



White-bellied Heron

Conservation Center Establishment and Management Plan



Royal Society for Protection of Nature

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TEAM & ACKNOWLEDGEMENTS

Authors

Mr. Indra Prasad Acharja, Chief, Species and Habitat Conservation Division

Mr. Jigme Tshering, Chief, Environmental Education & Advocacy Division

Mr. Tashi Phuntsho, Chief, Communications and Membership Division

Mr. Sonam Tshering, Sr. Research Assistant.

Mr. Tshewang Lhendup, Researcher

Mr. David Hecht, Research Partner

Advisors

Dr. Kinley Tenzin, Executive Director

Mrs. Rebecca Pradhan, Sr. Ecologist, WBH Expert.

Dr. Lungten Norbu, Specialist

Mrs. Catherine E. King, Long-legged Waterbirds Specialist

WBH International Technical Advisory Committee

Design and Layout

Mr. Sonam Rinzin, CED, RSPN

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ACRONYMS

WBH	White-bellied Heron
CCP	Conservation Center Plan
CC	Conservation Center
m.a.s.l	Meters above sea level
IUCN	International Union for the Conservation Nature
LCSG	Local Conservation Support Group
ITAC	International Technical Advisory Committee
ITACM	International Technical Advisory Committee Meeting
PMC	Population Management Center
UWICER	Ugyen Wangchuck Institute for Conservation and Environmental Research
CNR	College of Natural Resources
HR	Human Resources



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PREFACE

The White-bellied Heron (WBH) Conservation Center Plan (CCP) is a collaboratively generated document intending to guide conservationists and aviculturists to manage WBH in the conservation center. The information collated within this plan ensures a more organized, structured, and informed approach to the captive breeding and future successful release of the WBH in Bhutan. The WBH CCP is written as a dynamic document, representing current understandings of WBH ecology, captive rearing, and recommendations for managing this critically endangered species both in the breeding center and in the wild. While captive rearing of WBH was successfully explored in Bhutan through a collaborative endeavor with the San Diego Zoo, this reference will be the first of its kind. Therefore the 2020 CCP aims to form the basis for any future documents of this type to guide both center management and WBH population vitality.

Since 2003, in collaboration with partners, RSPN has collected invaluable data on WBH ecology that has helped to guide community-based conservation initiatives and joint projects to ensure the protection of this critically endangered species and the habitat upon which it depends. Over these years, dedicated professionals and a collection of diverse field experiences have improved and refined our knowledge-base, and the authors of this document have worked to gather together the most up-to-date information from that base of knowledge to develop the first WBH Conservation Center Plan. While much information and data was compiled in the process, many holes in the knowledge-base still exist. We hope that this plan not only serves to guide its users in the management and operation of the center, but also act as a catalyst for future development and scientific inquiry.

This CCP is divided into four sections. The first part of the document describes the life history and conservation status of the WBH within and in its global range, to the best of our knowledge. The second part of the document constitutes the population management, describing logistical concerns and infrastructural details to help guide present functionality and future developments maintaining genetic diversity. The third section is the center management, population, operations and facilities, and the fourth section is the Husbandry, detailing adapted guidelines for aviculture, care, and general captive management of endangered bird. As this manual is the first of its kind, given that all husbandry and care manuals within zoos and/or captive care or breeding facilities are highly species specific, this chapter aims to draw together data generated from WBH captive rearing trial in Bhutan from 2011, as well as lessons learned from other avian husbandry manuals.

It should be emphasized that the recommendations here-within are guidelines, and in all cases common sense and educated actions concerning center and animal management should be used. As a not-for-profit institution, the Royal Society for Protection of Nature (RSPN) operates and is guided by certain institutional parameters. As a living document the CCP will necessarily need to adapt to future changes in operations, finances, and management. We intend for this information to be revised and updated on a regular basis, not to exceed 5 years for each subsequent version.



VISION

"Improve the population vitality of White-bellied Heron in Bhutan, through scientifically-grounded conservation breeding, sound aviculture processes, and dedicated research."

GOALS

Establish a viable ex-situ gene pool.

Increase the global population of White-bellied Herons through conservation breeding and release program.

Maintain a stable wild population and promote juvenile recruitment.

Build capacity of staff and partners to effectively manage and operate the Conservation Center.

Advance public awareness and participation in the conservation of White-bellied Heron.



INTRODUCTION

Since 2003, the Royal Society for the Protection of Nature (RSPN) has been working to conserve and protect the critically endangered WBH in Bhutan, through scientific research, education & outreach, and community-based conservation projects. Through the diligent development of dedicated global partnerships around the world, the WBH Conservation Center was born, with a vision of supporting the wild population through modern captive breeding and rearing techniques in a well-designed center located in Tsirang, Bhutan.

With only 60 known individuals left on the planet, the WBH is on the verge of extinction, compelling the country's stewards of this species to pursue measures to try and revitalize the wild population, in this case through advancements in conservation breeding and captive population management. While captive breeding is usually not recommended within standard guidelines for conservation, requiring vast amounts of time, capital, and expertise, it is seen as a viable last resort in the case of critically endangered species, and likely one of the only ways to feasibly envision saving this species from extinction.

A pilot captive rearing project was initiated in 2011, through a collaborative partnership between RSPN and the San Diego Zoo. The project gathered invaluable preliminary data and knowledge that will help to guide the institutionalization and husbandry operations of the captive rearing centre. The success of this initial endeavor brings hope to the daunting prospect of upscaling conservation breeding strategies to ensure a future for the species.

While the primary focus of the WBH Conservation Center will be to safely breed WBH in captivity and release the birds back into their natural habitat, the centre will also act as a hub for emerging research, education and advocacy, and a catalyst to inspire changemakers within their home-range to look for out-of-the-box solutions for the species at large.

As this the first time a project of this scale and complexity has been undertaken for the species, there is important information and knowledge that we aim to address in this manual as well as significant knowledge gaps that will need to be explored in the future. We hope the WBH Conservation Center Plan will serve as a useful living document for those responsible for center operations, staff in-training, and future generations who carry the torch forward to protect the WBH, Bhutan's natural heritage.



01

NATURAL HISTORY

Taxonomy

The White-bellied Heron (*Ardea insignis* Hume, 1878) is the second-largest heron species of the family Ardeidae, order Pelecaniformes, and is found in freshwater ecosystems of the Himalayas. It was described by A. O. Hume in 1878 (Stray Feathers 6:470) as *Ardea insignis*.

This species has had a rather chequered nomenclatural history, having been linked with the specific names *fusca*, *insignis* and *nobilis* (Blyth 1844, Gray 1844, Gray and Gray 1846, Stray Feathers 6 [1878]: 470–472) as well as *imperialis*. Although *insignis* gained general acceptance, E. C. S. Baker (Bull. Brit. Orn. Club 49 [1928]: 40) later argued that it uses was invalid (a *nomen nudum*) and renamed the species *Ardea imperialis*. Although it was named the Imperial Heron *Ardea imperialis* by Collar and Andrew (1988), the accepted name now is *Ardea insignis*, the White-bellied Heron.

Scientific classification

KINGDOM	:	Animalia
PHYLUM	:	Chordata
CLASS	:	Aves
ORDER	:	Pelecaniformes
FAMILY	:	Ardeidae
GENUS	:	<i>Ardea</i>
SCIENTIFIC NAME	:	<i>Ardea insignis</i>
AUTHORITY	:	Hume, 1878
SYNONYMS	:	<i>Ardea imperialis</i> ssp. <i>imperialis</i> Hume, 1878 – Collar and Andrew (1988)

Common name

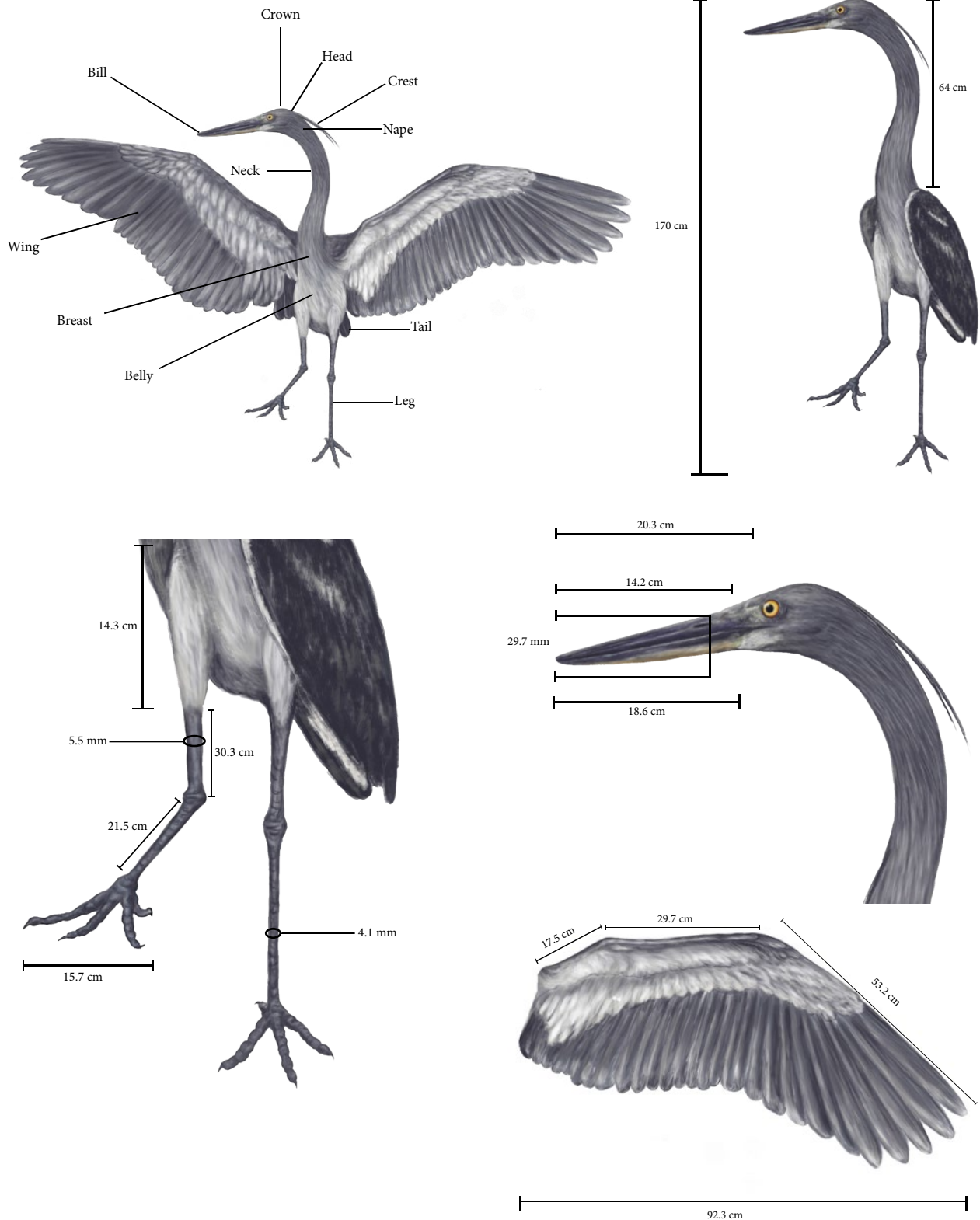
ENGLISH	:	White-bellied Heron
DZONGKHA	:	Chubja Phowkarp, Bja Eako Raem
LHOTSHAMKHA	:	Saray Haas, Raja Haas
KHENGKHA	:	Woong rila
SHARCHOPKHA	:	Ngangkha (not confirmed)
YANGTSEPAKHA/DZALAKHA	:	Ngäp-bja

Physical description

The WBH is a large, long-necked, and long-legged water bird found along the open banks of freshwater river systems in inner Himalayas. Its body is dark greyish with contrasting white throat, belly and vent, and white-streaked scapulars, fore neck and upper breast. Both male and female have two lace-like white-plumes; crest on nape. During breeding seasons, plumage turns light grey with whitish neck and crest. Juveniles appear darker than adults with more streaked neck, browner-tinged vent and smaller plumes. It has a large and sharply pointed black bill with slightly serrated lower mandible at the tip. The chin and lower mandible are whitish underside while upper mandible is black. Juveniles have shorter and greyish bill. The legs are blackish with scale-like texture on the tarsus. In flight, it



has a uniform dark grey upper wing and white underwing-coverts contrasting with dark grey flight feathers. The rump appears paler grey.



Physical characteristics of White-bellied Heron (Measurements are based on a single dead individual)



Vocalization and displays

White-bellied Herons are generally silent and call only during courtship or alerted. It has generally three distinguishable calls;

Courtship Call

During breeding season, herons usually stay in pairs and frequently call for each other when not in view. They usually call for partner during breeding season, even during the night and early morning. While building the nest, male usually fly out and collect materials and occasional female greet the male as it approaches the nest. The female greets him by making a deep loud croaking display call; auk auk auk urrrrrr. Usually after several calls they copulate.

Alert Call

The heron assumes the Upright alert posture when it senses a disturbance or threat. In the Upright, the heron raises its head up and out until straight, body feathers are raised moderately, and a threat call is usually given. It is usually short and loud croaking call; auk urr.

Call for partner

While guarding the nest, the partner in the nest usually call for other partner if it does not return to nest on time. They also sometimes call for partner while foraging or even young juveniles waiting for parents. It is usually short and loud croaking call; auk, urrr.



Image 1: WBH calling



Image 2: WBH calling in nest

Habitat and ecology

The WBH is primarily found in small to large rivers in inner Himalayas and foothills. They also occupy inland swamps, lakes, and rivers with sand or gravel bars, often within or adjacent to temperate and subtropical/tropical broadleaved forests. The bird is preferably piscivorous, and it can be found feeding along the shallow banks with medium to low riffle at 30–60 cm water depth.

Current data indicate that they breed in Chirpine and broadleaved forests between 200 - 1500 m.a.s.l. It is generally solitary but may aggregate into small flocks and family groups during winter and breeding seasons. The WBH is observed to be highly sensitive to disturbances and threats. The minimum flush distance in feeding habitat to human presence is 150 m. It is likely that the distance is even smaller for nesting habitat.



Image 3: WBH typical habitat



Image 4: WBH habitat at Phochhu

Territoriality

Unlike most other heron species, WBH lives in solitude. Its solitary nesting behavior is one of the distinct characteristics of WBH from its sister-species that nests colonially. 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, which can form colonies of up to 6, depending on brood size. Parents feed juveniles up to 2 - 3 months after fledging and are tolerant to their presence around until a few months after leaving the nest. Looking at the nesting and feeding behavior, WBHs are slightly territorial and often become aggressive when intruder approach into their territory. However, no detailed studies have been conducted on their territoriality and site selection behavior.

Diet and foraging habitat

Although herons in general are carnivores; feeding on anything ranging from macro invertebrates to even small mammals, the WBH is found to be restrictive in dietary preferences. It is believed to be a piscivore as there is no evidence of it foraging on any other species.

