WHITE-BELLIED HERON

Conservation Strategy 2015

The White-bellied Heron
Ardea insignis (Hume, 1878)

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The workshop led to establishment of a White-bellied Heron Working Group, located within the Heron Specialist Group of the IUCN Species Survival Commission (SSC). Members of the Working Group provided significant input into the development and review of this Strategy, with particular input from the Royal Society for Protection of Nature, Bhutan; Ashoka Trust for Research in Ecology and the Environment (ATREE), India; the Wildlife Conservation Society, Myanmar and IUCN's Asian Species Action Partnership.

This report was produced by Mark Stanley Price of the IUCN SSC Species Conservation Planning Sub-Committee (SSC SCPSC), in collaboration with Gemma Goodman of Synchronicity Earth and the current International Coordinator of the White-bellied Heron Working Group.

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Working toward a better future for White-bellied Heron

Many of Asia's vertebrates, from the iconic Tiger to less well-known species like the Saola, are at risk of extinction. Urgent action is required to ensure their long-term survival, which is why new initiatives such as this one to save the Critically Endangered White-bellied Heron, are vital.

The White-bellied Heron – the second-largest heron species – is one of the world's most threatened birds, and is listed as Critically Endangered in the IUCN Red List of Threatened Species. Despite a fervent desire to protect it, attempts to safeguard its future have thus far been uncoordinated between the three – possibly four – countries in which it occurs. Its population is tiny: estimates suggest there are fewer than 250 individuals left and knowledge of the species is surprisingly disparate, making targeted action particularly difficult.

Transboundary conservation presents many challenges, not least because of the differences between neighbouring countries. For example, the White-bellied Heron can be found in two of the world's fastest growing economies - China and India - with rapid development presenting new and intensifying threats to wildlife in both. Meanwhile, Bhutan measures prosperity by assessing the "happiness" of its people (rather than using traditional economic measures of growth). However, hydropower is central to the country's development plans, which may threaten the White-bellied Heron's habitat, as could increasing foreign investment in industrial-scale infrastructure development, mining and agriculture in Myanmar. Alongside this are existing local-scale threats from fishing, mining and hunting, as well as climate change globally.

The White-bellied Heron relies on forest and wetland habitats. Both are fast being degraded in all of its range states, which is why not only a transboundary but also an integrated ecosystem-based approach is required.

While well-coordinated conservation can bring significant benefits to people and wildlife, it is often viewed as an impediment to (rather than precondition for) economic growth by decision-makers. It will take careful negotiation to unite governments in the bird's range states behind the need for the White-bellied Heron's conservation.

This Species Conservation Strategy brings together disparate information on the White-bellied Heron and provides a blueprint for the global action needed to prevent its demise. It marks the start of a hard climb back to a healthy, viable population of White-bellied Heron, ensuring healthy habitats for people and wildlife and helping to pave the way for other collaborative initiatives throughout Asia.

Simon Stuart PhD, Chair of the IUCN Species Survival Commission.

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Appendices

Glossary

ATREE – Ashoka Trust for Research in Ecology and the Environment
BNHS – Bombay Natural History Society
CEPF – Critical Ecosystems Partnership Fund
CIA – Central Intelligence Agency
DGPC – Druk Green Power Company
DoFPS – Department of Forests and Park Services
EOO – Extent Of Occurrence
GAD – General Administrative Department
GEF - Global Environment Fund
GNH – Gross National Happiness
GPD – Gross Domestic Product
HVWS – Hukaung Valley Wildlife Sanctuary
IBAs – Important Bird Areas
IUCN – International Union for Conservation of Nature
KFBG - Kadoorie Farm and Botanic Garden Hong Kong
m a.s.l - metres above sea level
MOECAF – Ministry of Environmental Conservation and Forestry
MOF – Ministry of Fisheries
MOHT – Ministry of Hotel and Tourism
NF – Nature's Foster
NGOs – Non Governmental Organisations
NNR – National Nature Reserve
No. – number
Pers. comm – personal communications
Pers obs – personal observations
RSPN – Royal Society for Protection of Nature
SCPSC –Species Conservation Planning Sub-Committee
SE – Synchronicity Earth
SFU – Southwest Forestry University
SSC – Species Survival Commission
UFCN – United Forest Conservation Network
UNESCO – United Nations Educational, Scientific and Cultural Organization
USFWS – United States Fish and Wildlife Service
WBH – White-bellied Heron
WCD - Wildlife Conservation Division
WCS – Wildlife Conservation Society
WDPA – World Database on Protected Areas
ZSI – Zoological Survey of India

White-bellied Heron *Ardea insignis*
Conservation Strategy

1 Introduction

1. Introduction

This conservation strategy is designed to guide collaborative, targeted and effective conservation action to turn around the fortunes of the Critically Endangered White-bellied Heron. There are large gaps in knowledge of the species, but it can safely be said to occur in very low numbers and discontinuously across an area of diverse land forms. We hope that effective implementation of this Conservation Strategy, combined with ever-increasing knowledge of the species, will result in a secure and self-sustaining population of herons, representing a triumph for species conservation, and also for the continuing existence of healthy wetland systems in an area of global biodiversity significance.

The origins of the work that has led to development of this strategy are summarised in Box 1.

This strategy has been drafted for the benefit of decision-making authorities, principally governments and their agencies, and also for conservationists, researchers, academics and funders.

The strategy briefly outlines the status of the species, referring to a separate in-depth review of the White-bellied Heron (Appendix 4), and the need for action. This is followed by the results of a planning process which led to the following collectively agreed outputs:

- a range-wide vision (the ultimate aspiration/end point for the species),
- a set of goals (what needs to be achieved and where to save the species),
- a threat analysis (what threatens the survival of the species),
- a set of objectives (what is needed to achieve the goals and counter the threats), and
- action points (what needs to be done to address each objective, where, when and by whom). Both range-wide and country specific action points have been identified.

Box 1. Origins of the WBH Conservation Strategy

Based on formal assessment of the WBH's status (for example as in BirdLife International, 2013a), Synchronicity Earth[1], based in the United Kingdom, became aware of the larger picture of the WBH's range-wide survival prospects and the need for a more coordinated and cohesive conservation approach. Following discussions with experts and NGOs working within the region on WBH, it saw that:

(1) the WBH needed more targeted conservation support and action, based on

(2) collation of information and identification of knowledge gaps,

(3) collaborative conservation efforts for the WBH on a range-wide basis, and

(4) the species would be an excellent flagship for the conservation issues facing the Eastern Himalayas and their outstanding biodiversity.

Accordingly, Synchronicity Earth (SE) enlisted the help of the IUCN Species Survival Commission's (SSC) Species Conservation Planning Sub-Committee (SCPSC) with the aim of developing a Conservation Strategy for the WBH.

To progress this, the Bombay Natural History Society (BNHS) and the Ashoka Trust for Research in Environment and Ecology (ATREE) agreed to host a planning workshop.

1. http://www.synchronicityearth.org/

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2 Background

2. Background

2.1 White-bellied Heron: an overview

The White-bellied Heron, *Ardea insignis*, is the world's second largest heron.

Occurring mainly on the south side of the Eastern Himalayas, the White-bellied Heron (hereafter referred to as WBH) has a very large range, currently occurring as a resident there in three countries: Bhutan, India and Myanmar. Based on a single observation, its range may extend east of the Himalayas into Yunnan Province, China. However, WBH occurs at low density and the overall population is regarded as insufficient for future long-term survival. There are large gaps in its known distribution, with the proviso that very extensive areas of apparently potential habitat have not been surveyed for the species.

The WBH's presumed range is covered by three biodiversity hotspots: Eastern Himalayas, Indo-Burma, and South-West China (Myers *et al*., 2000); two Global 200 ecoregions: Terai-Duar savannah and grasslands and the Eastern Himalaya broadleaf and conifer forest (Olson & Dinerstein, 1998); 20 Important Bird Areas (BirdLife International, 2014) and the Himalaya global centre of plant biodiversity, possibly extending into the Indochina-China centre (Barthlott *et al*., 2005).

Whereas the whole Himalaya range is the source of eight of Asia's largest rivers, the mountainous topography of the Eastern Himalayas intercepts the annual monsoons, resulting in very high rainfall and great climatic variation and variability. Furthermore, the Eastern Himalayas have multiple biogeographic origins: the Indo-Malayan Realm of Southeast Asia, Indochina, the Palearctic and the East Asian or Sino-Japanese region. This combination of biotic and physical factors results in an extremely rich regional biodiversity (over 10,000 plant species and 350 mammal species) and means that the region is of outstanding global value.

The region is also well known for its cultural diversity because of its many indigenous and local communities each with their own traditions, cultures, languages or dialects. These often result in unique customs and relationships with natural resources and biodiversity, and their management. For example, in the state of Arunachal Pradesh (India) large tracts of forests are owned and managed by local communities.

The WBH's range is characterised by locally very high human numbers in lowlands and floodplains, where intense agricultural development has probably reduced WBH habitat over many centuries. It also occupies fast-flowing mountain rivers which are now coming under great development pressure for hydropower generation, based on both run-of-river and impoundment dams.

The heron's habitats of mountain rivers in forested landscapes and lowland wetlands are both providers of vital ecosystem services to the region's human populations. While the wetlands provide food, fodder and fuel for human communities, their water flows and levels are regulated by the forested uplands. In addition, the forests conserve and develop soil cover, reducing soil erosion, and provide pollination and many other regulating services. The forests also have cultural and religious values to the people dependent on them.

The WBH is assessed as Critically Endangered (BirdLife International, 2013a); the basis for this is amplified in section 3.4 (below).

The conservation status and declining trend in the WBH population is well known among concerned individuals, both within its range countries and internationally. In its range countries, government and non-government organisations have been researching and supporting the WBH. In Bhutan, especially, over many years there


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have been systematic surveys of rivers for WBH, nest sites have been monitored, captive head-starting tried, and efforts made to provide supplementary feeding sites. In India, there are ongoing surveys and behavioural and ecological work on the WBH. In Myanmar, WBH have been included in many waterbird surveys in Kachin State. Surveys in China's Medog County, on the Tibet and Tengchong border have not yet revealed any verified recordings of WBH (2014-2015).

2.2 Background to the WBH Conservation Strategy

The organisations most involved in stimulating action for the WBH, and the associated processes are described in Box 1. 'Origins of the WBH Conservation Strategy'.

