

White-bellied Heron

World's Rarest Heron



Royal Society for Protection of Nature

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Foreward

It gives me immense pleasure to present this publication of book on the White-bellied Heron, one of the world's rarest and most endangered bird species, and a symbol of Bhutan's rich natural heritage. This publication reflects our collective commitment to conserving a species that stands at the brink of extinction and highlights the continued efforts being undertaken to secure its future in Bhutan.

The foremost, I would like to express my deepest and most humble gratitude for the visionary leadership and enduring legacy of His Majesty the Fourth Druk Gyalpo. His Majesty's profound commitment to environmental preservation laid the very foundation upon which our work is built upon. We are equally honored by the continued stewardship of His Majesty the King and Her Majesty the Queen, whose unwavering support has been instrumental in RSPN's evolution as a pioneer non-governmental organization in the Kingdom. Bhutan's strong conservation ethos, inspired by the wisdom and guidance of our beloved Monarchs, has enabled the protection of globally significant species and habitats.

The Royal Society for Protection of Nature (RSPN) has remained steadfast in its mission to conserve Bhutan's biodiversity and fragile ecosystems. The White-bellied Heron conservation programme represents one of our most significant and long-standing conservation initiatives, integrating scientific research, habitat protection, community engagement, education, and sustainable livelihood interventions.

This publication is also a tribute to the dedication of our conservation partners, local communities, researchers, field staff, donors, and volunteers who continue to work tirelessly under challenging conditions to safeguard the White-bellied Heron and its riverine ecosystems.

As we move forward, RSPN remains committed to strengthening conservation actions through innovation, science-based management, and collaborative partnerships. We hope this publication will inspire greater awareness, responsibility, and collective action for the conservation of the White-bellied Heron and Bhutan's invaluable natural heritage.



Kinley Tenzin (PhD)

Executive Director

Royal Society for Protection of Nature

Tribute

The Remarkable and Much-loved Ellie Schiller

ELLIE SCHILLER (1944-2009) was a hard-working, no-nonsense, straight-to-the-point woman with a heart of gold, loved nature, and enjoyed the sunshine but shunned the lime-light. She became fascinated by the Himalayas, Tibetans and Buddhism when, following graduation from university, she spent half a year living with Tibetan refugees in Darjeeling where she taught the children mathematics.

When Ellie visited Bhutan with me in 2002, our excellent tour guide, Hishey Tshering, showed us a White-bellied Heron along the Mo Chuu (river) in Jigme Dorji National Park. Deep within the cathedral-like forest, the majestic heron stood motionless out in the water a few meters from a wide deposit of exposed gravel. Suddenly it thrust its long, grey neck and enormous, dagger-like beak into the water and caught a hefty fish almost as long as the heron's neck. By pressing her tiny camera to Hishey's telescope, Ellie took pictures of the drama. As a professional fisheries biologist, she was especially interested.

“It's been said that future generations will remember us for what we save. Ellie and the Felburn Foundation will always be remembered by what they did to help the White-bellied Heron during its time of peril.”

Ellie's father, J. Phil Felburn had established the Felburn Foundation with the simple mission of preserving nature. After he passed away in 1998, Ellie assumed primary responsibility for the foundation and supported many conservation initiatives.

One of Ellie's favorite sayings was, **“You can't put it back when it's gone.”** Consequently, the Felburn Foundation in partnership with WWF-Bhutan, through the International Crane Foundation and the Royal Society for the Protection of Nature, became a primary supporter of efforts to study and conserve one of the rarest and most endangered of birds worldwide, the White-bellied Heron.

It has been said that future generations will remember us for what we save. Ellie and the Felburn Foundation will always be remembered for what they did to help the White-bellied Heron during its time of peril. Let us hope that through these treasured birds, Ellie's remarkable spirit will always be in the Himalayas. Ellie will be especially missed for her good humor, unbridled joy at things she loved, and her unflinching championship of nature, children and education. She inspires us to continue her legacy.



George Archibald (PhD)

Co-founder

International Crane Foundation

Message from Chairperson

It gives me great pleasure to present this publication on the critically endangered White-bellied Heron. Recognized as the world's rarest heron, this remarkable species stands on the brink of extinction, with only a small population remaining globally. Bhutan is home to nearly half of the known global population, making our country one of the last strongholds for its survival.

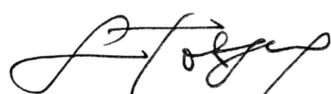
As the custodian of the largest remaining population of this critically endangered species, Bhutan fully recognizes its responsibility to ensure the continued survival and recovery of the White-bellied Heron. More importantly, we remain steadfast in our commitment to undertake all necessary measures for its conservation and protection.

This publication is the result of the sustained and dedicated efforts of the Royal Society for Protection of Nature (RSPN) in documenting and compiling comprehensive information on the White-bellied Heron, including its biology, behavior, habitat, distribution, population dynamics, threats, and the conservation initiatives undertaken to safeguard the species.

Since 2003, RSPN has spearheaded numerous conservation interventions aimed at protecting and recovering the White-bellied Heron population. This second edition, following the first publication in 2011, presents updated and expanded information derived from years of research and field observations, including new scientific insights into the species and its ecology.

It is my sincere hope that the wealth of information contained in this publication will contribute to greater awareness, inspire broader engagement, and strengthen conservation efforts for the species. I also hope that this work will encourage bird enthusiasts, nature lovers, policymakers, researchers, and conservation practitioners to develop a deeper appreciation and understanding of this extraordinary bird and the urgent need to secure its future.

With continued collaboration, commitment, and collective action, I am confident that we can rescue the White-bellied Heron from the brink of extinction and ensure that future generations continue to witness the grace and beauty of this magnificent species in the wild.



Sonam Tobgay
Chairperson
Royal Society for Protection of Nature

Glossary

BT FEC	: Bhutan Trust Fund for Environmental Conservation
CBD	: Convention on Biological Diversity
Changsi Pangkhep	: An ancient piece of woven textile that served as hand/knee towel
Chhu	: River
Chubja Phow-karp	: White-bellied Heron
DoFPS	: Department of Forests and Park Services
Dru Na Gu	: Nine varieties of crops, or nine important food crops
Dzongkhag	: District or District Administration
FNCA	: Forest and Nature Conservation Act
GBIF	: Global Biodiversity Information Facility
Gewog	: A group of villages-Village Block
IBAs	: Important Bird and Biodiversity Areas
IUCN	: International Union for Conservation of Nature
KBA	: Key Biodiversity Areas
LCSGs	: Local Conservation Support Groups
LULC	: Land use and land cover
Masl	: meters above sea level
NBSAPs	: National Biodiversity Strategies and Action Plans
NWFPS	: Non-wood forest products
RGoB	: Royal Government of Bhutan
RSPN	: Royal Society for Protection of Nature
SDG	: Sustainable Development Goals

1: Introduction

Bhutan forms a small but an important part of the Eastern Himalayan biodiversity region. Largely mountainous, the elevations range from 100 to 7,500 meters above sea level. The wide range of habitats, from tropical forests to glaciers and snow-capped mountains, offer a variety of ecological niches for many fauna and flora species. The country has documented more than 11,000 species of wildlife that includes mammals, birds, reptiles, amphibians, insects, and other microorganisms to date, indicating the presence of rich biodiversity.

In addition to the multiplicity of species, Bhutan is also celebrated for its cultural diversity for its disparate communities each with their own distinct traditions, languages, dialects and social and cultural habits and norms that evolved in isolation from each other, mainly as a result of geographic isolation. These unique customs and relationships have close associations with natural resources and biodiversity and their management.

Even today, Bhutan maintains its biodiversity largely intact, mainly because it has been mindful about its engagement with modernity. It has been successful in avoiding large-scale destruction to its environment and the natural habitats principally because it had the wisdom to approach development with caution, unlike other nations around the world who were so enamored with development activities that they ignored the long-term destruction that ensued with unchecked and unregulated development activities. In truth, Bhutan's good fortune has been that it had far-sighted and visionary leadership sitting at the helm of things. The country's successive monarchs have ensured that our living spaces and the natural world continue to thrive even as the citizens do. It helped that the Bhutanese people have a natural, inborn penchant for living in harmony with nature.

The formal adoption of the development philosophy of Gross National Happiness (GNH) that cate-

A Breakthrough.....

RSPN began our concerted effort towards the study and conservation of the White-bellied Heron as of early 2000. Until now, a host of articles and research papers on the bird have made conflicting claims and counterclaims about the year and place of the rare bird's first sighting since its resurgence in Bhutan in the modern times – mainly because it was not possible to separate truth versus hearsay.

But now, as of the publication of this book, based on a verifiable eyewitness account, the RSPN is happy to announce as follows:

Year of sighting :1974

Place of sighting :Sonagasa, Punakha

Further substantiation of the record of sighting is provided by Mr. Hishey Tshering, one of Bhutan's senior most birders, who is on record that late Gub Tolly had told him that he was present on the date and place when the first historic sighting was observed.

We are inclined to accept the record without contest since everything else falls into place: the environmental conditions are spot on, the area is not easily accessible, and the wide, open space provides safe and uninterrupted feeding and foraging for the birds.

gorically espouses environmental conservation as one of its four pillars has helped Bhutan's already impressive environmental conservation record. Today, it is said that more than 60% of the country's total geographical area remains covered with forests, and about 52% of the country's area falls within the network of protected areas.

Initiation of White-bellied Heron Conservation in Bhutan

In November, 2002, a group of tourists saw a lone White-bellied Heron flying over the Rimchu area, close to the boundary of Gasa and Punakha districts. After following the heron, they saw it waiting patiently and looking for fish in the river. The group managed to capture a photo of the heron. One of the lady tourists of the group, Ms. Ellie Schiller, was amazed with the bird's elegance and uniqueness and given its rarity, she later donated USD7000 on behalf of Felburn Foundation(USA) to roll out a study on the distribution of White-bellied Heron which happened in 2003 as the first White-bellied Heron Survey.



Figure 1.1. Ellie Schiller with her team.

Bhutan is particularly well-known for its rich diversity of birdlife. Various ornithological expeditions, surveys, constant monitoring and population counts of threatened species, and regular visits by bird tour groups have drawn increasing attention to documenting the rich birdlife in Bhutan. Today, the country has close to 800 bird species, with many of the species being globally threatened, and some endemic to the eastern Himalayan biodiversity region.

The White-bellied Heron is one of the world's most critically endangered bird species whose known global population is said to be fewer than 60 adults. The fact that Bhutan is home to its largest population at 31 adults as of 2026, places great responsibility on the country to ensure that its population does not decline but proliferates in the coming years. Given the rarity of the bird species, the risk of it going extinct cannot be overstated. We recognize the risk and thus, our responsibility, to ensure that these special birds receive the focused atten-

tion and care they need. It is for this reason that the Royal Society for Protection of Nature (RSPN) has spared no efforts, or resources to ensure that we are not found wanting in our tireless vigilance towards its conservation.

The conservation of the White-bellied Heron is significant for several reasons. Besides its rarity and critical risk of extinction, the species represents a convergence of ecological, cultural, and spiritual values. The conservation of the heron serves as an indicator of the health of freshwater ecosystems, the interconnectedness of biodiversity, and the relationship between nature and human well-being.

Ecologically, the White-bellied Heron is a specialized species that depends on river systems for its survival. From a broader biodiversity perspective, the conservation of the White-bellied Heron is linked to the preservation of other varieties of species that share the same habitats. These include many other bird species like River Lapwing, Pallas's Fish Eagle, Ibisbill, Crested Kingfisher, Great Cormorant, and several species of amphibians and reptiles whose ecology remains understudied. The same river is shared by different Otter species and varieties of fish, such as Golden Mahseer and Snow Trout. Riparian forests and grasslands also support many mammals, including Tigers, Leopards, Civets, Yellow-throated Marten, Dhole, Himalayan Blackbear, Sambar Deer, Himalayan Goral, Golden Langur, Black-capped Langur, Gray langur, Assamese Macaque, and Barking Deer, which rely on the ecological stability of riverine ecosystem. Given this interconnectedness, the White-bellied Heron functions as an umbrella species. In conserving the White-bellied Heron and its habitats, we inadvertently safeguard a whole host of co-dependent life forms that contribute to the health and resilience of the ecosystem. With the accelerating impacts of climate change, rising temperatures, glacial retreat, erratic monsoon patterns, and increased natural disasters like floods and landslides, protecting such ecosystems becomes even more critical. These environments offer climate resilience, acting as buffers against extreme weather and supporting adaptive capacity in both human and wildlife communities.



Figure 1.2. A ceremonial cloth (Changsi Pangkhep) adorned with a bird motif that quite resembles the White-bellied Heron.

In the Bhutanese context, the conservation of the White-bellied Heron carries cultural and spiritual significance. Bhutan's unique development philosophy balances material advancement with environmental conservation, cultural preservation, and spiritual fulfilment. Forests and rivers are often associated with local deities and spirits, and some animals are treated with reverence. The heron, known locally as *Chubja Phowkarp*, is seen as a rare, majestic, and mysterious bird creature that reflects the sacredness of wild places. Many Bhutanese people, especially in rural communities, view wildlife as part of a larger spiritual continuum in which humans and nature coexist in harmony. The conservation of the White-bellied Heron thus reflects Bhutan's Buddhist values, which emphasize compassion for all sentient beings and the interdependence of life.

Based on the moral and cultural value associated in conserving the White-bellied Heron, Bhutan takes extraordinary steps in conservation. The RSPN in partnership with the Royal Government of Bhutan, local communities, and international donors, carries out various conservation works including annual population monitoring, nest surveys, education campaigns, and the establishment of conservation breeding programs. In key White-bellied Heron habitat areas mostly in the Punatshangchhu and Mangdechhu river basins, efforts have been made to work directly with communities to protect the habitats, and promote alternative livelihoods that lessen pressure on the habitats. The initiatives such as climate-smart agriculture, nature-based tourism, and sustainable harvesting of resources are helping to align human needs with ecological sustainability. Local schools and communities are involved through "nature clubs" and "Local Conservation Support Group." Further, the conservation work aligns with international commitments under the Convention on Biological Diversity (CBD) and Sustainable Development Goals (SDGs), particularly those related to climate action, life on land, clean water, and responsible consumption.

The conservation of the White-bellied Heron also has significant benefits for Bhutan's green economy. Nature-based tourism, mainly through birdwatching and ecological education, accrues immense benefits to the country. The rarity and risk of extinction of the White-bellied Heron make it a prime attraction for bird watching tourists and ornithologists. The homestay establishment and nature trails in the communities within the White-bellied Heron landscape benefit rural communities.

Bhutan's leading role in the conservation of the White-bellied Heron also extends beyond its borders. As the country that is home to over 50% of the known global population, we take great pride in Bhutan's efforts that impact at the regional, as well as at the global level. Conservation success in Bhutan inspires similar efforts in India, Myanmar and China, where populations have drastically declined or are understudied. Transboundary cooperation is gaining momentum through regular knowledge exchange and strengthening of regional policy alignment through development of conservation management plans and strategies. These efforts are continuously fostering a sense of stewardship among citizens in making conservation of White-bellied Heron as a shared responsibility.

Besides these efforts, the White-bellied Heron is legally protected in Bhutan and other range countries, reflecting its critically endangered status and the urgent need for safeguarding the species. In Bhutan, the White-bellied Heron is listed under Schedule I of the Forest and Nature Conservation Act (FNCA) 2023, which guarantees the highest level of protection under the law. The law imposes severe penalties for any violations. Its significance was recognized by the Royal Government of Bhutan when two of the habitats of White-bellied Heron were identified as Key Biodiversity Areas. Similarly, in 2007, Royal Government of Bhutan issued notification declaring Phochhu (one of the main tributaries of the Punatshangchhu basin) as a designated White-bellied Heron Habitat (*Cabinet Secretariat letter No. COM/04/07/887, dated March 1, 2007*).

Bhutan's pioneering work in the conservation of the White-bellied Heron is seeing visible impact across some range countries. For instance, in India, the White-bellied Heron is now included under Schedule I of the Indian Wildlife Protection Act, by which full legal protection is provided. In Myanmar, the species is classified as completely protected under the Protection of Wildlife and Conservation of Natural Areas Law (1994), the highest level of protection under Myanmar's wildlife laws. Similarly, in China, endangered animals receive the highest level of protection.

At the global conservation frameworks, the White-bellied Heron is listed as Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List, making it a global conservation priority. It is further supported by international frameworks such as the CBD, which promote habitat protection, transboundary cooperation, and funding for threatened species. The range countries are Parties to the CBD. These countries commit to identifying and protecting the species through their National Biodiversity Strategies and Action Plans (NBSAPs), aligning local conservation efforts with global biodiversity targets. This alignment facilitates access to funding and partnerships essential for habitat protection, community engagement, and species recovery.

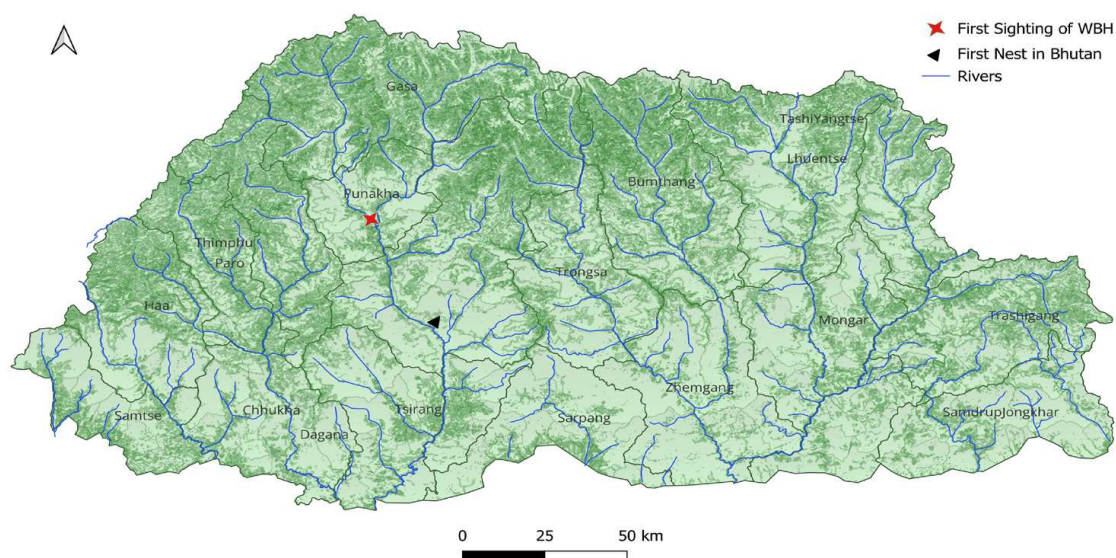


Figure 1.3. First sighting record (1974) and first nest(2003) places of White-bellied Heron in Bhutan.

2:Natural History and Physical Description

Taxonomy and Classification

The name *insignis* was first introduced by Brian Houghton Hodgson in his 1844 catalogue and unpublished paintings. However, because it lacked a formal description at that time, it was considered a *nomen nudum* (a name not available for use). The naming issue was further complicated when Hodgson’s specimens were later grouped with other species by G.R. Gray (1846) and used as synonym of *Ardea nobilis*. Later in the bird journal of Stray Feathers 1878, Allan O. Hume validly described the White-bellied Heron as *Ardea insignis* while making physical comparison to another heron species, the *Ardea sumatrana*. This resuscitated Hodgson’s name. However, Baker (1928) believed Hume’s 1878 name was a junior homonym “preoccupied” by Hodgson’s 1844 name, assuming the two referred to different taxa, and proposed *Ardea imperialis*. Later, *Ardea insignis* was identified as the correct name (Biswas 1960). Further Walters (2001) provided the clarification of *Ardea insignis* as the correct scientific name for the White-bellied Heron. The currently accepted name for the White-bellied Heron is *Ardea insignis* Hume (1878).

The White-bellied Heron belongs to the family Ardeidae and orders Pelecaniformes. The study conducted by Duan et al (2018) confirmed phylogenetic evolution of White-bellied Heron closely shares with Purple Heron *Ardea purpurea*. The study was done through mapping the mitochondrial genome of White-bellied Heron.

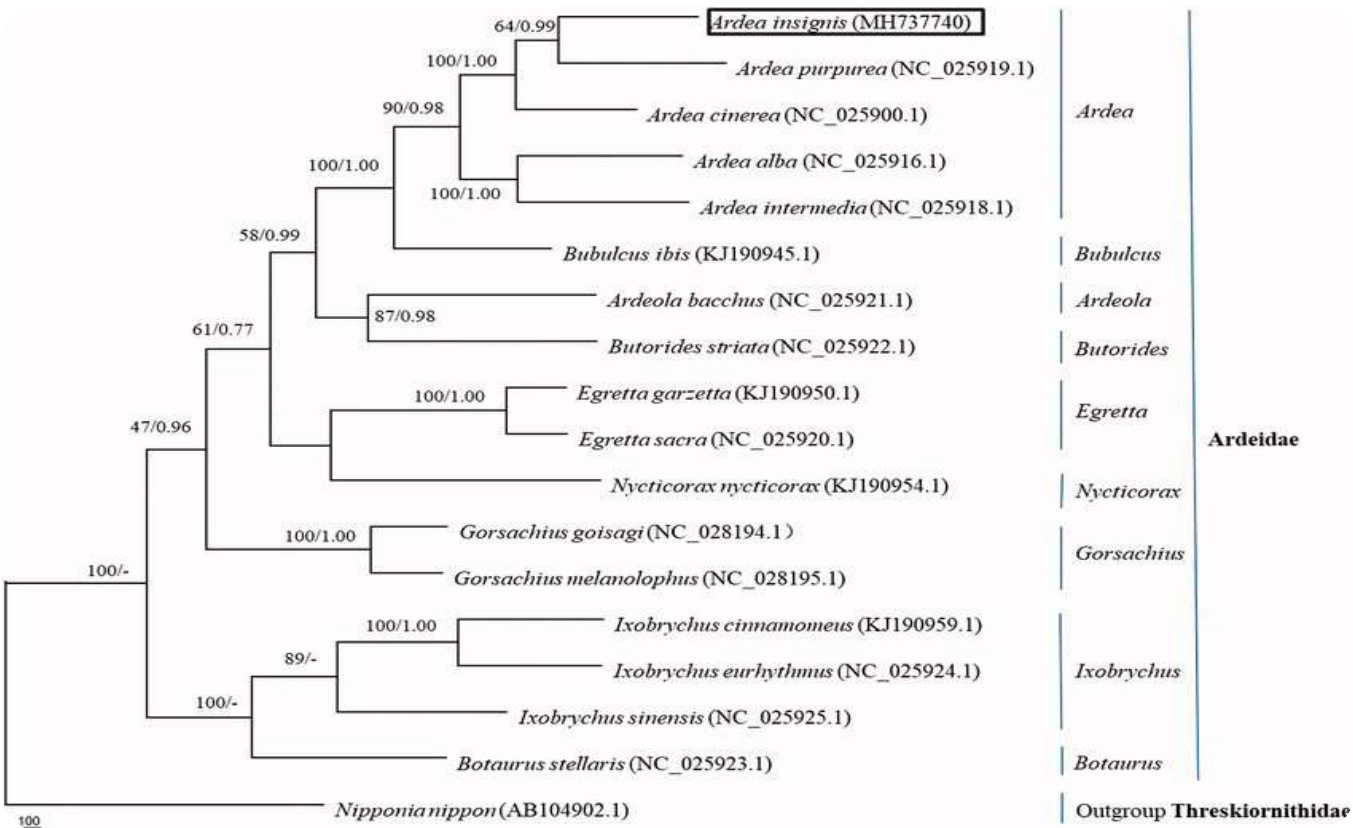


Figure 2.1. Phylogenetic Tree (Source: Duan et al 2018)

In Bhutan, the White-bellied Heron is locally known as *Chubja Phowkarp*. In India, particularly in regions of Assam and Arunachal Pradesh, it is referred to by various local names as *Ajingegega*, *Ajingtiseh*, *Boga-petua* and *Kona-muchi* and in Myanmar it is known as *Ngahsit-wan-phyu*.