Common fish species found along the WBH feeding habitats in Bhutan					
Location	Scientific Name	Location	Scientific Name	Location	Scientific Name
Punatsangchhu	<i>Barilius bendelisis</i>	Mangdechhu	<i>Barilius barna</i>	Kurigongri	<i>Garra gotyla</i>
	<i>Amblyceps apangi</i>		<i>Garra gotyla</i>		<i>Garra lissorhynchus</i>
	<i>Crosssocheilus lattius</i>		<i>Neolissochilus hexagonolepis</i>		<i>Glyptothorax sp.</i>
	<i>Garra annandalei</i>		<i>Parachiloganis hodgarti</i>		<i>Lepidocephalichthys guntea</i>
	<i>Glyptothorax cavia</i>		<i>Salmo trutta</i>		<i>Neolissochilus hexagonolepis</i>
	<i>Neolissochilus hexagonolepis</i>		<i>Schizothorax progastus</i>		<i>Psilorhynchus homaloptera</i>
	<i>Salmo trutta</i>		<i>Schizothorax richardsonii</i>		<i>Schistura reticulofasciata</i>
	<i>Schizothorax progastus</i>		<i>Tor putitora</i>		<i>Schizothorax richardsonii</i>
	<i>Schizothorax richardsonii</i>				
	<i>Tor putitora</i>				

Table 1: Fish species found in WBH foraging habitats in Bhutan



The WBH are known to forage on a wide variety of locales in fresh water bodies, including rivers and streams of both fast-flowing and still, wetlands and lakes. They also feed on water of varied turbidity ranging from clear water during winter to hazy lakes to highly turbid flooded waters during summer. They are sensitive to disturbances, particularly human caused disturbances and require a minimum of 150-200 m of flush distance. Presence of disturbances or interactions often result in heron shifting to new habitat or even abandoning the area for a prolonged period.

Feeding behavior and techniques

The WBH are mostly seen foraging in low lights, during early morning and late afternoon. They usually bask or rest during midday. It is often seen foraging along the shallow banks with medium to low riffle at 30–60 cm water depth. They also feed in still or stagnant waters in lakes and ponds. They are rarely seen diving into deeper water.

It displays various foraging techniques in natural feeding site. The most common techniques include, Stand and Wait, Stalk Slowly, Neck Craning, Pecking, Plunging and Foot Stirring. Stand and Wait is most commonly used method of all. The Stand and Wait duration vary from between 5 minutes to an hour before it pecks on the surface of the river and mostly accompanied with a successful catch of the prey. They swallow fish, head first and drink water several times before they begin the next hunt. When the catch is big, they move to a safer area out of water and let fish partially die before they rinse and swallow.



Image 5: WBH feeding



Image 6: WBH drinking water

When the areas around the foraging sites have enough open space with deposition of sand and gravel, it stalks around scanning for better feeding site and food. They also plunge their head into the surface of the water with their neck half immersed while the wings remain flapping in the air, and tuck out their catch. When the water is still, they also stir the water bottom, slowly scratching the substratum layer probably trying to lure fish out of the rock or crevasses.

Roosting and basking

After feeding for a few hours, the WBH usually roost or rest on trees nearby or on the banks of the river on large rocks or logs, occasionally on sparse low growing clumps of grass or shrubs during midday. It is observed that heron prefers to feed during low light, before the sun reaches to feeding site and roost in shade when its bright and hot. They are also often seen basking in the sand bar during the sunrise or late afternoon. They roost hunched or partially recumbent, resting on the tarsometatarsal. They are also often seen resting on sand bars, rocks, logs or even nearby trees after feeding, usually preening, cleaning and wiping bill.



Image 7: WBH resting on Chirpine



Image 8: WBH resting on rock



Image 9: WBH night roosting



Image 10: WBH basking

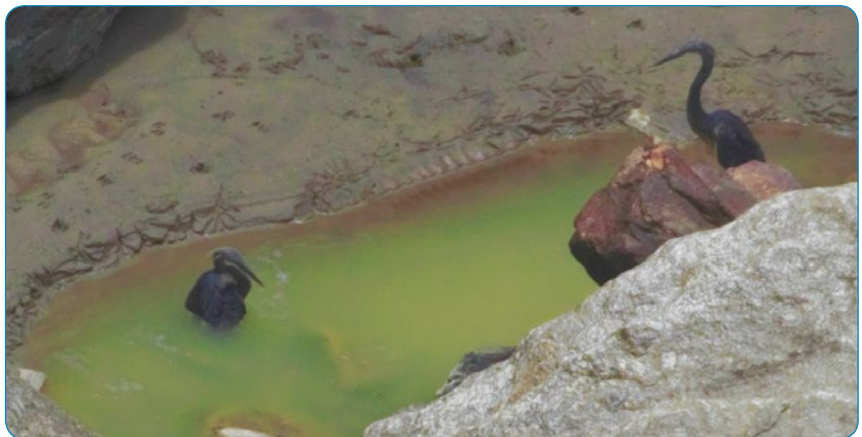


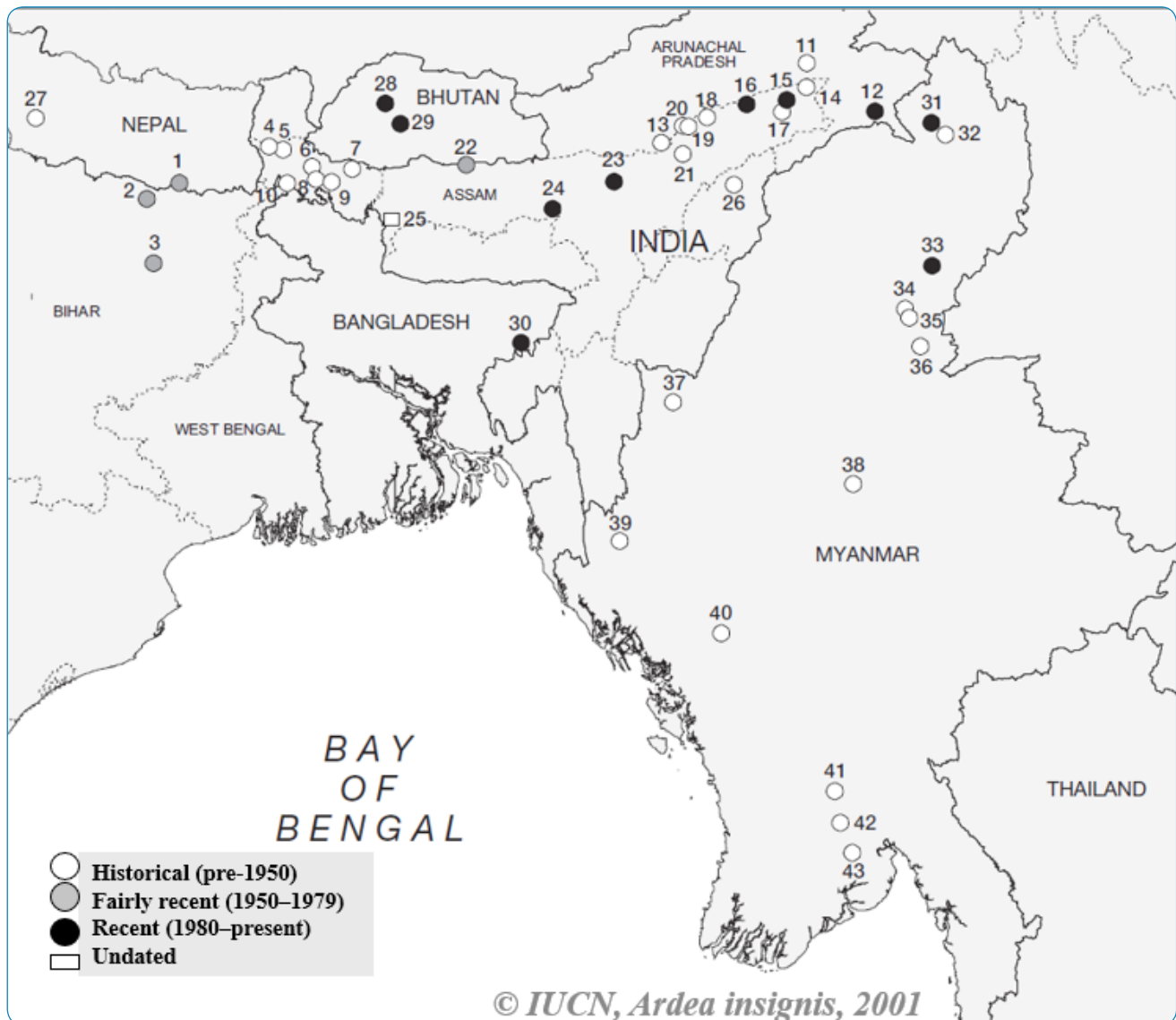
Image 11: WBH juveniles bathing

Sometimes, the WBH are seen bathing during hot sunny days while foraging. While bathing, herons slowly move into the water immersing its belly and lower wings. They slowly dip their tail and body into the water upto one minute at a time for about ten times. They then slowly walk to the sandbar vigorously shaking of the water with their feathers loosely ruffled. They sometimes spend hours preening and wiping bill and drying before flying off or forage.

At night they usually roost on tall trees. They often use same location up to 30 days before moving to a new feeding and roosting site. During breeding season, one of the parents stays in the nests and other roosts nearby.

Global distribution

The WBH global distribution has shrunk by more than 90 % in the last one and a half centuries. Historical ornithological literature shows that the bird 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, and Bhutan to southern Myanmar bordering with Thailand, during the first quarter of the 20th century (Baker 1928; Ali 1993; Hancock & Kushlan 2005). During the second and third quarter of the 20th century, the species was extirpated from most of its historical range, restricting itself to Bhutan, northern Assam, Arunachal, and northern Myanmar. The bird has been declared extinct from Nepal, and there are no recent records from West Bengal, southern Myanmar, or Bangladesh, suggesting that the overall range has contracted substantially.

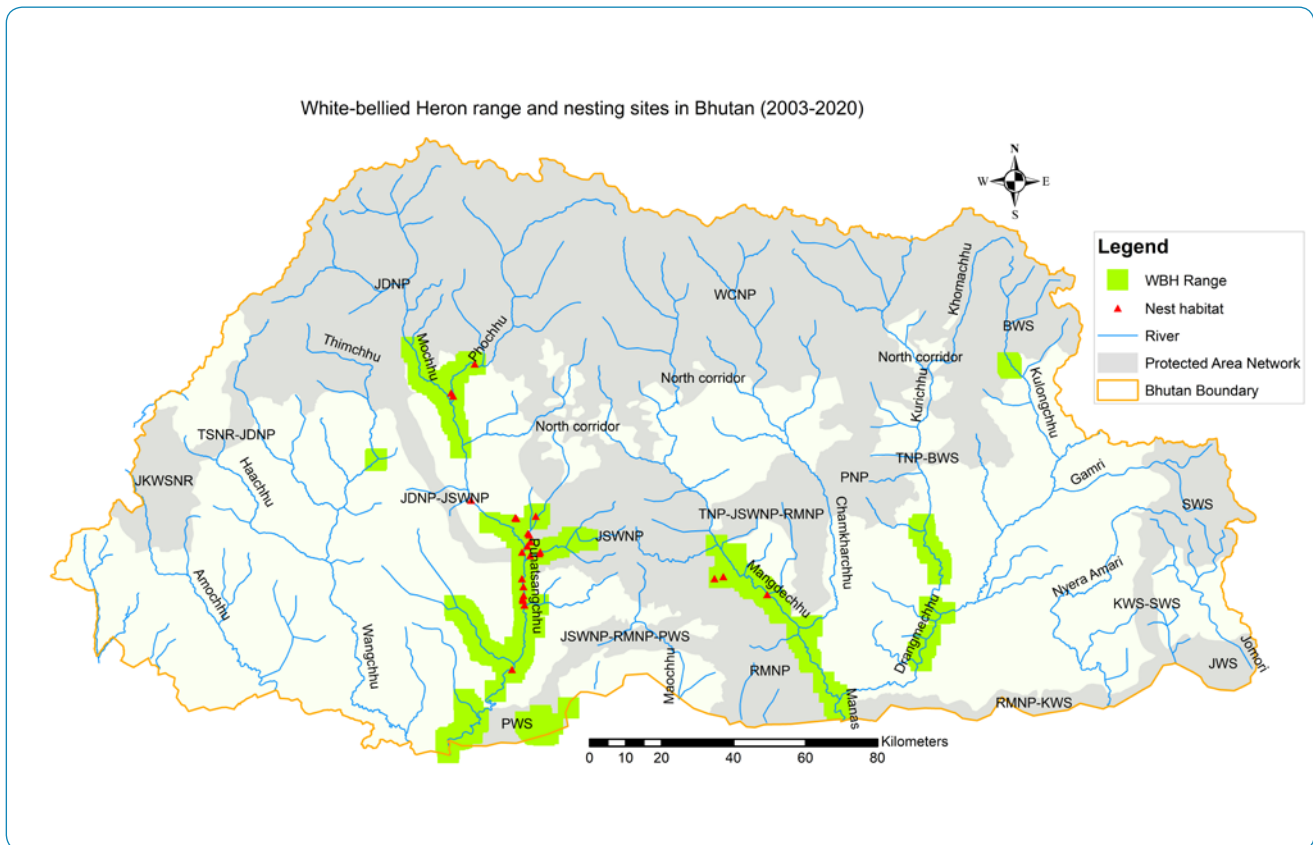


Map 1: Historical WBH distribution

Distribution in Bhutan

Although the possibility of WBH occurrence in Bhutan was foreseen during the 1890s (Baker 1928), there are no recorded sightings before 1976 (Royal Society for the Protection of Nature 2011). In Bhutan, WBH is distributed in temperate and mixed-broadleaf forests of three major river basins (Map 2); Punatsangchhu, Mangdechhu and Kurigongri, at an altitudinal range of 100–1800 m. Prior to 2012 the altitudinal range was thought to be limited to 600–1294 m (Dorji 2011). Starting in 1990, the sighting of WBH along the Phochhu, Mochhu, and tributories of Punatsangchhu rivers increased substantially. Beginning in 2003, the RSPN initiated the WBH conservation projects, which resulted in the discovery of the species in several other locations along the Punatsangchhu basin and Mangdechhu and recently in Kurigongri basin.

Today, it has been observed in more than 14 locales that are regularly occupied and used. As a result of the nationwide inventory conducted by RSPN and observations conducted by local birdwatchers, the distribution range in Bhutan expanded from previously recorded 600m–1200 m.a.s.l to above 1800 m.a.s.l in the inner Himalaya to below 150 m.a.s.l in the south. In recent years, the species has been sighted a few times from Kurichhu and Drangmechhu in eastern Bhutan.



Map 2: WBH population and nest distribution in Bhutan

Migration and movement

Seasonal movement and altitudinal migration of WBH are not well understood. Ali and Ripley (1968) believed that it is a resident species with within-range post-breeding dispersal, while Kushlan & Hancock (2005) suggested seasonal movement from higher breeding areas into marshy lowlands. The more recent observations by Pradhan (2008) found that WBH tend to occupy bigger rivers during winter and dry seasons and move to streams and tributaries when the rivers are turbid and the banks inundated. Recent records also indicate the presence of breeding birds in the same territory throughout the seasons. In 2016 RSPN tagged two juveniles with GPS-GSM satellite data loggers and from the data received for three months suggest that juveniles move from one feeding ground to another, flying up to 50 km along the rivers, lakes, and streams. Additional detailed research focusing on post-fledging dispersal of juveniles, philopatry, reproductive age, lifespan, and other life history is needed to better understand its movement, migration and home range.