The key activity in determining the shape and content of this strategy was a strategy planning workshop, held in December 2014. Full details of the planning process, covering design and preparation of the workshop, its programme and participants, and the subsequent development of the strategy are all described in Box 2.

Box 2. Developing the Conservation Strategy

The central process for developing the Conservation Strategy was a planning workshop with the participation of essential stakeholder persons and institutions from each WBH range country, plus other specific expertise deemed relevant.

Preparation for the workshop comprised several elements: a Technical Team was created, comprising BNHS, ATREE, SE, SCPSC, BirdLife International, the IUCN SSC Asian Species Action Partnership, the Royal Society for the Protection of Nature (Bhutan), the Wildlife Conservation Society (Myanmar), the IUCN SSC Heron Specialist Group, and Welt Vogel Park.

These organisations designed the workshop and programme.

All in-country administration and logistics (including invitations) were handled by ATREE, with support from BNHS.

The planning workshop was held 2-4th December 2014 at the Hotel Brahmaputra Ashok, Guwahati, Assam.

As background information, available to all, SE and SCPSC drafted a comprehensive Species Review for review by the Technical Team. The final Review (see Appendix 4) covers all essential aspects of WBH distribution and status, and as much information on its biology, and the threats faced by the species, as could be located. Further information on socio-economics, human development and demography in its range areas was also included.

The planning process at the workshop and the structure of this Conservation Strategy were essentially those recommended in the SSC's 'Strategic Planning for Species Conservation: A Handbook[2]'.

The key stages and outputs from this planning approach are summarised as:

1. Introductions and workshop administration.
2. Brief presentations from at least one person from each range country on WBH status and conservation, and a few further on more specific aspects of the same.
3. Development of a Vision which is a statement of the collective ambition for the WBH and its secure future; its content should be seen as challenging, yet realistic rather than idealistic, and should specify the duration to which it applies.
4. Development of a Goal or set of Goals, which are an operational version of the Vision, summarising **what** must be done for the WBH and its conservation, but **not how** this state will be achieved

Continued overleaf

5. Identification and classification of the Threats facing the WBH, exploring and amplifying those already listed in the Species Review. Threats include those affecting the WBH both directly and indirectly; a further set of Constraints to effective WBH conservation were identified; the final stage was to group similar Threats and Constraints into a hierarchical Threat tree, with the most immediate, fundamental or proximate Threats at the base, with larger, or more indirect, or more ultimate Threats higher up; Constraints will usually be around the top of the tree, as factors beyond the power of conservation to mitigate.

6. Specification of a set of Objectives for each Goal; these were formulated to address both the Threats, and Constraints to the extent possible, and by doing so they would meet the Objectives, and hence contribute to the Goals; ideally, Objectives should be precise and quantitative.

7. Development of a set of Actions for each Objective (depending on applicability to each range state): Actions specify what must be done to meet an Objective, while countering the Threats; they must be based on rigorous analysis of cause and effect, in order to avoid unintended and undesirable consequences; each Action must be SMART[1]; and each Action statement should:

    - specify the resources needed (money and others such as personnel, skills, equipment),
    - state who will do what and when,
    - state who is responsible for the Action and is answerable,
    - state the indicators of progress or completion, and
    - be prioritised.

It was agreed that the Vision, Goals, Objectives, and the Threats which were identified in the workshop would be treated as common to the WBH across its entire, international range. In contrast, the resulting Actions would be specific to each range country[2]. Accordingly, when not in plenary session (below), each working group comprised participants from each range country. In contrast, to develop country-specific Actions, each working group comprised of participants exclusively from each range country. A further set of relatively short-term Actions, inclusive of all range countries and involving the international conservation community, was developed.

The workshop programme and schedule are shown in Appendix 1. After welcomes, introductions and necessary administrative aspects, there was a plenary discussion on the purpose of the workshop and the shape of the resulting Conservation Strategy. This is reported in Appendix 2.

This was followed by a series of short presentations to all participants on current WBH conservation activities and status/knowledge of WBH in each range country and on further relevant, specific issues. There followed a mixture of plenary sessions and working groups, each reporting back in plenary. In addition, there were a few smaller working groups with specific tasks; the initial delineation on to maps of areas surveyed for WBH was also completed.

Forty-seven individuals participated in the workshop; these are listed in Appendix 3.

A report on the workshop was drafted, circulated to the Technical Team for comment and distributed in final form in March 2015. This is available at www.whitebelliedheron.org and on the Heron Specialist Group website.

Following the workshop the Conservation Strategy was drafted by SCPSC, edited and reviewed by the WBH Coordinator and subsequently the Technical Team and then by all participants between June and September 2015.

In view of the intention that the WBH Conservation Strategy should become official policy in each range country, the strategy is designed to be both an overall, range-wide document and one which can be split to provide a country-specific version for each range country.

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1. SMART: S = Specific; M = Measurable; A = Achievable (in principle the Action can be successful); R = Realistic (not only Achievable but resources etc. will be adequate); T = Time-bound.

2. http://cmsdata.iucn.org/downloads/scshandbook_2_12_08_compressed.pdf

2.3 Structure of the WBH Conservation Strategy

The Conservation Strategy contains the following:

- Vision
- Goals
- Threat Analysis
- Objectives
- Actions

The knowledge base for the workshop and strategy development is contained in the Species Review, included as Appendix 4. The Species Review was prepared in advance of the planning workshop and has subsequently been revised post workshop (up until October 2015) to include new or additional information.

Appendix 6 comprises an informal summary, compiled after the workshop of facts and uncertainties regarding the WBH. Information remains patchy and there are often contradictory observations from different parts of WBH range. This appendix also indicates the main areas for action, which are reflected in the country-by-country Actions (section 9).

While the Vision, Goals, Threat Analysis and Objectives in this strategy refer to the range-wide conservation of the species, the Actions are country-specific. This is done to allow easy separation of country-specific Conservation Strategies where they are needed for any range country's purposes.

The following strategy is deemed to meet the participants' stated purpose of the workshop and shape of the strategy for the WBH, as outlined in Appendix 2.

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Conservation Strategy

3 Introduction to the WBH

3. Introduction to the WBH

3.1 Taxonomy

The WBH was described by A. O. Hume in 1878 (Stray Feathers 6:470) as *Ardea insignis* from a specimen collected from somewhere in the Sikkim *terai* and/or the Bhutan *duars*.

Ardea insignis Hodgson, 1844 was a *nomen nudum* so was renamed *Ardea imperialis* by Baker (1928), the name used by various later sources. However, *Ardea insignis* Hume, 1878 is available and is identified as the correct name (Sibley & Monroe 1990).

Ali and Ripley (1987) called it the great White-bellied Heron due to its large size.

Although it was named the Imperial Heron *Ardea imperialis* in Collar and Andrew (1988), the accepted name now is *Ardea insignis*, the White-bellied Heron.

3.2 Appearance

The WBH is the second largest living species of heron, standing about 127cm tall and has a large blackish bill 15-18cm long. It is mostly dark greyish with a contrasting white throat, belly and vent and white-streaked scapulars, foreneck and upper breast. The legs and feet are grey. Adult males and females have two lace-like white plumes on their nape, while juveniles have smaller browner plumes. (BirdLife International, 2013b; www.heronconservation.org).

3.3 Distribution

Fig. 1 shows historic (pre year 2000) and recent (year 2000 to present) locality records of WBH and associated protected areas. Details of each record can be found in Appendix 8.

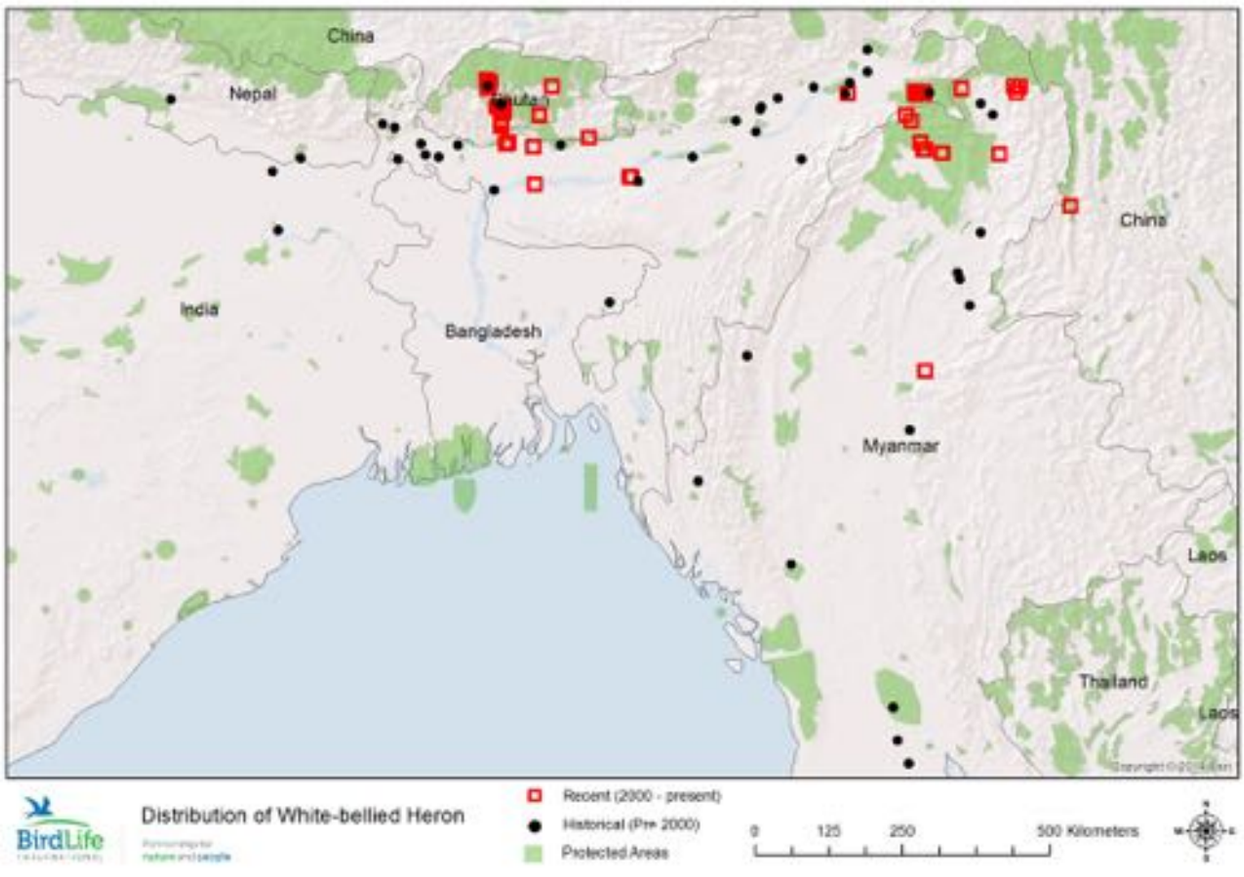

Figure 1. Distribution of White-bellied Heron

It is important to note that each spot represents a location at which one heron or several herons, on one or more occasions, have been recorded.