Conservation Status

The most recent assessment carried out of the White-bellied Heron for The IUCN Red List of Threatened Species was in 2018. It was categorized as a Critically Endangered species under criteria C2a(i). In 1988, the species was first placed on IUCN Red List, in the now obsolete category of Threatened. From 1994 - 2004, the species was uplisted as Endangered, and thereafter from 2007 assessments, the species has been further uplisted to Critically Endangered (Birdlife International, 2018). The population is small (Red List criterion C) with a continuing decline, observed, projected, or inferred, in numbers of mature individuals (2) and no subpopulation estimated to contain more than 50 mature individuals (a (i)).

Scientific classification

KINGDOM	: Animalia
PHYLUM	: Chordata
CLASS	: Aves
ORDER	: Pelecaniformes
FAMILY	: Ardeidae
GENUS	: Ardea
SCIENTIFIC NAME	: <i>Ardea insignis</i>
AUTHORITY	: Hume, 1878
SYNONYMS	: <i>Ardea imperialis</i>

Common Names

ENGLISH	White-bellied Heron
DZONGKHA	<i>Chubja Phowkarp</i>
LHOTSHAMKHA	<i>Saray Haas</i>
KHENGKHA	<i>Woong Rila</i>
SHARCHOPKHA	<i>Ngangkha</i>
YANGTSEPAKHA	<i>Ngäp Bja</i>

Physical Description

The White-bellied Heron is a large bird with an average height upto 160 cm tall. The body is dark greyish with the entire breast, abdomen, vent, and lower back in white colour. There are few striking light-color markings on the back. They have long necks, beaks, and legs. The wing measures 53 to nearly 58 cm. There are lace-like white plumes on the nape, and long streaking feathers in the lower neck region. The chin and lower mandible

are whitish undersides, while the upper mandible is black. The bill is 15 -18 cm long with serrations inside. The lower mandible is dull yellow-green at the tip, on the top edge, and at the gape. The irises are yellow, tending to ochre, while the loreal and orbital skin is green-yellow. The frontal feathers almost touch the eye above and behind. The legs and feet are dull grey.

In the field, it is identified by a combination of large size, grey color with white underparts, and, in flight, it flies with its neck crooked back, forming 'S' shape. It has grey upperwings and white underwing coverts with dark undersides to the flight feathers. The sexes are alike with male and female looking very similar and unable to differentiate.

Juveniles

White-bellied Heron can be distinguished from adults with their darker plumage and have underbelly and vent regions pale yellowish in colour. The white scapulars in the fore neck and upper breast area are shorter and the neck region looks brownish. The white striking mark on the back is also absent. Juveniles have also been observed with shorter lace-like white plumes on the nape, and the irises are of pale green colour.

Table 2.1. Morphological data (Source: Avibase)

Beak Length Culmen (cm)	Beak Length Nares - tip (cm)	Beak Width (cm)	Beak Depth (cm)	Tarsus Length (cm)	Wing Length (cm)	Tail Length (cm)	Mass (g)
16.041	12.925	1.852	2.843	17.848	53.86	19.4	2024



Figure 2.2. White-bellied Heron Pictures (Left-in flight) (right-juvenile heron)

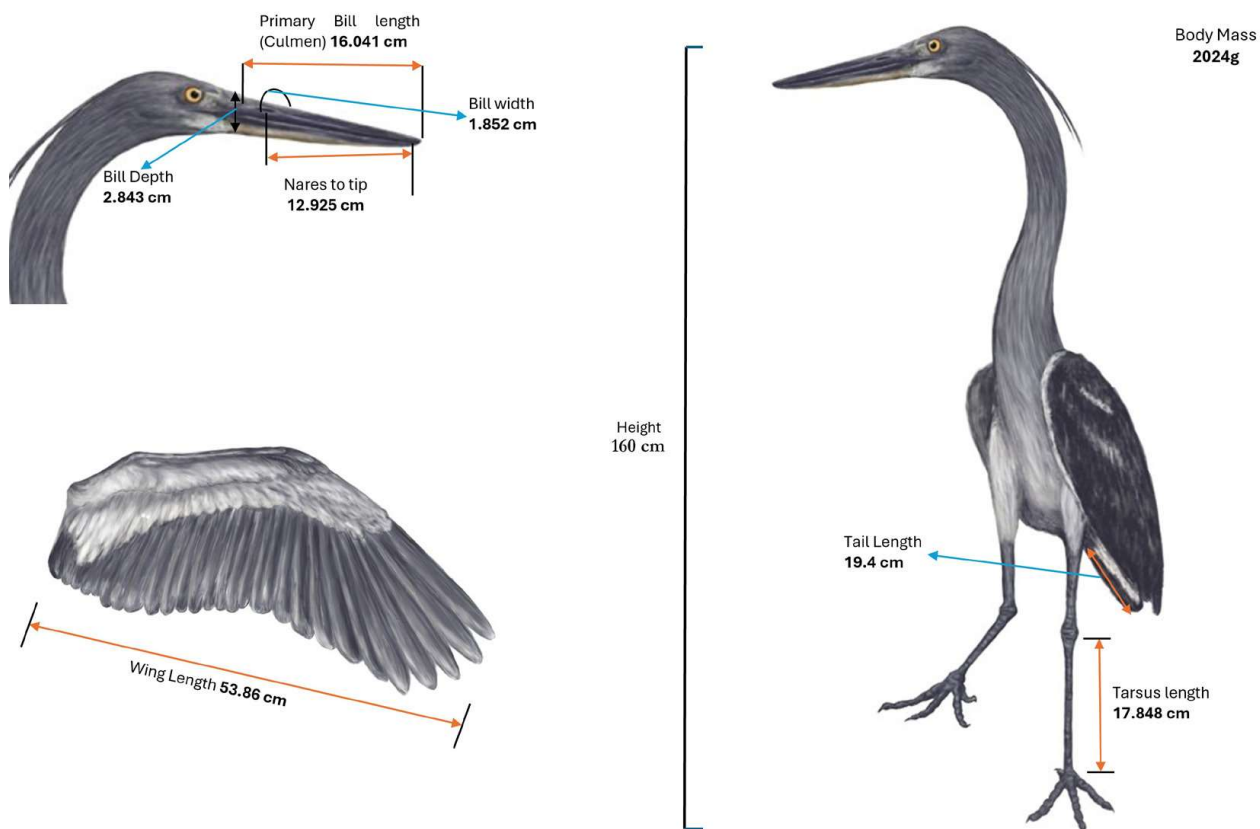
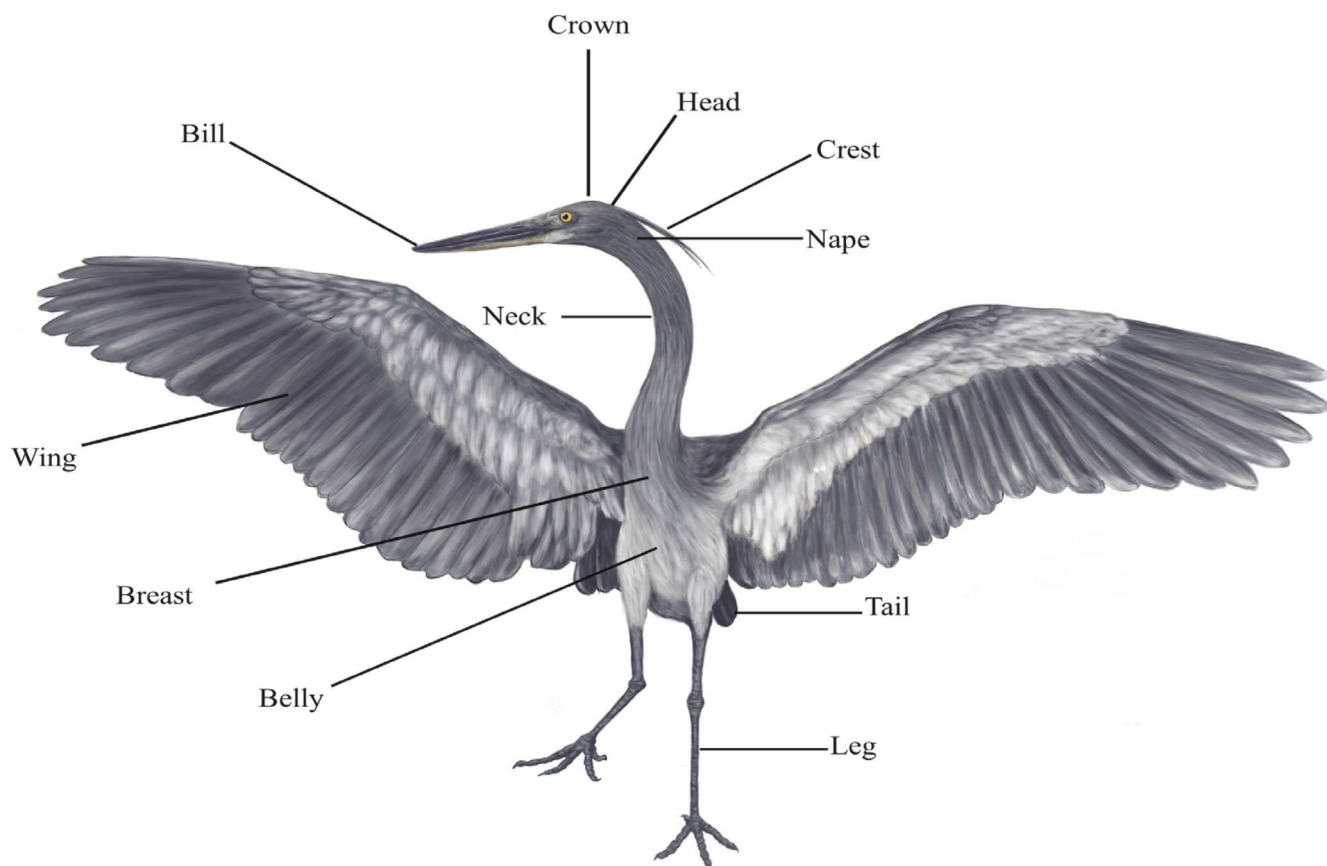


Figure 2.3. Physical features and measurements of White-bellied Heron

Skeletal System of White bellied Heron

White-bellied Heron skeletal system is highly specialized, supporting slow stalking behaviour, rapid prey capture and efficient flight. Like any other heron species, the White-bellied Heron's skeletal system is composed of the axial skeleton (including the skull, vertebral column, ribs and sternum) and the appendicular skeleton (the forelimbs or wings and the hind limbs), along with well-developed pectoral and pelvic girdles that support flight and locomotion.

Skull and Beak

White-bellied Heron skull is long and slender, providing support for its elongated, dagger-shaped bill. The skull also features large orbital cavities that house well-developed eyes positioned laterally. It has long, spear-like beaks that are adapted to rapid jabbing and grasping of fish. The inside part of the beaks has inward serration that helps in catching and holding the fish.

Vertebral and Neck

White-bellied Heron has elongated cervical vertebrae, typically numbering between 20 - 21. Herons possess a S-shaped neck formed by specialized cervical vertebrae.

Pectoral Girdle and Forelimbs (Wing)

The pectoral girdle is composed of the scapula, coracoid, and furcula (wishbone). The sternum features a well-developed keel (carina), providing attachment for the powerful flight muscles, as seen in other large herons that engage in sustained flight between feeding and roosting areas.

The wing bones including the humerus, radius, ulna, carpometacarpus, and phalanges are elongated and lightweight. It possesses a more robust wing to support its larger body mass.

Coracoids and Furcula

The coracoids are strong, pillar-like bones essential for supporting flight. The maximum length of coracoids is 8 cm in White-bellied Heron.

The furcular is 8.5 cm and functions primarily to strengthen and stabilize the shoulder girdle during flight.

Scapula

The scapula with a length of 10 cm functions as a key part of the shoulder (pectoral) girdle. It helps to stabilize the wing during flight.

Humerus

The humerus is the strongest of the wing bones as it bears most of the mechanical stress generated during flight. Its pneumatic tubular bones, with flat expanded proximal ends, provides a large surface area for the attachment of powerful flight muscles, while the smaller rounded distal end allows smooth articulation with the forearm bones. The humer-

us has an average length of 21 – 22 cm.

Radius and Ulna

The radius and ulna form the forearm of the wing. The ulna is thicker in width than the radius. However, both bones were comparatively of equal length, separated along their long axis by relatively wide interosseous space. The maximum length of ulna and radius is about 26 and 25.5 centimeters respectively.

Pelvic Girdle and Hindlimbs

The pelvic girdle is wide and firmly fused to the synsacrum, providing a strong and stable support for hindlimbs. The hindlimb bones, the femur, tibiotarsus, tarsometatarsus and digits are highly elongated.

In herons, the tarsometatarsus is long and slender. The toes are extended and widely spaced. These structural adaptations are common across the genus *Ardea* and are crucial for effective foraging in aquatic environments.

Femur

Femur forms the thigh segment of the hindlimb and is vital for support and movement. It bears much of the body's weight during standing, walking, and perching, and serves as an attachment site for powerful leg muscles involved in locomotion and takeoff. The femur measures 12 cm, though shorter than the other leg bones.



Tibiotarsus and Tarsometatarsus

The tibiotarsus and tarsometatarsus are the main bones of the lower leg that together support locomotion and perching. The tibiotarsus, formed by the fusion of the tibia with some ankle bones. It measures 29 – 30 cm. The tarsometatarsus measuring 19 cm is formed by the fusion of distal tarsal and metatarsal bones, acts as a lever for toe movements, aiding in gripping, running and landing.

Figure 2.4. Skeleton of White-bellied Heron

Toes and Toe Bones

The digits (toes) and phalanges (toe bones) are highly specialized for perching, walking, and wading in water. Herons typically have four toes on each foot, three facing forward (digits II, III, and IV) and one backward (digit I, the hallux). Each toe is made up of multiple phalanges, with a typical arrangement of 2 phalanges in digit I, 3 phalanges in digit

II, 4 phalanges in digit III, and 5 phalanges in digit IV. The distal phalanx at the tip of each digit supports the claw, aiding in gripping and stability.

Anatomy of Internal Organs

White-bellied Heron has a highly specialized internal anatomy adapted for flight, metabolic rates, efficient respiration and survival across diverse environments.

Circulatory System

Heron has a four-chambered heart similar to other birds. The heart is relatively large compared to body size, supporting the elevated metabolic demands associated with flight and thermoregulation. The juvenile heron heart weighs 25 - 28 g, whereas adult heron weighs 33 - 35g.

Respiratory System

Heron has an efficient respiratory system. Each lung weighs 11 - 13g with a length of 6.5 - 7 cm.

Digestive System

Birds generally have higher metabolic rates than mammals, allowing them to digest food more quickly. Unlike many birds, herons lack a crop, which in other species serves as a storage sac to hold food before digestion. Instead, herons swallow their meals directly down their flexible esophagus into their stretchable stomachs. Herons also lack a gizzard, which in other birds helps to grind tougher food items such as bones. The stomach measures 6 - 8.5 cm.

Urinary and Excretory Systems

The heron has a paired kidney located in depressions of the synsacrum that filter metabolic waste. Nitrogenous waste is excreted primarily as uric acid. Each kidney is divided into lobes. They lack a urinary bladder, and waste is eliminated through the cloaca. The final waste appears as a white, pasty material (urates) along with feces. The length of the kidney measures 6 - 7 cm in juvenile and adult herons, and weighs 14 - 16.5 g respectively.

Reproductive System

The reproductive system is adapted for seasonal breeding. Males have paired testes. In males, sperm produced in the testes is transferred to the female during mating, usually by a brief contact known as the “cloacal kiss.” Females possess ovaries.

Lymphoid and Immune Systems

The spleen, thymus and bursa of Fabricius are key lymphoid organs in birds that contribute towards maintaining the body's defense system against infections.

The thymus is located along the neck. The bursa of Fabricius, a unique organ found only in birds and situated near the cloaca, is also most prominent in juveniles. The spleen is located within the coelomic cavity near the digestive organs.

3: Behaviour and Ecology

The White-bellied Heron exhibits behaviours that distinguish it from many other heron species. It entirely depends on the river for food to feed only on fish and riparian forest for nesting and roosting. Unlike other herons, the pair builds a solitary nest. They also exhibit strong pair bonds, and a high degree of site fidelity.

Vocalization and Communication

White-bellied Herons remain generally silent and call only during courtship or when alerted. The vocalization is characterized by a distinctive deep croak, often described as “*auk auk urrrrrrr*” with the last note typically much louder than the first three short, milder notes. The vocalization occurs during following context;

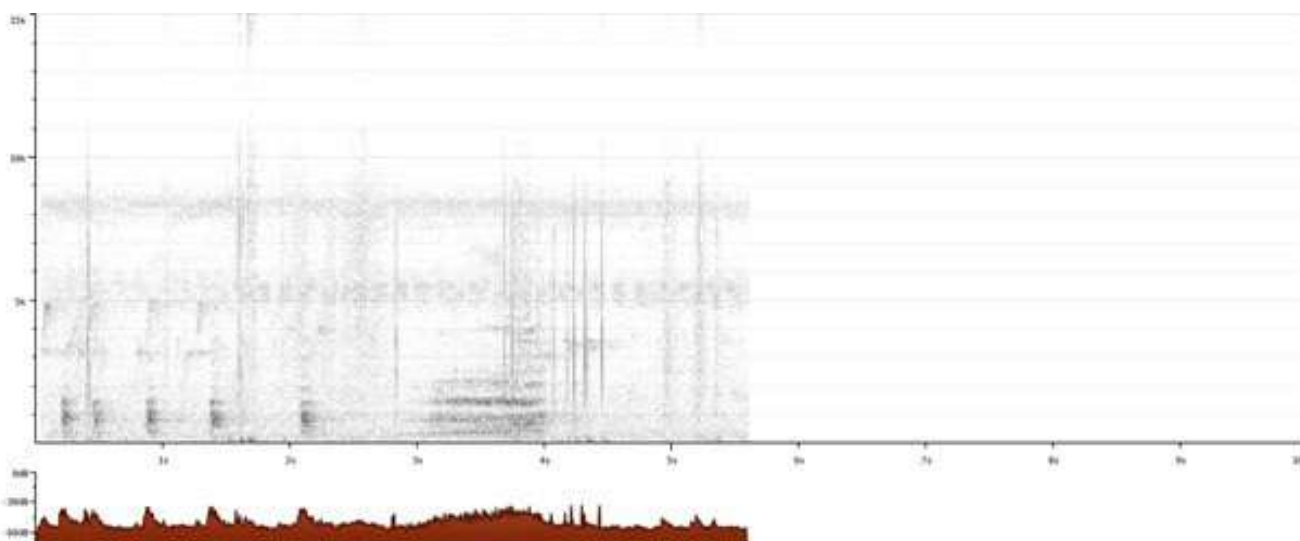


Figure 3.1. Sonogram of White-bellied Heron call.

Courtship Call

During breeding season, herons usually stay in pairs and frequently call each other. The frequent calls are made mostly during early morning. They also occasionally make the call late night. Typically, after several calls, they copulate.



Figure 3.2. White-bellied Heron performing courtship rituals.

Alert Call

The heron assumes the upright alert posture when it senses a disturbance or threat. In the upright position, the heron raises its head up and out straight, body feathers are raised moderately, and a threat call is usually made. It is usually a short and loud croaking call: “*auk urr.*”

Call for a partner

During the breeding period, the parents alternately incubate the egg and also guard the chicks. The heron guarding the nest is often seen making a call for its partner if the other partner tends to take a prolonged period to return from feeding.

Begging Call

The begging calls are made by chicks. The chicks of White-bellied Heron make a persistent call “*tek...tek...tek..*” mainly begging for food while they are in the nest.

Territoriality

Unlike most other heron species, White-bellied Heron lives in solitude, and a pair builds isolated nests. Generally, lone birds are seen feeding along the rivers, except during the courtship period when 2 to 4 birds may be found together. Juveniles and parents are seen feeding together, or juveniles following the parents during the early post-fledging period, forming groups of up to 6, depending on brood size. Parents feed juveniles up to 2 - 3 months after fledging.

Diet

Heron species in general are carnivores, feeding on anything ranging from macroinvertebrates to even small mammals. The White-bellied Heron is restrictive in terms of diet, preferring to feed on fish only.

The fish genera consumed are Schizothorax, Garra, and Salmo. The dominant prey consumed is the genus Schizothorax. However, it depends on the availability of fish species and the frequency and success of the heron's catch. Targeted fish sizes range widely (3 - 60 cm in some regions), with an average around 12 - 17 cm, depending on available prey. The study on the foraging ecology of the White-bellied Heron in Namdhapha found out that the most common prey size was up to 9 cm.

Foraging behaviour and capture success

White-bellied Heron displays various foraging techniques in natural feeding sites. The most common techniques include, Stand and Wait, Stalk Slowly, Neck Craning and Pecking. Stand and Wait is the most commonly preferred of all. The Stand and Wait duration vary between 5 minutes to an hour before it pecks on the surface of the river with high chances of a successful catch. Stepping rates in White-bellied Heron are also highly variable across observations (3 – 4 steps/min), and most steps are observed when herons moved between foraging places rather than during active hunting. Much of the time, herons spend standing still, peering into the water and/or poised to strike. These tech-

niques and sole use of visual cues and hunting by stand-and-wait or slow stalking typically resembles other large heron species. The Goliath Heron is probably closest in size to the White-bellied Heron and is similarly extreme in rare capture events, long periods of standing still waiting for prey, and very slow stepping rates. The White-bellied Heron often takes flights during a foraging bout and changes foraging location. It will range as much as 1,000 m. These flights appeared to be moving between foraging sites. Some of these flights appeared to be due to disturbance by humans and some are apparently birds moving between foraging sites or between foraging and roosting sites.

White-bellied Heron captures prey with a rapid downward or oblique jab. Fish are nearly always grasped between the mandibles rather than stabbed through the body. This may be due to the rocky substrate in the foraging ground used by the White-bellied Heron that posed a risk of injury by pushing through the prey item and striking a hard surface. They usually plunge their heads into the surface of the water with their neck half immersed while the wings remain flapping in the air and tuck in their catch. The frequency and success of the heron's catch are heavily determined by the age of the bird, the time of day, and the season. The observation also saw their body orientation to the river current even make differences in size of the fish they catch. When the heron faces into the current, it captures the majority of small fish. Conversely, the heron captures the majority of large fish while facing downstream. Adults are significantly more efficient foragers than juveniles. While juvenile herons exhibit a striking rate four times higher than adults, they are far less successful in actually securing prey. Adults capture more than thrice as many fish as juveniles, resulting in a much higher biomass intake rate. Juveniles are often restricted to simpler microhabitats like ponds and pools because they lack the sensorimotor faculties to handle prey in swifter "running" microhabitats.