Breeding

History

The records of breeding and nesting of WBH are scarce. Before the 1930s, only two nests presumed to be of this bird were found: one was recorded in Darjeeling, India before 1890; another in Myanmar, before 1930 (Baker 1928, Baker et al. 1922, IUCN 2017a, Walters 1976). After more than 70 years since the previously recorded sighting, an active nest was found in Bhutan in 2003. Since then, two to five active nests have been located in Bhutan from which two to eight new chicks have fledged annually. In India, one active nest was discovered in Namdapha Tiger Reserve in 2014 (Mondal and Maheswaran 2014), but there are no records of successful active nests in the area. There are also no records of active nests from Myanmar.



Breeding habitat

In Bhutan, the WBH breeds in temperate and subtropical forests at the altitude range of 200–1500 m.a.s.l. The climate is mostly Humid subtropical (Cwa), Köppen-Geiger system. The average annual precipitation range is 3,016–3,719 mm and the average temperature range is 18.2–19.7°C (Climate-data.org, 2018). Before 2017, all the nests in Bhutan were found on *Pinus roxburghii* while one nests in Namdapha was on broadleaved species. Since 2018 there are also records of successful breeding on broadleaved species in Bhutan.



Image 12: WBH nest on Chir pine



Image 13: WBH nest on broadleaved species



Image 14: WBH carrying twig to build nest

The WBH prefers to nest on the tallest of the available trees is selected site. Data also suggest that the height of the surrounding trees increases linearly with increasing distance from the nesting tree indicating preference for a lone tree with clear visibility of the surroundings. There is also uniformity in selection of aspect of the nesting landscape with preference to east (northeast, east or southeast) facing landscapes and also, a significant number of nests were uniformly aligned towards east, northeast, southeast directions. The nests are located as close as 300 m to up to 100 km apart in central and south-central Bhutan in both Mangdechhu and Punatsangchhu basins Map 2.

Courtship and breeding Season

It is observed that during courtship the male approaches the female, picking up small twigs and throwing them repeatedly. Male and female also peck in the water as if to showcase that they caught a fish. Such activities are performed several times a day, and may last for one to two weeks. While basking, the pair may also rub their necks together gently and make frequent courtship calls and displays. Even while nesting, they show their affection by preening and touching each other. The copulation is usually observed during nest building. The male drops off the twigs and the female build the nest. It is during this period that the multiple copulation, each lasting about a minute, is witnessed.

The breeding season lasts nearly six months, starting late January through July. Observation by RSPN's researchers found that the incubation takes around 30 - 33 days and are usually hatched in the first week of May. Parents alternately incubate the eggs.



Image 15: WBH copulating at Kisunachhu



Image 16: WBH arranging nest with chicks

The juveniles fledge (i.e., capable of sustained flight) after 70–74 days between June to mid-July. There are also some records of variation in breeding seasons prolonging through August in Bhutan.

Nest architecture

The WBH build a simple platform nest like any other large heron species. However, unlike most of the other large herons, which breed in colonies, WBH is a solitary breeder. No two active nests have been found closer together than 1 km in Bhutan.

The diameter of nests are 100-120 cm in the frontal intersection and 80-100 cm across lateral sides, excluding the extended edges. The nests are built using dried twigs and small branches of available plant species without any foliage. Like other heron species, the architecture of nest was not very complex, but there was a noticeable pattern in the arrangement of materials depending on length, diameter, shape, and rigidity. Bigger and longer twigs were placed at the bottom and along the edges, and smaller and pliable materials were on top and towards the inner side to establish the desired shape and stable platform for incubation, and to hold chicks at a later stage. The thickness of the nest bedding is 17 cm at the center and gradually decreased towards the edges to just a few sticks spread at the edges.

Similarly, the center of the nest was 12 cm deeper than the extended edges. Nests are built at different heights and branch levels mostly facing direction of the sun.



Location	Tree species	Nest height (m)	Tree height (m)	DBH (cm)	Branch level	Altitude (m)	Slope (deg)	Aspect	Nest azimuth	Year used
ADH	<i>Pinus roxburghii</i>	18.1	26.5	64.2	3	1280	41	NE	SE	2008, 2010, 2012, 2013
BAS	<i>Pinus roxburghii</i>	14.2	30.2	72.5	-	1120	78	N	SE	2007
BUC	<i>Pinus roxburghii</i>	18.4	29.8	72.9	6	452	41	E	SE	2013, 2016
BPL	<i>Pinus roxburghii</i>	6.5	20.4	37.4	4	406	34	NE	NE	2014, 2015
CBL	<i>Pinus roxburghii</i>	18.2	23.3	64.9	18	838	28	SE	SE	2011, 2013
DOM	<i>Pinus roxburghii</i>	18.1	40.1	87.5	3	991	41	SE	E	2005, 2006
HRU	<i>Pinus roxburghii</i>	15.5	29.0	52.5	6	777	59	E	S	2015, 2016
HRD	<i>Pinus roxburghii</i>	16.2	37.0	63.7	1	767	35	E	E	2013
HRO	<i>Pinus roxburghii</i>	-	-	-	-	736	87	SE	-	2007
KHO	<i>Pinus roxburghii</i>	15.7	19.1	50.3	Top	754	47	NE	E	2008, 2015, 2016, 2017
MTR	<i>Pterospermum acerifolium</i>	25.2	26.4	49.5	Top	443	16	SE	E	2018
NNS	<i>Pinus roxburghii</i>	23.6	34.5	69.3	5	655	4	E	NE	2009, 2010
NNT	<i>Pinus roxburghii</i>	10.2	14.8	31.7	2	817	79	NE	S	2009
NNF	<i>Pinus roxburghii</i>	38.0	38.8	64.4	Top	880	12	NE	SE	2010
NNO	<i>Pinus roxburghii</i>	12.8	19.5	43.6	4	602	86	NE	SE	2007, 2008, 2010, 2011
PHO	<i>Pinus roxburghii</i>	12.8	23.0	47.0	5	1368	48	E	NE	2011
TSI	<i>Michelia champaca</i>	23.5	23.5	65.4	Top	432	13	W	W	2018
TSO	<i>Pinus roxburghii</i>	24.5	44.8	79.5	4	1428	3	N	SW	2013, 2014
WAK	<i>Pinus roxburghii</i>	11.0	22.0	58.8	2	460	72	E	E	2014
YEU	<i>Pinus roxburghii</i>	25.5	39.9	103.1	11	986	22	N	W	2003, 2004
Mean ± SD		18.3±7.4	28.6±8.4	62.0±17.7	-	813.5±199.6	39.9±27.8	-	-	-

(Locations: ADH = Adha, BAS = Basachhu, BUC = Burichhu Confluence, BPL = Burichhu Plantation, CBL = Changbaling Berti, DOM = Domthang, HRU = Harachhu upstream, HRO = Harachhu old, HRD = Harachhu downstream, KHO = Khoti Berti, MTR = Mithuntar, NNS = Nangzhina 2, NNT = Nangzhina 3, NNF = Nangzhina 4, NNO = Nangzhina 1, PHO = Phochhu, TSI = Tsaidang, TSO = Tshosabu, WAK = Wakletar, YUE = Yeutama).

Table 2: WBH nest detail in Bhutan

Sexing

The WBHs are monomorphic; they look similar, visually differentiating between the sexes is difficult. Morphological variations are minor, it takes expertise and prolonged behavior observation to distinguish sexes. It is also easier to distinguish sexes if found in pairs and while building nest. Males perform for the females, flying around nesting tree and calling loudly. While building the nest, the male gathers the resources needed to build the nest. He presents the twigs to the female with great pomp, laying them at her feet and shrieking. The female then takes responsibility of arranging twigs and create padding for the eggs. Male and female herons take turns to incubate and feed chicks until they fledge.

Longevity and ageing

Hérons on average lives up to 17 years, in the wilds though no definite studies or observations for WBH made in the wild. It should be noted that the IUCN lists the lifespan at 10 years, as a general figure. As individual longevity in captivity has never been studied or observed, ageing in captivity will be a novel research. With proper care and husbandry, it is possible that individuals could live beyond previously projected lifespans, as has been shown with other captive avian species around the world.

Population

Global Population

While a complete global population assessment has never been carried out, a cursory enumeration of sightings made in the latter half of the twentieth century indicates that the bird has disappeared from most of its historical ranges. The bird has been declared extinct from Nepal, and there are no recent records from West Bengal, southern Myanmar, and Bangladesh, suggesting that the overall range has contracted substantially.



Based on the WBH International Workshop 2015, there are fewer than 60 adult birds in the wilds. The population is fragmented into three subpopulations in Bhutan, Northeast India, and Myanmar. The most recent surveys in the range countries have found 22 - 30 individuals in Bhutan, 6–8 birds expected in India, and fewer than 25 in northern Myanmar. Currently, active breeding pairs are only known in Bhutan, although breeding is expected to be happening even in wilds of India and Myanmar.

The population is expected to be rapidly declining due to habitat degradation and widespread disturbance, even in remote parts of the species' range.

Population trend in Bhutan

RSPN conducted the first comprehensive WBH population census in Bhutan in 2003. During the census, 14 birds were counted from five locations along the Punatsangchhu. For the next six consecutive years, the population and number of new sites increased to an all-time high in 2009 with 30 birds counted from 11 locations.

However, the apparent increase in population size was directly influenced by the discovery of additional birds in new habitats, while the total number of birds in each habitat remained the same or decreased. Despite the discovery of birds from several new habitats in recent years and 2– 8 additional juveniles fledging annually, the population in Bhutan has remained at 22–30 individuals for the last decade.

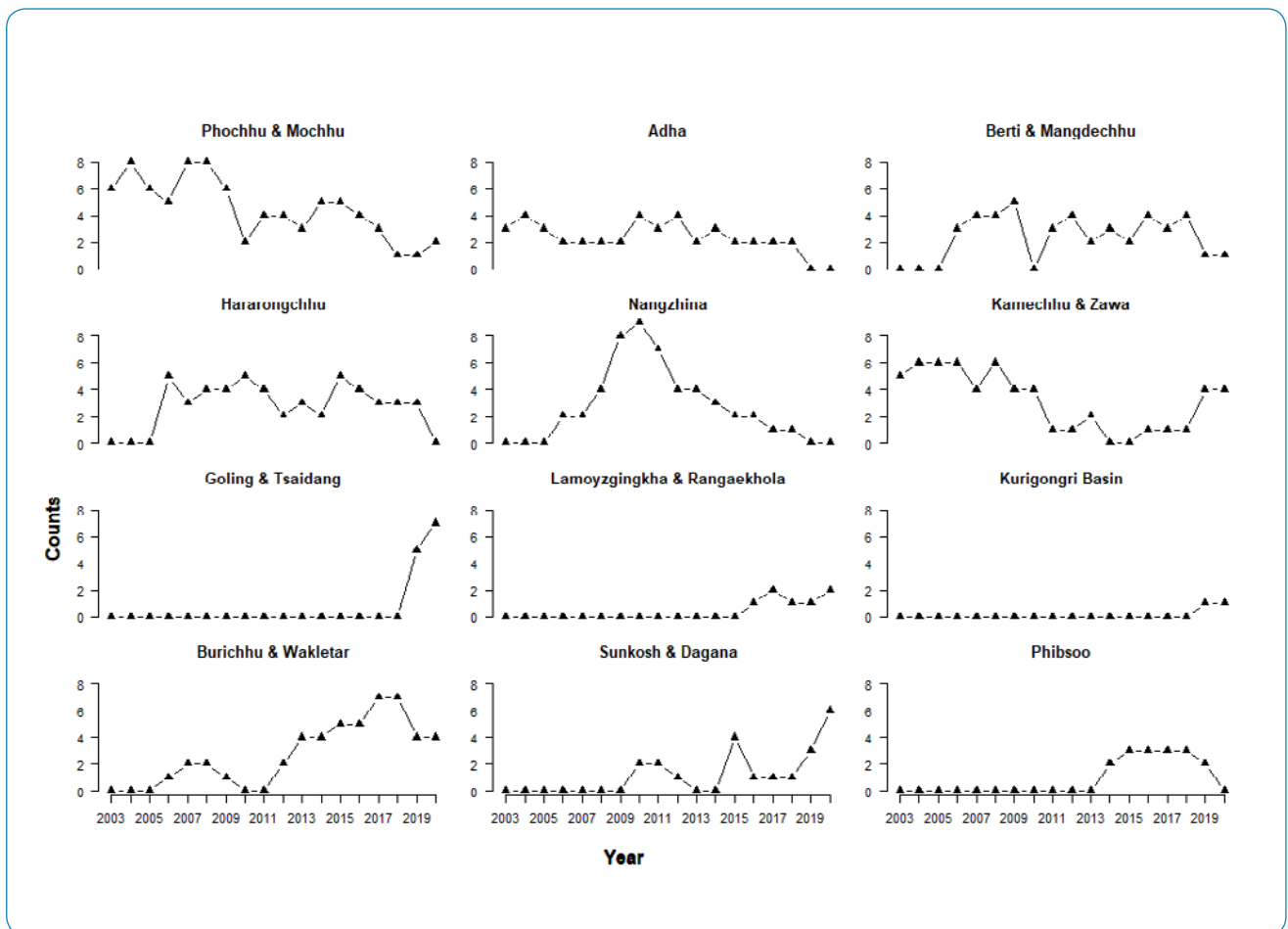


Figure 1: WBH population and foraging habitats from 2003 till 2020



There is a noticeable change in local population demographics in key foraging habitats. The population in older habitats (Phochu, Mochhu, Punakha, Zawa, Kamechhu, Adha, and Nangzhina) has drastically declined over the surveyed years. The Phochhu and Mochhu areas had eight birds during 2007 and 2008 and less than two currently.

Similarly, no birds were seen after 2013 in Zawa and the Kamechhu area, the oldest nesting site, where 6–8 birds were found before 2008. Overall, population trends are decreasing in Adha, Nangzhina, and proximate areas, which were preferred feeding and nesting habitats until 2010. The population in Berti and Goling were highest in 2009 and it is currently stable.

In contrast to these declining areas, in recent years, more individuals are being sighted in lower regions of Punatsangchhu and Mangdechhu basins. Burichhu and Wakletar are the most promising sites with both population trends and nesting frequency on a sharp increase. The species has been in these habitats since 2005, although it started nesting only after 2013. The census record indicates that the WBH population is fluctuating, with comparatively fewer numbers of birds further downstream the river Punatsagchhu, in Sunkosh and Dagachhu areas.

Since 2014, 2 - 3 WBHs have been sighted in Phibsoo Wildlife Sanctuary (PWS) which is located in southern Bhutan, bordering the Indian state of Assam. The area is at an altitude of 100 m.a.s.l and the vegetation is mostly moist-evergreen broad-leaved forest. In 2016, another lone bird was sighted in Lamoizhingkha range adjacent to PWS in the southernmost region of the Punatsangchhu. Although the vegetation composition and climatic conditions are different from previously known habitats, 3–5 birds have been recorded for the past five consecutive years, and the frequency of sightings has been increasing in the area particularly during the winter. Recent observations also indicate an increase in the lower regions of the Mangdechhu basin. A few individuals have been sighted feeding and nesting more than 20 km downstream from previously sighted areas which have comparable vegetation and climatic conditions to PWS.