Fig. 1 suggests that records of WBH, with accurate identification and provenance, are relatively few and are spread sparsely over an extensive range. The bulk of the recent records lie in Bhutan and on either side of the international boundary between northeast India and the extreme north of Myanmar. The following observations may be made:

1. Pre-2000 records are more numerous than those for 2000-2015; however, the former refer to a longer period, so the relative abundance of records may be of little consequence.

2. Surveying effort is not reflected in this figure.

3. There are no records in Bhutan pre-2000 but regular surveys only started in 2003. There are also no records pre-2000 along the border of India and Myanmar.

4. Despite the provisos in (1 and 2) above, the WBH appear to have been more widely distributed before 2000, and records are more widespread than are those since 2000.

5. Many pre-2000 records were along the course of the Brahmaputra river system and other rivers, whereas relatively few observations have been in these areas since 2000; such areas need to be re-surveyed.

6. The bulk of the records since 2000 are in mountainous areas of Bhutan; records from India and Myanmar are in valley lowlands, mostly adjacent to mountain areas.

The bulk of recent locations are in or adjacent to protected areas. From this the following tentative conclusions can be made:

1. The present range of WBH is greatly reduced compared to before 2000.

2. In the absence of evidence for any increase in density, the overall population of WBH is smaller than before 2000.

3. WBH are now found in mountainous areas, and in Myanmar the WBH is now largely found in lowland wetlands within generally mountainous areas, rather than in lowland landscapes.

4. The WBH is now mostly recorded in protected areas.

Interpretation of these location maps cannot be separated from knowledge of which areas have been surveyed for the presence of WBH, with the knowledge of when surveys were done and how. Fig. 2 shows the areas surveyed since 2000, with Table 1 showing the years of these surveys. Given the range of conditions and habitats in which WBH have been recorded, these maps indicate there is a critical need for more extensive and re-survey for WBH in areas that appear to be suitable habitat.

3.4 Conservation status

The WBH was uplisted to Critically Endangered status in 2007, and currently remains there based on criteria CR C2a(i) (BirdLife International, 2013a), due to:

- Population size estimated at fewer than 250 mature individuals (C) with a continuing decline, observed, projected, or inferred, in numbers of mature individuals (2) and no subpopulation estimated to contain more than 50 mature individuals (a (i)).

This decline is projected to intensify as more habitat is lost and degraded, with the possibility of direct exploitation and disturbance, especially when nesting (see Threats).

3.5 Legal status in each range country

Bhutan

The Royal Government of Bhutan has recognised the significance of the WBH which is evident in the order issued by the Cabinet Secretariat in 2007:

" Phochu is declared as White-bellied Heron Habitat vide the approval of the Cabinet Secretariat letter No COM/04/07/887 dated March 1, 2007 and 336th CCM Sessions which states:

1. Banning all quarrying operations along Pho-chu namely at Gubjithang, Khawaraja and Samdingkhar and declaring the areas as the Protected habitat of White-bellied Heron.

2. Enlisting White-bellied Heron in Schedule I of the Nature and Forest Conservation Act 1995 through the National Assembly."

Listing on Schedule 1 means that WBH is afforded the highest level of protection.

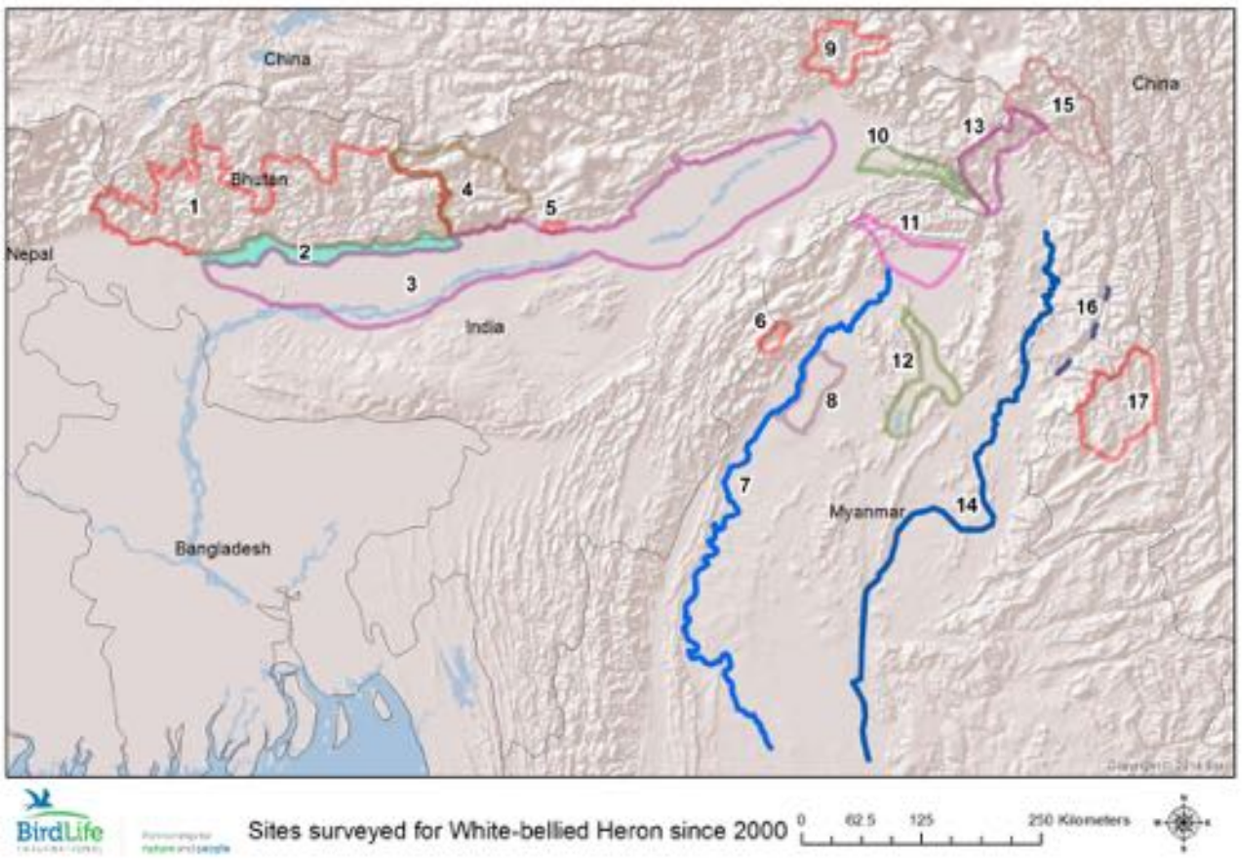

Figure 2. Areas surveyed since 2000

Table 1. Year and country of sites surveyed (site numbers refer to Fig. 2)

Site Number (on map)	Country	Year of survey
1	Bhutan	2003-2015 (ongoing)
2 & 3	India	2013-2014
4	India	2010-2011
5	India	2005, 2008, 2009, 2010, 2011
6	Myanmar	2007
7, 8, 12	Myanmar	2009-2011
9	India	2011
10	India	2005-2014
11	Myanmar	2011
13, 15	Myanmar	2005-2014
14	Myanmar	2007-2012
16	Myanmar	Unknown
17	China	2014- ongoing

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China

The WBH is not protected under any law within China. Its presence is not currently confirmed there.

India

In India the species is included in Schedule IV of the Indian Wildlife Protection Act. This means that the species is fully protected, but the penalties for contravention are much lower than for species on Schedules I-III.

Myanmar

The WBH is considered a completely protected species under the Protection of Wildlife and Conservation of Natural Areas Law (1994).

This is the highest level of protection under Myanmar law with the penalty explained as:

"37. Whoever commits any of the following acts shall, on conviction be punished with imprisonment for a term which may extend to 7 years or with fine which may extend to kyats 50,000 or with both:-

(a) killing, hunting or wounding a completely protected wild animal without permission, possessing, selling, transporting or transferring such wild animal or any part thereof without permission;

(b) exporting without the recommendation of the Director General a completely protected wild animal or a protected wild plant or any part thereof."

3.6 Literature on the species

The information sources used in this work are listed at the end of the Species Review (Appendix 4). While some high-quality sources are dedicated to aspects of WBH biology and conservation, there is a lack of information on many aspects of the species' ecology and behaviour. Statements on sightings and population estimates, based on no systematic survey process, are repeated across multiple sources. This situation alone highlights the need for analysis of knowledge gaps and then increased systematic information-gathering on the WBH.

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4&5 Conservation Strategy

THE CONSERVATION STRATEGY

Box 2 summarises the process of developing this strategy.

4. Vision

Following the process described in the workshop Report, the following Vision was developed:

"By 2020 we will achieve the effective conservation of White-bellied Heron across its range countries. White-bellied Heron conservation will inspire and challenge people to maintain and create healthy riverine eco-systems and their dependent human communities."

The very short time frame for the Vision reflected participants' consensus that conservation action for the WBH is urgent.

5. Goals and Objectives

Three main broad themes were identified; relating to each theme a single Goal was articulated. These Goals were then used to develop Objectives, incorporating the results of the Threat analysis (see Box 2)

Theme 1: Research/knowledge

Goal 1:

Collate scientific information in order to contribute to the design and effective implementation of immediate interventions to reduce the extinction risk of White-bellied Heron. Further research will provide a sufficient understanding of the species' distribution, population status, natural history, threats and their social context across its range.

Objectives

1.1 Implement a coordinated research strategy across the species' range to understand key aspects of ecology of the species including seasonal and daily movements, post- fledgling dispersal, foraging activity (and success), breeding success, habitat selection, and mortality.