White-bellied Heron often carries out "pseudo-strikes" that appear to be aimed either at sticks or leaves, or at nothing at all. They were distinguished by the shallowness of the strike (bill not fully penetrating the water) and the fact that strikes were repeated in the same location. Pseudo-strikes varied between being extremely powerful and fast and being obviously slower than strikes at prey. The function of these pseudo-strikes is unknown, and explanations may vary from practice striking to displacement behaviour.

Once prey is captured, herons typically swallow the fish quickly for small and medium-sized fish. Larger fish are carried to shore, where they are often repeatedly stabbed and consumed. White-bellied Heron often dipped subdued fish in the water several times before swallowing them. After swallowing, it usually drinks water 1 - 10 times, often intermittently shaking the head and extending the neck horizontally.

The feeding intensity varies throughout the day, peaking in the morning and afternoon and a reduction during the hot midday hours. It was observed that the capture rate is five times higher in the morning than in midday, and the success rate is at least three times higher during these early hours. Consequently, the biomass consumption per unit of time is more than two-fold higher in the morning.

Foraging activity also differs by season to accommodate the needs of the brood. The foraging rate is significantly higher during the summer than in the spring as this period coincides with the feeding of fledglings, during which parents provide food for both themselves and their young.

Table 3.1 Diet & Food Consumption

Category	Details
Main diet	Fish (~95% of prey)
Key fish prey	Schizothorax, Garra, Salmo.
Preferred feeding habitat	Shallow riffles, pools, slow water edges of river islands, ponds/lakes
Foraging techniques	Stand-and-wait, stalking, neck craning, pecking, plunging, stirring
Peak feeding times	Early morning, late afternoon; reduced midday activity

Energetics

The researchers have estimated the energetic expenditures of herons in two ways. First, calculated the Field Metabolic Rate (FMR) for herons based on allometric scaling of FMR for body mass of birds and then estimated caloric needs based on a 24-hr day. It was estimated that White-bellied Heron is 127 cm in height and weighs approximately 3,400 g. The estimation of energetic needs from behaviors was made based on activity-specific energetic costs as derived from other avian studies.

Energy intake

The estimated energetic intake was calculated using a combination of 1) caloric values of fish estimated from other studies, 2) estimated fish sizes, and 3) capture rates. Energy of fishes eaten was estimated by converting total estimated length of fishes (by increments of heron bill lengths) to mass using length-specific relationships for Brown Trout (*Salmo trutta*).

$$\text{mass (g)} = 3.01 (\log_{10} \text{length}) - 5.03$$

While this was probably not completely accurate for the other fish species likely to have been captured by White-bellied Heron (e.g., snow trout *Schizothorax richardsoni*), the two types of fish are not very different in body shape and proportions.

Based on previous work, a value of 7.87 joules/ gram of wet fish mass was assigned and assumed that herons eating a largely fish diet would have an assimilation efficiency of 79%.

Energy expenditure

It is assumed that White-bellied Heron birds standing still (roosting, loafing, or sleeping) expends energy close to their calculated Basal Metabolic Rate. Researchers used BMR/mass relationships that were based on measurements from four heron/egret species of

$$\text{Kj/hour} = 0.085(\text{mass(g)}^{0.705})$$

For the 3.2 kg White-bellied Heron, this translates into 0.419 kj/minute.

The main activity expenditure during hunting was stepping. Using this information, it was calculated mass specific stepping energy to be 0.387 joules/gram. This led to an estimate of 1.15 joules/step for the White-bellied Heron. Numbers of steps taken were multiplied by this figure to derive total energy expended by stepping. Similarly, energy used in flapping flight was calculated.

Total energy used was then calculated by multiplying activity-specific energetic costs by either the time (sitting), number of activities (steps), or distance (flapping flight). The activity-specific costs were then summed over all activities to derive the costs of an individual or group of birds. It was estimated total energetic costs during daylight hours using the average per-hour expenditure during foraging observations. For roosting hours at night, it was assumed birds were expending close to BMR.

Energetics of foraging during winter

Based on allometric scaling of Field Metabolic Rate (FMR) of large-bodied birds, researchers estimated that a 3.4 kg bird should expend between 2,600 kj/d (scaling from measurements of all birds). The timed behaviors was used to estimate energy use. While foraging, herons expended relatively little energy in active behaviors (stepping, flapping flight), which totaled less than 2% of total estimated diurnal energy expenditure. This is due to low energy spent; even during hunting, they spent the vast majority of time standing still, and energetically costly flights were rare. The stepping rates are also quite low, and relatively little energy is expended per step.

If total energy expenditure for White-bellied Heron includes energy during time of roosting at night, and flying to and from the roost, then individual birds would expend a total of 254 kj during daylight (daylight during winter lasts 9.5 h). Assuming night-roosting birds are expending close to BMR and flying up to 3 km one way to the roost, it is estimated they expend 362 kj during the approximately 14 h night. Total estimated daily energy expenditure for 24 hr would then be a total of 616 kj.

The estimated 616 kj/d is less than 24% of the FMR estimated using allometric scaling (2,600 kj). The result is not surprising because the herons seemed to be extreme energy minimizers, moving very slowly, if at all during the daytime and flying only short distances between foraging sites or to roosts. However, this may also have underestimated total energy expenditure using behaviors, since researchers did not include ambient tempera-

ture in the calculations. Since winter nighttime temperatures are quite cold (-2 to 40 °C for over 12 hours, this may have been an important oversight.

Daily Energy Budget

If White-bellied Heron captures and eats 17.5 g of fish per hour of daylight foraging on average, or 166 g in a 9.5 hour day, it suggests White-bellied Heron may be eating in the neighborhood of 5% of body mass each day. This daily amount translates into approximately 138 kJ/hour and with an assimilation efficiency of 0.79 they would have assimilated 109 kJ/h or 1,035 kJ/day, or 0.305 kJ-gram body weight-1day-1. By comparison with the estimated daily energetic needs of 616 kJ, the energy assimilated seems well in excess (1.7X needs), though of course this depends largely on body size, temperature and other factors. It is important to also point out that herons appeared to catch enough fish to meet needs on average. But there were some days when individual birds did not catch any fish. Therefore, there are considerable periods of starvation for these birds in between the large captures. In addition, these calculations do not include any allowance for birds foraging at night.

By comparison with the approximately 2,600 kJ estimated to be needed through allometric scaling, energy intake was only about 40% of energetic needs. Researchers suspect that this 2,600 kJ figure is not appropriate for White-bellied Heron because of their very low energetic expenditure. If true energy expenditure were as high as 2,600 kJ/d, the birds should have been quickly depleting body mass and starving.

Overall, the energetic studies of White-bellied Heron fit with the idea that White-bellied Heron is energy minimizers, even using very low-energy behaviours to achieve stand-and-wait foraging.

Food consumption pattern in the captive breeding centre

In the captive breeding centre, the hatched chicks, especially in their early days (Day 1 - 20) need frequent feeding, with about four to five times of feeding each day. The amount of food starts with 2 - 20 grams per feed. The diet consists of soft and small pieces of dead fish that are boiled and smashed.

From Day 21 to Day 60, feeding is reduced to

Captive Heron found feeding grasshopper

On 7 September 2023, at 1:00 pm in the afternoon, one of the captive herons (blue tagged) was found with dead grasshopper in its beak. It rinsed the dead grasshopper for several times inside the water. The heron also pecked several times keeping the grasshopper keeping it on the ground. Later, the heron finally swallowed the dead grasshopper.

After feeding the grasshopper the heron drank water for three times and after that displays normal behaviour such as playing with twigs inside the pond.



Fig 3.3. White-bellied Heron with Grasshopper

two or three times per day. The amount of food provided ranges from 80 - 120 g/day to 200 - 350 g/day. During this time, weight gain is highest, reaching up to 70 - 100 g per day. Around Day 50 onward dead fish and partially live fish, are introduced to the chicks.

From about Day 90 onward, feeding slowly shifts to once a day, mostly in the early morning around 6:00 - 7:00 am. This feeding pattern is continued for the rest of their life in captivity. As the heron grows older, feeding is made only once, but the amount of food provided ranges from 180 g on low-appetite days to 500 - 700 g on high-intake days. The weight gain slows down at this stage. As an adult, their preferred primary diet is live fish.

Roosting

After feeding for a few hours, the White-bellied Heron usually takes a rest. They perch on trees, large rocks, drift logs on shores, sandbars, and occasionally on sparse, low-growing clumps of grass or shrubs. It is observed that heron prefers to feed during low light, before the sun reaches the feeding site, and roost in shade when it's bright and hot. Roosting becomes most frequent after the sun reaches the river bar. Usually, White-bellied Heron start roosting on trees in the beginning of February when the surrounding temperature begins to rise. White-bellied Heron birds are often found roosting for long periods during the middle of the day even upto 5 to 6 hours, and usually observed preening, cleaning and wiping bill. During the roosting, they hunched or partially recumbent, resting on the tarsometatarsal. Sometimes, they lie down on the sternum in an incubation-like posture, usually on sand or fine gravel and on a rock.

Towards evening, when the temperature starts cooling down, they fly down to the feeding sites.

At night White-bellied Heron usually roosts in tall trees. They often use the same location for several days before moving to a new feeding and roosting site. During breeding season, one of the parents guards the nests while the other roosts in nearby trees or on conspicuous rocks or trees.

Bathing

Sometimes, the herons are seen bathing on hot sunny days. While bathing, herons slowly move into the water, immersing itself up to its belly and lower wings. Both belly-dipping and tail-dipping positions were held for several minutes at a time and were then followed by flapping wings in the water and dipping the head and neck quickly into the water. Following the bathing in the water, herons would walk to the bank and rouse several times and then preen by standing either at the water's edge or on a log, rock or other roosting sites.

Migration and Dispersal

Unlike many of its relatives in the family Ardeidae, such as the far-flying Grey Heron or the transcontinental Great Blue Heron, White-bellied Heron is not considered a true migratory species. There is no clear evidence of predictable, seasonal, long-distance

flights between distinct breeding to non-breeding grounds. However, the species exhibits facultative movements best described as post-breeding dispersal, opportunistic journeys driven by immediate ecological needs. Following the breeding season, primarily from late autumn onwards, individuals particularly juveniles and non-breeding adults shift from primary nesting rivers by moving upstream or downstream along their natal river systems or into adjacent tributaries.

The first empirical evidence for this dispersal was observed in 2016 through a telemetry study. Two juveniles were tagged at the Burichhu nest in Tsirang. However, one of the tags was later recovered from Lhamoizingkha, near the Bhutan-India border, which is approximately over 50 km downstream from the nest. Similarly, in 2025, another juvenile was tagged at the Tsaidang nest in Zhemgang. After two weeks of fledging from the nest, the bird was found dead due to a collision with an electrical transmission line that is approximately 10 km away from the nesting site. This indicates the juveniles move as far as this range of distance after fledging from the nest.

Insights from tagging trial of the White-bellied Heron.

The movement ecology of the White-bellied Heron remains poorly understood, representing a critical knowledge gap in the conservation of this endangered species. To address this, the Royal Society for Protection of Nature initiated a collaborative study with research partners from Austria and Germany to track the spatial movements of wild herons using eobs bird-tagging technology. As a preliminary step, a pilot trial was conducted at the White-bellied Heron Conservation Center to assess the feasibility of fitting a tracking device on a juvenile heron in captivity. During the trial, a tag was attached to the bird using a back-mounted harness. However, within an hour of observation, the heron's beak was found entangled in the harness. To prevent potential injury or stress to the bird, the tag was immediately removed.

Subsequent examination revealed that the issue was linked to the distinctive morphology of the heron's beak. The White-bellied Heron possesses sharp inward serrations along the edges of its beak. During routine preening behavior, these serrations easily caught on the harness material, leading to entanglement.

Further attempts were made using harnesses made from different materials and designs. Nevertheless, the trials demonstrated that the serrated edges of the beak could readily snag or even cut through the harness material. These observations suggest that conventional back-mounted harness systems are unsuitable and potentially unsafe for tagging the White-bellied Heron.

4: Breeding Ecology

The White-bellied Heron is a solitary breeder characterized by strong site fidelity and long-term pair bonds. The nest is extremely rare. In recent years, from the distribution range countries of the White-bellied Heron, Bhutan is the only country with regular observation of active nests. Historically, the first presumed nest was reported in Darjeeling, India, before 1890, and another was recorded in Myanmar before 1930. No further active nests were identified globally for over 70 years until the first nest in Bhutan was sighted in 2003 at Zawa under Wangdue Phodrang district in Bhutan. Since then, an active nest of two to five has been annually observed in Bhutan.

Breeding Range

The White-bellied Heron breeding observations were made in Bhutan, India, and Myanmar. Except in Bhutan, there are limited breeding records in India and Myanmar. The recent breeding record in India was in the year 2024. The nest with two chicks was observed at Namdhapha National Park and Tiger Reserve. In Myanmar, there has been no information on breeding records since 1930. In Bhutan, since the discovery of the nest in 2003, there have been regular breeding records. So far, the nesting sites have been found only in two of the river basins in Bhutan, the Punatshangchhu and Mangdechhu basins. Annually, two to three nests were observed along Punatshangchhu basin, and one to two nests in the Mangdechhu basin. During the annual population and nest survey 2026, six active nests were discovered in Bhutan. This is the highest record of active nests in a single breeding period of the white-bellied heron. Four nests were observed along the Punatshangchhu basin, and two nests in the Mangdechhu basin.

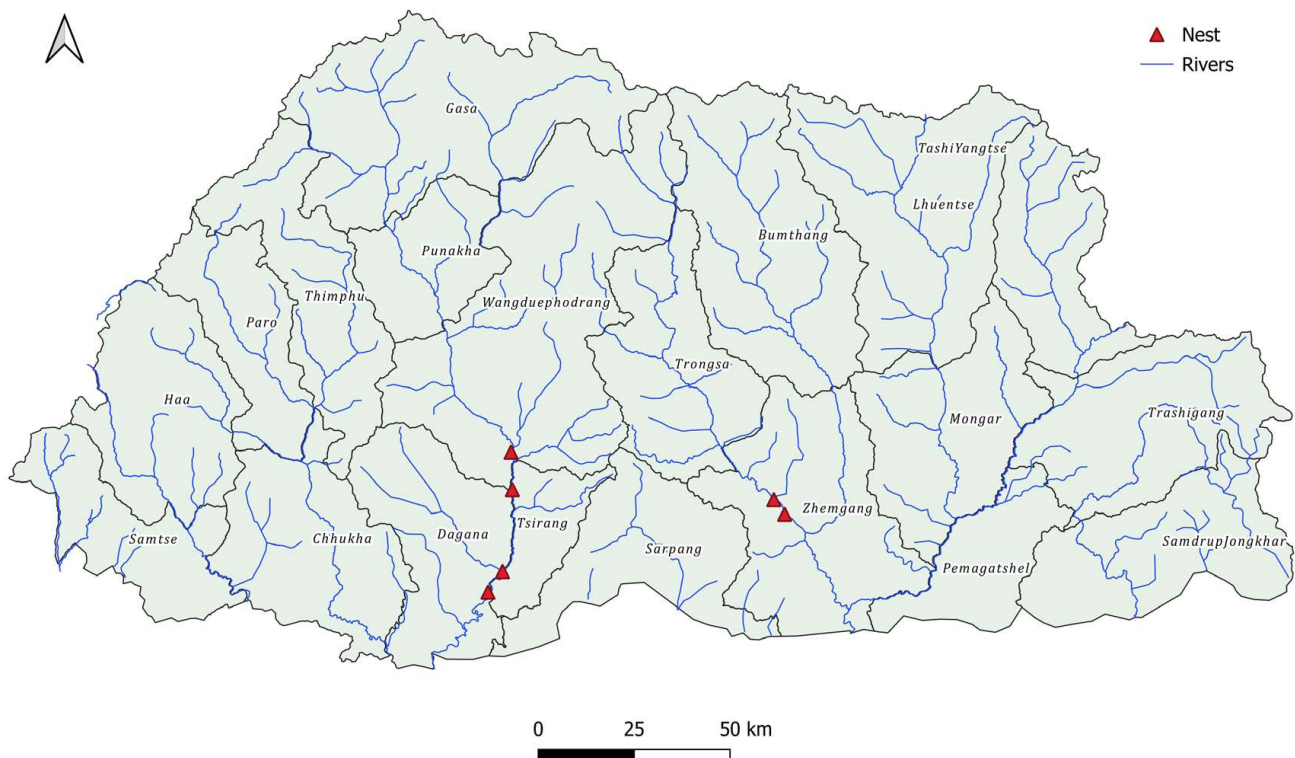


Figure 4.1. White-bellied Heron breeding records in Bhutan as of 2026.

Breeding season

The onset of breeding begins from the end of January with courtship display and building of the nest. By March, they start laying eggs. The breeding period ends by June and July with the fledging of chicks from the nest.

They breed once a year and span for about six months. Unlike other herons, the White-bellied Heron nests in isolation.

Breeding Plumage

During the breeding season, the adult bird's plumage turns lighter grey, with a few of the feathers at the back and wings becoming a striking whitish.



Figure 4.2. White-bellied Heron in breeding plumage

Courtship Behavior

The courtship behaviour of the White-bellied Heron begins with the assembly of prospective mates at the nesting site. This initial gathering typically consists of a single pair, though occasionally a larger group may congregate. Once assembled, the birds dedicate several hours, particularly in the mornings and evenings, to intense interactions marked by frequent courtship displays and persistent calling for partners.

A distinctive component of this ritual is nest solicitation. Often, a solitary bird, presumed to be a male, performs courtship displays while being in an old nesting site or actively building a new nest, attempting specifically to persuade a partner. This elaborate courtship period sets the stage for pair bonding, allowing pairs to proceed with breeding.

Nesting

The White-bellied Heron builds its nest in the forest close to the river. The nest-building process of the White-bellied Heron is a collaborative effort between bonded pairs that occurs over a period of two to three weeks before the egg is laid. The activity typically

takes place during morning and evening hours, involving specific courtship behaviours. After the egg is laid, they continuously maintain the nest; often, the pairs return from the foraging ground, carrying the nesting materials.

During nest building, the herons are highly selective of their materials, often picking up and discarding numerous twigs before choosing one that meets their requirements. The materials used for the nest are dried, leafless twigs and small branches ranging from 0.5 - 2.5 cm in diameter, with an average length of about 25.8 cm, though some branches may reach up to 112 cm. While pairs frequently build new nests each season, they are also known to reuse and repair old nest remnants.

The architecture of the nest follows a specific functional pattern with larger, sturdier twigs placed at the bottom and along the edges to provide a stable foundation, while smaller, more pliable materials are used for the inner lining and top layers.

The size of the nest measures between 105 cm and 121 cm in diameter, with a thickness of approximately 17 cm at the center. The center of the nest is typically 12 - 20 cm deeper than the extended edges, creating a stable area for incubation.



Figure 4.3. Nest of White-bellied Heron(In Tsaidang 2025).

Renesting

Renesting was also observed during the same breeding period if the previous clutch of eggs failed or chicks at an early stage were destroyed by the predators. However, no successful hatching of eggs was recorded from the renesting clutch.

The new nest is usually built either in the same nesting site or shifted about one kilometre away from the old nest. In the year 2022, the pair in Mangdechhu built another nest within the same nesting site and laid three eggs after their first nest failed with two chicks.

Egg laying and clutch size

A clutch of three to four eggs is laid after the pair is bonded. The eggs are laid asynchronously with one to two days of gap, resulting in a full clutch of three eggs or four in a week. Many breeding pairs lay their eggs in the months of February and March. Observations were also made of a few breeding pairs laying eggs in the months of May and June. The eggs that are laid in the later months are usually addled eggs and fail.

The eggs of the White-bellied Heron are light blue in colour and lack markings, except for occasional blood streaks.

In terms of physical dimensions and weight, the egg measures an average of 73 x 52 mm with a weight of up to 85 gm by two weeks.



Egg incubation and hatching

The incubation of eggs is continuously carried out for almost a month. The parents take turns incubating the eggs. During incubation, adults periodically turn the eggs and consistently change their posture. Similar to egg laying, the hatching also occurs asynchronously.

Although clutches usually contain three or four eggs, successfully breeding pairs typically raise a brood of only two to three young. Observations have recorded instances of parents potentially contributing to this failure by being implicated in the disappearance or discarding of unhatched eggs.

Figure 4.4. Egg of White-bellied Heron

Renesting

In 2022, the breeding pair of White-bellied Heron in Tsaidang, Mangdechhu was observed laying three eggs again in a new nest as soon as the two chicks of one week old were lost to predation. The new nest was built approximately 20 m away from the old nest.

Similarly, in 2023, the breeding pair in Toedsang in Punatshangchhu laid four eggs in the new nest after the eggs from the nest were all removed/lifted to the conservation breeding center. The new nest was built about 1 km away from the old nest.

7. SOME OBSERVATIONS ON THE EGGS OF THE GREAT WHITE-BELLIED HERON, *ARDEA INSIGNIS*

The Great Whitebellied Heron *Ardea insignis* Hume (ex Hodgson) is a little known species occurring in swamps, marshes and forests from Nepal through Sikkim, Bhutan and N.E. Assam to Bangladesh, Arakan and North Burma. Only four eggs appear ever to have been taken, all of these being in the collection of the British Museum (Natural History). They all came originally from the Stuart Baker Collection, but one egg was apparently given by Baker to J. Davidson and reached us with the latter's collection. The eggs are two and two, two from Sikkim and two from Arakan, the Sikkim eggs being markedly smaller than the others, and for this reason were not accepted as genuine by Baker; they do not appear in the manuscript catalogue of Baker's collection, and it was one of these two which Baker gave to Davidson. These two were addled eggs taken from two separate heron's nests each of which

also contained two chicks (Baker 1929), which fact might explain their small size. The Arakan eggs were two from a set of four and were on the point of hatching. One egg (the larger) is partially broken and filled up with wax. They were collected by a Mr W. S. Thom and given to J. C. Hopwood who passed them to Baker. It is not recorded what became of the other two eggs in the clutch. The measurements of the eggs are as follows:

Sikkim eggs: 63.0×42.9 and 63.1×41.65

Arakan eggs: 69.0×49.7 and 72.2×50.9

It would be unusual, but by no means impossible for the two pairs of eggs collected to have come from the extremes of the species' normal size range. To ascertain what range might be expected I compared the eggs of *A. insignis* with the normal range for *Ardea cinerea*, as given by Witherby *et al.* (1940). The range for *A. cinerea* is 53.5-66.7 and 40.0-49.7. It will

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be seen therefore that the difference in size of the two lots of eggs of *A. insignis* is no greater than the normal range of *A. cinerea* and therefore the size difference is not, in itself, a valid reason for rejecting the Sikkim eggs.

No other large heron is known to breed in Sikkim. Salim Ali (1962) lists only one pos-

sibility, *Ardea goliath*, which may occur as a vagrant, but is not recorded as breeding anywhere within the Indian sub-continent. Therefore, if the Sikkim eggs of Baker's are *not* the eggs of *Ardea insignis* they are the eggs of some other species of heron hitherto unrecorded from Sikkim.

BRITISH MUSEUM (NATURAL HISTORY),
CROMWELL ROAD,
LONDON, S.W.7,
January 30, 1975.

MICHAEL WALTERS

Chick Development

White-bellied Heron chicks are altricial and hatch in a highly dependent and fragile condition, with sparse down feathers, pinkish-grey skin, closed or partially open eyes and a soft bill. After hatching, the chick remains in the nest for approximately 72 - 75 days, during which both parents alternatively provide food and care. As the chick develops and acquires sustained flight ability, it eventually fledges from the nest and moves to the river shore and nearby habitats.