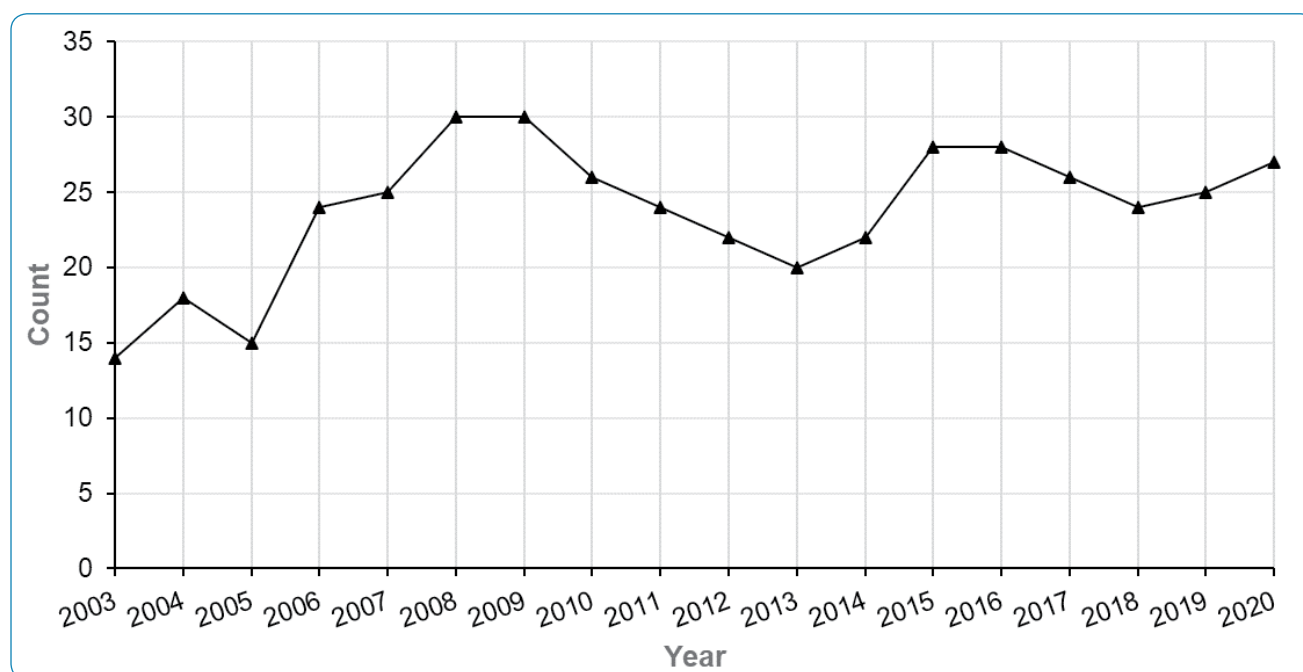


Figure 2: Population trend of WBH in Bhutan 2003- 2020



Conservation status

The White-bellied Heron is categorized as Critically Endangered C2a(i) ver 3.1 under IUCN Red List of threatened species. It was listed as threatened in 1988, uplisted to endangered in 1994, and to critically endangered since 2007. It is also the 94th species of the Top 100 EDGE Birds on the EDGE of Existence list (EDGE of Existence 2018). The species is facing an extremely high risk of extinction in the wild.

The species is listed under Schedule I, a totally protected species under Forest and Nature Conservation Act of Bhutan, 1995.

The WBH International Workshop 2015 recommended concerned government of range countries to accord the highest level of legal protection status for WBH. This is to encourage and ensure full commitment and strengthening of capacities of the government in effectively enforcing protection and legal actions.

Threats and cause of population decline

WBH has gone extinct in most of the previous habitat/range countries presumably due to habitat degradation, disturbance and loss. These still remain a threat in the present range countries.

In Bhutan, one of the fastest developing countries, anthropogenic activities like infrastructural development, and increased human disturbances remain the two major threats. The local communities at Phochhu associate decline in the number of nests to the increasing frequency of rafting, picnicking, and riverside recreational activities in the area. The LCSG member at Zawa attributes the drastic decrease in the number of WBH sightings to the road and bridge construction at Digchhu. Similarly, a decrease in population in Adha and Harachhu was associated with new road construction and mega construction work at the Harachhu-Punatsangchhu confluence.

The WBH habitats are shrinking at an exponential rate and the river habitats are transforming at an alarming pace with an increasing number of constructions. These are expected to impact resource availability and isolate one micro-population from another, which would affect breeding and genetic viability for the extremely low surviving populations. It is likely that genetic introgression and fixing of deleterious genes may be already occurring, making genetic rescue necessary. This warrants an elaborate evaluation and study of genetic diversity.



Image 17: Threats to WBH by fishing



Image 18: Threats by rafting



Image 19: Threats by forest fire



Overall, the population decline is the cumulative effect of multiple factors, including loss of feeding and nesting habitat, declining food resources, disruption of movement and flight routes, low gene pool, natural disasters, and human caused disturbances. Also, there is limited knowledge on direct threats and lack of research conducted on juvenile mortality and genetic diversity.

Therefore, studying major threats, ecology, juvenile mortality and genetics is important to effectively revive the population.

Threats in current WBH range in Bhutan

River Basin	Threats	
Punatsangchu basin	<ul style="list-style-type: none"> • Illegal fishing • Cattle grazing • Firewood collection • Picnic spot • Rafting site • Forest fires • Camping spot • Road construction 	<ul style="list-style-type: none"> • Spiritual site • Agricultural land • Cattle shed • Trekking route • Electricity transmission lines • Sand extraction • Stone extraction
Mangdechhu basin	<ul style="list-style-type: none"> • Cattle grazing/Cow shed • Sand quarry • Electricity transmission lines • Car washing • Road construction 	<ul style="list-style-type: none"> • Permitted fishing • Illegal fishing • Picnic spot • Cattle grazing • Forest fires

Table 3: Threats to WBH in currently occupied habitats

Conservation initiatives

RSPN in collaboration with partners has been monitoring WBH since 2003. Several conservation initiatives have been taken to protect and revive the population size. The 2015 White-bellied Heron Conservation Strategy, collaboratively developed by experts and researchers from the species range countries, has streamlined species conservation priorities. Efforts are being made to streamline conservation of the birds across the range.

White-bellied Heron Conservation Strategy 2015 (http://whitebelliedheron.org/?page_id=52)

In Bhutan, RSPN has mapped the distribution across the country and identified essential feeding and nesting habitats. Consecutive population surveys have been conducted for nearly two decades, and population demographics, nest sites, and juvenile recruitment is being closely monitored. RSPN has also educated, inspired, and engaged local communities, students, researchers, institutions, and policymakers in the conservation of the species.

*<http://www.rspnbhutan.org/white-bellied-heron-conservation/>
White-bellied Heron Conservation Strategy 2019-2039 (RSPN)*



Currently research to understand the genetic diversity, ecology, biology, and threats to WBH are being undertaken throughout the habitat range. RSPN plans to tag juveniles with satellite transmitters to study the movement, local migration, and resource use by the species.

WBH Conservation Center in Tsirang will hopefully secure an ex-situ gene-pool and seed population to supplement the wild population through captive breeding and release programs.

Establishment of WBH Breeding and Research facility in Bhutan (Punatsangchhu Proposal)

Establishment of Endowment Fund for White-bellied Heron (Ardea insignis) Conservation Center

First artificial incubation and captive rearing of White-bellied Heron

Soon after the beginning of Punatsangchhu Hydropower Project (PHPA I & II) construction work, it was realized that the impending threat lies within the hydropower development along the Punatsangchhu. The imminent threats were expected from the construction two mega dams which encroached some of the most important nesting and feeding habitats, obstructed fish migration and overall reduction in fish population and disturbance especially from increasing human activities, infrastructure development, movement of heavy machineries and excavation. Since the largest WBH population was residing in this river basin, it was feared that the new hydropower could drive the species to extinction.

The only rescue then, to the population which was already at the verge of extinction was then realized the Captive breeding and reintroduction program. Therefore, in 2011, with technical support from the San Diego Zoo, USA, RSPN conducted the first artificial incubation and captive rearing of WBH with an egg lifted from the wild nest. The chick was successfully reared and released back to the wild after raising in captivity for 134 days. This experiment not only helped us gain skills in captive management and build confidence to revive the population through such a conservation breeding program but also gave opportunity to understand its developmental processes, dietary preferences, and biology.

The project was funded by PHPA, and the technical assistance was provided by Dr. Michael Mace, Mr. Don and Debbie from San Diego Zoo Global California, and Dr. George Archibald, International Crane Foundation, USA.

Need for captive population

Although, the captive breeding and reintroduction is only recommended for extinct or near extinct species, the extremely low population size and rapidly decreasing trend of the WBH 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 WBH and achieve an ecologically effective population in the wild. It is important to find a middle path to mitigate the current declining habitat and food sources from recent development activities, natural calamities, climate change and impact on the ecosystem. With the onset of climate change process, preservation of natural habitat and survival of WBH has become more unpredictable. With all the emerging natural, environmental and man-made pressures, the wild population might become extinct in the near future before conservationist could clearly understand the cause. Therefore, establishment of a safe and reliable ex-situ gene pool, and complementing the wild population through captive breeding and release program has become necessary to continue conservation and research.



In December of 2015 in Punakha, Bhutan; an International meeting was convened to discuss the conservation of this species. During the meeting, it was urgently recommended that a conservation center to be established in Bhutan to safeguard the species from extinction. Captive breeding is only one of the methods of reviving a dwindling population, and therefore, equal and consistent effort needs to be accorded to habitat and wild population conservation.

Establishment of the WBH Conservation Center would be one of the convenient conservation approaches for this critically endangered species. The center will not only serve to preserve the gene pool but would also be a center for breeding and release program to increase the wild breeding population. It would also serve as the center for WBH scientific research and development and training for captive breeding programs. As recommended by conservationists, the captive breeding will aim to create a self-sustaining population of WBH through its breeding and release program.



02

CAPTIVE POPULATION MANAGEMENT

Context

There is a lack of detailed studies conducted on the genetic diversity of the WBH at present. With the initiation of the conservation breeding program, one of the first and primary aim will be to study the genetic diversity and institute a genetic management strategy. The genetic and demographic management of captive populations will focus on maintaining genetic diversity in order to minimize undesirable genetic changes due to selection in the captive environment, avoid deleterious effects of inbreeding depression, and maintain future options for genetic management.

The initial phase of the program shall select founder population from multiple separate sites. Upon determining productive breeding pairs with varied genes and the desired population size for the centre, offspring from these shall be released to the wild population.

The conservation centre shall aim to achieve the target viable population and maximum genotype diversity within the centre by the end of the first phase.

Year 1	Year 2	Year 3	Year 4	Year 5
Prepare site for rearing first founder population	Collect additional founder population from wild nest, either chicks, juveniles or eggs considering genetic line of existing population	Pair bonding of selected individuals /Isolate successful breeding pairs for breeding.	Pair bonding and breeding continued	Artificial insemination, if necessary
Collect founder population from wild nest, either chicks, juveniles or eggs.	Rearing and management of the existing and the new population in the center	Collect additional founder population from wild nest, either chicks, juveniles or eggs considering genetic line of existing population	Continue collection of additional founder population from wild nest if target breeding pairs are not achieved	Pair bonding and breeding continued
Rearing of the acquired founder population	Genetic analysis/sexing of the additional population	Rearing and management of the existing and the new population in the center	Lift clutch from the successful pair in the center for increasing population.	Continue collection of additional founder population from wild nest if target breeding pairs are not achieved.



Genetic analysis/sexing of the founder population	Selection/ pairing of potential breeding individuals	Genetic analysis/sexing of the new population	Genetic analysis/sexing of the new population	Genetic analysis/sexing of the new population
	Relocation of potential breeding pairs for natural bonding	Selection of potential breeding individuals and relocation to breeding aviary	Initiate release program in accordance to the population and housing capacity.	Map and match the potential breeding pairs based on the genetics.
		Initiate release program in accordance to the population and housing capacity.		Initiate release program in accordance to the population and housing capacity

Table 4: Projected time-line to kick-start WBH conservation breeding program-Phase-I

Acquisition of founder population

At present, there are three known active nesting sites in Bhutan (Kisonachu and Mithun Tar along Punatsangchu basin, Tsaiding in Mangdechhu basin). The selection of the nest for harvesting would require assessment of the nest and the breeding pair: breeding history of the pair, accessibility of the nest for harvesting, susceptibility to disturbance or predation, etc. Based on these assessments, either juveniles or eggs will be collected as founder population. In the subsequent years, juveniles or eggs will be harvested considering genetic line of existing population ensuring maximum genetic diversity.

During the 2011 captive rearing program, two eggs from the clutch of four were lifted from the wild nest at Phochu. One egg was found to be sterile but the other egg hatched. The chick was raised in captivity for 134 days and released back into the wild.

Founders will not necessarily or optimally enter the wild population at the inception of the captive propagation project. Immigrants from the wild will periodically be incorporated into the captive population if possible. Wild-caught, however, will be obtained only after extremely careful consideration of the potential effects of such removals on the wild population.

For juvenile as the founder population, one/two chicks will be lifted from the nest after 2 - 3 weeks of hatching. The number of chicks to be lifted from each nest will be determined based on a careful assessment of the nest and other chicks in the nest.

Another option for establishing the founder population is by lifting eggs from the wild nests. Number of eggs will be lifted from the wild nest after evaluating the clutch size if necessary. Injured adults or juveniles or rescued birds can also form the founder population.



Procurement of WBH for the breeding center (ITAC recommendation)

As previously mentioned, the current view is that at least 50 individuals are needed to maintain a viable captive population. Having as much genetic diversity as possible is of course desirable. The genetic study discussed at the White bellied heron meeting in India in 2014 indicated that genetic diversity in the population is considered robust. Of course, it will be desirable to look at degree of relatedness of WBH taken for the captive breeding program, and to source the founders for this captive population from as many different genetic lines as possible.

There are two options currently being considered when initially working toward the goal of building a WBH captive population: collecting eggs from the wild and collecting chicks from the wild. It may be that as time goes on both will be used, depending on the circumstances. It might be possible to use a decision tree (available) to decide for each case which choice is the best. There are advantages and disadvantages to both methods.

Removal of Eggs

Advantages

- If the entire clutch was removed it would theoretically be possible to have three or four chicks from one nest, and the parents might recycle/double clutch. The chicks would be very similar in age, which would make hand-rearing easier.

Disadvantages

- Transporting eggs, a long distance can be challenging, as the eggs need to be kept stable both regarding temperature and movement. Eggs may be less likely to hatch when incubated artificially than when incubated by the parents
- Eggs should only be taken if they can easily be transported with one day. Additionally, it might not be possible to determine whether the eggs are viable or not when taken. It is possible that the parents would re-nest somewhere else if they re-nest at all, making their second nest more difficult to find.