1.2 Identify and survey areas where the species is expected to occur (or has occurred historically).

1.3 Understand population size, connectivity, trends and spatial heterogeneity/patterns across the range.

1.4 Define the known and potential threats and understand the role each may have in the extinction risk of the species across its range.

1.5 For each threat study and interpret the human motivation and needs that produce/contribute to it.

Theme 2: Healthy Heron Habitat and Habitat-based Threat Reduction

Goal 2:

Maintain healthy riverine ecosystems in the White-bellied Heron's range with governance frameworks that ensure development and livelihood activities are consistent with the species' conservation, based on best scientific evidence.

Objectives

2.1 Ensure appropriate protection and designation are afforded to all priority WBH habitats.

2.2 Ensure there are no illegal or destructive fishing practices within designated priority WBH habitats.

2.3 Establish that there should be no new dam construction and operation on rivers with key WBH populations without complete, publicly available environmental and social impact assessments, coupled with a full suite of appropriate mitigation measures, with dam developers / operators responsible and accountable for complying with formally-specified measures and conditions.

2.4 Prevent sand or gravel extraction, or gold-mining within designated priority WBH habitats.

2.5 Power lines (high voltage and reticulation) should incorporate global best practice engineering design to mitigate collisions/electrocution risk to large birds, with modification measures to existing power lines to mitigate risk to flying WBH.

2.6 There should be no new road construction along rivers with confirmed breeding populations of WBH without measures to mitigate negative impacts on the species, informed by global best practice.

Theme 3: Human Communities

Goal 3:

Empower communities through education and awareness to enhance their sense of responsibility to, and ownership of, the White-bellied Heron and its habitat, and to inspire governments, civil society and donors to engage in coordinated and immediate efforts to conserve WBH.

Objectives

3.1 Ensure the highest level legal protection status for WBH in each range country and encourage the full commitment and strengthening of capacities of the government in effectively enforcing protection and legal actions.

3.2 Sensitise, raise awareness and inform all sectors of society for more concerted efforts for WBH conservation by government and other relevant organisations, with support of the general public and donors.

3.3 Reduce unsustainable and illegal practices that negatively impact the WBH or its ecological requirements (for foraging, resting, breeding etc.), by providing alternative sustainable opportunities, which do not threaten the heron, with as much local-level oversight and management as possible and appropriate.

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6 Threats

6. Threat analysis

The methods used for assessing Threats and Constraints to effective conservation of WBH are described in Box 2 (stage 5).

The full set of Threats identified is presented as Appendix 5, with each Threat assigned to the most relevant Goal.

The combined set of headings from the raw Constraints and both Direct and Indirect Threats were converted into a Problem tree after the workshop in the diagram below (Fig. 3). It should be noted that:

- Appendix 5 contains much detail on the Threats which require addressing for effective WBH conservation but which is only summarised in simple terms in Fig. 3, and
- not all Threats and Constraints are relevant at all locations or in each range country

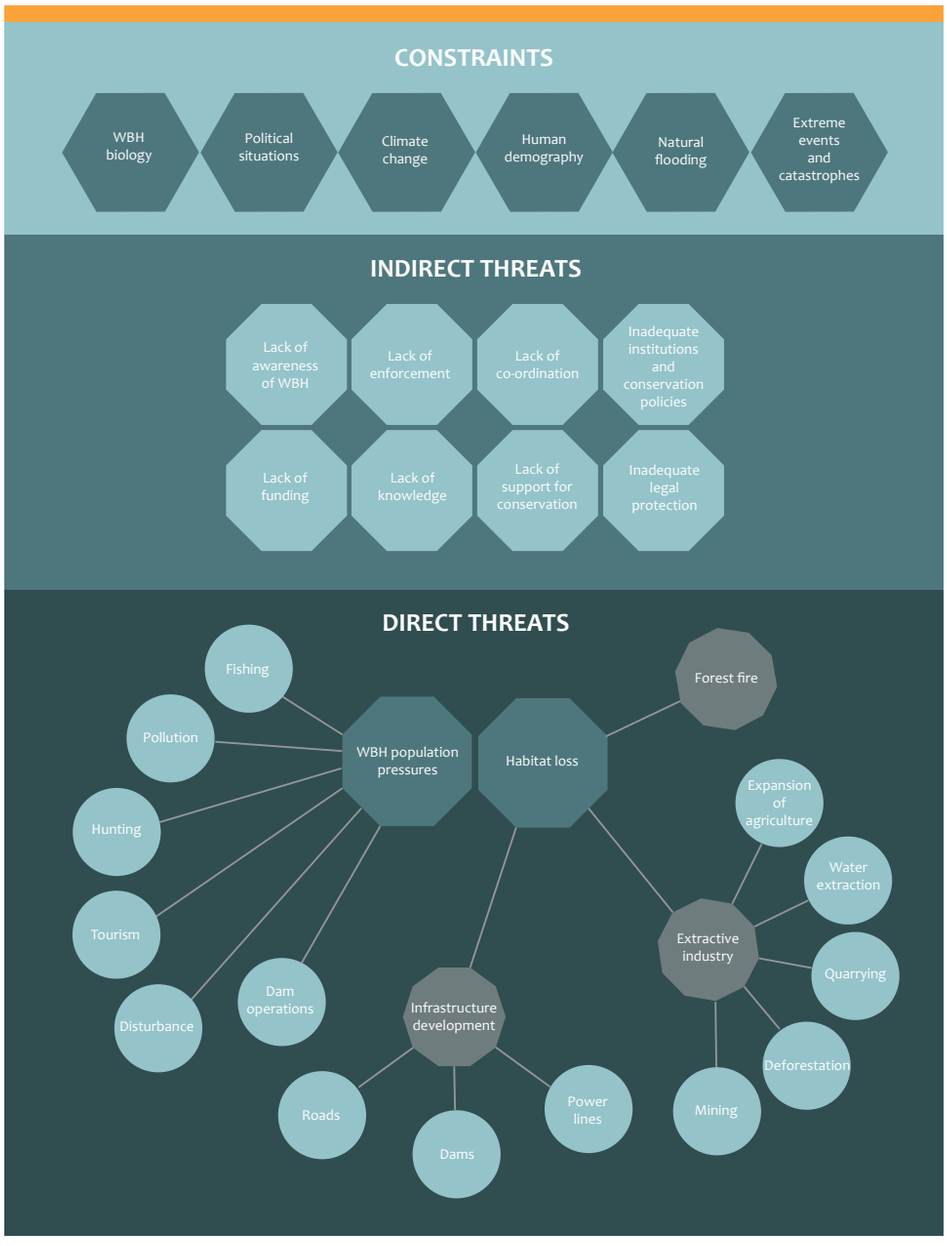

Figure 3: Constraints, direct and indirect threats to WBH persistence.

White-bellied Heron *Ardea insignis*
Conservation Strategy

7 Actions

7. Actions

The process by which Actions were identified and their required attributes are described in Box 2.

The following were developed:

1. The short-term Actions identified, including immediate workshop follow-up and then implementation of the Conservation Strategy.

2. The Actions for each range country, separated out by the Goal to which they apply.

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8 Short-Term Actions

8. Short-term Actions

No.	Country	Action	Responsibility	Timing	Comment
1	International	G. Goodman / Synchronicity Earth to be interim International Coordinator	G. Goodman	Immediate; to last until substantive Coordinator post is funded and suitable person found	In place January 2015
2		Appointment of International Coordinator: 1. Develop job description 2. Secure funding 3. Recruit and in position	G. Goodman, W. Duckworth, J. Tordoff	1. by April 2015, 2. by April 2015, 3. by June 2015	Early 2016 now seen as more realistic
3		Establish WBH Working Group: possibly located within IUCN SSC Heron Specialist Group: approach Chair SSC and Chair Heron SG	G. Goodman, W. Duckworth	February 2015	Completed Feb. 2015
4		Develop an agreed list of Action points both collectively and for each range state, through refinement of workshop Action list	Technical Team, Interim Coordinator	To be finalised for input to Conservation Strategy, by June 2015; to be reviewed at Nov. 2015 work-shop	Completed
5		Preparation of agreed follow up workshop in November 2015, to be hosted by Bhutan	S. Wangchuk, RSPN	Through 2015	Planned
6		Update survey, range and historical record maps	M. Crosby BirdLife, RSPB	March 2015	Completed June 2015
7		Review, update and add to WBH Status Review	M. Stanley Price, G. Goodman & Technical Team	June 2015	Completed
8		Circulate workshop report	M. Stanley Price, G. Goodman	January 2015	Completed January 2015
9		Circulate draft range-wide Conservation Strategy for review	M. Stanley Price, G. Goodman	April 2015	Completed
10		Complete range-wide WBH Conservation Strategy with country strategies separated out	M. Stanley Price, G. Goodman	June 2015	Completed
11		Identify potential funding sources and each range state to submit proposed list of priority funding needs	Range state representatives, J. Tordoff, W. Duckworth, G. Goodman	June 2015	
12		J. Tordoff to join the Technical Team	M. Stanley Price to add to distribu-tion list	December 2014	Completed
13		Publish and disseminate information about WBH and its conservation	G. Maheshwaran, R. Pradhan, Thet Zaw Naing, W. Duckworth	Starting first half of 2015	Revised to late 2016

Continued overleaf

No.	Country	Action	Responsibility	Timing	Comment
14	Bhutan	Appointment of National Facilitator	Bhutanese participants	First quarter 2015	Completed in Feb, 2015: Rebecca Pradhan
15		Completion of Bhutan Action Plan for WBH	Bhutanese participants	Will be available in March 2015 to all	Revised to June 2015
16		Bhutan National Heron Week: all to be advised of dates	Bhutanese participants	January 2015	Bird Festival planned in Central Bhutan for October 2015
17		Send formal letter to government/ ministry for regarding WBH and surrounding actions once purpose and contents agreed	Relevant Bhutanese organisations, Chair SCC, G. Goodman, M. Stanley Price	Before completion of Conservation Strategy, mid-2015	
18	India	National meeting on species recovery to be held	A. Rahmani	When possible in 2015	Provisional dates: August w/c 25th
19		Selection of National Facilitator for India	A. Rahmani, S. Khaling	First quarter 2015	Completed March 2015: Sarala Khaling
20		To obtain endorsement of WBH Conservation Strategy for India from government	A. Rahmani	Following completion of Conservation Strategy for India, mid-2015	Pending completion of strategy
21		Raise awareness of WBH in India through, for example, a postage stamp	A. Rahmani	When appropriate	
22	Myanmar	Selection of National Facilitator for Myanmar	Htay Win, Thet Zaw Naing	First quarter 2015	Completed May 2015: Than Zaw
23		Send formal letter to government/ ministry for regarding WBH and surrounding actions once purpose and contents agreed	Relevant Myanmar organisations, Chair SCC, G. Goodman, M. Stanley Price	Before completion of Conservation Strategy, mid-2015	
24	China	Selection of National Facilitator: Prof. Han selected		Done at workshop	Completed December 2014