Chick 0 - 3 days old - Hatching and Post-hatch Stage

The chick is sparsely covered with pale grey down feathers on the head, back, and sides. The throat, belly, and wings appear relatively bare and pinkish-grey. The eyes are slightly open after hatching with a yellowish eye-ring. The chick is weak and unsteady, unable to stand or sit upright without support. The bill of the chick is also soft and weak. The chick spends most of the time sleeping and vocalising softly, producing faint begging calls. The chicks weigh a little over 80 g. Parents feed chicks by regurgitating semi-digested slimy food. In the wild and in conservation centers chicks are hand-fed using a puppet, and they respond mainly by sound and touch.

Chick 4 - 6 days old - Early Down Stage

The chick's body remains mostly bare, but the down feathers become denser on the head, neck, and back. The pinkish skin tone gradually turns pale grey, especially on the upper surface. The chick gains slight control over its head and neck, though it still cannot sit up steadily. The chick continues to sleep extensively, with short active periods for feeding. Its legs and toes are soft and weak, and attempts to balance the body are clumsy. Begging calls become louder and more frequent, indicating stronger feeding responses.

Chick 7- 10 days old - Transitional Growth Stage

The chick shows growth in size with an average weight of 150 - 300 g. Down feathers become more visible, covering over much of the body. Chicks build strength and raise their head and beak, but remain in a crouched posture. The beak darkens slightly, and the neck begins to elongate, showing early heron-like proportions. The chicks still sleep for long periods, conserving energy for rapid growth.

Chick 11-15 days old - Strengthening and Coordination Stage

The chick's skin loses its pink tone, appearing paler grey, and it can lift and turn its head steadily with improved neck control. It begins to sit upright briefly and can shift position in the nest with some balance. Down feathers become thicker and more evenly distributed on the head, neck, wings, and back, though the belly remains lightly covered.

Chick 16 - 20 days old - Early Mobility and Feather Development

Contour feathers start emerging beneath the down feathers, particularly along the wings and tail base, appearing as dark pinfeathers. The chick's posture becomes stronger. Legs and feet begin to harden and show darker pigmentation. Chicks' coordination improves, and their eyes are fully alert and reactive following movement and responding to the feed-

er. Bill length becomes more noticeable.

Chick 21- 25 days old - Pre-fledgling Transition

Down feathers thin out as more juvenile feathers emerge on wings, back,, and chest, giving a mottled appearance of grey and white. White colouration on the belly and throat becomes more prominent. The chick can stand for short periods on slightly bent legs and sometimes attempts wing flapping to strengthen muscles. The chick becomes alert to the surroundings.

Chick 26-30 days old - Advanced Nestling Stage

The chick now exhibits a strong posture and can stand upright for extended periods with increasing feather coverage on the body parts. Neck elongation becomes prominent, and neck streaks appear, resembling the adult heron's proportions. The bill becomes darker and sharper with the ability to grasp the food. Wing stretching and flapping become frequent, and sleeping time decreases, being replaced by more active behaviour.

Chick 31-40 days old - Feather Growth and Strength Building

Feathering becomes dense and distinct. Feathers on wings and back take on a dark-grey sheen, while the belly and throat remain white. Neck streaks also appear. Chick can now stand and walk steadily within the nest. Wing-flapping exercises become vigorous and regular, strengthening muscles for eventual flight. Bill continues to lengthen and harden, showing improved precision in grasping food.

Chick 41 - 50 days old - Pre-fledgling Independence

The chick's plumage is now well-formed, with a smooth surface of dark grey feathers and clear white underparts. The primary and secondary flight feathers are nearly full length, and chick engages in frequent wing-stretching and hopping behaviour. They begin short practice flights or hops within the confined areas. Their legs become much stronger, allowing for longer standing and walking periods. Preening and feather maintenance are frequent, indicating physical maturity. Feeding becomes semi-independent; chicks begin recognizing and picking up food, although they still rely on parents or feeders for supply.

Chick 51- 60 days old - Early Juvenile Stage

The chick has achieved almost full feather coverage. Its body takes on the sleek outline of a heron, with long primaries and secondaries growing strong enough for short glides. By this period, the chicks have transformed into juvenile herons, with nearly full feather coverage and adult-like proportions. The neck is elongated and flexible, used for balance and foraging. It begins making short and controlled flights. Body balance and coordination are strong, enabling walking, perching, and wing flapping without instability. The bill and legs have further darkened, resembling adult colouration. The chick now weighs 2-3 kg.

Chick 61-75 days old - Fledgling and Independence

The juvenile heron is now the size of an adult. Its plumage is lighter than when they were 41 - 50 days and darker than adults, with visible white streaks on the neck and a brownish

vent. It is capable of strong, sustained flight around the nest and roosts independently in nearby tree branches, marking its transition from a dependent chick to a fledgling capable of surviving in the wild.



Figure 4.5. White-bellied Heron chick, more more than 60 days old.

Fledging

Fledging happens with chicks coming out of the nest and taking short flights, hopping, and walking over the other branches of nesting trees or nearby trees. The chicks are often found with continuous practice of wing flapping. Gradually, they tend to avoid the nest during extreme weather conditions of high temperature or rain by sheltering under the nearby branches. The parents also tend to avoid the nest and remain on other nearby trees. This behaviour helps chicks to move and make short-distance flights around the nest. Such routine activity is repeated each day, evolving from stationary flapping to jumping and fluttering between the nest edges, a crucial rehearsal for take-off and landing. The fledged chicks fly towards the riverbank and remain in the same area, occasionally making flights to the nearby areas. Here, they practice how to fish and thrive independently, though initially, parents guide them.

Post fledgling

For approximately one and a half months (often from mid-July to late August), the White-bellied Heron fledgling entered a phase of guided exploration and practice. During this phase, the parents continue to feed the juveniles, but their method shifts from direct feeding to a form of training along the riverbank. A parent will often land and perch at a distance from the juvenile, which the chick must then fly accurately to the parent to receive food, thereby practicing its flight control, landing precision, and navigational skills within the familiar home territory. The fledgling spends long periods in shallow, sheltered margins of the river, pecking and striking at twigs, leaves, and debris in the water, honing its skills. After a few months, the fledgling independently survives, exploring the new habitat areas.

Difficult times of raising the chicks of White--bellied Heron

On 8 March 2023, four eggs were collected from the Balwani nest and transported to the conservation center for artificial incubation. Upon arrival, the eggs were examined through candling, which confirmed the presence of developing air cells and visible blood vessels, indicating embryonic development. The eggs were then measured and recorded for weight, length, and diameter. Immediately afterward, they were placed in an artificial incubator maintained at a temperature of 37.7 °C and relative humidity of 65%. An automatic egg turner was programmed to rotate the eggs three times daily. Each morning, the eggs were weighed and candled to monitor development. These procedures egg rotation, weighing, and candling were discontinued after sometimes, as the eggs approached the hatching stage.

The first sign of pipping was observed on the eighth day of artificial incubation in egg number two. The first chick successfully hatched on 9 April. The second chick hatched on 12 April, followed by the third on 14 April, all without assistance or complications. One of the four eggs was later confirmed to be infertile.

After hatching, the chicks were kept in the incubator, which was converted into a hatchery unit equipped with a soft mat and feather warmer. For the first two days, the hatchery environment was maintained at a temperature of 35–36 °C and relative humidity of 65–70%. Initial feeding occurred approximately 12 - 15 hours after hatching, consisting of a very small portion of half-cooked fish fillet. After two days, the chicks were transferred to a nest tub lined with a soft mat and feather warmer, supplemented with a heating bulb. Subsequently, they were moved to an artificial nest constructed with straw and twigs, where temperature and humidity were carefully maintained and the chicks were closely monitored.

Feeding was provided four times daily at 06:30, 11:00, 15:00, and 18:00. Each feeding consisted of approximately 10% of the chick's body weight. The diet was supplemented once daily with a pinch of Bio-blend AB2D3K vitamin and 0.25 ml of calcium liquid per 100 g of body weight. The chicks fed actively and accepted both half-cooked fish and live fish. Sunbathing was introduced when the chicks reached five days of age. They were exposed to sunlight for 15 - 20 minutes per day.

The chicks were weighed each morning prior to feeding, and their body growth showed a steady increase over time. In addition to weight monitoring, regular body measurements were taken to assess overall development. However, at approximately one week of age, the eldest chick developed a leg deformity (splay leg). Similar deformities were later observed in the other two chicks over the following weeks. Bandaging and corrective measures were attempted, and consultations were conducted with Bhutanese veterinarians as well as external experts. Despite these efforts, the leg condition did not improve, although the chicks continued to exhibit normal appetite and body growth. Approximately two weeks after hatching, two chicks died during the course of medical intervention. The remaining chick was later euthanized due to poor prognosis and very low chances of long-term survival. Although the exact cause of the leg deformities could not be conclusively determined, experts suggested several possible contributing factors. These included stress during egg transportation and handling, improper positioning of the chicks in the artificial nest, potential trauma during handling, and possible genetic abnormalities.

5. Habitat

The White-bellied Heron is associated with water bodies between an elevation range of 100 and 2000 meters. The rivers provide a mosaic of microhabitats for the White-bellied Heron to forage, and the riparian forest nearby supports breeding and roosting.

Foraging sites

The heron is known to forage in a wide variety of locales in freshwater bodies, including rivers and streams of both slow and fast-flowing rivers and still water like lakes. The width of rivers varies from approximately 15 - 300 m (braided rivers), and small lakes like *Ada* and *Peldhen Lhamo Tsho* (lake) in Bhutan of approximately 100 - 200 m diameter. They feed on water of varied turbidity, ranging from clear water during winter to highly turbid, flooded waters during summer. They are sensitive to disturbances, particularly human-caused disturbances. The disturbances to their habitat often result in herons shifting to a new habitat or even abandoning the area for a prolonged period. Generally, they prefer to feed on multiple channels of rivers where rivers run flat and become braided. This offers shallow areas to forage, open areas with clear field of view, and small puddles and depressions where fish may be stranded or simply easier to catch.

The foraging microhabitat includes riffles, pools, ponds and runs.

Riffles

Riffles are the most commonly used habitat. They are characterized by shallow water (0.2–0.5 m deep) agitated by rocks with moderate velocity.

Pools

Pools are part of the main river that consists of shallow to deep water (0.5–1 m) with a smooth surface and low velocity.

Ponds

Ponds are naturally formed, temporary, static water bodies along riverbanks that are not connected directly to the main river.

Runs/Rapids

Runs or rapids consist of deeper (> 1 m) and faster water (> 0.34 mps), typically found at the center of main river channels.

Lakes

Lakes consist of large inland waters, typically larger than ponds. Herons remain along the lake margins and hunt for the fish.



Figure 5.1. Different micro habitats (A- Riffle) (B-Pool) (C-Pond) (D-Run) (E-Lake)

The choice of foraging ground might also be largely driven by the availability of fish. They often forage in confluences, possibly due to easier catching of migratory fish. The migration of fish could be another reason for determining the choice of river channels to forage. The seasonal changes also significantly influence foraging locations. During the monsoon, when major rivers are swollen and turbid, herons shift to smaller streams and tributaries where the water remains clearer and recedes more quickly. During winter, they are mostly seen feeding along the main rivers. The observations recorded that the White-bellied Heron is being more sighted downstream of the rivers of Bhutan during the wintering period.

Nesting sites

All nests observed in Bhutan are located within 1-3 km distance from the confluence of tributaries and the main stems of Punatshangchu and Mangdechhu. Besides preferring to nest near main stem rivers, they also nest on tributaries. The preferred nesting altitude area ranges from 400 m to around 1500 m. The nest is located within 100 meters of the nearest riverbank or the water body. Some of the nests discovered were also found on trees close to the edge of the river and on the branches extending to and overhanging the river.

Nesting near human settlement

In recent years, it has been observed that although nests are generally located in areas with low human population density, they are often built in close proximity to human settle-

ments and infrastructure such as roads and bridges. All nests recorded between 2020 and 2026 were found near human habitation. In 2024, a nest in Mangdechhu basin was located 100 m from a suspension bridge and about 300m from an isolated house with an orange orchard and the main highway connecting Tingtibi and Panbang. In the Punatshangchhu basin, one of the nests observed from 2024 to 2026 was situated on the same slope as a small labor camp consisting of a few houses, at a distance of 250 m. Similarly, three other nests recorded along the Punatshangchhu basin in 2026 were all located near settlements and infrastructures.

White-bellied Heron found feeding in domestic fish ponds

In 2022, an injured White-bellied Heron was rescued from the local fish pond in Lhamoizingkha. The heron was found with an injured wing due to entanglement with a net covered over the fish pond. In a similar case, another White-bellied Heron was found feeding from the local fish pond of the local community in January 2025. Both the herons were juvenile, probably 1-2 years old.



Figure 5.2. White-bellied Heron found feeding in local fish pond at Tentalay, Lhamoizingkha (27 January 2026)

Nest territory size

In Bhutan, active nests are generally well spaced, with no two nests occurring in proximity. Before 2013, the shortest distance recorded between two active nests was 300 m along the Nangzhina river, a tributary of the Punatshangchhu basin. In recent years, however, the minimum distance between active nests has increased considerably. In 2026, the closest nests recorded in the Mangdechhu basin were five kilometres apart, while in the Punatshangchhu basin the nearest active nests were separated by seven kilometres. The White-bellied Heron, therefore, seems to need large territories for nesting. These territories may be along the same river or tributary, and birds from one territory seem to freely move upstream and downstream through neighbouring territories. The need for large territories suggests that the density of nesting in Bhutan will always be quite low, and large spaces will be needed for a sustainable population.

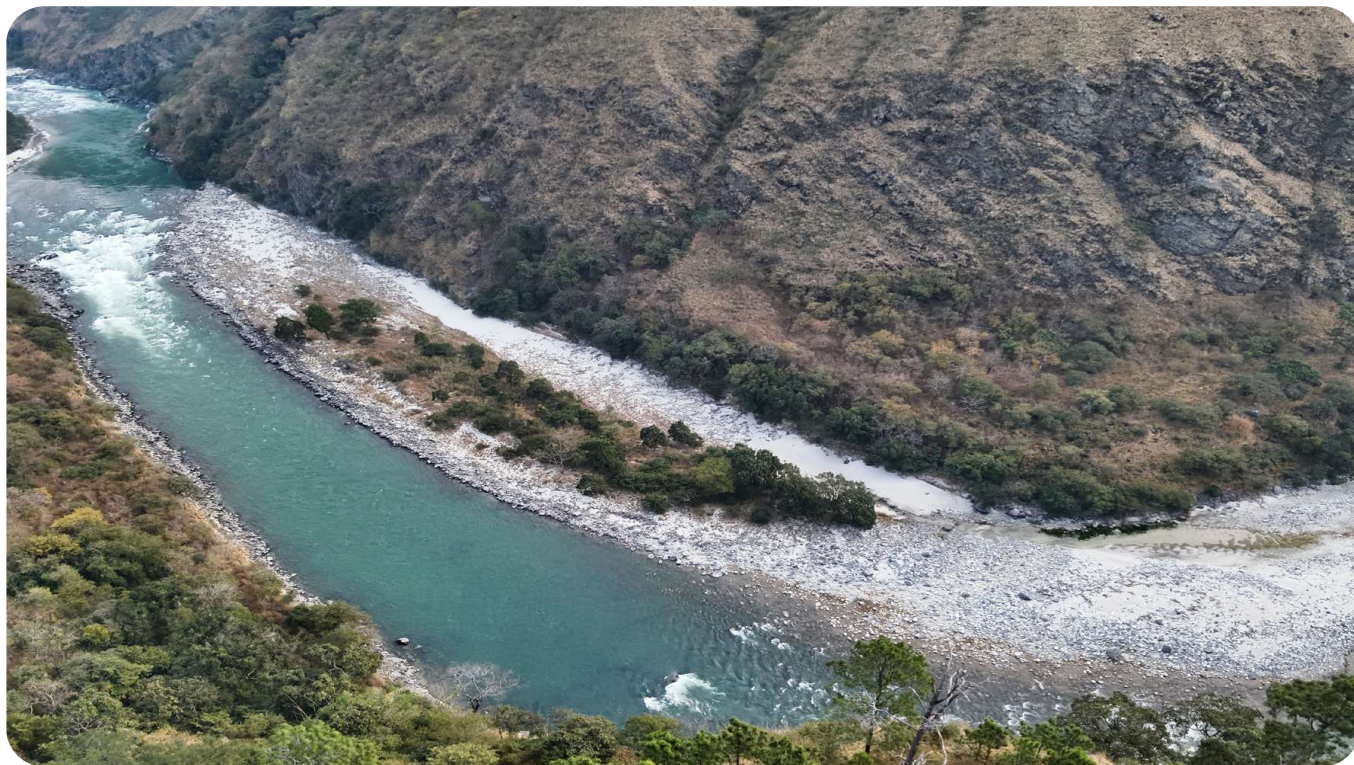


Figure 5.3. Nesting site of White-bellied Heron (Kisonachhu area).

Slope

Nests are typically situated on elevated sites, preferably on east-facing slopes ranging from 42 - 68°. This is to ensure a clear view of the surroundings and maximize exposure to the sun for incubation. Unlike in the past, nesting habits of White-bellied Heron are now known to nest in broad-leaved trees, and selected sites do not have slopes as steep as in the past. The frontal view of the nest has an open distance of 500 m to 1 km of river stretch. Besides frequent usage of the areas by parents for foraging, the open areas are also later used by fledged chicks. Usually, the chick during its first fledging flight lands on this open area and remains several days there learning to feed and other behaviours.

Nesting trees

Historically, the nesting tree preferred is predominantly tall *Pinus roxburghii* trees, positioning the nest on lateral branches. The average height of nest locations on trees is 18.3 meters. Nests were never built at the top of the canopy, probably because movement by wind is accentuated at the top. Instead, nests were usually built at 1 - 4 m away from the main trunk on middle branches with a diameter of about 30 cm. Since 2018, all the nests recorded in Bhutan were found in the broadleaf forests, located at lower altitudes than previously known. The nest in broad-leaved forests is also built in large trees. The nests are placed on forked primary branches or a platform that provides significant support. They are generally fully exposed, lacking canopy cover.

Roosting sites

The White-bellied Heron takes a rest or a night roost in the tall trees nearby the rivers. The roost sites are usually near the foraging sites or nesting sites and identified mainly

through the droppings and identifying the vegetation type, mainly consisting of large trees. There are no specific tree choices for roosting, and it depends upon the type of forest the bird is in. In chir pine forests, *Pinus roxburghii* trees are dominantly used as roosting sites. In broadleaved forests, trees such as *Duabanga grandiflora* and *Syzgium formosa* are dominantly used.

Vegetation and Riverine Structures

In Bhutan, most of the rivers where the White-bellied Herons inhabit originate from high mountains of the Himalayas and flow southward. Here, the rivers flow through a wide altitudinal gradient, from cool temperate mountain environments to warm subtropical lowlands. This elevation change creates distinct vegetation zones and forest types along the riverbanks and adjacent slopes. Across the main river basins inhabited by White-bellied Heron in Bhutan, the Punatshangchhu, Mangdechhu, Wangchhu, and Drangmechhu, the dominant vegetation type surrounding the White-bellied Heron habitat areas include cool mixed broadleaf forest, chirpine forest, and broadleaf forest. The major flora species consist of *Pinus roxburghii*, *Bridelia retusa*, *Quercus glauca*, *Lagerstroemia parviflora*, *Bauhinia purpurea*, *Daubanga grandiflora*, *Talauma hodgsonii*, *Alnus nepalensis* and *Schima wallichii*.

Cool Mixed Broadleaf Forest

In the upstream of the river systems, especially in inner valleys and higher catchments, the forest is dominated by cool mixed broadleaf forest which typically occurs at elevations ranging from 1,800 to 3,000 meters, though in certain areas it descends much lower in shaded valleys and north-facing slopes. The climate here is cool and moist.

The forests here are characterized by a diverse mixture of temperate broadleaf tree species, often including oaks *Quercus*, maples *Acer*, birches *Betula*, laurels, and magnolias. The forest canopy is generally dense and multilayered, with a well-developed shrub and herb layer beneath. Mosses, ferns, and epiphytes are common here.

Even though these forests lie largely upstream of core foraging habitats, they remain ecologically connected to the heron's survival. The White-bellied Heron is rarely observed foraging in this habitat's river stretches.

The roost site in Punakha

It is approximately 1 km (straight line) from the closest edge of the river, and approximately 200 m from the edge of open paddy fields that adjoined the river on slopes that ranged from 30 - 40 degrees.

Roost trees were located in an open heavily grazed forest dominated by Chir Pine (*Pinus roxburghii*) and roost trees were clearly the tallest trees in the stand. The three roost trees were 10, 14, and 16 m in height, and inter-roost tree distances ranged between 52 and 105m, with little or no mid-story or understory vegetation. The site is regularly grazed by cattle, and, based on local information and fire scars on trunks, is subject to fires of unknown frequency. Distances from roost trees to nearest overstory trees ranged between 8 and 14 m.

The roost sites are mainly identified based on whitewash locations. Most birds were roosting near the ends of relatively large lateral branches between 8 and 10 meters above ground level.



Figure 5.4. Cool mixed broadleaf forest

Chirpine Forest

Descending into lower and warmer elevations, especially in central Bhutan's inner valleys and rain-shadow areas, the vegetation often shifts into chir pine forest, dominated by *Pinus roxburghii*. These forests occur between about 900 and 1,800 m, although their exact range varies with slope, aspect, and local climate.

Chir pine forests are most common on dry, south-facing slopes, steep valley sides, and well-drained ridges. The overall structure of these forests reflects adaptation to seasonally dry conditions, frequent natural or human-induced fires, and shallow, rocky soils.

Along river valleys, chir pine forests often form a distinct belt above the riparian zone. While the immediate riverbanks may still support patches of broadleaf vegetation, the surrounding slopes are dominated by pine. Towards the lower stretches of river, the mixed growth of chirpine forest and broad-leaved forest is seen.

For the White-bellied Heron, these river stretches with chir pine forests are one of the primary habitats. Some of the wide valleys in these areas support good foraging ground for the heron. The forest also supports nesting and roosting areas.