Timing of egg removal

- An egg removed 7-10 days after parental incubation is initiated rather than just after laying has a higher chance of hatching, and the parents are more likely to re-nest if eggs are removed that early in the breeding cycle. However, the parents might move to a new nest location since they were unsuccessful, and it may be difficult to find the second nest location. The best hatch rate would be expected of eggs removed from the nest very close to hatching, but the parents would be much less likely to re-nest if the eggs are removed then.
- Given that the parents abandoned the nest when two eggs were taken in 2011, taking a partial clutch does not seem advisable. Therefore, the best option could be to remove the entire clutch 7-10 days after incubation is initiated if removal of eggs rather than chicks is the preferred method. However, unless the nest is constantly monitored it is difficult to know the exact laying dates, and removal of eggs would then certainly be less desirable than removal of chicks.



Removal of Chicks

Advantages

- *It is easier to keep a chick (older than a week) than an egg viable during transport to the breeding center, and the entire artificial incubation stage, with its risks, is avoided. If the smallest chick of a nest of two or three chicks, or possibly the two smallest chicks of a nest of three or more chicks, were taken the effect on productivity of the nest would not be great, as often the smallest chicks often do not survive. It might also be possible to remove the largest chicks, so that the parent's efforts are concentrated on the younger ones. Larger chicks would be easier to transport and would already be somewhat more imprinted on their parents.*
- *It is also less likely that the parents abandon the nest if one or more chicks remain in the nest (rather than if eggs are taken), as the calling of chicks in the nest serves as a strong stimulus to the parents.*

Disadvantages

- *Rearing chicks together is thought to reduce the likelihood that hand-reared birds will fail to imprint properly on their own species. It is desirable to hand-rear similarly aged chicks together, so that there is not much size discrepancy, potentially leading to inter-chick aggression. This would be more difficult to accomplish if only one chick is removed from a nest, as multiple nests would need to be targeted, and chicks would be less likely to be of very similar ages. In any case it might be necessary to initially physically separate the chicks (with visual and auditory contact) in at least some cases because of aggression. Again, being prepared for every possibility is advisable.*

Conclusion

Although removal of chicks rather than eggs for initially acquiring WBH to serve as founders for the captive population is preferable because success is more assured and the removal of chicks would be less intrusive for the parents, both methods may have their place. It may also be that for some reason the parents are unable to finish incubation of their eggs, and artificial incubation is the only option for the eggs to hatch.

Additionally, as the herons removed from the wild begin breeding themselves it may be desirable to (partially) artificially incubate eggs.

Therefore, suitable incubation facilities and expertise as well as rearing facilities are desirable in any eventuality.



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 WBH are stable, healthy and viable for the foreseeable future. If achieved, the center will maintain up to nine breeding pairs and up to 32 non-breeding birds at a time to ensure a robust genetic diversity.

The overall goal of the conservation breeding program for the next five years is to establish a productive population size with a diverse gene pool. The current setting of the conservation breeding centre is designed to accommodate two breeding pairs. The centre population target in the future with the extension of the centre facility is targeted at nine breeding pairs and maintain at least 50 birds at the center.

Reproduction and breeding procedures

While informed by previous experience and expert guidance from different species avicultural practices, reproduction & breeding procedures for WBHs in captivity will largely necessitate on-site learning and adaptability. All attempts will be made to replicate natural breeding behaviors via facility procedures. WBH breeding pairs will be allowed to naturally copulate, lay and incubate eggs, and rear young without significant human intervention. If the pair is unable to support and rear young ones, avicultural staff will intervene to aid juvenile survival.

If it appears that the breeding pairs are accustomed to breed naturally in captivity, they will be left undisturbed to breed and raise juveniles in a natural state, with subsequent release procedures followed.

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. As the captive bred WBHs are released, the individuals will represent the genetic characteristics of the original founders and improve the chances of establishing their own gene pool (Lacy et al. 1995). Studies show that genetic variation is key to strengthening the species potential to adapt to environmental changes and thereby, ensuring its survival.

Genetic management needs to focus on maintaining all levels of genetic variation: diversity at the single locus as well as diversity for quantitative traits, loci that are under selection and those that are not (but may be in the future). 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 could be 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.



Genetic Management Procedures

For maximizing genetic diversity within the captive population, pairing should be done between individuals from different population.

Starting a new population (Adapted from Population Management guidelines, PMC Lincoln Park Zoo)

1. *Begin with a large number of unrelated individuals.*
2. *Breed each individual.*
3. *Breed each individual equally (as much as possible).*
4. *Keep breeding pairs together; only re-pair if mate dies, etc.*
5. *Don't mix generations unless there are no other options.*
6. *Prioritize breeding the parental generation before the offspring.*
7. *Record parentage of all individuals (or, if group managed, record group histories – sources, merges, splits, etc.).*

Recommendations for population management

- *Separating/contracepting individuals to prevent breeding*
- *Importing individuals to increase population size or improve population structure (age and/or sex)*
- *Exporting individuals to decrease population size or improve population structure*
- *Removing individuals from a captive population for release into a reintroduced population*
- *Maintaining individuals to breed at another time*
- *Designating an individual as surplus to the program (no longer needed in the population)*
- *Conducting a reproductive evaluation (e.g., determine whether females are cycling, examine sperm quality)*
- *Collecting and banking gametes for future use.*

These management actions can be used to manage a population's size and structure, and ultimately to ensure reaching the long-term demographic and genetic goals of population management.

Ex-situ research

The captive WBH population would 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 will liaise with UWICER, CNR and other national and international research institutes in conducting research, developing hands on training and capacity building programs for researchers.

Some of the potential research areas includes:

- Genetic diversity
- Life cycle/Lifespan
- Reproductive age



- Breeding biology
- Artificial incubation parameters
- Developmental biology
- Dietary requirements and preferences

Releasing strategy

The release from the captive center into the wild will be initiated upon achieving the target population at the center. It may be appropriate, in the right circumstances, to release juveniles prior to the next breeding season, as parents/breeding pair may show aggression towards juveniles after a period of time.

Selection of individuals for release

Some of the important elements to be considered for selection of individuals to be released into the wild population include:

- Reproduction success/contribution in captive population
- Genetic line/parentage
- Age
- Social group
- Health and fitness
- Disease

Preparing selected individuals for release

Prior to the release, every effort should be made to prepare the bird to survive in a new environment. In other captive facilities with species who share similar life histories, it has been observed as a best practice to allow juveniles to remain with their parents for at least three months, to allow the juvenile to develop skills needed for adult life. Typically, at three months, parents will start to wean their young by encouraging them to hunt food for themselves. At 4-5 months, juveniles can be moved to another enclosure or selected for release, given the health status and circumstances are appropriate for release. The selected individuals should be well trained, hardened and acclimatized following proper pre-release hardening procedures to be able to survive in wild once released. As the captive bred birds are released to the wild, they might be stressed trying to adapt to the new environment. It is important to ensure that they are in good health. Genetic defects and diseases should be ruled out before the release. It is also advised that factors which would enable and ease their integration into the new environment are considered. Factors such as environmental weather conditions, time of day, and time of year should be included in considerations for date of release.

Selection of sites for release

The sites for releasing the captive-bred individuals should be selected considering current and future knowledge about feeding and nesting habitat preference and availability, historic distribution, level of disturbances and other emerging threats at key habitat. Appropriate site selection and timing is key to any successful release, as well as to fostering recruitment into a genetically viable population. It is important to consider that captive-bred released individuals may not thrive in areas with patchily-distributed resources. Therefore, disturbances from large infrastructure projects such as hydro-power (i.e. Punatsangchhu I & II, Sunkosh I- proposed), should be examined with increasingly more attentive research and fisheries management. Reintroduction protocols may be most successful when pursued alongside community-based conservation, restoration, and management initiatives.



Post-release ecological research will be invaluable in determining the appropriate distance between release sites according to emerging data on WBH population social structure or site-specific competition. With many years of grassroots level community involvement, and the creation of a network of local heron stewards through the Local Conservation Support Group (LCSG), it will be important social resources to draw from when considering the most appropriate sites and seasons for release. The release site selection will be a collaborative effort between the RSPN and respective parks, wildlife sanctuaries and territorial forest divisions under the umbrella of the department of forests and parks services. Selection of release sites, release, and post-release monitoring should be discussed and incorporated into the management plans of the respective sites.

Potential sites for release include the following; requires thorough assessment and must be aligned with the plans of the respective sites:

- Central region : Chamkharchhu, Mangdechhu, Bertichhu (and tributaries)
- Eastern region : Kurichhu, Drangmechhu, Kholongchhu (and tributaries)
- Western Region : Punatsangchhu (and tributaries)
- Southern region : Phibsoo Wildlife Sanctuary, Dagachhu, Mouchhu (and tributaries),
Deurichhu (and tributaries)

Release timing

There are several aspects to consider regarding timing of release, including season, weather conditions, time of day, resource availability, etc. As a diurnal species, with the primary period of activity occurring during daylight hours, release should be considered in the morning to provide time for individuals to locate essential resources. Weather conditions should factor in to release timing as well, with all attempts made to avoid release during or before heavy precipitation events. Importantly, preparation and knowledge of appropriate timing, alongside individual health assessments and habitat suitability, should be developed prior to the date of release. Successful preparation will include considerations of site-specific acclimatization periods, essential resource availability and relative abundance, as well as presence/absence of free-living individuals, which will be crucial for considerations of possible pair bonding, imprinting, resource competition, and territoriality concerns. Timely release of sexually mature sub-adults may be particularly important for improving chances of con-specific pair bonding. While transportation of birds during the breeding season may result in increased stress levels, pre-breeding season release may facilitate pair-bonding during courtship periods. It would be appropriate to consider release across a number of years, reducing the impact of potentially adverse circumstances impacting released birds in any one year. A post-release monitoring and management plan would be a valuable resource to considering developing, and may help to improve success of successive release events in the future.

Post release monitoring

Hérons released from captivity into the wilds will be ringed and tagged with data loggers to track their post-release behaviour and movement. Released birds will also be monitored closely in collaboration with local communities, local conservation support groups, resource groups, territorial forest divisions, national parks, and wildlife sanctuaries. Efforts will be made to ensure the successful acclimatization and survival of released birds in the wild. If the released birds fail to adapt in the wild, they will be rescued and taken care back in the center. An effective monitoring protocol will be developed in collaboration with partners and supporters.



03

CONSERVATION CENTER MANAGEMENT

This CCP outlines the existing and projected infrastructure, human resource, expertise and facilities requirements for the conservation center. This plan will provide a strategic guideline for the management and operation of the center ensuring supply of adequate resources and proper management of the birds in captivity.

Captive Herons should be provided the best care while in captivity. Incorporation of principal elements of their natural habitat at the aviary, ensuring security and safety and meeting the requirements of their physical, social and psychological needs are vital. The center should also factor in practices that are conducive to the wellbeing of the species and improve the chances of successful breeding. Also, the aviaries measurement and configuration should meet standards that will allow easy movement and allow breeding birds to choose a mate.

Taking these elements into consideration, the centre's architectural design was conceived. The design, due to financial and other resource constraints was limited to two aviaries, one lab, one Office and five unit staff quarter. However, new establishments will need to be added in the due course of time.

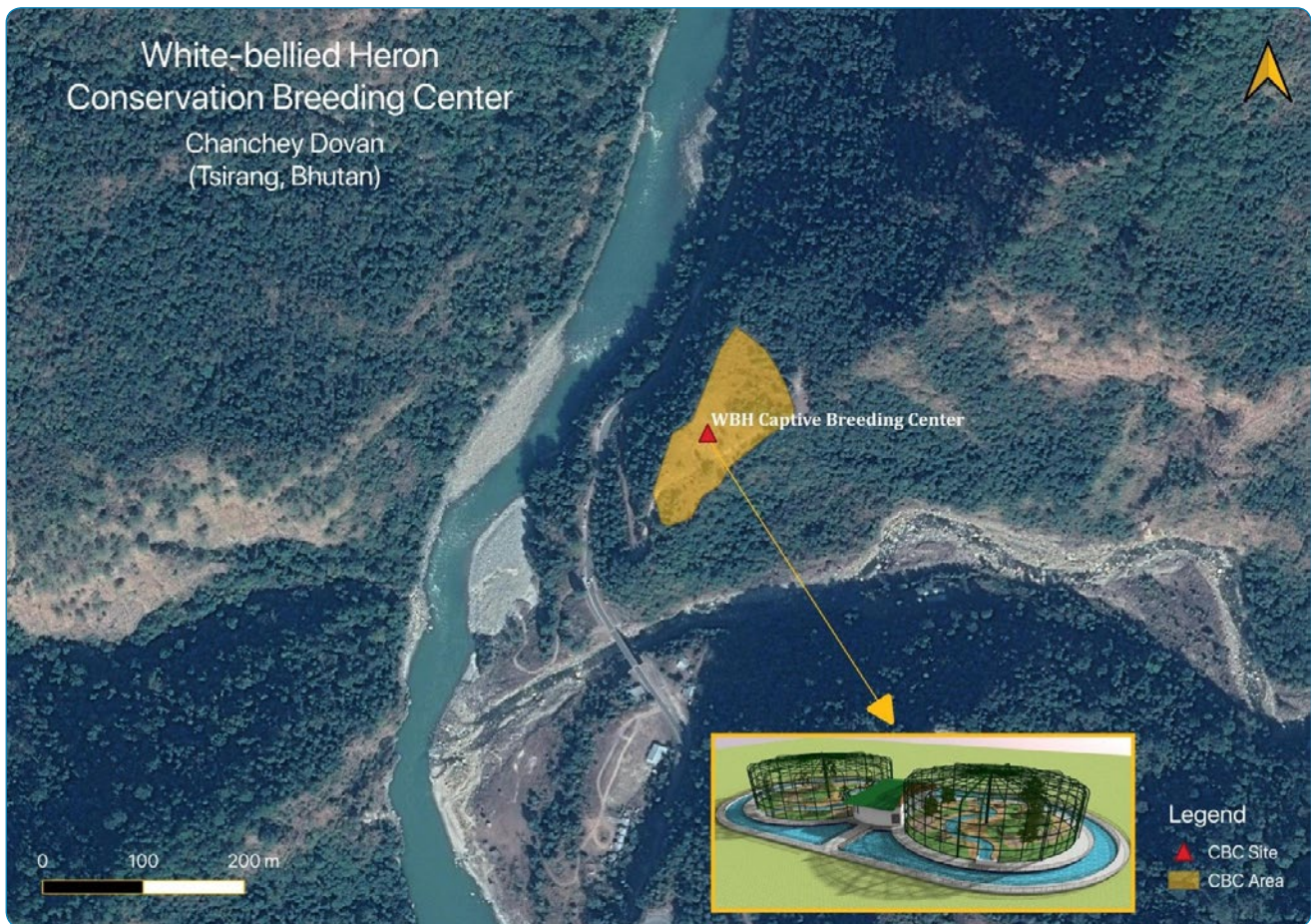
The Human Resource management plan should be prepared in consideration of the population of the captive Herons and the infrastructure. Adequate human resources can ensure proper management of the centre.

Location of the center

The center is established within 18.224 acres of land located at Changchey Dovan, under the jurisdiction of Tsirang dzongkhag. Its geographical locations are; 27° 2'1.71"N and 90° 4'34.01"E at an elevation of 375masl. It is a state land acquired in the name of the White-bellied Heron Rehabilitation Center, approved vide letter no. NLCS/DoLAM/RD (14) 2016/003167, dated October 10, 2016.