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9 Specific Actions

9. Specific Actions for each WBH range country

9.1 Bhutan

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (USD)	Resources obtained & when?
Goal 1: Collate scientific information in order to contribute to the design and effective implementation of immediate interventions to reduce the extinction risk of WBH. Further research will provide a sufficient understanding of the species' distribution, population status, natural history, threats and their social context across its range.								
Obj. 1.1: Implement a coordinated research strategy across the species range to understand key aspects of ecology of the species including seasonal and daily movements, post- fledgling dispersal, foraging activity (and success), breeding success and habitat selection.								
1.1.1	Update distribution mapping of WBH through seasonal and annual surveys including hotspots	DoFPS/RSPN	2015- on-going	WCD	H	WBH distribution map	50,000	No resources yet
1.1.2	Research studies on genetic diversity of WBH	DoFSP/RSPN	2015-18	RSPN	H	Result of the genetic study	200,000	Secured 0.2% fund from Bhutan trust Fund for 2015-2018
1.1.3	Establishment of captive breeding centre	RSPN	2015-18	RSPN	H	Established captive breeding centre	2,300,000 over 5 years In country Training for 5 breeders one Hylux Camera traps, GPS, binoculars, sporting scopes and subsistence expenses	May get in kind (captive Breeding Facilities) from Phunatsangchu Hydropower Project I & II)
Obj. 1.2: Identify, prioritise and survey areas where the species is expected to occur (or has occurred historically).								
1.2.1	Undertake study on WBH home range and behaviour ecology including population dynamics	DoFPS/RSPN	2017-20	RSPN/ WMD	M	Scientific report	50,000	Secured 15% fund from Bhutan Trust Fund 2015 -2017

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (USD)	Resources obtained & when?
Obj. 1.4: Define the known and potential threats and understand the role each may have in the extinction risk of the species across its range.								
1.4.1	Undertake studies to understand known and potential threats to WBH	DoFPS/RSPN	2015-18	WCD/ RSPN	H	Scientific reports	10,000	Secured 50% fund from Bhutan trust Fund 2015-2017
Obj.1.5: For each threat, study and interpret the human motivation and needs that produce it.								
1.5.1	Undertake studies to understand anthropogenic pressures on the dispersal of WBH within its range	DoFPS/RSPN	2016-18	WCD/ RSPN	M	Scientific report	30,000	Secured 50% fund from Bhutan trust Fund 2015-2017
Goal 2: Maintain healthy riverine ecosystems in the WBH's range with governance frameworks that ensure development and livelihood activities are consistent with the species' conservation, based on best scientific evidence.								
Obj. 2.1: Appropriate protection and designation afforded to all priority WBH habitats.								
2.1.1	Assessment of riverine ecosystem health and mapping	DoFPS/RSPN	2016-20	WCD/ WMD/ RSPN	M	Scientific report	40,000	No resources yet
2.1.2	Preparation of WBH Conservation Management Plan	DoFS/RSPN	2018-19	WCD	M	WBH Conservation Management Plan	1,000	No resources yet
Obj. 2.3: No new dam construction and operation on rivers with key WBH populations without complete, publicly available environmental and social impact assessments, coupled with a full suite of appropriate mitigation measures, with dam developers / operators responsible and accountable for complying with formally-specified measures and conditions.								
2.3.1	New dam construction plans to include science-based mitigation measures as a policy support to WBH conservation. Strengthen monitoring.	DoFS/RSPN	2018-2020 and long term monitoring	WCD	M	Report on policy interventions	10,000	No resources yet

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (USD)	Resources obtained & when?
Obj. 2.5: Power lines (high voltage and reticulation) incorporate global best practice engineering design to mitigate collisions/electrocution risk, with modification measures to existing power lines to mitigate risk to flying WBH.								
2.5.1	Explore cost-effectiveness of insulated power lines in critical WBH sites	DoFPS/RSPN/ DGPC		WCD/ DGPC	H		To be discussed in the Dec. 2015 workshop, following preliminary investigation by RSPN	
Goal 3: Empower communities through education and awareness to enhance their sense of responsibility to, and ownership of, the WBH and its habitat, and to inspire governments, civil society and donors to engage in coordinated and immediate efforts to conserve the species.								
Obj. 3.2: Sensitise, raise awareness and inform all sectors of society for more concerted efforts for WBH conservation by government and other relevant organisations, with support of the general public and donors.								
3.2.1	Continue awareness and sensitization workshops	DoFPS/RSPN	2015	WCD/ RSPN	H	Workshop reports, pamphlets	50,000	No resources yet
Obj. 3.3: Reduce unsustainable and illegal practices that negatively impact the WBH or its ecological requirements (for foraging, resting, breeding etc.), by providing alternative sustainable opportunities, which do not threaten the heron, with as much local-level oversight and management as possible and appropriate.								
3.3.1	Promote and encourage alternative livelihood options and behaviours to engage local communities for reducing conflict and threats on WBH	DoFPS/RSPN	2016	WCD	H	Report on alternative livelihood undertakings and their impacts on threats	100,000	
Total							2,841,000	203,803

9.2 China

Action No.	What?	Who?	When?	Who?	Priority	Indicators	Resources needed? (USD)	Resources obtained & when?
Goal 1: Collate scientific information in order to contribute to the design and effective implementation of immediate interventions to reduce the extinction risk of WBH. Further research will provide a sufficient understanding of the species' distribution, population status, natural history, threats and their social context across its range.								
Obj. 1.2: Identify and survey areas where the species is expected to occur (or has occurred historically).								
1.2.1	Communication with range state co-workers to help identify survey sites; identification of key persons to assist with basic ecological requirements of WBH to identify possible survey sites	Han, Bosco	Ongoing and continuing to take advantage of any new surveys	Han, Bosco	High	Clear identification of priority survey areas	No cost	
1.2.2	Identify, prioritise and survey areas of expected WBH occupance. Survey 4 sites in Yunnan Province with information from colleagues in Myanmar and India and local information, and field survey:							
	1/ Dulong river area of Gaoligongshan NNR	Han	Autumn 2015	Han	High	Completed survey report	10,000	Currently no funds available
	2/ Tengchong's Zizhi area of Gaoligongshan NNR	Bosco	Each season 2015	Bosco	High	Completed survey report	20,000, from KFBG	Funds are obtained and managed by KFBG in 2014
	3/ Ruili Nanwan River (= Shuili River in Myanmar) of Tongbiguan NR	Han	Spring and Autumn 2015	Han	High	Completed survey report	7,000	Currently no funds available
	4/ Chayu area of southern Tibet close to Aranachal Pradesh	Han, Bosco	Spring 2016	Han, Bosco	High	Completed survey report	25,000	Currently no funds available
1.3, 1.4, 1.5 not applicable to China for time being								
Goal 2: Maintain healthy riverine ecosystems in the WBH's range with governance frameworks that ensure development and livelihood activities are consistent with the species' conservation, based on best scientific evidence.								
Not applicable to China for time being								

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicators	Resources needed? (USD)	Resources obtained & when?
Goal 3: Empower communities through education and awareness to enhance their sense of responsibility to, and ownership of, the WBH and its habitat, and to inspire governments, civil society and donors to engage in coordinated and immediate efforts to conserve the species.								
Obj. 3.1: Ensure the highest level legal protection status for WBH in each range country and encourage the full commitment and strengthening of capacities of the government in effectively enforcing protection and legal actions.								
3.1.1	Advocate for legislation to give WBH formal protected status once occurrence in China confirmed through surveys	Han	Immediately and continuing when WBH occurrence in China becomes confirmed	Han	High	Citizen science articles that advocate for legislation and conservation to be published in magazines. Legislation and awareness materials to be printed and distributed in government and non-government sectors. WBH to be listed as protected species in nature reserves.	1000	Currently no funds available
Obj. 3.2: Sensitise, raise awareness and inform all sectors of society for more concerted efforts for WBH conservation by government and other relevant organisations, with support of the general public and donors.								
3.2.1	Raise awareness among key stakeholders Raise awareness of WBH and its status and conservation needs along the Sino-Burmese border with such as government officials, scientists, nature lovers and local communities at potential WBH occurrence sites	Southwest Forestry University, Kadoorie Farm & Botanic Garden, all wildlife-related governmental departments and nature reserves within areas along Sino-Burmese border (including 7 border counties in Yunnan: Dulongjiang, Gongshan, Lushui, Tengchong, Yingjiang, Longchuan and Ruili)	WBH Conservation Workshop in September and October, 2015 Hornbill Conservation Workshop in December, 2015	Han from SWFU, Bosco from KFBG	High	1/ Government and scientific sectors (including ornitholo-gists) in China are more aware of critical status of WBH and its range in Yunnan and Tibet by including and assessing possible species occurrence in following regional bird survey report 2/ Local communities start to report sightings of WBH with doubtful or confirmed records	2320 GBP (3580 USD) from Synchronicity Earth	All awareness materials are in preparation and will be available in September, 2015 3 persons from SWFU will organise WBH workshop and about 30 governmental staff and community rangers will be trained through WBH workshop, photos of possible suitable habitats for occurrence assessment will be taken in as well. Another Hornbill conservation workshop will be organised in Yingjiang county, December 2015 by KFBG; related WBH awareness materials and knowledge in Chinese language can be shared at a wider scale with invited participants (including Chinese bird watchers and professional ornithologists) from other parts of China)
Total							66580	