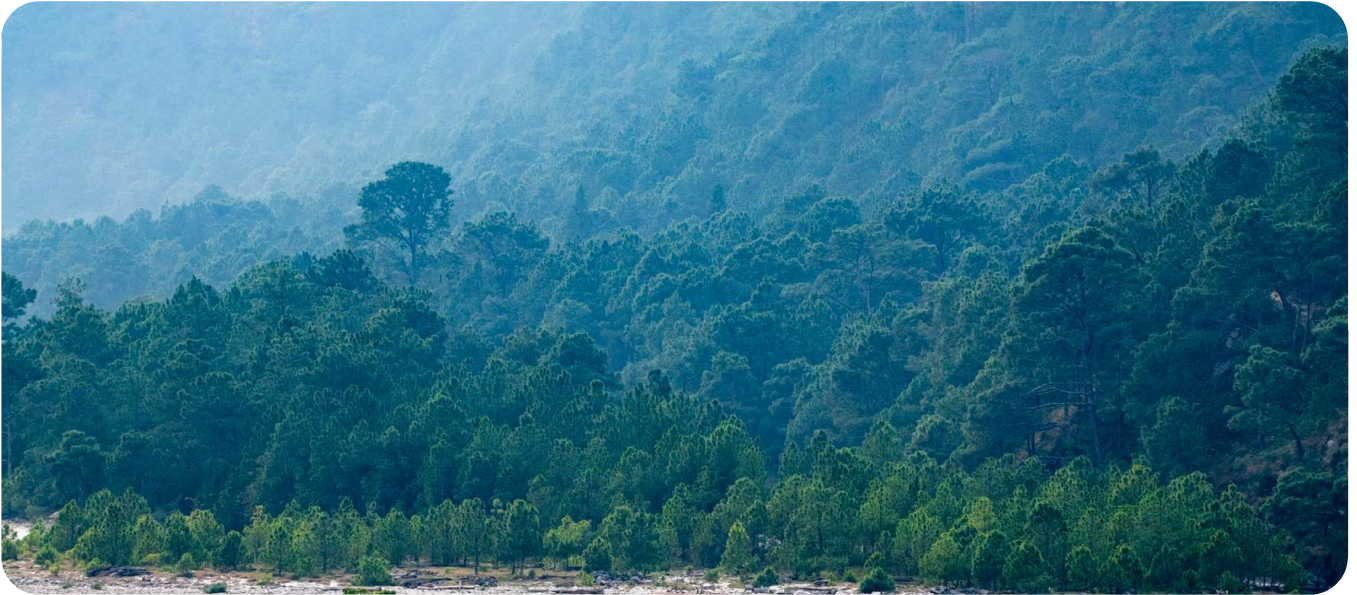


Figure 5.5. Chirpine Forest

Subtropical Broadleaf Forest

Downstream of Bhutan's river systems, particularly below about 600 - 800 m and toward the southern foothills, the vegetation becomes dominated by subtropical broadleaf forest. These forests develop under warm, humid climatic conditions.

Subtropical broadleaf forests are characterized by tall, dense, multi-layered canopies, a high diversity of tree species, including Duabanga, Terminalia, Michelia, and many others, and abundant of climbers, epiphytes, and a rich understory of shrubs and herbs.

Along this stretches of river, the forests have overhanging branches, fallen logs, and complex bank structures. Some of these forested areas are used as nesting and roosting sites by the heron. In the downstream of this area, there are vast floodplains and braided rivers. The herons often used the area as foraging ground.

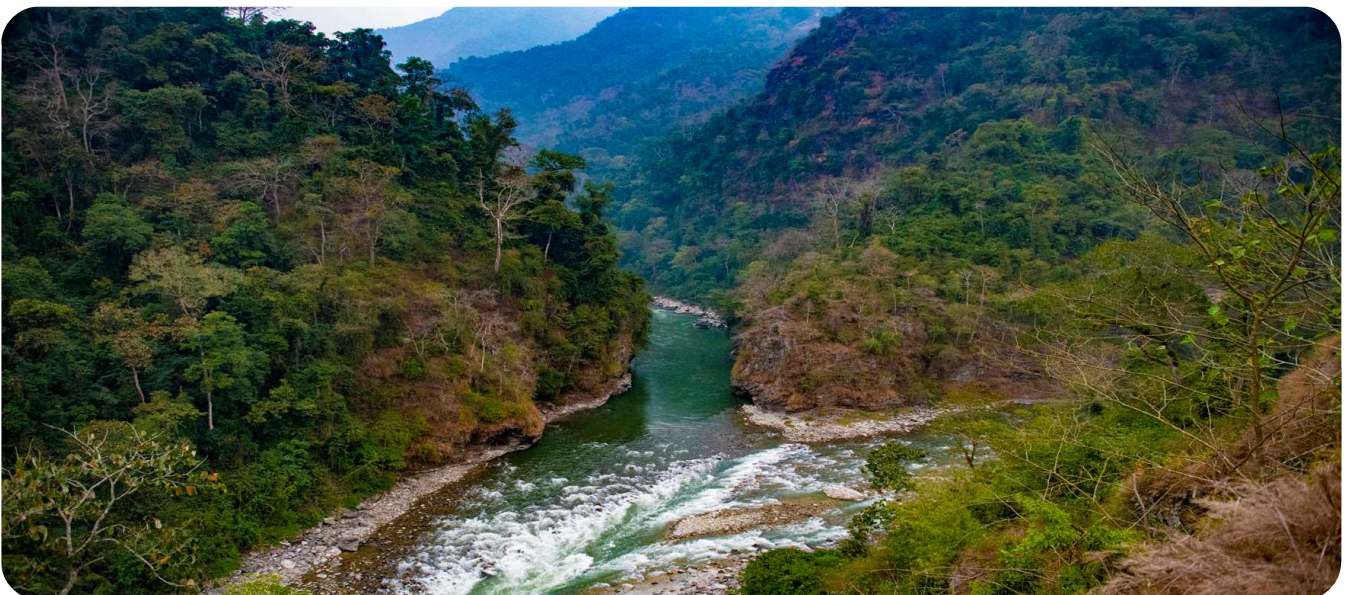


Figure 5.6. Broadleaf forest

Land Use and Ecosystem

The river valleys like Punatshangchhu, Mangdechhu, Drangmechhu and Wangchhu are among the most important human settlement corridors in Bhutan. These valleys, with high concentrations of human population are the centers of agriculture, trade, and commerce. As a result, the riverine landscape represents a mosaic of natural forests, agricultural land, settlements, and infrastructure, with the intensity of human presence varying along the altitudinal gradient.

Human settlements along these rivers are not uniformly distributed. In upper reaches and steep gorges areas, they are sparsely populated due to rugged terrain, narrow valleys, steep slopes, and limited arable land. Here, forest cover remains relatively intact, and human activity is largely restricted to small hamlets, seasonal grazing areas, and scattered farmhouses. In mid-valley sections, this zone contains the highest concentration of settlements, including major towns, numerous villages, road networks, other infrastructures, and agricultural practices. The valley floor and lower slopes are intensively used for paddy cultivation, orchards and cash crops, and sand dredging and settlement expansion. In lower reaches toward the southern foothills, settlements become more dispersed again, though agricultural use remains significant. Along the river basin, hydropower infrastructure, construction camps, transmission lines, and access roads are prominent features.



Figure 5.7. Settlement along the White-bellied Heron landscape (Goling, Zhemgang)

6. Distribution and Population Dynamics

Historically, the White-bellied Heron occupied a large area of the Himalayan foothills, from the plains of Nepal across northeast India, including Sikkim, Darjeeling, West Bengal, Assam, Arunachal, and Nagaland, to southern Myanmar. During the second and third quarters of the 20th century, the species was extirpated from most of its historical range. The bird has been reported extinct from Nepal, and there are no recent records from West Bengal, southern Myanmar, and Bangladesh. The distribution of the species is now restricted to Bhutan, northeast India, and northern Myanmar only. The species sightings were also reported from China.

The White-bellied Heron's distribution range is characterised by lowland wetlands and floodplains in the south, and forested landscapes of mountain rivers in the north. It is covered by three biodiversity hotspots, the Eastern Himalayas, Indo-Burma, and South-West China; two Global ecoregions, the Terai-Duar savannah and grasslands, and the Eastern Himalaya broadleaf and conifer forest; 20 Important Bird Areas; and the Himalaya global center of plant biodiversity, possibly extending into the Indochina-China center.

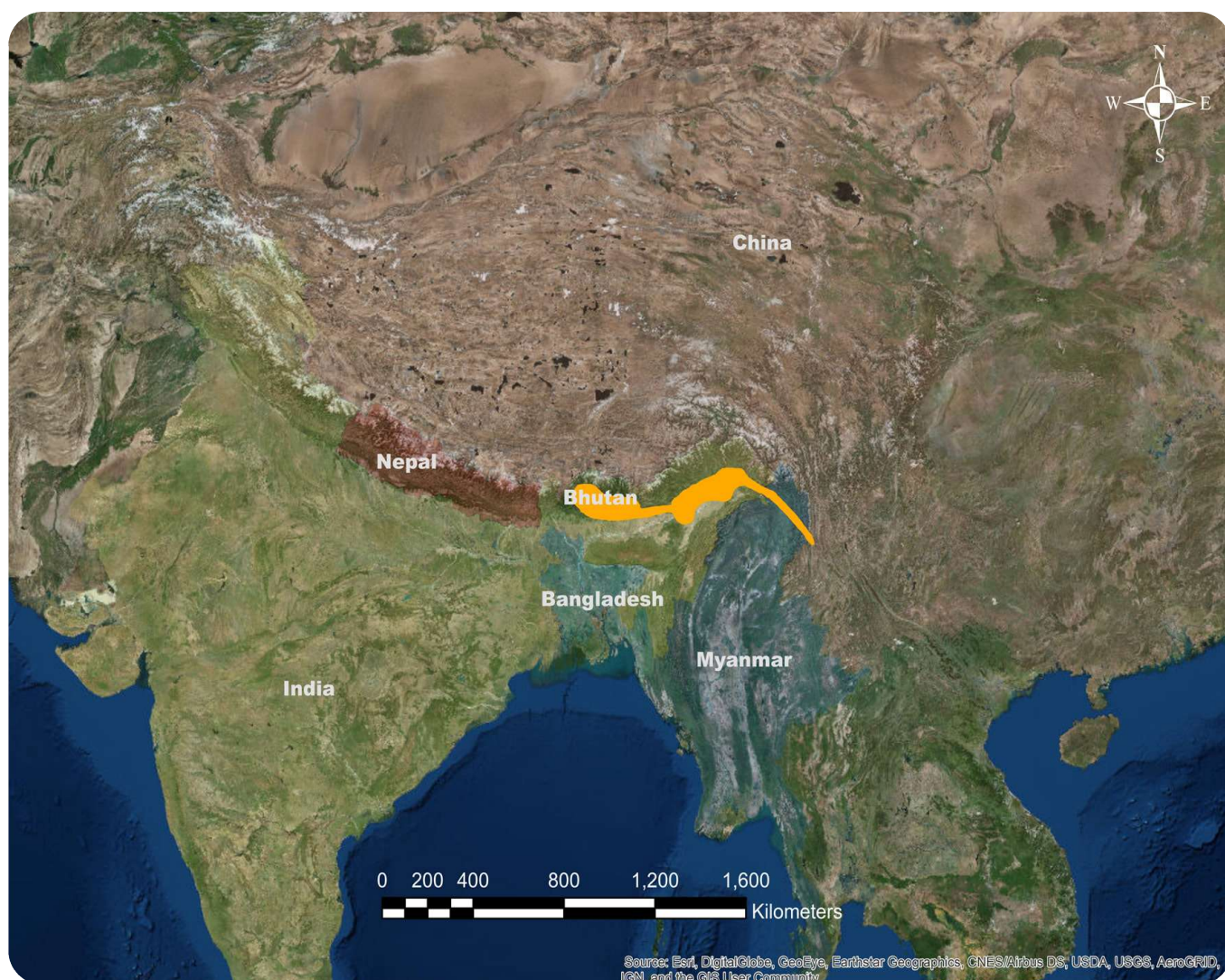


Figure 6.1. The current known distribution range of White-bellied Heron

Distribution in Bhutan

In 1974, the White-bellied Heron was first sighted in Bhutan at Soenagasa in Punakha. By the late nineties, the bird's presence in Bhutan slowly gained the attention of bird watchers. In 2001, as many as five White-bellied Herons (3 juveniles and 2 adult birds) were observed at Soenagasa. The first population survey of White-bellied Heron in Bhutan carried out in 2003 counted 14 individuals.

In Bhutan, over the years, systematic surveys of rivers for White-bellied Heron were carried out on a regular basis. The major rivers in Bhutan, Punatshangchhu, Mangdechhu and Wangchhu are important hotspots for the occurrence of the species. However, there is a continuous decline in sightings of the species from the upstream of Punatshangchhu (Phochhu and Mochhu) that was once known for frequent sightings and occurrence of nesting sites. Within the last decade, the species distribution was more concentrated in the lower river basin of the Punatshangchhu basin and with over 50% of the known population found in Bhutan. The species occurrence was also reported from the lower river basin of the Wangchhu river and its tributary, the Jigmechhu. The sightings in eastern Bhutan river basins are still limited to a few individuals and observed rarely.

An optimistic habitat suitability model predicts that only 3891.06 km² (10.13 %) of the total area in Bhutan is highly suitable for White-bellied Heron, an additional 5747.97 km² (14.97 %) is suitable, and 93.83 km² (0.24 %) is least suitable. The remaining 74.65 % (28661.12 km²) is not suitable, which comprises areas that fall above an altitude of 2000 m, near the settlement, built-ups, agricultural land and rocky outcrops.

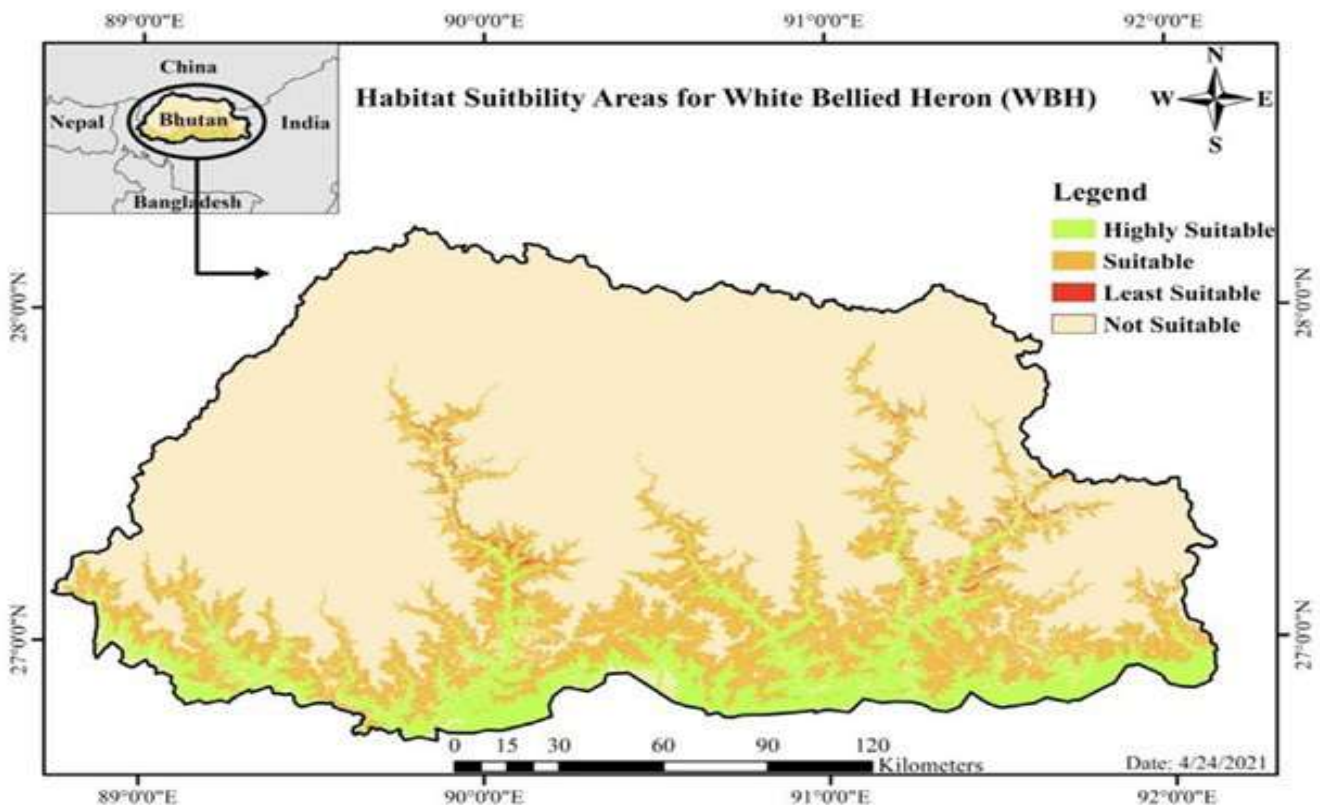


Figure 6.2. White-bellied Heron habitat suitability map

The habitat suitability model also projects Bhutan will see a net gain in climatically suitable areas for White-bellied Heron. However, this gain will be offset by intensified fragmentation. Current places like Dagana and Tsirang having good distribution of herons are projected to face significant suitability declines in near future.

During 2003 to 2010, multiple surveys were conducted in Wangchhu, Amochhu, Pachhu, Phochhu, Mochhu, Punatshangchhu, Sunkosh, Dagachhu, Kisonachhu, Hararongchhu, Mangdechhu, Chamkharchhu, Bertichhu, Serichhu, Kulongchhu, Kurichhu, Dangmechhu, and Nyeramachhu. During these surveys, the herons were sighted in Zawachhu, Ada lake, Kisonachhu, Nangzhina, Kamechhu (Digchhu), Hararongchhu, Phochhu (Tshekhang), Mochhu (Sonagasa), Phochhu-Mochhu Confluence, Near Sunkosh area (Salamji), Cherichhu, Bertichhu and Magdechhu. The White-bellied Heron was regularly sighted in the Punatshangchhu basin and tributaries below 1500m, and along Bertichu, a tributary of the Mangdechu in Central Bhutan.

From 2011 to 2020, similar efforts were made to survey the same area and also some other stretches of potential rivers. The population survey in 2012 and 2013 shows that the distribution of White-bellied Heron was reported from Hara Rongchu, Nangzhina, Ada, Burichu, Phochhu, Mochhu, Tingtibi/Berti and Wakleytar. Phochhu recorded the highest individual count of four herons. Between 2014 and 2015, herons were sighted in Phibsoo Wildlife Sanctuary as well. In the following year, new sightings were again made at Doksum in Trashiyangtse and Lhamoizhingkha in Dagana. In 2019, the heron was sighted in the Kurichhu and Drangmechhu basins, and in 2020 in Bumdeling Wildlife Sanctuary and Rangae Khola under Dagana district.

From 2021 to 2025, an in-depth habitat inventory of potential rivers in eastern and southern Bhutan was carried out. The White-bellied Heron sightings were made from new places in 2021, the Wangchhu and Jigmechhu under the Chukha District. In 2025, two herons were regularly reported from Kuri-gongri (Yangbari) in Pemagatshel. In 2026, the heron was first reported from kanamakurachhu under

White-bellied Heron recorded at Bumdeling Wildlife Sanctuary, Trashiyangtse.

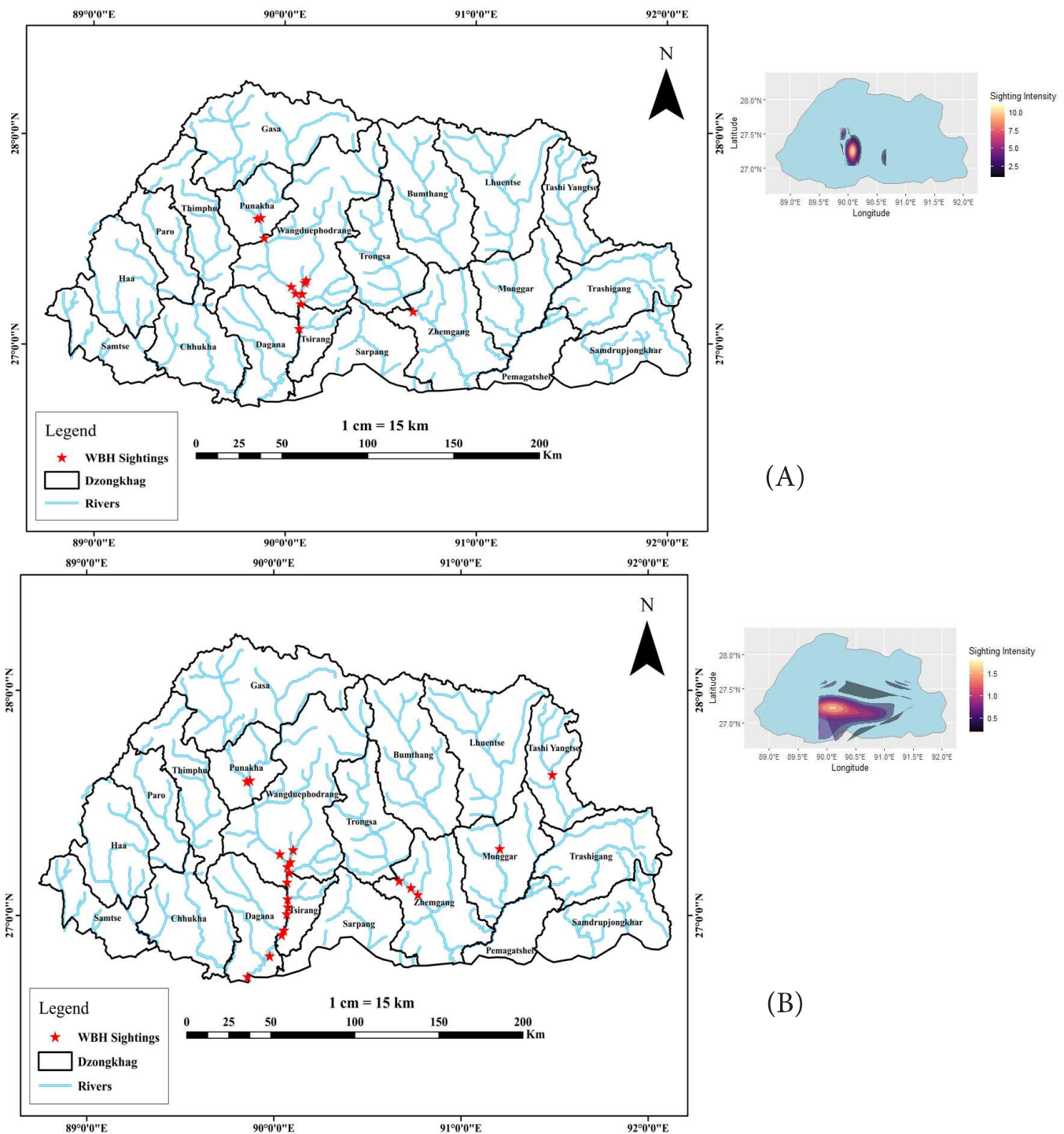
The sighting was made in the afternoon hour on 12 April 2020 from the Black-necked Crane roosting area in the park, Kholongchhu river (N27°04'27.0", E91°26'21.6") at an elevation of 1892 masl. It was first seen by forester Tshering Chopel.

White-bellied Heron sightings in the area in the first record for the Park and the second record for Trashiyangtse Dzongkhag. The earliest record of this species sighting in the Dzongkhag was made on 18 April 2016 from Jamkhardang by the second batch of nature guides and ecotourism trainees of UWICER.



Figure 6.3. White-bellied Heron in Bumdeling Wildlife Sanctuary (12 April 2020)

Royal Manas National Park. The annual population survey carried out from 2021 to 2026 recorded the heron distribution in Dagachhu, Goling, Kamechhu, Phochhu, Gewachhu, Toesang, Tshaidang, Relangthang, Burichhu, Sunkosh, Yangbari, Balwani, Berti, Rangae Khola, Wakleytar-Burichhu, Lhamoyzhingka, Phibsoo Wildlife Sanctuary, Chamkharhhu (Zhemgang), Adha, Nagzhina, Hararongchhu, and Kisonachhu.