The National Environment Commission issued the environment clearance vide letter no. NECS/ESD/Dzo-Tsirang/3445/2017/100 dated January 18, 2019 and forest clearance from the Department of Forests and Park Services vide letter no. TFD/For/3-27/2015-2016/132 dated May 31, 2016. The National Land Commission has also issued the User Right Certificate (URC) vide འགན་ཁུར་གྱི་མགོ་གཟུངས་ལྟར་ ༡༢༩/༢༠༡༥-༢༠༡༦/༥༨༡༥

It is a plateau at the confluence of the Punatsangchhu 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 WBH and remains close to some of the most frequently used feeding 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 is a source of water for fisheries and it would also serve as a site to prepare birds (soft release) for release to the wild.



Map 3: WBH Conservation Center located at Changchey, Tsirang.

Housing requirement

Habitat Design & Environment

There are numerous variables to consider when designing an environment to replicate the natural habitat of the species of concern in captivity. Clearly, it will not be possible to completely mirror environmental conditions experienced by White-bellied Herons along the river systems in Bhutan, but the space provided should allow for a complete range of behaviors and expression of social, psychological, and physical needs.

Facilities should be large enough to allow for full-winged flight, tree roosting, and basking behaviors, as well as interactive socialization and pair bonding. Behavioral cues or poor physical health may be indicators that the space provided is not appropriate. It will be valuable to continue research on social behaviours of wild WBHs which can be integrated for captive management and the general health and well-being of the bird.

Preferred Habitat

Consideration should be given to help control and manage sound, light, ambient temperature, and water/air quality. While most facilities will be open to the air, and therefore replicating natural conditions, indoor concrete facilities should have mechanisms and tools to control temperature and humidity to protect from excessive cold or heat, and overly dry or humid conditions.



Additionally, indoor facilities should be considerate in regards to replication of natural photo periods, that is, the duration of light versus dark in a 24-hour period, particularly for chick development; the light intensity (i.e. min. of 500 lux) and light cycle should mimic and track alongside changing day lengths and seasons. Skylights, when possible, should be installed and well maintained, particularly considering sunbathing habits of WBHs.

Facilities should foster rather than hinder species-appropriate behaviors:

Flight & Locomotion:

If possible, full-winged flight should be possible within the design of the aviary. Herons are wading birds, but frequently fly to access additional territories, feeding sites, and nesting sites. The ability to wade in unobstructed ponds and standing water should be present.

Foraging:

As indicated in the aforementioned aviary design, ponds should be sourced with live fish to facilitate natural foraging behavior

Bathing:

Herons at least partially thermoregulate within the water features of their natural habitats, and therefore deeper water to facilitate bathing, as well as shallow pond, should be continually provided and structurally maintained.

Nesting Materials:

Natural materials should be provided, aligned with animal enrichment guidelines and behavior management, as source materials for nest construction, particularly during the breeding season.

The two existing aviaries are designed to replicate the natural environment, and reduce any potential threats for captive birds by providing both natural areas for roosting, bathing, basking, and artificially constructed hides (i.e. shade cloth) to minimize stress from outdoor activities. Tension netting should be considered as an added feature within the aviaries to reduce potential injury from flight collisions, and minimize debris and damaging winds in the event of extreme weather. Substrate within the aviary should be non-abrasive and consist of natural elements found in wild habitats. We suggest placing soft materials below nesting trees in the event chicks fall from the nest.

Human imprinting versus familiarity with people

It is of course desirable to avoid the herons imprinting on people, as this could affect their social behavior with conspecifics and additionally puts people at risk- such a large heron can be quite dangerous and become aggressive to people, especially during the breeding season if they are not afraid of approaching humans.

On the other hand, it is desirable that the herons reared at the breeding center are not as shy towards humans as the wild herons are. Having people walking around, and working around the enclosures when the birds have fledged and moved out of the brooder facilities. Initially the staff should take caution not to startle the herons, but young herons should quickly adapt to the presence of people.

At no time, or no age, should people offer the herons food from an obviously human hand or in other ways encourage the herons to become tame.



Aviary

The current breeding centre has two aviaries, each with a housing capacity of one breeding pair each or a few non aggressive juveniles. However, for species like WBH with poorly known breeding biology and husbandry, it is suggested that sustaining a population of 50 individuals is required to retain at least 85% genetic diversity. It was also discussed and agreed by experts during the WBH International Advisory Committee Meeting (WBH-IACM) 2017 & 2019 to maintain at least 50 birds in captivity for the conservation breeding program.

As WBH are solitary in the wild, we assume that they could be very territorial in captivity. Therefore, it is important to be prepared for the worst-case scenario, that the WBH are very solitary and aggressive, and thus need to have large enclosures for breeding that are far from each other. The enclosure design should be such that a bird cannot easily be cornered and pair members can distance themselves from each other.

A series of holding enclosures in addition to the breeding aviaries will definitely be necessary, for young birds or other non-breeding adult WBH. These holding aviaries need not be as large as the breeding aviaries and could be closer together. The design could be flexible, so that, if found that the WBH are not so aggressive and territorial, multiple birds can share the same enclosure. It might even be possible to use some of these smaller enclosures for breeding and some of the larger enclosures to house groups of immature WBH. Having both types of enclosures would certainly maximize flexibility, providing a solution for every eventuality.

Therefore, to accommodate at least 50 birds with maximum genotype diversity, additional aviaries should be added for both non-breeding and breeding pairs.

Sl no	Facilities	Dimension	Housing capacity	Existing	Additional requirement					Total
					2021	2022	2023	2024	2025	
1	Outdoor brooding for stage-3 chicks	15m dia (circular)	4	1	-	-	-	-	-	1
2	Aviary for Non-breeding birds	15m dia (circular)	4	1	-	-	-	-	-	1
3	Aviary for breeding pairs/non-breeding	15m x 10m x 6m (LxBxH)	Pair	-	Fencing	4	2	2	2	10
4	Incubation and rearing Lab	6 chambers	6	-	-	-	-	-	-	1
5	Quarantine & Veterinary center	-	2&1	-	1	-	-	-	-	1
6	Large training cages (pre-release)	Large		-	-	-	-	-	-	1

Table 5: Existing aviaries, housing capacity, status and requirement



Suggestions for breeding aviaries for White-bellied Heron Breeding Center (ITAC)

Option 1 (Essentially) Round Shape

Advantages:

- A bird cannot be easily cornered in cases of intraspecific aggression (may be important)
- It is much easier for birds to fly in a circle than to turn in a small space. WBH are reported to be clumsy fliers so an essentially round shape reduces chance of injury. Having the opportunity to fly is good for the musculature of the birds.

Disadvantages

- This is a more expensive and difficult to construct shape
- Use of space is less efficient within an enclosure and between enclosures
- Separation of birds within the enclosure is more difficult

Size Essentially round shaped aviary:

A diameter of 20 meters (314 m² area) is recommended because:

- This gives the birds an opportunity to fly; WBH are reported to be clumsy fliers so they need more room than other species that are very agile fliers.
- It gives the birds more possibilities to avoid each other as the WBH is a solitary species.
- The birds still have an adequate enclosure is subdivided for introduction of a bird or during other times of the year as desirable necessary.
- There should be two doors (1.0 - 1.5 m wide 2 m high) to outside if the aviary will be subdivided, on each side of sub-division.
- Separation of birds within enclosure is more difficult.

Option 2 Rectangular Shape:

Advantages

1. Much easier and cheaper to built
2. More space efficient

Disadvantages

1. One bird can more easily corner another
2. Less room for the birds to be able to fly

Size Rectangular shaped aviaries

Two adjacent aviaries 15 X 10 X 6-5 meters (measurements length X width X height middle-height far side) aviaries, with two 1m or wider interconnecting doors in the barrier wall between the two adjacent aviaries, one towards the far end and one towards the near end, allowing the birds to circle the two aviaries when both doors are open. Sliding doors work best, as the width of the opening can be altered, and there is no chance that a bird can become trapped behind a door. The possibility to remove the interconnecting barrier wall entirely should be included in the design.



Height all aviaries

A height of 5- 6 meters is recommended because:

1. If properly perched it gives the birds good opportunities to keep distance from each other and
2. The birds often nest and sit high in trees, six meters is a good height to have them well above people but is not so high that management and maintenance of the enclosure becomes difficult. Height gives security.

Debris collects on flat roofs more easily than domed or slanted ones. Roofs should not be tent-like because some species of birds lose control flying in an increasingly small space and crash. The top of an essentially circular aviary should be slightly domed if possible (height at periphery 5 m, center 6 m). The top of rectangular aviary could be 6 m high at the middle barrier separating two enclosures, sloping to 5 m at the far side.

Construction materials:

1. Structure must be very strong to withstand high winds and heavy rains (ice and snow does not seem to be an issue, there is very little precipitation in the colder times of the year).
2. Top should have a bit of give so that if the birds fly into it, they bounce off (can also hang strips of material 40-50 cm long in rows so birds fly into these rather than the actual roof).
3. Top netting should be 3 x 3 cm fine steel mesh
4. Side netting could be 2 x 2 cm fine steel mesh to keep birds from tangling in it and also to keep most other birds out. Another, less expensive, option is chain-link, which is readily available in Bhutan.
5. The supporting structure could be metal or wood. Wood is easier to work with, but would not be suitable if wet much of the time. The wood can be encased in metal at the base to reduce the amount of moisture from contact with the ground.
6. Support structures should be external to the aviary so that the birds do not fly into them

Furnishings: Shelter

- Many large water birds do not use shelters, even in the most inclement of weather. However, it is a good idea to provide a shelter option so that the birds can choose. With weather patterns throughout the world becoming more erratic and extreme, having a place to shelter birds in extreme weather conditions may be useful.
- Just as important, a shelter is useful for catching, handling and treating and isolating birds. Catching the bird for treatment or for moving to another enclosure this is more easily accomplished in a small space, and risk of injury is reduced, particularly if the shelter walls and roof have soft surfaces. For example, a layer of soft material can be attached ca 30 cm below the roof so that if a bird is startled and flies up during capture or at another time the risk of injury is far less.
- Shelters can also provide a way to introduce a bird to an enclosure, if the shelter has a front and also possibly side that can be partially see-through (e.g.



- with a mesh front or windows) so that the bird can get to know the enclosure before having to maneuver in it. It could be possible to construct the shelter with a mesh frame on part of the front and sides that can be covered with a removeable solid barrier so that the shelter can better serve as an introduction cage.
- Having two shelters next to each other with the potential for auditory and partial visual communication allows physical separation of two birds without entirely separating them.
- Providing the majority of the diet in the shelter in the morning, so that the birds are quite used to going into the shelter, simplifies management. The shelter door should preferably be closeable from outside the enclosure, and the door closed each day. After the bird has eaten the shelter can be opened. Preferably the keeper can enter the enclosure through the shelter.
- Shelter size: 5 X 2 X 3 m for all enclosures. Shelters in two adjacent enclosures can be placed next to each other to facilitate introductions.

Pool

- Essentially round enclosure: 10 m diameter circle, in middle
- Rectangular enclosure: 5 X 10 m oval
- A large pool is highly recommended because these birds spend much time in water. The easiest is to use a concrete base for the pool, but because Ciconiiform birds are very susceptible to foot problems on concrete, the concrete should be covered with other materials: mostly sand, but also some gravel and small rounded stones as they encounter in their natural habitat. The edges of the pool should be more or less flush with the ground substrate, but can have a rim that prevents additional gravel/sand falling in. The pool should have a drainage system (drain at lowest point, but have drain opening higher than sand layer), and a water faucet for filling. A possibility to attach a hose to the faucet should exist, so that personnel can clean the enclosure using water.
- Water depth should vary from 5-10 cm at the banks to 50 cm in the middle (for bathing).

Substrate

- The substrate should be similar to what the birds encounter in the wild: sand, gravel and small round stones with larger boulders and logs that they can stand on. Some shrubs could be put in the enclosure as well.

Nest

- A double nest platform can be put on either side of the barrier separating the enclosure in two so that the birds can engage in nest activity together but separately before being introduced. If the birds are very aggressive and need to be separated at other times, they can also practice simultaneous but separate nesting activity at the beginning of the breeding season before re-introduction. Normally birds prefer to be on the highest structure, therefore the nest should be close to the same height as the highest perch. A nest camera can be placed above the nest to monitor activity. Alternative nests can also be placed in the enclosure so that the birds can choose height and location. It would be good to provide a nest structure (and possibly also some perches with an umbrella-like cover in case the birds want to choose for protection from rain and sun.



Perches/nest platforms

- Live or dead trees can be placed in the enclosure for perching and nesting. It is good to leave a clear flight path for the birds when arranging these, and to have the height of any possible perch/platform no closer than 2 m to the top of the enclosure to protect against predation. Perches can be variable in size, but most should be wide enough that when the bird is perched the toes curl around 2/3 of the perch perimeter or more. Perches can be covered in artificial grass to reduce likelihood of foot lesions, as is routinely practiced for Ciconiiformes and birds of prey that are not on exhibit. Artificial grass is pliable, durable and easy to clean.

Curtain (Essentially round shape)

- It is important to introduce individuals of such a solitary species to each other very gradually, and the male and female may need to be separated at other times as well. Therefore, it is good to have a temporary way to separate the birds that allows for complete or partial closure. The curtain should extend the entire diameter of the enclosure, and be fixed on all sides and along the floor. It can be drawn up and tied when not in use. This is fine, it also serves as a reminder to the birds that there is a top to the enclosure.
- Once birds being introduced seem fine with each other the curtain can be opened 2 meters on both sides so that the birds can meet each other physically, but still have the opportunity to escape each other. Having an opening on either end prevents a bird becoming trapped.

Dimensions of existing aviaries

Currently, there are two large circular aviaries surrounded by a large fish pond. Each aviary measures 30m in diameter and 10m high, offering space for the birds to move and for short flights. The space can facilitate running and short flight exercise especially for the juveniles. Two aviaries can accommodate either two breeding pairs or up to 8 juveniles.

Recommendation for additional aviaries (ITAC)

Breeding aviaries:

These should be visually and physically separated from each other by at least 100 meters. Vegetation or other screens should block the view on at least one-third of the periphery (continuously) so that the birds are not exposed on all sides.

Row of eight additional holding aviaries

- Four sets of two aviaries 10 X 5 X 6-5 meters (measurements length X width X height middle wall barrier – height outer wall barrier), each set with two 1 m (or larger) interconnecting doors between the two adjacent aviaries, one towards the far end and one towards the near end, allowing the birds to circle the two aviaries when both doors are open. Sliding doors work best, as the



- width of the opening can be altered, and there is no chance that a bird can become trapped behind a door.
- The possibility to remove the interconnecting barrier wall entirely should be included in the design.
- 10 meters space with vegetation or other visual barriers should be included between the aviary sets. Should the herons not behave very territorially the 10 meters wide space could be turned into another set of enclosures when expansion is required, reducing the amount of fencing needed.
- Each enclosure should have a shelter outside the aviary (see section breeding aviaries).
- Each enclosure should have a shallow pool and appropriate substrate and perches (see section breeding aviaries).
- Each enclosure should have a separate keeper door at the end of the aviary, this should be at least 1 m wide and 2 m high so that the keepers can get a wheelbarrow and enclosure furniture through.