9.3 India

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (lakhs)	Resources obtained and when?
Goal 1: Collate scientific information in order to contribute to the design and effective implementation of immediate interventions to reduce the extinction risk of WBH. Further research will provide a sufficient understanding of the species' distribution, population status, natural history, threats and their social context across its range.								
Obj. 1: Implement a coordinated research programme across the range, to understand key aspects of ecology of the species including seasonal and daily movements, post fledging dispersal, foraging activity, breeding success and habitat selection.								
1.1.1	Conduct surveys in historical, existing and potential areas across WBH range in India from West Bengal, Assam and Arunachal Pradesh.	G. Maheshwaran -ZSI, S. Khaling -ATREE (WB); A. Bose - NF, Aaranyak, UFCN-BTC, BNHS, Government of Arunachal Pradesh, Assam, West Bengal	2015-2017; a comprehensive survey proposal in 2016; • ATREE for 2016 onwards, • NF and Forest Department Manas 2016, • BNHS/ATREE- Buxa in 2015, • Teesta by ATREE,	Above mentioned, common protocol development- research performa- Maheshwaran, Khaling, HJ Singha	4 surveys and then comprehensive proposal. Very high	Survey reports, publications, funded proposals	50 lakhs	
Obj. 2: Identify, prioritise and survey areas where the species is expected to occur or has occurred historically).								
1.2.1	Conduct detailed studies on WBH ecology in 2-3 sites based on the above survey results and for these develop a separate comprehensive research programme using latest modern technology.	BNHS with ZSI, Aaranyak, ATREE and other institutions according to their areas of interest	2016 onwards	Jointly	High	Research reports, publications and proposals.	Rs. 60 lakhs	
Obj. 3: Understand population size; understand connectivity, trends and spatial heterogeneity/pattern across the range.								
1.3.1	Conduct genetic studies on the population structure, phylogeny, and distribution in different locations, extending preferably across all range countries.	Aaranyak with support of providing samples from other research organisations	2017 onwards	Aaranyak	Medium	Research reports, researchers involved and publications	Rs. 30 lakhs	

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (lakhs)	Resources obtained and when?
Obj. 4: Define the known and potential threats and understand the role each may have in the species extinction risk across its range.								
Obj. 5: For each threat study and interpret the human motivations and needs that produce it as a basis for conservation action.								
1.5.1	Threats and their impacts will be covered by the detail study projects	Arunachal Pradesh Forest Department, ATREE, NF, UFCN, ZSI	2016 onwards along with ecological surveys	Jointly	High	Research reports, researchers involved and publications	Rs. 10 Lakhs	
Goal 2: Maintain healthy riverine ecosystems in the WBH's range with governance frameworks that ensure development and livelihood activities are consistent with the species' conservation, based on best scientific evidence.								
Obj. 1: Appropriate protection and designation afforded to all priority WBH habitats.								
Obj. 2: No illegal or destructive fishing practices within designated priority WBH habitats.								
2.2.1	By 2017 WBH habitats prioritised and community protection started based on survey results of 2015 and 2016	Local NGOs (Nature Fosters, Aaranyak, ATREE, UFCN-BTC with Respective State Forest Department	On going but 2016 onwards will be done more intensely	Jointly	High Priority	Reports of activities and project reports	Forest Department and Local People; Rs. 10 Lakhs	
Obj. 3: No new dam construction along rivers with confirmed breeding populations of WBH without measures to mitigate negative impacts on the species, informed by best available science.								
2.3.1	Based on the surveys of 2016-17, we will know high priority areas. All legal measures will be explored to see comprehensive EIA's are done and mitigatory measures are taken.	Aaranyak (Ajay Das), BNHS, Kalpabriksh (Niraj Vajholikor), Civil society of Arunachal Pradesh. Information to be provided by the organisations conducting surveys	Ongoing	Jointly	High Priority	Meeting reports and minutes with government and other civil society groups	10 lakhs	
Obj. 4: Prevent sand or gravel extraction, or gold-mining within designated priority WBH habitats.								
2.4.1	Respective Forest Department/ respective councils will be approached to address threats brought about by collection of boulders from WBH habitats. Wherever required even (e.g. Subankhata) picnickers' access should be regularised in key habitats.	Local NGOs	Now onwards	Jointly with the government	Medium	Deterring signage, awareness generation programmes	Nil	

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed? (lakhs)	Resources obtained and when?
Obj. 5: Power lines (high voltage + reticulation) should incorporate global best practice engineering design to mitigate collisions/electrocution risk to large birds, with modification measures to existing power lines to mitigate risk to flying WBH.								
Obj. 6: No new road construction along rivers with confirmed breeding populations of WBH without measures to mitigate negative impacts on the species, informed by global best practice.								
2.6.1	Best practices and policies from other countries are explored to address negative impacts while developing new infrastructure near WBH habitats	BNHS, Aaranyak, Nature Fosters, ATREE	Now onwards	Jointly with the government	Medium	(although we do not have any record of WBH colliding with power lines this needs to be studied in India).	10 lakhs	
Goal 3: Empower communities through education and awareness to enhance their sense of responsibility to, and ownership of, the WBH and its habitat, and to inspire governments, civil society and donors to engage in coordinated and immediate efforts to conserve WBH.								
Obj. 3.1: Ensure the highest level legal protection status for WBH in each range country and encourage the full commitment and strengthening of capacities of the government in effectively enforcing protection and legal actions.								
3.1.1	To ensure the highest protection status of WBH in each range country and encourage the full commitment and strengthening capacities of the government in effectively enforcing protection/ legal actions.	BNHS, ATREE,	2016 onwards	Jointly with the government	Medium	Meetings reports with government.		
Obj. 3.2: Sensitise, raise awareness and inform all sectors of society for more concerted efforts for WBH conservation by government and other relevant organisations, with support of the general public and donors.								
Obj. 3.3: Reduce unsustainable and illegal practices that negatively impact the WBH or its ecological requirements (for foraging, resting, breeding etc.), by providing alternative sustainable opportunities, which do not threaten the heron, with as much local-level oversight and management as possible and appropriate.								
3.3.1	Already identified agencies such as ATREE, Aaranyak will play a major role.	Same as above	2016 onwards	Jointly	Medium	Project reports, photographic evidences	Not estimated	
Total							180 lakhs	

9.4 Myanmar

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed?	Resources obtained and when?
Goal 1: Collate scientific information in order to contribute to the design and effective implementation of immediate interventions to reduce the extinction risk of WBH. Further research will provide a sufficient understanding of the species' distribution, population status, natural history, threats and their social context across its range.								
Obj. 1.1: Implement a coordinated research strategy across the species range to understand key aspects of ecology of the species including seasonal and daily movements, post- fledgling dispersal, foraging activity (and success), breeding success and habitat selection.								
1.1.1	Research on the ecology of known populations of WBH using relevant techniques	Coordination of MOECAF, WCS, other NGOs and Institutions	2015 to 2020	MOECAF and WCS	High	WBH ecology, through habitat, feeding behaviour, causes of mortality (through inspection of carcases) will be better known	Financial, three persons and one boat, camera, camera-traps, GPS, binoculars and spotting scopes etc. 125,000 USD	MOECAF and WCS received GEF-5 project and Gibbon project from USFWS for HVWS and Hponkanrazi WS. WBH survey in parallel with other survey activities will be covered by these two projects.
Obj. 1.2: Identify and survey areas where the species is expected to occur (or has occurred historically).								
1.2.1	Survey population size, nesting sites and distribution of WBH based at historically recorded sites	Coordination of MOECAF, WCS, other NGOs and Institutions	2015 to 2017	MOECAF and WCS	High	Population size and distribution range will be approximately known	Financial, six persons and one 4WD car, two small boats, camera, GPS, binoculars and spotting scopes etc. 105,000 USD	MOECAF and WCS received GEF-5 project and Gibbon project from USFWS for HVWS and Hponkanrazi WS. WBH survey in parallel with other survey activities will be covered by these two projects.
Obj. 1.4: Define the known and potential threats and understand the role each may have in the extinction risk of the species across its range.								
1.4.1	Field survey and desk studies on known and potential threats, using the results from 1.1.1 and 1.2.1	Coordination of MOECAF, WCS, other NGOs and Institutions	2015 to 2017	MOECAF and WCS	High	The risk and severity of potential threats will be defined in a report	15,000 USD	MOECAF and WCS received GEF-5 project and Gibbon project from USFWS for HVWS and Hponkanrazi WS. WBH survey in parallel with other survey activities will be covered by these two projects.

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed?	Resources obtained and when?
Goal 2: Maintain healthy riverine ecosystems in the WBH's range with governance frameworks that ensure development and livelihood activities are consistent with the species' conservation, based on best scientific evidence.								
Obj. 2.1: Appropriate protection and designation afforded to all priority WBH habitats.								
2.1.1	Strengthen law enforcement to reduce the increasing amount of threats to WBH	Coordination of MOECAF, NGOs and other relevant Dept.	2015 to 2020	MOECAF	High	Decrease the illegal threats to WBH as measured by annual counts. Enforcement will be monitored within protected areas through SMART Patrolling system.	Financial and SMART Patrol Trainings to Protected Areas staff USD 2.5 million – Full law enforcement budgets for HVWS, HPWS, HKNP	WCS has been providing SMART Patrol Trainings to Protected Areas staff under GEF-5 project. Substantial equipment support will be provided through GEF-5 and other project support to HVWS and Hponkanrazi Wildlife Sanctuaries and Hkakaborazi National Park
2.1.2	Expand the national protected area network (Protected Area System)	MOECAF, MOF and GAD	2018 to 2020	MOECAF and MOF	High	More space for WBH protected by law	Financial and Supports of MOECAF and Regional Government 500,000 USD – primarily for public consultation to expand protected areas	UNESCO, MOECAF and WCS have already proposed the expansion of a protected area named southern extension of Hkakaborazi NP where WBH has occurred.