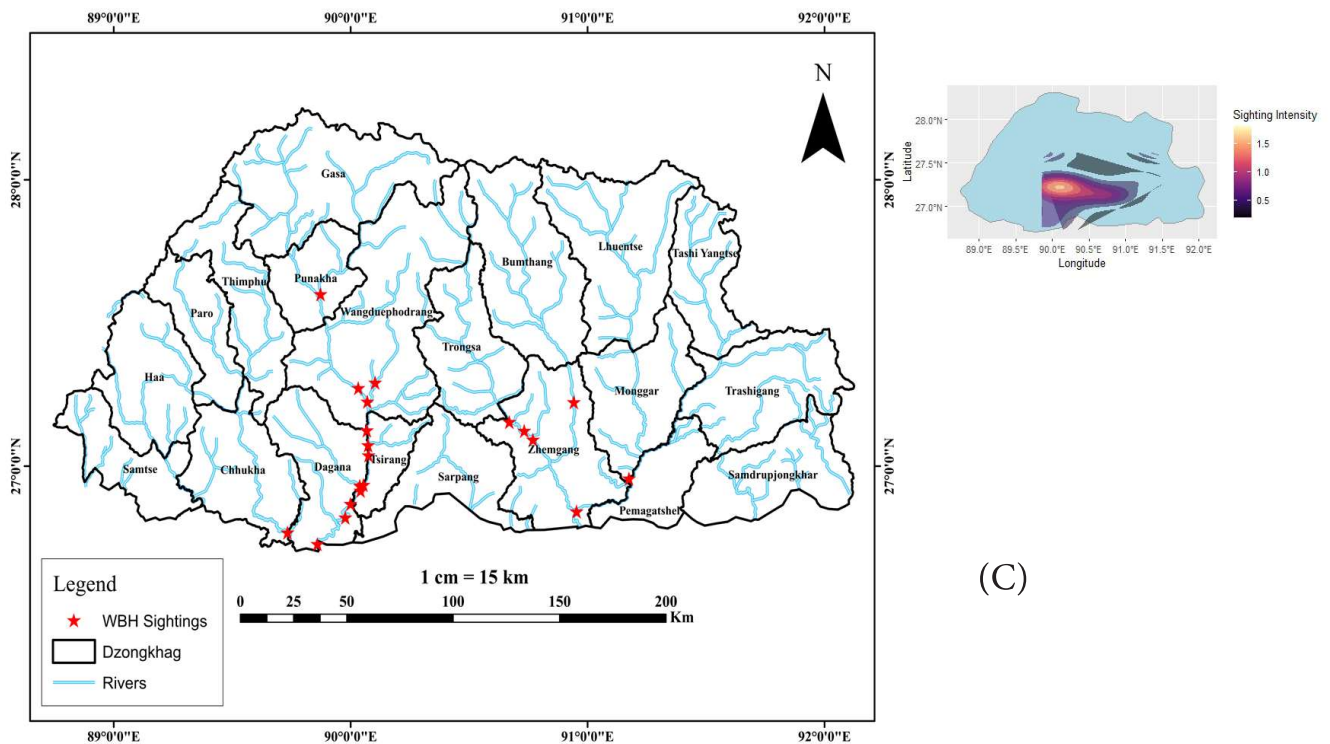


Figure 6.4. Distribution of White-bellied Heron in different Places with hotspot places (A-2003-2010) (B-2011-2020) (C-2021-2025)

Distribution in India

In India, the current known distribution of White-bellied Heron is from Arunachal Pradesh and Assam. The earlier sightings of the species from India include West Bengal, Sikkim, and Arunachal Pradesh, but they have largely disappeared from the western portions of this range.

Namdapha National Park and Tiger Reserve in Arunachal Pradesh is the most significant known place in India for the occurrence of the White-bellied Heron. It is the only Indian site where successful breeding has been documented. The sightings have been confirmed in Kamlang Tiger Reserve at high altitudes (1200 m) in Walong (Anjaw District). In Assam, the species occurs seasonally in Manas National Park, Kaziranga, Dibru-Saikhowa, and Pabitora Wildlife Sanctuary. A juvenile was also photographed at Maguri Beel in 2015.

Distribution in Myanmar

Historically, the White-bellied Heron was widely distributed across Myanmar. The bird is now largely found in lowland wetlands within generally mountainous areas of northern Myanmar, rather than in lowland landscapes. No active nests have been recorded in the country since 1929. Historically, a nest containing four eggs was recorded in 1929. The currently known White-bellied Heron population in Myanmar is limited to the Hkakabo Razi Landscape of northern Myanmar due to its intact broadleaf forests and lowland wetlands. Recent sightings were recorded in the Shinsan, Nam Ro, Tan Jar, and Ma Jaw War streams near Putao. Substantial numbers were found in the Hukaung Valley in the early 2000s, but this area has not recently been surveyed.

Distribution in China

The sighting of the White-bellied Heron in China is rare. During the White-bellied Heron International Workshop in 2015, only one individual was reported to have been sighted in China. Ecologically, the species is expected to occur in the southeastern part of China. This area is geographically contiguous, sharing borders with northeast India and Myanmar. The first confirmed record of this species in China was recorded east of the Nujiang River (Salween) in Gaoligong Mountains National Nature Reserve, Yunnan Province, China, in August 2014. The bird was found being traded along the roadside at an elevation of around 2,500 m a.s.l. (although the local terrain is predominantly 800 - 1800 masl). The client who purchased the heron reported it to the authorities after two days, and then it was sent to Yunnan Wild Zoo, where it died within three to four days. The photograph of the same bird confirmed that it was weak since its juvenile days. In 2019, another White-bellied Heron was sighted and rescued in Southwest China's Yunnan province. Following rehabilitation, it was released with a satellite tracking recorder to monitor its movement.

Population Dynamics

The known global population of the White-bellied Heron is estimated to be fewer than 60 individuals. The species suffers from a low reproduction rate, a shrunken geographic range, and an increasingly fragmented population structure. The species may be currently caught in an "extinction vortex," a self-reinforcing cycle where small, fragmented populations suffer from genetic bottlenecks, declining reproductivity, and high juvenile mortality. As a solitary species with a large individual home range, its population densities were likely never high.

Population Survey

In Bhutan, the Annual Population Survey of White-bellied Herons started in 2003, and it is conducted at the beginning of every breeding season. The population survey is planned, especially in terms of timing. It takes place during the last week of February or the first week of March each year to ensure an accurate count of the population before the herons begin nesting and incubating, which could otherwise lead to some being missed during the survey.

During the survey, the surveyors searched for five consecutive days within their designated site marked as zones. The survey is reinforced by continuous monitoring and reporting on other days. Understanding the heron's population trend and distribution in Bhutan relies primarily on this survey. The population surveys and monitoring data are used to identify immediate threats, other issues, and to design conservation programs. During the population survey, documentation of other associated species that are seen within the landscape of the White-bellied Herons is also done. This helps in providing an understanding of the overall biodiversity health of the White-bellied Heron landscape.

Population of White-bellied Heron in Bhutan

The White-bellied Heron population in Bhutan between 2003 and 2010 sets the baseline population for herons in Bhutan. In the initial phase of counting, the known population

Records of White-bellied Heron in India

In September - October 2011, a heron was sighted twice in Namdapha Tiger Reserve on the banks of Noa-Dehing River (27° 31' 44.6N, 96° 23' 24.7E) at Naharbadil. In 2014, the existence of active nests in Namdhapha was also reported. Subsequent studies were carried out in the same reserve, where a resident population of eight individuals was recorded. Other sighting reports recorded were from Manas Tiger Reserve of Assam in 2018 and Kamlang Tiger Reserve of Arunachal Pradesh in 2019.

Two herons were seen in Subankhata Reserved Forest, Baksa district (approximately 70 km northwest of Guwahati) in 2010.

In October 2015, a juvenile heron was sighted and photographed at Maguri Beel in Assam.

In the first week of April 2021, two individuals of heron were spotted and photographed in the Walong area, on the banks of River Lohit.

During surveys in Manas Tiger Reserve between October 2013 and June 2014, two herons were seen twice on the Phibsu River, adjacent to Bhutan.

The sightings were also recorded from the Polo area on October 10, 2019 and another from the Zomduar area on August 15, 2020.

In a survey carried out in Raimona National Park, a lone adult heron was sighted in the Peku River on February 27, 2023. Two additional herons were sighted along the Miao-Vijaynagar Road and were repeatedly encountered during August and September.

Records of White-bellied Heron in Myanmar

A total of 16 birds were sighted: eight at Tawang stream, three at Tarong stream, two at Lauk Lai and one each at Sakse stream, Sanip stream, and near Khine Lung.

In Hponkanrazi, two White-bellied Herons were recorded near Ziyar Dam and four to six sightings were obtained from Hponkanrazi Wildlife Sanctuary in 1998 and 1999.

During a series of bird surveys from 2001 to 2020, heron was observed in Hkakabo Razi Landscape: a) one individual foraging in the Shinsan stream, north of Gawli, on 10 and 11 March 2016 and on 26 February 2018 at the same site. b) one individual at the Nam Ro Stream near Wasadam village. c) one individual in the grassland close to Tan Jar stream at Lone Shanyan village on 1 November 2020. d) One individual and a pair were observed in the Tan Jar stream in December 2020. e) One individual foraging in Ma Jaw War stream close to Putao in November 2020.

On 31 October 2005, a heron was recorded at the Nat Kuang River, in the vicinity of Warazup village.

In Shweli River of East Myanmar Ornithological Region, two numbers of White-bellied Heron were sighted and photographed.

In February 2015, White-bellied Heron was recorded from Hponkanrazi Wildlife Sanctuary, and during April to June, it was sighted in Naungmung, just outside of Hkakaborazi National Park.

Juvenile heron was observed and photographed at the Ayeyarwady River bank, not far from Myitkyina on 23 January, 2018.

From June 2022 to December 2023, the heron occurrence was recorded along the rivers and streams across two river catchments in Kachin State, with an estimated population of two to three individuals.

In 2023, Northern Wildlife Rangers conducted surveys along all rivers and streams in the two river catchments, at Putao-Wai Lang Dam in the west of the study area and at Nawnngmung in the east. The study recorded several sightings of a single individual heron across the two river catchments.

steadily saw the growth reaching a historical peak before starting a slight decline towards the end of the decade. The first RSPN's comprehensive population survey in 2003 recorded 14 individuals across five locations in the Punatshangchhu basin.

During this period, the known population count appeared to rise through the mid-2000s, approximately 18 in 2004, 15 in 2005, 24 in 2006, and 25 in 2007, reflecting both new sightings and expanded survey coverage. By 2008 and 2009, the count reached 30 birds, which is the highest count in the wild recorded so far in Bhutan. The following year in 2010, the count dropped to 26 individuals.

From 2011 to 2020, the heron's known population in Bhutan during this period fluctuated with a geographic shift from historical high-altitude strongholds toward lower river basins. The total known population remained between the lowest of 20 birds (2013) and the highest of 28 birds (2015, 2016). This population trajectory revealed the gradual abandonment of traditional nesting and feeding grounds. Despite continuous conservation programs and the annual fledging of 2 - 6 juveniles, the total population did not show a net increase during this period. Specifically, the population survey recorded 24 birds in 2011, 22 in 2012, and a decade-low of 20 in 2013, followed by 22 in 2014 and a peak of 28 in 2015. The latter half of the decade saw counts of 25 (2016), 26 (2017), 24 (2018), 25 (2019), and finally 27 in 2020.

Habitats like Phochhu, Mochhu, Zawa, Kamechhu, Adha, and Nangzhina experienced a sharp population decline. However, new sites in the lower Punatshangchhu (Relangthang, Dagachhu catchment, Balwani) and Mangdechhu basins (Tsaidang) showed an increasing population trend. Sightings of lone heron have also been reported from Eastern Bhutan since 2016, especially along Drangmechhu, Kholongchhu, and Kurichhu.

During the 2021 to 2026 period, the known population count was 24 - 31 individuals. The 2021 annual population survey recorded 25 herons. By the 2023 survey, 27 White-bellied Heron individuals were recorded (24 in the wild, 3 at the conservation center), marking an 11% increase against 2022. The Punatshangchhu basin accounted for the highest number (58%), followed by the Mangdechhu and Wangchhu basins (16.5% each). The 2024 annual survey reported a slight decline to 25 individuals (22 wild, 3 in captive breeding center). In the 2025 annual population survey, 29 White-bellied Herons were recorded (24 in the wild and 5 in the captive breeding center). In 2026, an increase by two individuals was recorded, a total of 31 individuals (26 in the wild and 5 in captive breeding center). During this period, as evident from the above discussion, the geographic distribution shifted significantly, with historical nesting strongholds in the Upper Punatshangchhu (Phochhu and Mochhu) being completely abandoned. Instead, the population appeared to concentrate in the middle stretch of Punatshangchhu and expanded into the Wangchhu basin, Royal Manas National Park, and Phibsoo Wildlife Sanctuary.

The period from 2021 to 2026 also witnessed a landmark shift in the White-bellied Heron conservation history, where it transitioned from passive and conventional population

monitoring to active biological intervention, with the initiation of a captive breeding facility and landscape-level project activities.

Population of White-bellied Heron in India

In India, the population of White-bellied Heron is located in the northeastern states of Arunachal Pradesh and Assam, where sightings are frequent and fragmented.

While a specific total number for the country is not provided, recent records are limited to only six to eight individuals. But large areas of suitable habitat have not yet been searched for the species.

Population of White-bellied Heron in Myanmar

The easternmost population of White-bellied Herons extends to Myanmar. The reports estimated fewer than 25 individuals. However, recent observation records (2020-2023) by a Myanmar research team show only 9 birds in northern Myanmar.

Population of White-bellied Heron in China

The presence of the White-bellied Heron in China is poorly documented and appears to be extremely rare. There is no established resident population count, however, a single captive fledgling was discovered in 2014 and similarly, a fledgling in 2019 was recorded.

These individuals were found in Yunnan Province. The habitat in Yunnan where the fledgling was recorded is characterized as a mountainous region rich in freshwater fish, with elevations potentially reaching 1,500 m above sea level.

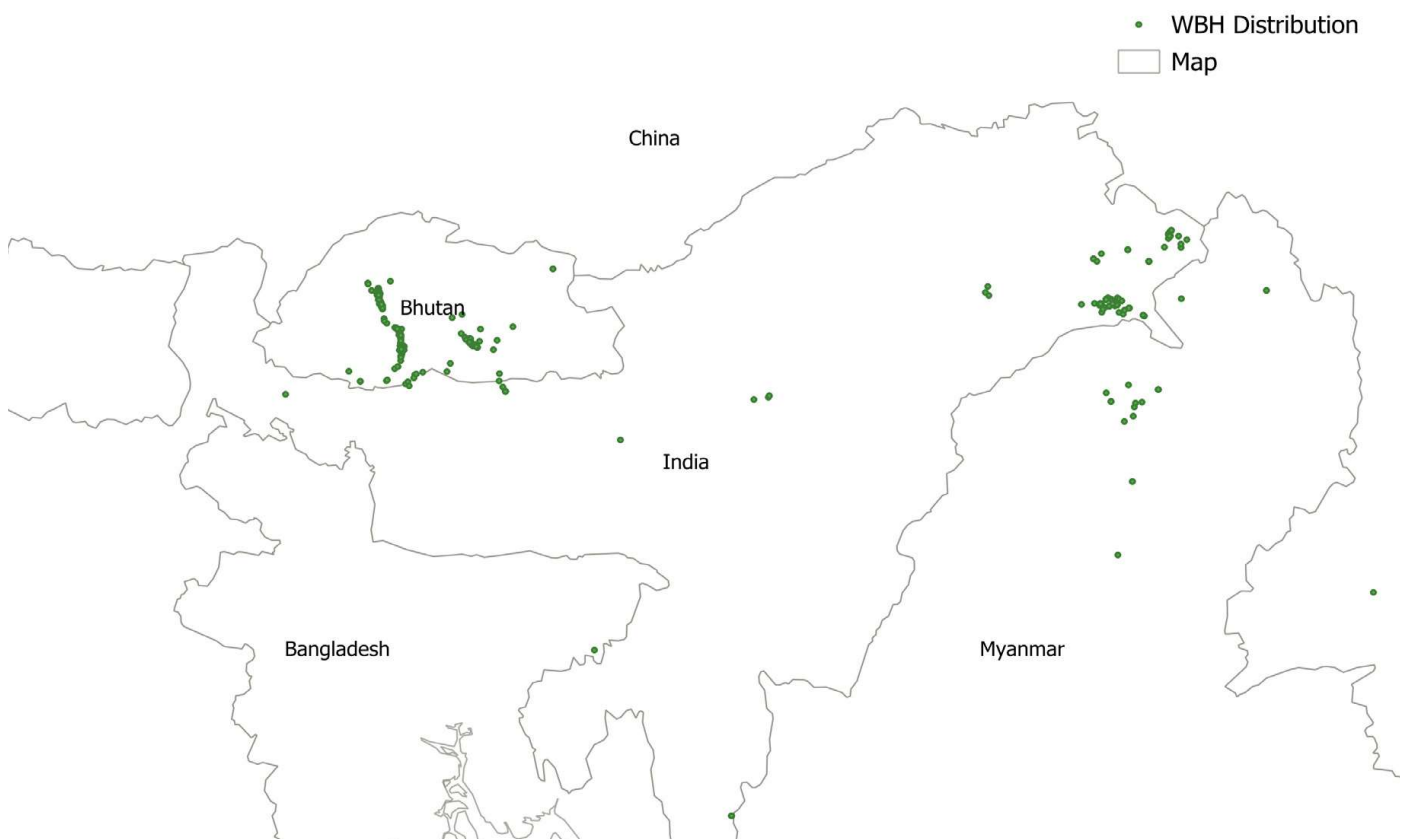


Figure 6.5. White-bellied Heron sighting records in range countries(Data source GBIF)

7: Conservation Challenges

The White-bellied Heron presents a difficult case for effective conservation and management for the simple reason that the species is already so highly endangered, and it has characteristics and habitat preferences that do not mesh well with high human population densities or habitat uses. Here, we describe the major anticipated threats to the White-bellied Heron species that seem most evident at the time of writing this second edition of the book.

Today, the White-bellied Heron faces growing concern over a shrinking population that is mainly caused by various factors, including the bird's small genetic pool. The habitat loss due to various factors may be a principal threat to species, causing habitat fragmentation and reducing the available nesting and foraging sites. Furthermore, frequent forest fires in the landscape are also noted as a threat. The demand for natural resources, infrastructure, energy, transportation, and services has increased with the human population along the White-bellied Heron landscape. The species is subject to direct threats at the local level, as well as to major global and regional changes that will impact biodiversity more broadly in the future.

Small gene pool

The population of White-bellied Heron seems to be very discontinuous in distribution, with one small group in Bhutan, and others of unknown size and connectivity in Arunachal Pradesh and Myanmar, and some vagrant individual records from China. The latter three groups are potentially close enough to interbreed freely, but at present, nothing is known about dispersal and movements in relation to breeding. The known population of fewer than 60 birds worldwide also includes juveniles, which may not breed until they are several years old. In Bhutan, almost half of the total population may be pre-breeding or not breeding in any year.

Coupled with the effects of splitting the population into at least two different genetic breeding pools, this suggests that the effective population size from the point of view of genetics may be much smaller.

In the case of the Bhutanese population, there have never been more than 5 breeding pairs discovered in any one breeding season for the last many years, except in 2026, when six breeding pairs were observed, representing a maximum of 12 adults. Even if surveys had missed nesting locations and the breeding population were 50% larger, this would still only bring the total to 15 adults and seven or eight breeding pairs. A population this small is predicted to undergo genetic introgression and the fixing of deleterious genes fairly quickly. The same is true even for populations several times this size. For these reasons, the prediction is that the White-bellied Heron population is in immediate danger of genetic isolation effects and inbreeding. Therefore, a small gene pool is considered to be the most important single threat to the existence of the species.

When a species like White-bellied Heron is pushed to the brink of extinction, the remaining survivors face an internal threat, a shrinking gene pool. With so few individuals known to be left, the remaining population is forced to mate, triggering inbreeding depression. This could eventually lead to low fecundity, even when breeding pairs are active, the hatching success remains low. This genetic flow can also result in harmful recessive traits, often resulting in hereditary diseases and fragile chicks that often face difficulty surviving. For instance, in 2023, three wild eggs of herons were artificially incubated and hatched. However, all three chicks suffered major deformities in their legs and could not survive. Similarly, the same breeding parents failed to produce chicks in the following years of 2024 and 2025 with all the eggs being sterile. Many experts believed it could be linked to hereditary diseases, of course, it is also hard to rule out other factors. The small gene pool can also affect the entire population for adaptability. Without genetic diversity, the species lacks the ability to survive a new disease outbreak, sudden climate change, and other factors.

Habitat degradation

Many of the habitat features that appear important to the White-bellied Heron are under threat of modification or degradation by humans. Direct habitat modification seems most evident in the form of riverine projects, but it is important to recognize that many, much more subtle forms of habitat degradation may be just as effective in making the habitat unsuitable for herons.

Increasing human use and habitation of river valleys

Hérons are apparently able to tolerate relatively low levels of human disturbance, but regular approaches closer than 200 meters and many other kinds of human disturbance (trucks, boats, construction, logging, mining activities, fishing, insect collection, algae collection, driftwood collection) can probably render even excellent habitat unsuitable for herons. The kind of human activities most important for herons are those within 100 meters of the river's edge, and unfortunately, human activities are most likely to occur in the very habitat that herons prefer shallow, braided sections of the river. These routine human activities, if carried out along the foraging and nesting sites, may disturb the heron. For example, fishing in the early morning and late evening is detrimental to herons as it clashes with the foraging habits of herons.

Logging

Logging has a large potential impact on herons directly through disturbance at proximity to nesting or foraging habitat or indirectly by changing the nature of nesting and, to a lesser extent, foraging habitat. Herons choose very large, probably old trees for nesting, many of which would also be targeted for timber harvest. Nonetheless, logging might in the right circumstances, also be used to thin forests in a way that promotes the relatively low densities of large pines that herons seem to favour for nesting or roosting.

Threats from logging increase as the intensity of the practice increases, and where logging removes ground cover from steep slopes and promotes soil erosion, the suitability of riv-

ers for fish may become impacted through siltation.

Wildfire intensity

In the past, fires directly threatened the White-bellied Heron nest as frequent outbreak of fire took place in the chirpine forest. With the shift in nesting location mostly now in broadleaf forest, there is no imminent threat to nests directly. However the forest fire occurrence in the chirpine forest disturbs roosting places and degrades habitat. The land subjected to forest fire becomes barren, and high sedimentation occurs in the river during rainfall.

Mining

The mining of sand and stones is more common in the White-bellied Heron habitats. The major sand mining happens at Bajothang in the Punatshangchhu basin and Pirchen in Mangdechhu basin. These places are also important foraging ground for the herons. The operation in Bajothang is permanent and involves continuous and near-complete removal of sediment along approximately 2 km of sand and gravel bars. Permanent and semi-permanent operations lined the bank of the river in the form of sheds, heavy equipment, and stockpiled gravel and sand.

Water pollution

Water pollution can occur in many forms, and for wildlife may include increased exposure to disease agents, increasing trophic status through nutrient enrichment, altered aquatic community composition, decreased oxygen, increased turbidity, and exposure to toxins and endocrine disruptors. Since herons depend directly on fish for food, they will be strongly affected by anything that markedly reduces their prey resource.

The status of water pollution in White-bellied Heron is poorly known. Water quality is not regularly monitored, and the levels of pesticides, herbicides, heavy metals, fertilizers and sewage information in the river are limited. There is strong potential for even moderate levels of pollution to cause habitat shifts in aquatic environments and to directly alter demography and community composition of fishes through a variety of processes. The excess sedimentation from land use practices can affect the suitability for fish spawning and fish survival. A large number of pesticides, herbicides, and even fertilizers can affect the development and sex of fish through endocrine disruption, to the extent that population declines can result. Water quality could be an important threat to White-bellied Heron and the aquatic community on which it depends.