Protection/predator proofing in aviaries

All enclosures need to be secured against predators. Predation is a big issue for birds in cages, and it is important to be very cautious. The current WBH breeding center will have a perimeter wire mesh fence to deter predators, trespassers and to demarcate the property for the breeding center. The dome shaped aviaries will have proper predator proof wire mesh protection. Besides the wire mesh protection, the surrounding fish pond's concave architectural design above the water surface will act as a safety measure especially from snakes. The fish pond will have fencing on either side to ensure additional safety. To avoid confrontations between the two groups due to their territorial nature, the two aviaries will be separated by a concrete structure that will house a laboratory. The aviaries will be in circular shape to ensure that weaker birds are not cornered during conflicts or aggression, providing space to escape around.

A proper surveillance and regular monitoring system will be put in place to ensure that the birds, and enclosures are not easily accessible for trespassers and free of predators and other potential threats. At a later phase, a large naturalistic aviary for strengthening flying abilities of birds to be released, with possibilities to capture live fish could be provided.

Recommendation for Predator proofing (ITAC)

1. A wall made of plastic, concrete, or another slippery material that cannot be climbed by small mammals or snakes, should be fixed on the outside of enclosure meshing to a height of 1.2 meters. This should be very firmly attached to the floor structure.
2. Two strands of electric wire should be fixed 10 centimeters apart at the base of the 1.2 meters wall and two at the top.
3. The periphery enclosure barrier should have an L-shaped wall extending underground to keep out rats and digging predators (see drawing).
4. Perching in the enclosure should not be so high that a night avian predator can grab the birds through the top (no closer than 2 m from enclosure top).
5. A fence overhang can also help to keep out predators such as snakes.



Other features

The enclosure will retain natural trees that will provide shade/protection from the sun and the opportunity for the WBHs to perch on its branches. Numerous shrubs, tussocks, substrates, rocks or boulders, natural perching logs, and a stream will also be incorporated to retain some of the aspects of a natural environment. The natural trees in the aviaries will also provide herons a natural nesting platform.

Food supply inside enclosures

The enclosures and the laboratory are surrounded by a large fish pond. Each enclosure will have a stream with fish supplies running through it. The stream will be directly fed from the fish pond surrounding the two aviaries. It is to provide a natural feeding environment for herons in the center. Additional fish will be supplied in artificial feeding tubs only if the birds fail to feed from the pond or during unavoidable circumstances.

Feeding inside the aviaries (ITAC)

Feeding buckets with water should be used as has been done in the past. Feeding buckets should be offered in the shelters. Fish and other food should NOT be put into the pool that the birds have to stand and bathe in because the fish oils accumulate on the water surface, then getting on the feathers of the birds. This makes the plumage dirty and removes its waterproofing.

Laboratory

The laboratory is connected with aviaries and have access for releasing chicks, manual feeding or during emergencies. It has multiple compartments designated for specific purpose as follows;

The concrete structure of the lab will ensure that there is no visual access between the two breeding groups. Also, the experts' dormitory within the lab will ensure 24-hour monitoring and care. Only the breeders, researchers and experts will have access to the lab. The lab is connected to outside by a bridge over the fish pond which might need additional predator proofing installation.

Incubation and Rearing chambers:

Incubation and hand-rearing facilities, next to each other, but separate rooms. These facilities are easily accessible to personnel, so that eggs and chicks can be monitored, but at the same time the hand-rearing facility are a quiet area, where the chicks will not have much exposure to human voices and will see people as little as possible when using their outdoor pens. The hand-rearing chamber are connected and have a view of a breeding enclosure, exposing chicks to adults as soon as possible.

Medical chamber:

A space for storage of chemicals, medicines and nutrients and treatment of injured, diseased or bird requiring medical attention. A space for small refrigerator for storing medicines, samples.

Research Lab:

A research space with proper examination table with good lighting, computer, microscope, oxygen maker, radiograph machine and other basic lab equipment. A space for breeders, researchers and experts to conduct research and monitor eggs, chicks or adult birds regularly.



Expert's dormitory:

A resting space for breeders, researchers and support staff working inside the laboratory while monitoring newly hatched chicks, incubating eggs or birds requiring medical attention.

Quarantine:

A separate space to monitor or isolate a new individual, diseased or requiring medical attention. At least three quarantine cages (5 X 3 X 3 meters) in separate room, each with keeper door, the two shared walls dividing the enclosures could be removable to make larger space. The quarantine room *are recommended to have access from outside as well as inside (ITAC).*

Kitchen:

A proper kitchen space with refrigerator for thawing of fish, freezer for storing some food fish in case it is not possible to acquire fresh fish. The kitchen will also be used by researchers and breeders working inside the lab for tea and coffee.

Incubation-hatching facility (Recommendations by ITAC)

Protocols for artificial incubation and hand-rearing can be provided

Equipment and furnishings

- Sink with faucet
- Counters for incubators, record keeping etc.
- Minimally two incubators (e.g. Grumbachs)
- Hatcher (chick put in this for a short time, e.g. 1 day, post hatching before being moved to hand rearing unit. An incubator can be modified to be a hatcher. The hatcher normally has a higher humidity and slightly lower temperature than the incubator, and is set up so that the chick can dry off and get its strength after the tiring hatching process, so it needs a place to lay and sit.
- Weight scale for monitoring egg water loss
- Candler to assess egg fertility and development
- Ambient temperature and humidity control
- Shelf for storing records

Hand-rearing facilities and methodology

Avoiding imprinting

- *It should be possible to visually isolate chicks from humans from hatching to fledging, only "puppet" caring for them. The chicks can be monitored remotely by camera to reduce contact with humans. The puppet should resemble an adult WBH to the degree possible.*
- *Because we don't know what the chicks imprint on, to the degree possible the hand-rearing unit they are in for stages 1 and 2 should simulate a WBH heron nest, and the nest should also be present during stage 3 so that the chick can stand on it.*
- *Talking to the chicks and talking to other people in close vicinity of the chicks*



- *should be avoided during stages 1 and 2. During housing stage 3 the fledgling chick will see and hear people when outside, but people should not talk to it. A chick should always have contact with other chicks, and if this is not possible the chick should be provided with a mirror so that it sees another WBH. The mirror should be provided throughout the rearing process until the chick is brought into contact with other live WBH. The chick should have visual and auditory contact with adult WBH as soon as possible.*
- *WBH of any age should not be fed from what is obviously a human hand (versus a hand puppet).*

Chick housing

Two large brooders that can be divided into at least four compartments each (thus eight in total) that can be serviced and closed from top. These can be placed in the Indoor area of rearing enclosures described below, and thereby make use of the heat and UV source there.

Four enclosures with indoor and outdoor areas

These will need to be cleanable with water and a hose. The indoor areas need to have a drainage system that the water can flow to, and an adequately large opening. The floor should have a slight slope leading downward to the drainage. The drainage can run along all four enclosures, flowing out at one point where debris can be collected and the water goes into some type of sewage system.

- *Indoor area a 2 X 2 X 3 m, equipped for heat lamps and UV lamps (both with adjustable heights and placement, see drawing for one solution). Concrete floor that can be covered with other substrates as appropriate. The walls should be solid on the outside, or 2 x 2 wire meshing covered with a replaceable matting. The inner walls separating adjacent rearing areas should definitely be constructed from 2 X 2 cm mesh.*
- *Each indoor area should have a keeper door to a central hand-rearing space, and a 1.0 X 0.5 m sliding door that can be remotely closed between indoor and outdoor areas for the herons. This could be part of a larger, keeper access door.*
- *Outdoor area 4 x 2 X 3 m, with 2 x 2 cm wire meshing. Interconnecting keeper doors between the four aviaries (increases management and space flexibility), and a keeper door at the far end of each enclosure. Furniture such as the shelters with artificial grass-covered perches that the adults will use should be also put in this enclosure so that the birds become accustomed to them. Substrate should be similar to that in wild (boulders, gravel, sand, with a few shrubs, and or logs.*

Housing stages

Incubation and rearing will involve up to four different housing stages, according to the stage of egg/chick development of the WBH received at the facility. While herons are normally reared with siblings, some herons are known to practice siblicide, and it may be that brood reduction in WBH is at least in part caused by sibling aggression. We do not have a current understanding of siblicide in the wild, nor do we have any way to predict whether sibling aggression would be more likely to occur in the captive situation than in the wild. It probably would not be as likely, since food will be readily available, however we do not know all the



factors that could drive such a behavior. Therefore, it is important to have different options for rearing chicks, so that they can be together, or separate but with visual and auditory contact.

Stage 0: incubator/hatchery

Stage 1: Day 1 to 1 week- brooder box used, with twigs and nest lining. It may be that the chicks can be held together with no problem, but should there be sibling aggression it is important to have the option to separate them at all, or for any other reason, therefore the option to make the brooder boxes in to smaller subunits is recommended.

Stage 2: 1 week to ca. 75 days- indoor area of rearing enclosure only. The indoor area alone should be used until the chick starts walking around, in the wild this would be the age that the chick begins leaving the nest to explore the nest tree. An artificial nest constructed to resemble a heron-built nest could be used, with the nest lining (e.g. soft plant material) replaceable, so that the nest can be easily cleaned even when the chick is not mobile enough to defecate over the edge of the nest. Should chicks be aggressive to each other, they could be placed in adjacent indoor areas with the meshing in between.

Stage 3: ca. 75 days to 4-5 months- indoor and outdoor areas. Once the chick is mobile it should have access to the outside area whenever possible, but it is good to be able to shut it inside if the weather is terrible, or to close the door to keep the chick inside or outside, for cleaning or for maintenance in the other area.

Transition from rearing enclosure to large enclosure

Introduction to large enclosures need to be progressive. If the juveniles are going into a large enclosure a temporary small enclosure built inside the enclosure (or the shelter) can be used so that the bird can familiarize itself with the surroundings before being released. Feeding the birds to be introduced in their shelter will help facilitate future managements.

Sl no	Equipment	Quantity
Lab Equipment		
1	Incubator (Grumbach)	2 nos
2	Hatcher	2
3	Egg Candler/ torch	1
4	Ambient temperature and humidity control (Hygrometer/Humidity meter/Thermometer)	1
5	Plastic thermometer	10
6	Digital Weight Scale	2
7	Spring Scale	3
8	Weight sling/bag	5
9	Digital Egg Monitor (Buddy)	2
10	Heat lamps for chick rearing	6



11	UV lamp	6
12	Tubs / feeding Plates/Bowl/ (1 set)	20
13	Kitchen equipment (knife, scissors, cutting board)	1 set
14	Stainless steel forceps	5
15	Galvanized steel bucket	4
16	Puppet	As required
17	Curtains	As required
18	Kettle for hot water	1
19	Supplements for hand rearing	As required
20	Bedding	As required
21	Bird capturing/ Handling equipment	2 sets
22	Bird transportation facility	2
23	Mirrors everywhere chicks reared	10
24	Computer/Database/Record keeping system/Information display system (2 sets for lab and office)	2
25	Sinks with faucets	1
26	Furniture/Working tables/Shelves (lab/office/quarter)	As required
27	CCTV lab and aviaries security and surveillance system	As required
28	Generator 20Kv (Power backup system)	1
30	Kitchen facilities for keepers	1 set
Veterinary facilities		
1	Refrigerator/Medical storage unit (can be small)	1
2	Medical supplies (included under operations cost)	As required
3	First Aid Kit/Medical facility (1 set)	As required
4	Freezer/ storage unit for dead birds/ medicines/Chemicals, etc.	As required
5	Microscope and accessories	1 set
6	Oxygen Concentrator	1
7	Radiograph machine	1
8	Stainless steel examination/operating table with good lighting	1 set
9	Weigh scale up to10 kg	1
10	Sinks with faucets in quarantine room and in vet facility	2
11	Literature	1
12	5X3X3 m quarantine cages	3

Table 6: Equipment and furnishings for Laboratory

Facilities and accommodations

Office and information center

A common working space for researchers, breeders and support staff is also available at the center. The WBH information center is located adjacent to the entry point, leaving a safe distance from the aviary. This is mainly to reduce the disturbance from the visitors. The office and information building can accommodate around five staff.

The centre with its information displays will aim to educate the visitors about WBH and will be the first stop point for the visitors. The information centre will also endeavor to enhance awareness and knowledge on the, eco-tourism programs in the area, local vegetation, flora and fauna, and the community, and operates as a one-stop shop for information, resources, and souvenirs. The administrative office will be located within the information centre.



Multi-purpose Education, Meeting and Visitor Center (ITAC suggestions)

- A building that can be multi-functional such as the visitor center at the Black-necked crane wintering site could be quite useful. It can provide a place to meet with local people to discuss WBH related-matters; for conservation related events to be held; for school groups from Bhutan to come to interactively explore the WBH, its ecosystem and its conservation; and for other visitors to refresh themselves as well as to learn about the species and its habitat. Tourism could also provide an opportunity for local people to sell various wares (e.g. food, souvenirs) and perhaps guide groups. Employees of the breeding center could also take their breaks here.
- The back side of the education center could be inserted in the perimeter fence (at the east end of the property), so that the building can be accessed through side doors without going into the breeding center complex.

What might be desirable to have in an education center?

- Classroom with tables for children to write, draw and construct other items, for example models of herons (with separate entrance in addition to entrance to main hall)
- Meeting room seating 30 people
- Small theatre for showing films
- Kitchenette for preparing drinks and serving, already prepared foods, storing and cleaning dishes and cutlery, with refrigerator, with separate access to building so that deliveries do not have to go through main hall, as well as main hall access.
- A large, central space with educational materials, a seating area for refreshments, a gift shop corner, possibilities to hold larger gatherings, and for remote viewing of WBH enclosures, and hand-rearing facilities, on one level (without stairs)
- Double front doors, wheelchair accessible
- Rest rooms (for tourism would be good to have men and women restrooms separate, with at least two toilets for men and two for women, and at least one of each wheelchair accessible)
- All-important visitor facilities should be on ground floor or otherwise wheelchair accessible.
- Parking lot (two buses, 20 cars, 10 motorbikes)

Staff quarter and guest house

To ease accessibility and ensure that the WBHs are monitored round the clock, staff quarters will be built within the centre compound.

The allotment of the apartment to the staff will be based on need, appropriateness, and requirement for close proximity to quarters related to individual job description. The guest house will be for external experts and officials visiting and can also house the volunteers and interns.