Continued overleaf

Action No.	What?	Who?	When?	Who?	Priority	Indicator	Resources needed?	Resources obtained and when?
Goal 3: Empower communities through education and awareness to enhance their sense of responsibility to, and ownership of, the WBH and its habitat, and to inspire governments, civil society and donors to engage in coordinated and immediate efforts to conserve the species.								
Obj. 3.2: Sensitise, raise awareness and inform all sectors of society for more concerted efforts for WBH conservation by government and other relevant organisations, with support of the general public and donors.								
3.2.1	Improve conservation awareness for target groups such as migrant workers and gold prospectors, and increase local responsibility and protection for WBH in areas of resource extraction	Coordination of MOECAF, WCS, other NGOs and other relevant Dept.	2015 to 2020	MOECAF	High	Increase community participation and awareness and measure effectiveness through reduced WBH mortality and changes in attitudes as measured by periodic attitude surveys.	Financial, three persons, computer, projector, camera, generator, educational aid materials etc. 75,000 USD	MOECAF and WCS received GEF-5 project and Gibbon project from USFWS for HVWS and Hponkanrazi WS. Awareness raising of WBH in parallel with other environmental education activities will be covered by these two projects.
3.2.2	Expand the role of national and regional media to increase awareness	Coordination of MOECAF, NGOs and other relevant Dept.	2015 to 2020	MOECAF	High	Increase the knowledge and awareness of community on WBH conservation as measured by number of media placements and documented responses from the public	Financial support for content development and monitoring 25,000 USD	WCS Myanmar Program has already created and distributed the information of WBH on the following websites; http://programs.wcs.org/myanmar/en-us/meet/birds.aspx , www.myanmar-biodiversity.org , and Facebook and Twitter sites.
Obj. 3.3: Reduce unsustainable and illegal practices that negatively impact the WBH or its ecological requirements (for foraging, resting, breeding etc.), by providing alternative sustainable opportunities, which do not threaten the heron, with as much local-level oversight and management as possible and appropriate.								
3.3	Promote community based eco-tourism focusing on WBH conservation sites	Coordination of MOECAF, MOHT, NGOs and other relevant Dept.	2018 to 2020	MOECAF and MOHT	High	Increase community participation and awareness as measured through ecotourism investment and eventually number of ecotourists	Financial support for initial feasibility and planning assessments 75,000 USD	WCS will be conducting ecotourism assessments along the Chindwin River with the support of IUCN and KFW starting in December 2015.
Total							3,420,000 USD – based on planned investment over 5-year plan	

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Appendices

Appendix 1

Workshop 1, Assam, India: programme and schedule

	Time	No.	Activity
DAY 1 Tuesday 2nd December			
	0900-0915	1	Welcomes by Governments of India and Assam representatives
	0915-0945	2	Introductions
			Hosts
			Facilitators
			Sponsors
			Participants
	0945-1000	3	Housekeeping aspects
			Workshop protocols
			Times and timeliness
			Meals, evenings
			Local expenses
			Travel arrangements
			Help!
	1000-1030	4	Workshop objectives, and products
			What is the final product?
			Will the Agenda deliver this product
			Agreement on the proposed schedule
	1030-1100		COFFEE BREAK
	1100-1230	5	Current and planned research and conservation activities
			Who is doing what now?
			When are the results anticipated?
			What are the significant findings for WBH conservation?
			Will they contribute to workshop objectives, above?
			What new research or conservation work is planned?
	1230-1330		LUNCH
	1400-1530	6	Structured discussion on WBH biology and conservation, based around Status Review, and session 5.
			What do we know about WBH?
			What do we assume we know about WBH?
			What does GIS and modelling show us?
	1530-1600		TEA BREAK
	1600-1630		What do we definitely not know about WBH?
			Where and how are regional differences important?

Continued overleaf

	Time	No.	Activity
		7	Developing a Vision for the WBH
	1630-1730		What would be our ideal situation for the WBH in 30 years time?
Day 2 Wednesday 3rd December			
	0900-0930		A Vision is defined and agreed
	0930-1030	8	Developing Goals
			How do we translate the Vision into specific terms, the Goals?
			How many WBH do we want, where and by when?
			Under what conditions of protection and management?
			How does WBH conservation fit into the larger picture?
	1030-1100		COFFEE BREAK
	1100-1300	9	Problem analysis
			What are the Threats to the WBH, biological and non-biological?
			What are the constraints to achieving the Goals for the WBH?
			Which can we do something about?
	1300-1400		LUNCH BREAK
	1400-1600	10	Developing Objectives
			What are the specific Objectives within each Goal that will counter the Threats and Constraints?
	1600-1630		TEA BREAK
	1630-1730	11	Developing Actions
			Introduction to Actions
Day 3 Thursday 4th December			
	0900-1230		What are the Actions within each Objective that will meet our Objectives
			Who must do what, when, how and be responsible?
			TEA BREAK: TIME ACCORDING TO SITUATION
	1230-1330		LUNCH BREAK
	1330-1430	12	Workshop follow-up
			What is needed to ensure the workshop has been a success?
			Who will do what to complete the workshop product
			How will the product become official plan in each range state?
	1430-1530	13	Implementation of WBH Conservation Strategy
			Range states views?
			Others' views?
			Evaluating progress?
			Collaboration / coordination mechanisms?
	1530-1600		TEA BREAK
	1600-1615	14	Thanks
			Thanks are offered by all relevant persons
	1615-1630	15	Closing formalities by Governments of India and Assam representatives

Appendix 2

The Purpose of the workshop, the shape of the Conservation Strategy, and moving forward with the Strategy

WBH Biology

Participants agreed the workshop should identify gaps in knowledge on the WBH and identify by whom and how these gaps would be filled. As a summary of current knowledge, the Species Review prepared before the workshop has been, and should continue to be, updated and developed further.

WBH Conservation Strategy

The Conservation Strategy to be developed should be both realistic in its aims and effective in implementation. It should cover both short-term and longer-term planning and actions. To ensure the Strategy has impact, it should contain both high-level Goals and then include specific recommendations and solutions for individual range countries and heron sites.

The Strategy should not be lengthy or complex, and should be reviewed by all participants and any others relevant, with all in agreement on it.

The Strategy should be widely accessible, with its targeted audience not only those present at the workshop and WBH conservationists, but also further relevant decision-makers and necessary experts. It would provide the basis for a collaborative agreement between range states and international audiences about what necessary actions are required to ensure that viable populations of WBH exist in the long-term.

Political aspects

Participants agreed that the Conservation Strategy must become official policy in each range country; hence, there should be one over-arching Strategy that would be separable into range country strategies, including specific recommendations for each. Further, there should be formal mechanisms for collaboration between range countries, including sharing of information. The Strategy should also enable better contacts between governments, access to decision-makers for conservationists, and better support from governments to NGO's.

The mechanisms for collaboration between range countries and for responsibility for adoption of the Strategy, and then its implementation in each range country should be defined at the workshop and be included in the Strategy.

A mechanism for accessing further technical support from outside range countries should be specified, with a potential role for groups such as the IUCN SSC Heron Specialist Group and BirdLife International.

The workshop was envisaged merely as the start of a process of increased conservation effort for the WBH. Therefore, the mechanisms for implementation and the need for further or regular meetings of key persons and organisations should be specified.

Resourcing

As support for WBH conservation would require financial and in-kind commitments from multiple agencies, the Strategy should identify all necessary Actions. These actions could then be prioritised and budgets attached. Follow-up after the workshop and continuing good relations between all parties involved would be necessary to avoid competition for funds with, preferably, a multi-range country approach to significant funding.

Appendix 3

Workshop Participants

No.	Country	Name	Affiliation
1	China	Bosco Chan	Kadoorie Farm & Botanic Garden, Hong Kong, China
2	China	Han Lianxian	Southwest Forestry University, Yunnan, China
3	Myanmar	Htay Win	Nature and Wildlife Conservation Division, Myanmar
4	Myanmar	Khin Khin Ei	Nature and Wildlife Conservation Division, Myanmar
5	Myanmar	Sein Tun	Nature and Wildlife Conservation Division, Myanmar
6	Myanmar	Than Zaw	WCS, Myanmar
7	Myanmar	Thet Zaw Naing	WCS, Myanmar
8	Bhutan	Jigme Dorji	College of Natural Resources, Lobesa, Phunakha, Bhutan
9	Bhutan	Kaka Tshering	Watershed Management Division, RGOB, Thimpu, Bhutan
10	Bhutan	Kencho Drukpa	Wangdue Forest Division, Thimpu, Bhutan
11	Bhutan	Pema Wangda	Chief Forestry Officer, RGOB, Thimpu, Bhutan
12	Bhutan	Rebecca Pradhan	RSPN, Thimpu, Bhutan
13	Bhutan	Rinchen Wangmo	RSPN, Thimpu, Bhutan
14	Bhutan	Sither Dorji	Tsirang Forest Division, Bhutan
15	Bhutan	Sonam Wangchuk	Wildlife Conservation Division, Thimpu, Bhutan
16	Bhutan	Tandin Wangdi	WWF, Bhutan
17	India	A.U. Choudhury	The Rhino Foundation, Assam, India
18	India	Amit Kumar	Volunteer, Tata Institute of Social Sciences, Assam, India
19	India	Arnab Bose	Nature's Foster, Bongaigaon, Assam, India
20	India	Asad Rahmani	BNHS, Mumbai, India
21	India	Beauty Narzary	ATREE, Assam, India
22	India	C R Bhobora	Forest Department, Assam, India
23	India	Deba Kumar Dutta	WWF India, Assam, India
24	India	Dhritiman Das	ATREE, Assam, India
25	India	Dimpi Bora	Forest Department, Assam, India
26	India	Gopinathan Maheshwaran	Zoological Survey of India, Kolkata, India
27	India	Hillol Jyoti Singha	Assam University, Silchar, Assam, India
28	India	Himangshu Sarma	ATREE, Assam, India
29	India	Jaydev Mandal	Gauhati University, Assam, India
30	India	Niraj Kakati	ATREE, Assam, India
31	India	Parag Deori	BHNS, Assam, India

Continued overleaf

No	Country	Name	Affiliation
32	India	Priyadarshi Shrivastava	Volunteer, Tata Institute of Social Sciences, Assam, India
33	India	Purnima Devi Barman	Aaranyak, Assam, India
34	India	Rajual Islari	United Forest Conservation Network -Bodoland Territorial Council, Assam, India
35	India	Roopak Goswami	The Telegraph, Assam, India
36	India	Sachin Ranade	BHNS, Assam, India
37	India	Sarala Khaling	ATREE, Sikkim, India
38	India	Thajum Yumcha	Namdhapa Tiger Reserve, Arunachal Pradesh, India
39	India	Thanmi Kashung	Dam Affected Villagers Organisation, Manipur, India
40	India	Udayan Borthakur	Aaranyak, Assam, India
41	India	Upen Deka	Volunteer, Gauhati University, Assam, India
42	International	Cathy King	Welt Vogel Park, Germany
43	International	Gemma Goodman	Synchronicity Earth, UK
44	International	Jack Tordoff	CEPF, US/UK
45	International	Mark Stanley Price	IUCN SSC, UK
46	International	Nigel Collar	Birdlife, UK
47	International	Will Duckworth	IUCN SSC, UK

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Appendix 4

Species Review for the White-bellied Heron

Background

A comprehensive review of knowledge on the White-bellied Heron (hereafter known as WBH) was prepared for the December 2014 workshop. This document is in essence the same review, subject to:

- some material being transferred into the Species Conservation Strategy,
- addition or updating with information presented at the workshop and obtained since (up to October 2015),
- the removal of a section in the original Species Review entitled 'Conservation Actions proposed' as these are superseded by the agreed contents of the Species Conservation Strategy.