Infrastructure Development

The infrastructure development along the rivers without proper management plans represents a significant threat to riverine ecosystems. The construction of infrastructure demands a huge requirement of areas, especially for hydropower infrastructure and road networks. This leads to habitat loss and fragmentation. The impact is also sustained for a long period of time, as some construction takes many years to complete fully. The disturbed sites, especially the muck dumpyard area and deforested areas from hydropower

construction become deserted, with sporadic vegetation coverage by grasses and shrubs replacing riparian forest coverage. The associated infrastructure, like high-voltage power lines, is also attributable to the mortality for the heron.

Hydropower project effects on herons can be in broad areas, effects on migratory fishes, effects on resident fishes, construction effects, effects on foraging habitat and nesting, and collision and electrocution risks with powerlines and poles.

Effects on migratory fishes

All but the lowest dams effectively block the passage of migratory fishes in both directions, since adults cannot pass through outlets going upstream or downstream, and juveniles and larvae do not survive passage through turbines going downstream. Fish can only be moved around dams by trapping and lifting mechanically, or on low dams through the use of fish ladders or flow ways. Thus, it seems nearly certain that in the absence of elevators or mechanical movement, migratory fishes will be effectively blocked from movement up or downstream in between the dams. Since fish are often migrating because of spawning opportunities upstream, this also means that recruitment to the population will be muted, perhaps catastrophically.

Land or reservoir-locked breeding populations of some migratory species do exist in the world but they are relatively rare; it is unknown whether the species of interest to White-bellied Heron will survive and reproduce in reservoirs.

Effects on resident fishes

The distinction between long-distance migratory and truly sedentary fish is an easy concept to portray. In practice, there are probably many riverine fishes that migrate short distances seasonally, and use floodplains and smaller streams during periods of floods or during spawning. While short-distance movements might make fish somewhat less vulnerable to the blockage of movements imposed by dams in comparison to true long distance migrants, there remain several dam effects that may be quite detrimental to locally moving fish. Dams create stable pools (reservoirs) above the dam and highly pulsed and unnatural releases of water into river reaches below; both conditions may be unsuitable for nonmigratory river fish. For example, reservoirs would offer a lower oxygen environment, greater thermal gradient and stratification, less cover and a much greater volume-to-surface ratio than the original riverbed, especially in the shallow, high gradient rivers of Bhutan. These changes in conditions would favour species tolerant of high temperatures and planktivorous feeding and select against those that need constant cold water, high oxygen and bottom-based insectivory or algae grazing. The constant environment may also remove cues for breeding, and it is possible that cues that identify spawning sites (current, temperature, smell of tributary streams) may become difficult for fish to find and aggregate in flat pool conditions of the reservoir. As an example, we are aware that White-bellied Heron relies to a substantial degree on snow trout as an important prey item in Bhutan. This is a bottom-feeding fish found in fast-moving and cold water that feeds on algae and insects living on the surface of rocks. These characteristics make the species very unlikely to do well in reservoirs.

Construction effects

Construction of dams requires large numbers of workers for a period of several years, and in aggregate may require several decades of construction to complete. The dam construction for the Punatshangchu II, for example, took many years and employed huge numbers of workers at various stages of construction; with camp followers, families and service vendors this number is likely to be a considerable underestimate. The effects of so many people in a relatively unpopulated valley in the center of the heron foraging and nesting distribution must be considered carefully. The very large number of workers involved will doubtless create a considerable demand for resources, including illegal fishing and other wildlife poaching activities. Effects of fishing on local fish populations are likely to be severe, and this is the resource that herons depend upon.

Construction may also directly affect disturbance to herons that forage in the river. Construction at various times for dams and hydropower structures is likely to occur over a 20-km stretch of river that sometimes spans major tributaries on which herons feed. Depending on the time of year and conditions, herons often forage on the main stem of the Punatshangchhu or at the tributaries. The disturbance from heavy construction, road works and large numbers of workers is likely to significantly alter the quality of foraging habitat for herons, and the efficiency of foraging, by repeated flushing.

During construction, power lines, cable lines and other kinds of wires will be placed across the river as temporary or permanent parts of the process of building bridges, dams and hydropower structures. Large birds tend to be susceptible to power line injuries for various reasons, including reduced manoeuvrability and large wingspan; herons often fly the river corridor at dusk and dawn (and perhaps at night); this suggests that power lines and other kinds of linear impediments across the river could be a recurring source of mortality for herons. Since the heron population is so small, even one or two deaths count heavily. From 2003 and 2025, seven herons in Bhutan were found dead related to collision and electrocution. Power line-induced mortality can be reduced in many cases by placing permanent shapes and markers on the lines.

Sightings of White-bellied Heron in hydropower areas

It was observed that the disturbance to herons mostly occurred during the construction phase of the infrastructure, such as hydropower, roads, and bridges. The high traffic movements, workers' movements, and use of explosives and machinery deter the herons from using the place. However, the few sightings were made of herons reusing the earlier habitat, especially in hydropower established sites, once the disturbance in the area subsides. Sightings were made of herons using even the large reservoir sites of hydropower for foraging ground. It was also found that the dewatered stretch of hydropower with enough flow of water (shallow depth) was used frequently by herons to forage.



Figure 7.1. White-bellied Heron at PHPA-II Reservoir (Photographed on 29 May 2025)

In addition, due to damming of rivers, the water entering the tailrace will be de-silted at the dam, and the silt load will be dumped at the bottom of each dam. Thus the river stretches between each dam and the next downstream reservoir and will have highly unnatural water release schedules, and will carry the entire normal silt load with a fraction of the normal flow.

Climate Change

Due to climate change impacts, the natural and climate-induced disasters like forest fires and floods will become more frequent and pose serious risks and threats to White-bellied Heron. More frequent occurrences of glacial lake outburst floods, landslides, and siltation in the river will negatively result in changes to riverine ecosystems and impacts to the wildlife including the heron.

Climate change can also affect the breeding behaviours and movement patterns of the heron. For instance, the study conducted (Acharja et al 2026) found that there is variation in egg laying dates from year to year, with this variability increasing in recent years. It was observed that the eggs laid in February and March are more successful in hatching than the eggs that are laid in later months of the breeding period. The shift in climate change will directly impact this phenophase of the heron, especially its breeding ecology.

Avian Disease

There is also a risk associated with diseases such as avian malaria and avian flu. Avian malaria is known to be caused by Plasmodium parasites and leads to high mortality rates in birds. The elevation range of White-bellied Heron distribution is found to be a favourable range for the transmission of avian malaria. Similarly, any unregulated presence of livestock farms lacking biosecurity measures along the river basins poses a serious risk in avian flu transmission and other diseases.

Predation by other Wildlife

Predation happens especially during the breeding season of the White-bellied Heron. The observations were made; in most cases, the breeding parents lost either eggs or chicks. The predation risk from other wildlife known so far includes Assamese Macaque, which is commonly observed at the nesting sites of White-bellied Heron, Yellow-throated Marten, Civet, and raptors birds. The research done in understanding nest predation dynamics (Khandu 2022) in one of the nesting sites in Bhutan (Burichhu, Tsirang) found that Masked Palm Civet was attempting to raid egg-baited traps. The study further identified seven other potential egg predators in the study site, including Assamese Macaques, Hoary-bellied squirrels, Gray Treepie, Common Green Magpie, Black Bulbul and Black-crested Bulbul.

Table 7.1. Threats and the contributing factors

Threats	Contributing factors
Timber extraction and NWFP harvesting	Inadequate homegrown/commercial substitute for forest resources
	Affordability/purchasing power for commercial substitute goods and services by local communities
Extraction of sand, gravel and stones	Inadequate homegrown/commercial substitute for forest resources
	Affordability/purchasing power for commercial substitute goods and services by local communities
Fishing in habitats	Market for local fish/Additional income, Community based Capture Fisheries
Construction of Dams	Inadequate implementation of mitigation measures
Collusion on network of naked electricity distribution lines	Inadequate stakeholder consultation and planning
	Energy demand & economic driver
Tourism & Recreational Activities (Rafting, photography, camping, picnicking, water-sports, fishing, Bird watching etc.)	Inadequate implementation and monitoring of tourism rules and regulations
	Lack of awareness & ethics of tourists, guides, rafters, birders, photographers, agencies and communities
	Lack of proper guidelines for recreational/tourism activities in heron habitats
Human-WBH co-existence (competition for habitat and resources)	Private land ownership within critical habitats
	Conventional farming & livestock rearing practice
	Collection of driftwood and other natural resources
	Unorganized/unregulated resource collection
	People's attitude and social association towards the wildlife
	Co-existence of farmlands
Infrastructure development (roads, bridges, services)	Water pollution and waste disposal
	Development Activities
Mortality, invasive species and predation/low population recruitment	Inaccessibility of some habitat areas and limited monitoring
	Human disturbances
	Decreasing food base
	Increasing population of Predators
	Low breeding population/small gene pool
	Limited knowledge, information and research available
Climate Change	Habitat alteration/loss due to fluctuations in seasonal flow and river volume (narrowing of river course, floods, erosion, and many other potential factors)

Documented case of egg predation

On 25 May 2022, a CCTV camera installed near the nest at Tsaidang recorded the loss of three eggs of White-bellied Heron to predation by the Assamese Macaque. The footage showed an adult macaque climbing to the nest tree and successfully driving away the incubating heron.



The macaque initially took one egg from the nest and descended to a lower branch. After a few minutes, the same individual returned to the nest and took the remaining eggs. During the second attempt, the parent heron tried to defend the nest by flying back to the nest, however, it was unable to prevent the macaque from taking the remaining eggs.

Figure 7.2. Assamese macaque predating eggs of White-bellied Heron

8: Conservation Strategies

Constant and consistent conservation programs are pursued to save the population of White-bellied Heron and its habitats. The conservation programs guided by White-bellied Heron Conservation Strategy (2015) and Conservation Action Plan (2022-2031), among others, include scientific monitoring, engagement and building community stewardship, threat mitigation, and establishment of conservation breeding facilities.

In Bhutan, the implementation of conservation works related to the White-bellied Heron is guided by the ten-year conservation action plan of the White-bellied Heron that was endorsed by the government. The action plan focuses on two approaches of conservation; the in-situ, conservation of wild population and their habitat, and ex-situ, strategies and actions for conservation breeding, ex-situ population management, and release plans.

Scientific Monitoring

Scientific monitoring is undertaken in a rigorous and constant manner, integrating traditional field-based monitoring and the use of cutting-edge technology. This includes the conduct of a nationwide annual population count of White-bellied Heron, daily monitoring by Local Conservation Support Group members, and the use of technology in monitoring the species and habitat. This enables the gathering of credible baseline data, which allows for designing targeted conservation programs.

Use of advanced science and technology has become critical in addressing some of the gaps of conventional observation and monitoring. The deployment of CCTV surveillance and camera traps at nesting sites helps in documenting elusive breeding behaviours and identifying causes of nest failure, such as egg predation. The unmanned aerial vehicles (UAVs) and non-invasive camera traps and acoustic monitoring are utilized to survey inaccessible riverine stretches and monitor other ecological behaviours of the heron. Attempts to use satellite transmitters (PTT) were made but found challenging due to the White-bellied Herons' physical features and the nature of their habitat. Constant effort is made to design feasible equipment, emphasizing the use of advanced tagging technology to study the post-fledging dispersal and seasonal site occupancy of juveniles.



Figure 8.1. White-bellied Heron incubating in the nest discovered through the aid of drone (March 2, 2026)

Drone trial for monitoring White-bellied Heron

In the beginning of 2025, RSPN with the support of Synchronicity Earth conducted drone trial in monitoring White-bellied Heron. The trial set out to achieve three aims related to the White-bellied Heron surveying and monitoring part. First, determine the cost-effectiveness of drone surveying and monitoring. Second, determine the capacity for drones to expand the area that is accessible for surveying and monitoring for herons. Third, determine the capacity for drone usage for survey and monitoring to decrease risk for persons conducting heron surveys and monitoring.

The results indicated that drones can deliver on all these aims. In total we found five White-bellied Herons with the drones. The surveys were made more effective as the drones provided data in a fraction of the time and allowed for access to areas that are virtually impossible to reach on foot. Even the usage of drones was found much safer for the survey team as there is no descending on risky footpaths where there is a chance of falling and/or encountering wildlife that poses a risk. The drone usage was also found safe for the herons, as no notice of any disturbance to the herons of the drone flying which is crucial as particularly during the nesting phase disturbance can potentially be detrimental to nesting success.

Community-based conservation approach

Local communities living within the White-bellied Heron landscape generally practice subsistence and conventional farming. They largely rely on the forest and its surrounding natural resources for their livelihood. The co-existence of White-bellied Heron and local communities is dependent on keeping these natural resources intact. Any human pressure on these natural resources is seen as a threat to forest and riverine ecosystem integrity that can disturb the livelihood of local communities and the survival of herons. Therefore, the community-based conservation supports are instrumental for successful conservation of the White-bellied Heron, transforming residents from competitors or threats to dedicated guardians of heron conservation. This involves integrating conservation works with community livelihood enhancement projects and incentivising the communities to embrace conservation, which indeed mitigate the threats to White-bellied Heron.

Some of the typical programs carried out include sustainable management of natural resources, climate smart agriculture, nature-based enterprises, and carrying out capacity building programs. The programs are designed in a manner that provides alternative livelihood opportunities and enhances their socio-economic conditions, thereby reducing pressure and dependence on natural resources. For instance, the support of a small-scale community fishery provides a sustainable source of food and income for the communities while reducing the pressure of illegal fishing in the herons' foraging grounds.

For heron conservation, communities also support through the membership of Local Conservation Support Groups. The group, which consists of voluntary community members, are trained to conduct regular monitoring of herons and support the implementation of conservation works in the communities.

Some milestones achieved in conservation of White-bellied Heron

RSPN's work for the White-bellied Heron integrated landscape-scale conservation, works to benefit the heron, associated species, communities, and overall environment. In the last five years alone, RSPN has achieved significant milestones in conservation of White-bellied Heron:

- *Improved 11 priority habitat sites of White-bellied Heron through 54.9 hectares of forest plantations.*
- *Over 100 local community members identified as the Local Conservation Support Group to support White-bellied Heron conservation program.*
- *Designated 1540 hectares of White-bellied as Key Biodiversity Areas (KBAs)*
- *Successfully installed bird flight diverters in key foraging and nesting sites of White-bellied Heron to mitigate collision risks of the herons with electric lines.*
- *Initiated a conservation breeding center for the White-bellied Heron*
- *Facilitated the community adoption of White-bellied Heron habitats in Punakha and Wangdue Phodrang, where residents now restrict activities like tree harvesting and fishing from key sites.*
- *Trained over 4000 people in biodiversity conservation, livelihood activities and climate adaptation activities*
- *Expanded Climate-Smart Agriculture initiatives to 35 sites across 18 Gewogs(Blocks).*
- *Provided reliable, clean drinking water to over 800 households through Rural Water Supply Scheme.*
- *Established and certified 32 village homestays, developed four eco-campsites, and created four nature trails to promote ecotourism in the White-belleid Heron landscape.*
- *Implemented solar/electric fencing across 550 acres of farmland, achieving 67% success rate in mitigating human-wildlife conflict.*
- *Hosted the White-bellied Heron International Conference in 2026.*
- *In the 2026 population survey of White-bellied Heron, Bhutan counted 31 individuals of White-bellied Heron and six active nests. The observation record is highest so far during more than two decades of conservation efforts.*

Ex-situ Conservation Effort

In tandem with in-situ conservation, an ex-situ conservation program is embraced as well to recover the species population and prevent it from total extinction. This conservation program strives to secure a gene pool and a mechanism to supplement the wild population through conservation breeding and a strategic release initiative.

The need for a conservation breeding center for White-bellied Heron was realised with the increasing risk of losing the species. Although captive breeding and reintroduction is only recommended for extinct or near extinct species, the extremely low population size and rapidly decreasing trend of the White-bellied Heron warrants such a program. Considering the current population status, survival rate, distribution and changing environment, it is apparent that conservation efforts for the next 20+ years may be necessary in order to conserve herons and achieve an ecologically effective population in the wild. The risk

is much attributed to a series of developmental activities like hydropower infrastructure planned along the rivers, the key habitats of herons. It is also important to consider natural calamities, climate change and impact on the ecosystem. With all the emerging natural, environmental, and man-made pressures, the wild population might become extinct any-time in the near future without immediate conservation measures. Therefore, the establishment of a safe and reliable ex-situ gene pool, and complementing the wild population through a captive breeding and release program has become necessary to continue conservation and research. Accordingly, in 2011, with the financial support from Punatshangchhu Hydroelectric Project Authority (PHPA) and technical support from the San Diego Zoo, USA (Dr. Michael Mace, Mr. Don and Debbie), and Dr. George Archibald, International Crane Foundation, USA, RSPN conducted the first artificial incubation and captive rearing of White-bellied Heron with an egg lifted from the wild nest. The chick was successfully reared and released back to the wild after being raised in captivity for 134 days. This experiment not only helped gain skills in captive management and build confidence to revive the population through such a conservation breeding program, but also gave the opportunity to understand its developmental processes, dietary preferences, and biology. Following the success of 2011 captive rearing program of White-bellied Heron, the International conference held in December 2015 in Punakha, Bhutan, further recommended the urgent need to establish the conservation center in Bhutan to safeguard the species from extinction.



Figure 8.2. White -bellied Heron Conservation Center

In 2018, with another round of support from PHPA, the basic infrastructure required for the establishment of a long-term conservation center was established at Changchey Dovan,

under Tsirang district in Bhutan. The center known as White-bellied Conservation Center is established within 18.224 acres of land. Its geographical locations are; 27° 2'1.71"N and 90° 4'34.01"E at an elevation of 375 masl. The landscape is defined with a plateau at the confluence of the Punatshangchhu and Changcheychhu. The plateau is well above risk of inundations from flood waters and is bordered by undisturbed forest. In addition, it falls within the currently occupied habitat of White-bellied Heron and remains close to some of the most frequently used foraging areas. The area is close to two currently known nesting sites, which would be easily accessible for collection of founder population for the center. The Changcheychhu which flows within 50 meters of the center will serve as a site to prepare birds (soft release) for release to the wild.

The center started to fully operate in 2021 with the raising of three White-bellied Heron chicks that were lifted from the wild nest. The center is designed with facilities to house and breed herons with specialized facilities such as aviaries, a veterinary and quarantine center to manage diseased or rescued birds, and the fish ponds to ensure a consistent food base for the herons.

The main programs in the center include the following:

Captive population management

Population management is integral to successful conservation. Thus, the contribution of the centre to ex-situ conservation via captive breeding program requires prudent population management planning. The purpose of population management is to ensure that populations of White-bellied Herons are stable, healthy, and viable for the foreseeable future. During the initial phase, the center focuses on maintaining sufficient breeding pairs and non-breeding birds to ensure a robust genetic diversity.

The management, reproduction and breeding procedures of White-bellied Heron in captivity will be guided by the previous experience and the experts from different species avicultural practices around the world. Attempts are made to replicate natural breeding behaviours via facility procedures. The breeding pairs will be allowed to naturally copulate, lay and incubate eggs, and rear young without significant human intervention.

Genetic management

To meet the long-term goal of achieving a sustainable population, it is vital to maintain a viable genetic diversity and demographic security. Maintaining genetic diversity will help reduce the dilution of genetic constitution. The genetic goals of captive breeding programs are currently based on maintaining overall levels of average heterozygosity. It is therefore important to maximize genotype diversity of the captive bird to be released in the wild. Emerging techniques in molecular genetics are utilized to assess founder genetic diversity, and guide continuing management and monitoring of successive generations to maximize both retention and future genetic diversity within the population.

Ex-situ research

The captive population will also provide an opportunity for researchers to investigate more about the species biology, conservation needs and train field workers especially in protection and fitting radio transmitters on the captive birds. RSPN liaise with relevant stakeholders in conducting research, developing hands-on training and capacity building programs for researchers.

Some of the research areas embarked are on genetic diversity, life cycle/lifespan, reproductive age, breeding biology, avian diseases, artificial incubation parameters, developmental biology, and dietary requirements and preferences.

Information hub

The information hub at the center related to White-bellied Heron and other biodiversity components of Bhutan is the first stop point for the visitors. The information center aims to enhance awareness and knowledge on White-bellied Heron, its conservation program, and operates as a one-stop shop for information and resources.