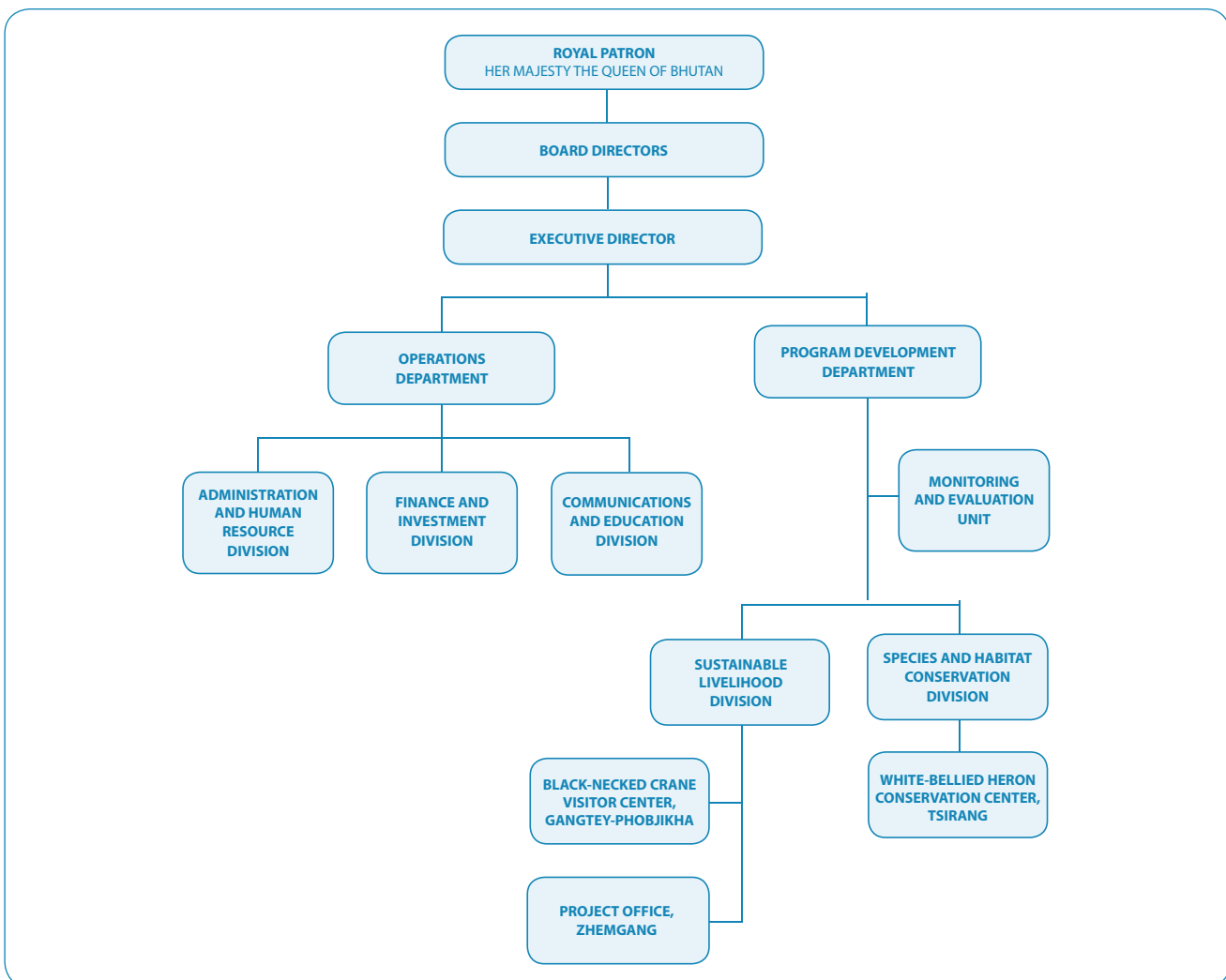
Sl no	Facilities	Housing capacity	Existing	Additional requirement					Total
				2021	2022	2023	2024	2025	
1	Office	4 staff	1	0	-	-	-	-	1
2	Information and Exhibition Centre with public toilet	25-30 ppl	-	1	-	-	-	-	1
3	Staff quarter	5 staff	1	-	-	-	-	-	1
4	Guest house	2 units	-	-	-	1	-	-	1

Table 7: Housing capacity, status and gaps

Human resource

Management

The overall supervision of the centre will be from the RSPN Headquarters, while the day to day operation of the centre will be manned by personnel who have a sound working knowledge of White-bellied Herons.



The number of staff at the center might grow with increase in breeding and non-breeding herons in the center or with increase in human resource requirements with expansion of the center. Additionally, as other research initiatives are instituted the human resource requirement too shall change. The curator at the will be responsible for overall management of the center and accordingly report to the chief at headquarters. It is also responsibility of curator to oversee day to day record keeping and administrative work at the center.



Documentation required	Frequency	Responsibility
Progress report	Quarterly	Centre Coordinator/Curator
Health book	Regular checkup	Veterinarian
Record keeping (Food, weight, behavior, etc.)	Daily	Breeder/Fish manager
Studbook maintenance	As per requirement	Researcher/Curator
Program review	5 yearly	Chief Researcher/RSPN Team
Visitor Information	Monthly	Centre Coordinator/Curator

Table 8: Program Administration

sl no	Designation	Responsibilities	Time (%)	Existing HR	Additional HR projection					Total	Remarks
					2021	2022	2023	2024	2025		
1	Executive Director	Provide strategic direction for management and implementation of project, meeting of advisory committee and dealing other external affairs/unseen matter related to programs.	20%	1	-	-	-	-	-	1	
2	Program Director	Co-ordination, planning, monitoring, and evaluation of programs.	20%	1	-	-	-	-	-	1	
3	Administration	Records keeping, resource coordination, scheduling, and ensuring compliance with government and safety regulations.	20%	1	-	-	-	-	-	1	
4	Finance	Management of fund, maintain book of account and preparation of regular financial reports	20%	1	-	-	-	-	-	1	
5	Communication	Communication, and materials, conduct outreach programs to politicians, government, and public.	20%	1	-	-	-	-	-	1	



6	Specialist/Chief	Provide technical and professional services for captive breeding and conservation of White-bellied Heron	100%	1	-	-	-	-	-	1	-	-	-	1	Will be recruited through IKI. Salary will be covered through IKI until 2025.
7	Researchers	Co-ordinate and support specialist and initiate subsidiary researches on White-bellied Heron. Monitoring of wild population, research in wilds, finding nests, inventories and mapping of new habitats and other activities outside connecting wild habitats and captive breeding programs.	100%	-	2	-	-	-	-	-	2	-	-	-	Will be recruited through IKI. Salary will be covered through IKI until 2025.
8	Veterinarian	Provide veterinary care and services (health examination, vaccination, disease control, medication, nutrition, etc.) and help breeders in raising heron at the center.	100%	-	1	-	-	-	-	-	1	-	-	-	New recruitment
9	Breeders	Carryout breeding and rearing activities. Assist specialist and Researchers for implementation of research projects, assist fieldworks and other conservation works on White-bellied Heron	100%	2	-	-	-	-	-	-	-	-	-	2	Sonam Tshering & Tshewang Lhendup
10	Information Center Manager	Overall, in-charge of the information center. Responsible for management, operation, IEC, visitor management and daily operation of Information center	100%	-	-	-	-	1	-	-	-	-	-	1	New recruitment
11	Security Guard	Center security and visitors monitoring.	100%	-	1	-	-	-	-	-	-	-	-	1	New recruitment
12	Caretaker	Management of fishpond and food supply, maintenance of aviary, utilities, security equipment, protection, site development, etc.	100%	-	-	-	-	1	-	-	-	-	-	1	New recruitment

Table 9: Management team, status and requirements



Safety for conservation center and keepers

Health and safety measures for the staff at the CC and visitors as well as for the captive herons, should be one of the priorities of the centre management. Probable risks associated with the functioning of the CC would be; fire, landslide, flood, earthquake, windstorm, zoonotic diseases, predators, injury while handling birds, theft, etc. Up to date emergency response equipment like first aid boxes, fire extinguishers and other supplies should be maintained within the premise of the centre. While it is the responsibility of the management to ensure a safe environment for the staff, visitors, captive herons and anyone else who may be affected by the functioning of the centre, it is also the responsibility of the staff at the centre to comply by the directions given by the management for health and safety and to carry out work in accordance with the established safe work procedures.

Fisheries management/food supply

Fishery at the center

The WBH center has a fishery pond of 70 m X 20m X 3m around the aviary as the fish rearing facility for the WBH in the center. Fish will be reared in the external fish pond surrounding the enclosure, and the streams running through the enclosure with live fish will act as the primary feeding place for the herons. However, provisions should be made to facilitate rearing the fish in different stages i.e nursery, breeding and fattening stages. Depending on the dietary needs, manual feeding can be initiated.

In the future, when the center start operating at its full capacity, the feed demand will rise to at least 5000 kg per year. The fishery at the center is expected to only partially support fish supply needed. Timely arrangement for additional supply both internally and from external suppliers is necessary to meet the demand. Construction of additional fishery for every additional aviary constructed is necessary to keep balanced. Other arrangement could be through community fisheries. Partnering with and entrusting the local communities to rear fish and supply to the center will not only help meet food demand at the center but also provide the locals with alternative income generation opportunity. The Center can also partner with the Department of Livestock (DoL) and Fisheries and devise strategies to ensure long term food sustainability and manage unforeseen circumstances like infection and/or mortality of fish in the pond.

In the long term, the center might require a full-fledged fishery production and management unit to meet the fish demand as there are no mega fisheries in Bhutan to supply adequate live fish on demand.

Partners and collaborators

The centre with its objective of securing a safe ex-situ gene pool, breeding and research, and reviving the wild population by releasing the captive bred birds into protected natural habitats, will require support and participation of various institutions and partners. Therefore, the initial partners would be as follows:



#	Institution/Partners	Expertise
1	Zlin and Prague Warsaw Zoo	Captive Rearing
2	San Diego Zoo, USA	Captive Rearing
3	Korat Zoo, Buriram, Thailand Zoological Park Organization of Thailand	Captive Rearing & Veterinary
4	National Museum of Nature and Science, Japan	Genetics
5	Department of Forests and Park Services (DoFPS)	Captive Rearing & Veterinary
6	Department of Livestock	Captive Rearing & Veterinary

Table 10: Technical Backstopping

#	Institution/Partners	Expertise
1	Bhutan Trust Fund for Environmental Conservation	Funding, Financial management
2	Synchronicity Earth	Funding, Networking
3	MAVA Foundation	Funding
4	PHPA I & II	Funding
5	BirdLife International	Funding, Outreach & Advocacy
6	International Crane Foundation	Funding, Networking
7	WWF Bhutan Programme	Funding, Networking
8	Bhutan Foundation	Funding, Networking

Table 11: Financial and Networking

#	Institution/Partners	Expertise
1	Department of Forests and Park Services	Regulatory, and Research partner
2	Ugyen Wangchuck Institute for Conservation and Environmental Research	Regulatory, Research and Education
3	National Biodiversity Center	Regulatory
4	Local Government	Consultation and Information

Table 12: Regulatory and Decision-making



Funding and sustainability

Endowment Fund

The operation cost of the centre shall be met from the investment interest generated from the proposed endowment fund of USD 3.0 million. The MAVA Foundation has contributed USD 1.5 million which is named after Dr. Heinz Hafner to honor his legacy in the study and conservation of herons of the world. The Heinz Hafner Endowment Fund for the Conservation of the White-bellied Heron is maintained by RSPN, currently managed by Bhutan Trust Fund for Environment Conservation. RSPN shall endeavour to raise additional USD 1.5 million to meet the target endowment fund.

As conservation of the WBH requires consistent and continued effort, surveillance of the wild population and public education will undoubtedly always be needed which will require additional financial support. The conservation effort and support required outside of the centre will be mobilized from other donor support and subsidiary projects.

Further, the Board of Directors and Management of RSPN instituted the technical advisory committee to provide strategic direction to acquire additional funding and conservation of White-bellied Heron in Bhutan.

International Technical Advisory Committee

1. Dr. George Archibald, International Crane Foundation
2. Gemma Goodman, Synchronicity Earth
3. Dr. Thierry Renaud, Mava Foundation
4. Catherine E. King, Long-legged Waterbirds Specialist
5. Dr. Kinley Tenzin, Executive Director, RSPN
6. Rebecca Pradhan, Ecologist, RSPN



Grants/Donations/Other funds

The center will also have an Education center (EC) which will mainly focus on advocating and imparting information about WBHs. The EC will also aim to generate income through entry fees, souvenir sales, initiating crowdfunding and organizing nature excursion, bird watching, trekking, camping, fly-fishing etc. The funds generated will be put into the endowment fund.

Code	Item	Unit	Qty	Rate	Total cost (USD)					
					2021	2022	2023	2024	2025	2026
1. Operational Cost										
1.1	Pay and allowances (Ref. HR requirement and salary for details)	Head	12	Varies	61,930.38	61,930.38	73,196.35	73,196.35	73,196.35	88,593.97
1.2	Office utilities (telefax, electricity, water, fees, etc.)	Month	12	675.68	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11
1.3	Office supplies (files, papers, pens, tapes, drives, stationaries, etc.)	Month	12	40.54	486.49	486.49	486.49	486.49	486.49	486.49
1.4	Maintenance and site development (database, aviary, utilities, security equipment, protection, etc.)	Month	12	540.54	6,486.49	6,486.49	6,486.49	6,486.49	6,486.49	6,486.49
1.5	Travel and transport	Month	12	270.27	3,243.24	3,243.24	3,243.24	3,243.24	3,243.24	3,243.24
	Sub-total 1				80,254.70	80,254.70	91,520.67	91,520.67	91,520.67	106,918.29
2. Workshops and meetings										
2.1	Advisory committee meeting									
a	Food and accommodation (national participants -7, International Participants - 8 (4 days)	head	15	121.62	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65
b	Transportation	days	4	67.57	270.27	270.27	270.27	270.27	270.27	270.27
c	Meeting materials	head	15	13.51	202.70	202.70	202.70	202.70	202.70	202.70
d	Visa fees	head	8	40.54	324.32	324.32	324.32	324.32	324.32	324.32



2.2	Training, meeting & workshops																				
2.2.1	Capacity building (staff)																				
a	Travel (DSA) (7 days)	head	1	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	
b	Travel (Air fare)	head	1	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	
2.2.2	National meetings & workshops																				
a	Food and accommodation (3 days)	head	30	81.08	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	
b	Travel		30	121.62	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	3,648.65	
c	Transportation (30 heads)	days	3	810.81	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	2,432.43	
	Sub-total 4				16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	16,359.46	
3. WBH Conservation Center supplies																					
3.1	Medical supplies	annual	1	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	
3.2	Food and nutrition (incl. fishpond management)	monthly	12	675.68	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	
3.3	Captive breeding, rearing, population management cost (Incl. in-lab research and information development)	annual	1	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	4,545.00	
3.4	Technical services (hire experts, library, and information, etc.)	annual	1	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	8,108.11	
	Sub-total 2				23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	23,761.22	
	Grand Total				120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	120,375.38	

Table 13: Current financial status, gaps and funding requirements for the next five years to operate the White-bellied Heron Conservation Center



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Mr. Indra Prasad Acharja, RSPN

Mr. Sonam Tshering, RSPN

Mr. Tshewang Lhendup, RSPN

Mr. Pema Khandu, MoE

Mr. Phuntsho, DoFPS, MoAF

Mr. Phub Dorji, JDWNP, DoFPS, MoAF

Mr. Thinley Phuntsho, Intern, RSPN

Mr. Dorji Norbu, Intern, RSPN

RSPN Archive



Royal Society for Protection of Nature

P.O. Box: 325, Building No.: 25

Lhado Lam, Kawajangsa | Thimphu 11001, Bhutan

Phone: +975 2 322056 | 326130 | Fax: +975 2 323189

Website: <http://www.rspnbhutan.org> | E-mail: rspn@rspnbhutan.org
