, and conservation status of hornbills in Bhutan | <i>Research on hornbill habitat, ecology, and demography conducted and reviewed</i> | Review the conservation status and distribution of five Hornbill species | Information on Hornbills of Bhutan updated | Reports | UWIFoRT & NCD | PAs & FDs, RUB |
| 24 | | | Study on the movement and home-range pattern of three vulnerable hornbills | Movement pattern and home range ascertained | Reports | UWIFoRT & NCD | PAs & FDs, RUB |
| 25 | | | Study impact of climate change on hornbill and its habitat | Climate impact ascertained and predicted | Reports | UWIFoRT & NCD | PAs & FDs, RUB |



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| 26 | | Study and document social perspectives towards hornbill conservation and socio-cultural significance | Social perspectives on conservation documented | Reports | UWIFoRT & NCD | PAs & FDs, NBC, RUB |
| 27 | | Ascertain genetic diversity of the three hornbills of Bhutan | Genetic diversity of five hornbill species ascertained. | Reports | UWIFoRT & NCD | PAs & FDs, NBC, RUB |
| 28 | <i>Research on hornbill diet, reproduction other threats strengthened</i> | Study hornbill feeding and foraging behavior | Food preferences and foraging behaviour ascertained. | Reports | UWIFoRT & NCD | PAs & FDs |
| 29 | | Determine hornbill breeding biology for all five species | Breeding and reproduction of hornbills ascertained. | Reports | UWIFoRT & NCD | PAs & FDs |
| 30 | | Assess and monitor anthropogenic threats on hornbill habitats | Anthropogenic threats monitored | Reports | UWIFoRT & NCD | PAs & FDs |
| 31 | | Monitor and document phenology for hornbill fruit trees | Phenology of preferred fruit trees ascertained | Reports | UWIFoRT & NCD | PAs & FDs |
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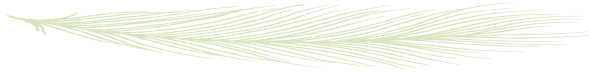


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| 32 | | Hornbill related zoonotic and fungal disease incidences monitored and reported annually by field offices | Risk of diseases to hornbills ascertained. | Reports | PAs & FDs | UWIFoRT & NCD, RVL/DOL |
| 33 | <i>Human resource and institutional capacity strengthened</i> | Take part in international hornbill conservation initiatives such as conference, workshops, and trainings. | International events and programmes attended. | Reports and Proceedings | DoFPS | HSG, Conservation Partners |
| 34 | | Train frontline rangers on hornbill survey techniques and monitoring | No. of frontline rangers trained | Training reports | UWIFoRT & NCD | PAs & FDs |
| 35 | | Equip field offices with necessary gears for hornbill survey and monitoring | Offices and rangers well equipped. | GIMS Reports | DoFPS | Conservation Partners |



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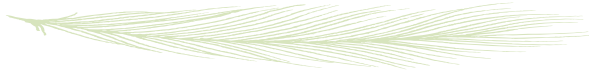


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