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Appendix I

White-bellied Heron Population Survey record for each year since 2003

Location	Year												
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ada	3	4	3	2	2	2	2	4	3	4	2	3	2
Dagachhu	0	0	0	0	0	0	0	0	0	0	0	0	2
Kamechhu	3	2	2	2	2	4	3	2	1	1	0	0	0
Mochhu	0	3	1	1	1	2	1	0	0	0	0	1	1
Nangzhina	0	0	0	2	2	4	7	6	5	4	4	3	2
Punakha	4	2	2	2	2	3	3	1	1	0	0	0	0
Zawa	2	4	4	4	2	2	1	2	0	0	2	0	0
Doksum	0	0	0	0	0	0	0	0	0	0	0	0	0
Yangbari	0	0	0	0	0	0	0	0	0	0	0	0	0
Kisonachhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Rangae Khola	0	0	0	0	0	0	0	0	0	0	0	0	0
Baragumtey	0	0	0	0	0	0	0	0	0	0	0	0	0
Samarchhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Berti	0	0	0	3	4	4	5	0	3	4	2	3	2
Phochhu	2	3	3	2	5	3	2	1	3	4	3	4	4
Lamoyzhingkha	0	0	0	0	0	0	0	0	0	0	0	0	0
Goling	0	0	0	0	0	0	0	0	0	0	0	0	0
Kurichhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Burichu - Serutar	0	0	0	1	2	2	1	0	0	2	4	2	3
Phibsoo	0	0	0	0	0	0	0	0	0	0	0	2	3
Sunkoshgoan	0	0	0	0	0	0	0	2	2	1	0	0	2
Relangthang-Walk-leytar	0	0	0	0	0	0	0	0	0	0	0	2	2
Toedsang Balwani	0	0	0	0	0	0	0	0	0	0	0	0	0
Hararongchu	0	0	0	5	3	4	4	5	4	2	3	2	5
Gewaronchu	0	0	0	0	0	0	1	3	2	0	0	0	0
Tshaidang	0	0	0	0	0	0	0	0	0	0	0	0	0
Thamchen-Jigmech-hu	0	0	0	0	0	0	0	0	0	0	0	0	0
Wangchhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Mangdechhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Chamkharchhu	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Mangdechhu (Pantang-Panbang)	0	0	0	0	0	0	0	0	0	0	0	0	0
Manas (Karnamakarachhu)	0	0	0	0	0	0	0	0	0	0	0	0	0
Ex-situ Population	0	0	0	0	0	0	0	0	0	0	0	0	0
Total No.	14	18	15	24	25	30	30	26	24	22	20	22	28

Location	Year										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Ada	2	2	2	0	0	0	0	0	0	0	0
Dagachhu	0	0	0	0	2	0	0	1	1	2	0
Kamechhu	1	1	1	0	1	3	3	0	1	0	1
Mochhu	0	0	0	0	0	0	0	0	0	0	0
Nangzhina	2	1	1	0	0	0	0	0	0	0	0
Punakha	0	0	0	0	0	0	0	0	0	0	0
Zawa	0	0	0	0	0	0	0	0	0	0	0
Doksum	1	0	0	0	0	0	0	0	0	0	0
Yangbari	0	0	0	0	1	0	0	0	0	0	0
Kisonachhu	0	0	0	0	3	0	0	2	2	2	2
Rangae Khola	0	0	0	0	2	1	2	0	1	1	2
Baragumtey	0	0	0	0	0	0	1	0	0	0	2
Samarchhu	0	0	0	0	0	0	0	0	0	0	1
Berti	4	3	4	1	1	3	1	0	0	0	0
Phochhu	4	3	1	1	2	0	0	1	0	0	0
Lamoyzhingkha	1	2	1	1	0	3	0	3	1	0	0
Goling	0	0	0	1	2	2	1	1	1	0	1
Kurichhu	0	0	0	1	0	0	0	0	0	0	0
Burichu - Serutar	3	5	5	2	2	4	2	0	0	1	0
Phibsoo	3	3	3	2	0	1	1	2	2	4	3
Sunkoshgoan	1	1	1	1	1	0	0	2	2	0	0
Relangthang-Walkleytar	2	2	2	2	2	0	3	2	2	4	2
Toedsang Balwani	0	0	0	2	3	2	0	2	0	2	2
Hararongchu	4	3	3	3	0	0	2	1	2	0	1
Gewaronchu	0	0	0	4	0	0	0	0	0	0	0
Tshaidang	0	0	0	4	5	2	2	2	2	2	4
Thamchen-Jigmechhu	0	0	0	0	0	0	0	3	3	3	1
Wangchhu	0	0	0	0	0	0	1	1	0	1	1
Upper Mangdechhu	0	0	0	0	0	0	0	1	1	0	1
Chamkharchhu	0	0	0	0	0	1	2	0	1	2	1
Lower Mangdechhu (Pantang-Panbang)	0	0	0	0	0	0	2	0	0	0	0
Manas (Karnamakarachhu)	0	0	0	0	0	0	0	0	0	0	1
Ex-situ Population	0	0	0	0	0	3	2	3	3	5	5
Total No.	28	26	24	25	27	25	25	27	25	29	31

Appendix II

Record of Nesting site since 2003

Nest Location	Latitude	Longitude	Year	Status
Domthang, Zawa	27.296	90.048	2003	Successful
Domthang, Zawa	27.296	90.048	2004	Successful
Yuetama	27.294	90.051	2005	Successful
Yuetama	27.294	90.051	2006	Successful
Nangzhina One	27.225	90.082	2006	Successful
Yuetama	27.294	90.051	2007	Successful
Basochu	27.340	89.924	2007	Successful
Nangzhina Two	27.236	90.090	2007	Successful
Harachu	27.201	90.090	2007	Successful
Adha	27.300	90.105	2007	Successful
Nangzhina Two	27.236	90.090	2008	Successful
Nangzhina Three	27.253	90.087	2009	Successful
Nangzhina Three	27.225	90.082	2010	Successful
Nangzhina Four	27.236	90.090	2011	Successful
Changbaling	27.142	90.606	2011	Successful
Changbaling	27.142	90.606	2011	Successful
Phochu	27.609	89.867	2011	Successful
Nangzhina Four	27.257	90.083	2012	Successful
Adha	27.300	90.105	2012	Successful
Burichu Confluence	27.077	90.073	2012	Failed
Phochu Bjara	27.601	89.873	2012	Failed
Adha	27.300	90.105	2013	Successful
Tshosabu	27.682	89.934	2013	Successful
Harachu Upstream	27.210	90.118	2014	Successful
Adha	27.300	90.105	2014	Successful
Burichu Plantation Opp	27.093	90.068	2014	Successful
Wakleytar	27.143	90.066	2014	Successful
Tshosabu	27.682	89.934	2014	Successful
Harachhu Downstream	27.206	90.115	2015	Successful
Adha	27.300	90.105	2015	Successful
Khoti	27.147	90.631	2015	Successful
Tshosabu	27.682	89.934	2015	Successful

Nest Location	Latitude	Longitude	Year	Status
Khoti	27.147	90.631	2016	Successful
Burichu Confluence	27.077	90.073	2016	Successful
Khoti	27.147	90.631	2017	Successful
Burichu Cliff	27.089	90.070	2017	Failed
Tsaidang	27.101	90.753	2018	Successful
Burichu	27.101	90.071	2018	Failed
Burichu	27.089	90.070	2018	Failed
Relangthang	27.123	90.070	2018	Successful
Relangthang	27.123	90.070	2019	Successful
Kisonachhu	27.211	90.067	2019	Successful
Relangthang	27.123	90.070	2020	Successful
Tsaidang	27.101	90.753	2020	Failed
Balwani	26.917	90.037	2020	Successful
Tsaidang	27.101	90.753	2021	Successful
Relangthang	27.123	90.070	2021	Successful
Balwani	26.917	90.037	2021	Successful
Tsaidang	27.101	90.753	2022	Failed
Tsaidang (re-nest)	27.101	90.753	2022	Failed
Relangthang	27.123	90.070	2022	Successful
Balwani	26.917	90.037	2022	Failed
Tsaidang	27.101	90.753	2023	Failed
Relangthang	27.123	90.070	2023	Failed
Balwani	26.917	90.037	2023	Failed
Balwani(re-nest)	26.953	90.029	2022	Failed
Tsaidang	27.099	90.756	2024	Successful
Relangthang	27.123	90.070	2024	Failed
Balwani	26.933	90.042	2024	Successful
Kisonachhu	27.211	90.067	2024	Successful
Tsaidang	27.085	90.778	2025	Successful
Relangthang	27.123	90.070	2025	Failed
Balwani	26.933	90.042	2025	Failed
Kisonachhu	27.211	90.067	2025	Failed
Tsaidang (Bulichhu)	27.098	90.758	2026	Successful
Tsaidang (Near Praling)	27.063	90.787	2026	Successful
Kisonachhu	27.123	90.071	2026	Successful
Relangthang	27.123	90.071	2026	Successful
Balwani	26.933	90.042	2026	Failed
Rangaekhola	26.882	90.007	2026	Successful

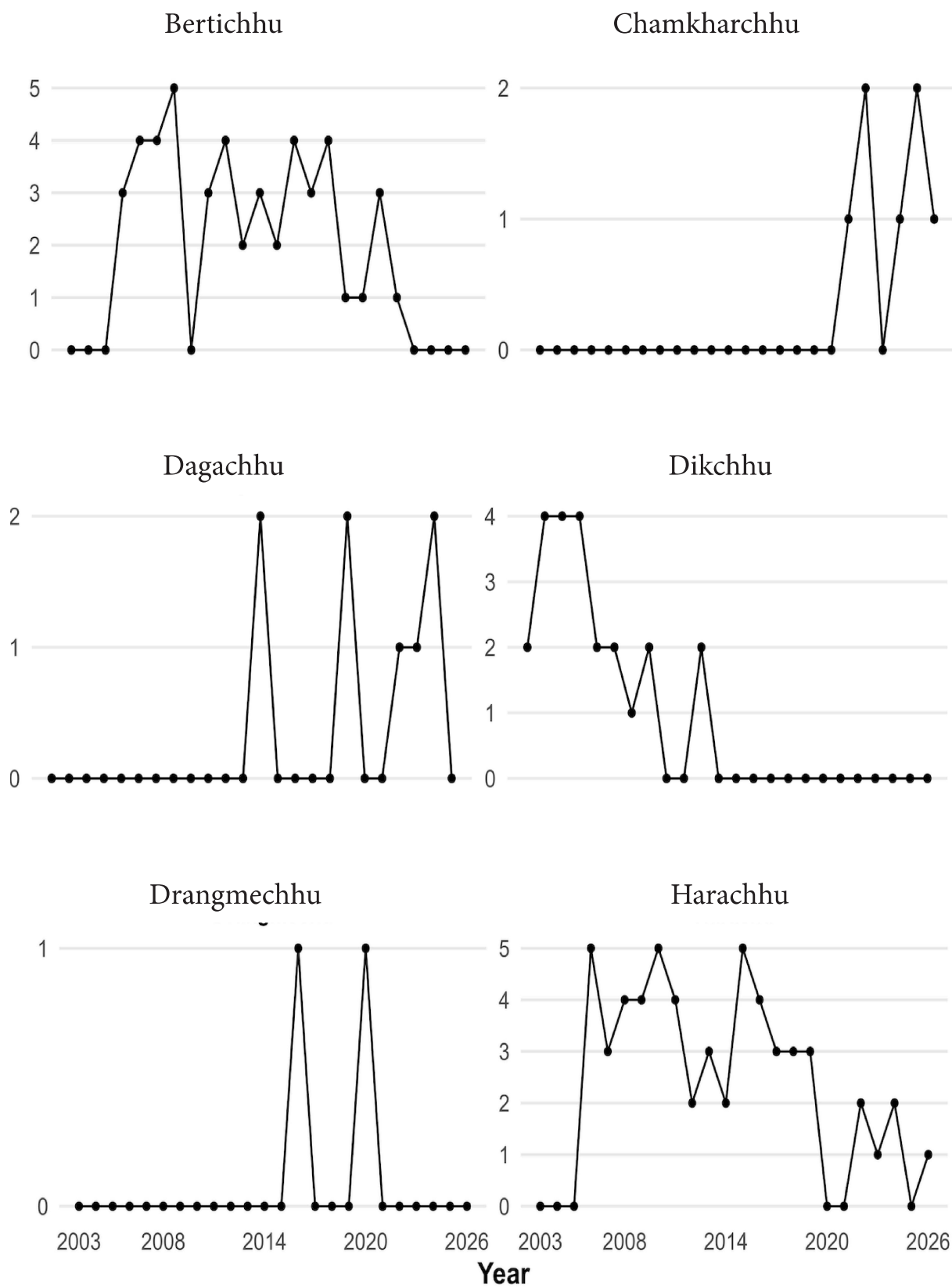
Appendix III

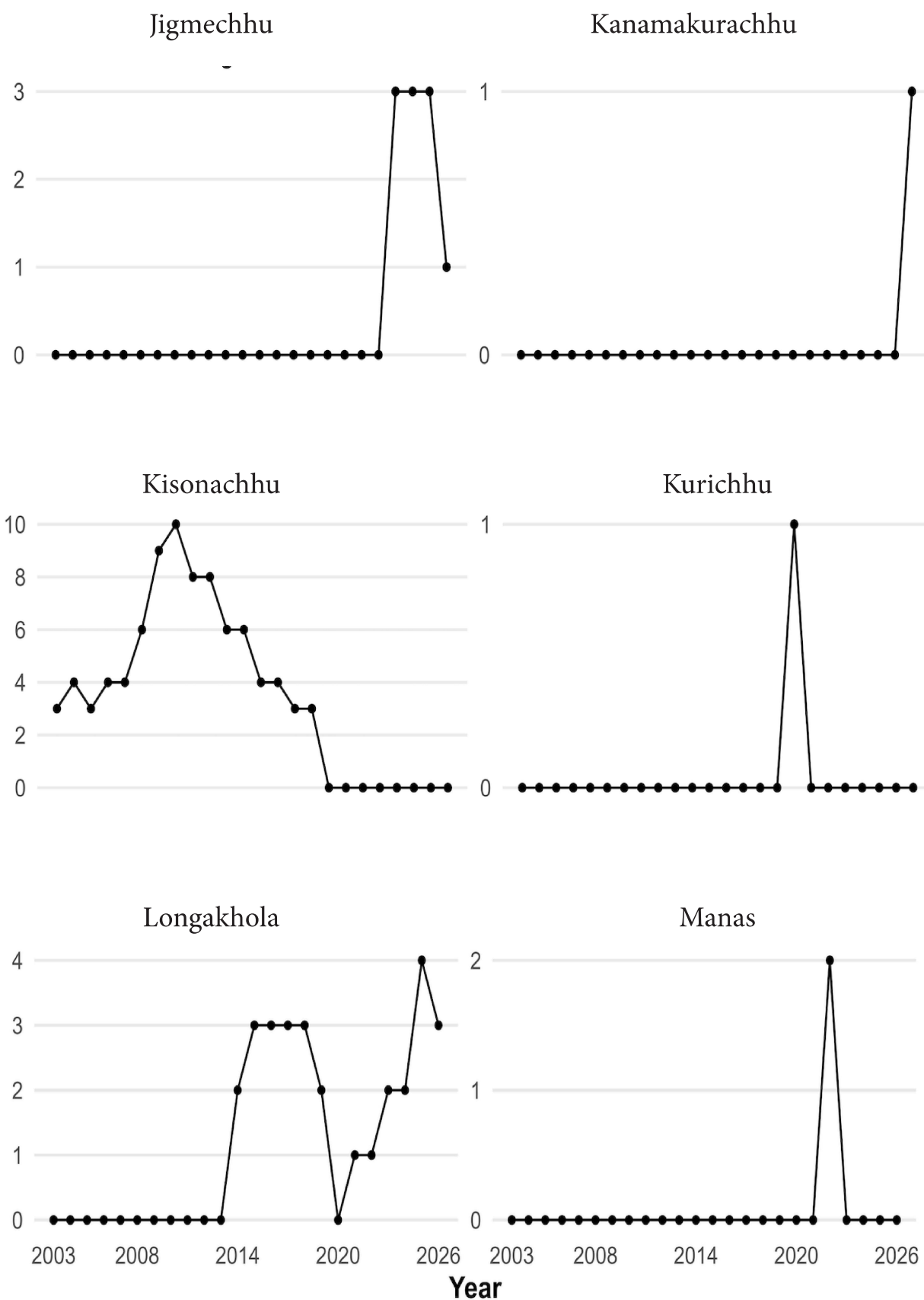
White-bellied Heron Mortality record

Year	Location	No. of Death	Remarks
2008	Basochhu	1	Electrocuted
2011	Phochhu	3	Predation
2012	Kamechhu	1	Collision with powerlines
2012	Phochhu	1	Electrocuted
2013	Hararongchhu	1	Injury
2014	Kamechhu	1	Electrocuted
2014	Hararongchhu	2	Predation
2015	Burichhu	1	Fell from the nest
2015	Hararongchhu	1	Predation
2015	Tshosabu	2	Unidentified Cause
2017	Kalikhola	1	Predation
2018	Berti	1	Collision with powerlines
2019	Toebirongchhu(Begana)	1	Collision with powerlines
2019	Kisonachhu	1	Injury
2019	Pagna, Tsangkha	1	Predation
2020	Tsaidang	1	Infanticide
2021	WBHCC	1	Collision with pillar
2021	Changcheychhu (above confluence)	1	Unidentified Cause
2022	Tsaidang	3	Predation
2022	Burichhu	1	Unidentified Cause
2023	WBHCC	3	Deformities
2023	Tsaidang	2	Predation
2024	WBHCC	1	Deformities
2024	Kisonachhu	1	Fell from the nest
2025	Goling	1	Collision with powerlines
2025	Kisonachhu	1	Fall from nesting tree
2025	Relangthang	1	Likely of predation by Owl(Spot-bellied Eagleowl)

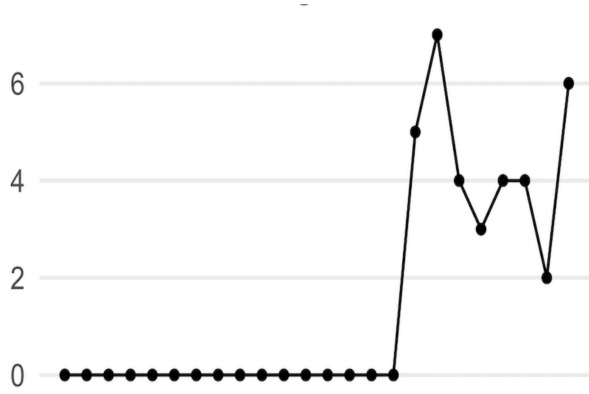
Appendix IV

White-bellied Heron distribution by rivers since 2003

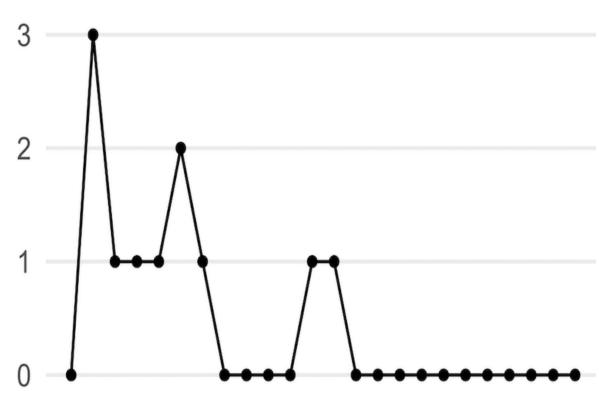




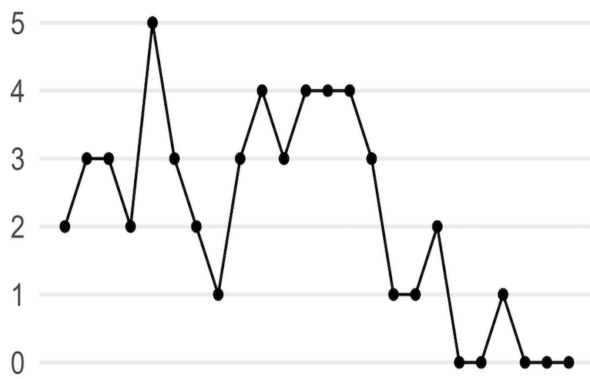
Mangdechhu



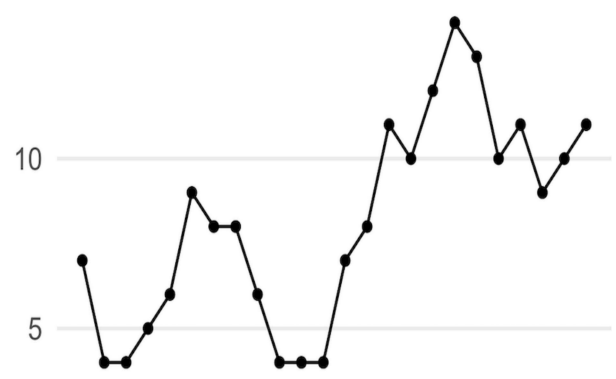
Mochhu



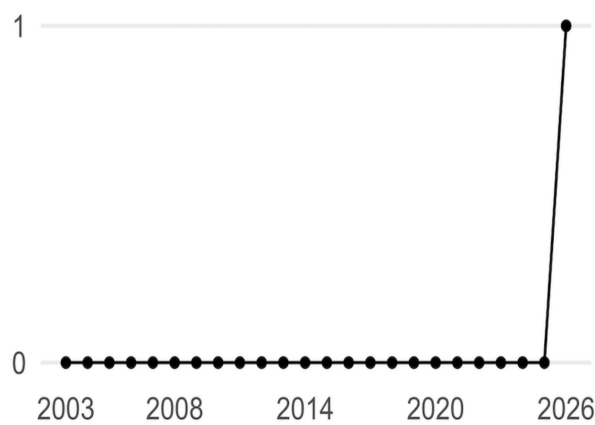
Phochhu



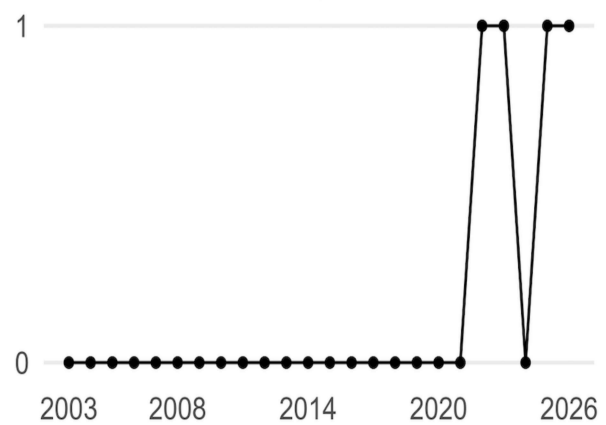
Punatshangchu



Samachhu



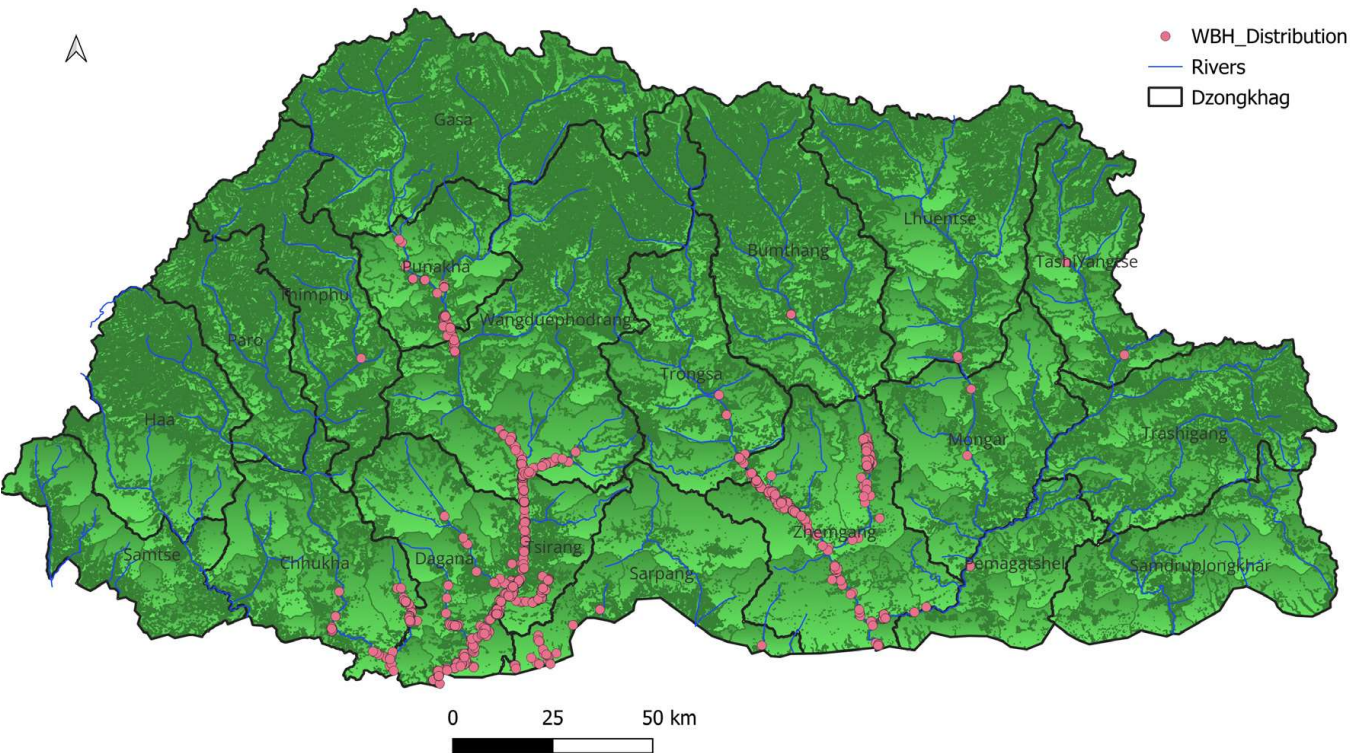
Wangchhu



Year

Appendix V

Map 1: White-bellied Heron distribution from 2016 - 2026 in Bhutan.



Map 2: White-bellied Heron habitat zones in Bhutan.