Introduction

This document is designed to give an account of the best available information pertaining to WBH biology, ecology, behaviour and the threats to the species. The aim is to provide conservation practitioners and decision makers with a single comprehensive reference point on the species in order to better understand the context surrounding calls to action within the Species Conservation Strategy, and, as a result support necessary research and conservation interventions.

This will be an evolving document, updated regularly by the White-bellied Heron Working Group, ensuring the most recent information is captured and included.

Background information for range countries

Bhutan

Bhutan is a small country (just over 38,000 km^2) in south Asia, sitting in the Himalayas between China and India. It is home to roughly 734,000 people, with a population growth rate of approximately 1.11% per year (CIA, 2015).

Bhutan has a wide range of terrains, from subtropical plains to sub-alpine heights and is regarded as a haven for some of the world's best-known and rarest species, such as tigers (*Panthera tigris*) and snow leopards (*P. uncia*).

The Bhutanese monarchy has promoted the philosophy of "Gross National Happiness" (GNH) since 1972. GNH strives to achieve a balance between the spiritual and the material by assessing nine domains: living standards, health, education, time use, good governance, ecological diversity and resilience, psychological wellbeing, community vitality and cultural diversity and resilience.

The environment has always played a significant role in the lives of many Bhutanese people and has therefore been integrated into the GNH. Bhutan pledges to protect 60% of its forests in perpetuity; living up to its promise, 75% of Bhutan's land is covered by forest. It has twenty protected areas, covering 47% of the country (WDPA, 2015).

It was not until 2008 that Bhutan moved away from an absolute monarchy to a democratic constitutional monarchy. The government and the King still view the environment as a priority.

The majority religion in Bhutan is Buddhism, followed by Hinduism. Buddhists often believe in a close connection to the natural world, including all animals. While not all Buddhists are vegetarian, the religion generally teaches that it is wrong to harm animals without exceptional and necessary cause. This may explain why hunting and direct persecution are not major threats to most wildlife

in Bhutan, though immigrants may adopt different behaviours.

Tourism in Bhutan is highly restricted and the main sources of income are hydropower, agriculture and forestry, with hydropower being its largest export product, primarily to India.

There is clearly national awareness of and pride in the WBH, with some local people taking part in regular monitoring activities. Some informal indications of the positive attitudes of rural Bhutanese to the heron can be seen in a video clip: https://www.youtube.com/watch?v=yAuxK_3DWfI. Attitudes of people in Berti, Bhutan who have raised concerns about potentially damaging sand extraction activities and participated in community monitoring also reflects positive attitudes towards the species.

WBH is afforded the highest level of national protection in Bhutan.

China

China is the world's most populous country (approximately 1.4 billion) and has the world's fastest growing economy, having become the largest global exporter in 2010.

The Himalayan region of China, including Yunnan province, where WBH has most recently been observed, is one of China's most biodiverse regions, particularly rich in freshwater fish, plant and bird species. This mountainous region has a lower population density than much of China, though it has a high level of ethnic diversity. It borders Viet Nam, Lao PDR and Myanmar.

Yunnan province has a strong agricultural economy, with tobacco the primary export product, and is rich in natural elements (copper, lead and zinc) (Chinaperspective.com, 2015).

China has a long history of wildlife use, both for consumption and traditional Chinese medicines. Increasing disposable incomes have led to an increase in consumption of rare and expensive wildlife products (Anon, 2010). The government has joined global conventions and launched national initiatives to improve legislation, enforcement and compliance. Awareness raising campaigns have been designed to drive down demand.

Birdwatching has gained popularity in recent years and numerous citizens take part in bird surveys, identification and management of important bird areas (Birdlife International, 2015). WBH is not generally recognised by the public in China as there have been no observations of the species in the wild since a doubtful record in the 1930s. However, on-going wildlife surveys in Yunnan province could help identify wild individuals.

The only recent record of WBH is of a young captive specimen found in 2014 in Salween Valley, Yunnan. This area populated primarily by Lisu, Chingpaw and Nu people that posses a long tradition of wildlife hunting (Han Lianxian pers. comm. to G. Goodman 2 July 2015).

The Law of the People's Republic of China on the Protection of Wildlife was adopted on November 8, 1988. However, WBH is not protected under this law or any other in China.

India

India has the world's second largest population (estimated at 1.25 billion). It has a diverse and growing economy and is one of the most rapidly developing countries in the world, although rates of growth have slowed somewhat since 2011.

India encompasses a wide range of landscapes, climates, cultures, languages and religions, though by far the largest of the latter is Hinduism.

The WBH occurs in northeastern India in Assam and Arunachal Pradesh. Northeast India is one of the most culturally diverse areas of India, with over 200 ethnic groups and associated dialects. While the Himalayas make up much of the landscape, Assam also includes the northern Plains (Brahmaputra) and Barak River Valley. Much of the area remains under forest cover and so is rich in biodiversity.

Unlike in much of India, people in northeast India often eat meat. Hunting wild animals in many rural areas of northeast India is regarded as a cultural norm and a traditional practice (Aiyadurai, 2010).

The Assamese name for WBH is Bogapetia Ajan, but no cultural values have been found to be associated with this species in the Assam part of the range. However local people are of the view that the bird is very rare (Nilmani Rabha and Dhritiman Das pers. comm. to S. Khaling 2014). Within WBH range in Arunachal Pradesh, there also seems to be no cultural value attached to the species and it apparently has no local name (G. Maheswaran pers. comm. to S. Khaling, 2014).

WBH is included in Schedule IV of the Indian Wildlife Protection Act (1972) meaning that, while fully protected, penalties for contravention are much lower than for species on Schedule I-III.

Myanmar

Myanmar only started to reintegrate into the global economy and to attract external investment due to its transition to a civilian government in 2011. As a result, it is only recently that its economy has started to grow, with foreign direct investment doubling within one year. Its major export products include food, clothing, wood and natural gas. Consumptive use of wild plant and animal species is widespread.

Buddhism is the majority religion in Myanmar, although hunting of wildlife is nevertheless commonplace. The country is divided into seven states, each named after seven ethnic minorities with the Bamar or Burman people making up the majority. There is a similar or greater number of divisions hierarchically equivalent to the states for local government, where the majority ethnicity is Bamar. However, there are thought to be around 135 ethnic groups in total; conflicts between groups continue to fuel social unrest within Myanmar. At times, this means some areas of the country are inaccessible to outsiders, including researchers and conservationists.

Myanmar has a diverse landscape ranging from snow-capped mountains to tropical evergreen forest and dry deciduous forest. It is part of the Indo-Burma Biodiversity Hotspot due to its significant biodiversity and endemism.

Discussing the species with diverse tribal peoples in northern Myanmar, no particular cultural values were attached to the heron (R. Tizard pers. comm. to M Stanley Price 20 October 2014). However, WBH is given the highest level of protection in Myanmar under the 'Protection of Wildlife and Conservation of Natural Areas Law (1994').

Current distribution

The findings of field surveys are supported by reports from local people, suggesting the species has declined in the region in recent years (D. Wilson *in litt*. 2006, in BirdLife International, 2013a).

Most of the few recent records come from five or six sites in Assam with a few individuals regularly seen in Namdapha National Park of Arunachal Pradesh, India; two sites in Bhutan; one state (Kachin) in northern Myanmar and a single captive fledgling WBH found in China in 2014.

The species is known historically from West Bengal (India), Sikkim, the Eastern Himalayan foothills in Bhutan and northeast India to the hills of Bangladesh, north Myanmar and across west and central Myanmar (Birdlife International, 2001). It may have occurred, or still persists, in south-west Tibet, China (Birdlife International, 2013a).

Based on medium quality data[1], its total Extent of Occurrence (EOO) (as a breeding / resident species) is 56,300 km^2, while the non-breeding EOO is estimated at 58,100 km^2 (BirdLife International, 2013b).

Valid sightings of WBH have triggered the criteria for 20 sites to be Important Bird Areas (IBAs) (Table A4.1), but not all may remain known WBH range, for example Lawachara / West Bhanugach Reserved Forest, in Bangladesh where the species is now considered extinct (BirdLife International 2014; Sayam U. Choudury pers. comm. to M. Stanley Price 6 November 2014). In contrast, further areas may now be within WBH range but are not recognised as IBAs.

Table A4.1. Important Bird Areas where WBH has triggered the IBA criteria

Country/Territory	IBA Name
Bangladesh	Lawachara / West Bhanugach Reserved Forest
Bhutan	Ada lake / Puna Tsangchu
Bhutan	Jigme Dorji National Park
India	Bordoloni – Sampora
India	Dibru - Saikhowa Complex
India	Jamjing and Sengajan
India	Kaziranga National Park
India	Manabum and Tengapani Reserve Forests
India	Namdapha – Kamlang
India	Nameri National Park
India	Namsangmukh – Borduria
India	Pabitora Wildlife Sanctuary
India	Upper Dihing (East) Complex
India	Upper Dihing (West) Complex
Myanmar	Ayeyarwady River: Bhamo Section
Myanmar	Hkakaborazi
Myanmar	Hponkanrazi
Myanmar	HVWS
Myanmar	Kaladan River
Myanmar	Nam Sam Chaung

Source: BirdLife International, 2014.

1. "Based on reliable but incomplete or partially representative quantitative data"

Bangladesh

No recent records (Sayam U Choudury pers. comm. to M. Stanley Price, 6 November 2014).

Bhutan

The Royal Society for the Protection of Nature (RSPN) in Bhutan has identified two key sites for the species in Bhutan: 1) Punatsangchu basin, Wangduephodrang Dzongkhag and 2) Berti, Zhemgang Dzongkhag.

Six breeding sites from two rivers of central Bhutan have been recorded, but the eastern part of the country has not been thoroughly surveyed (Pradhan, 2007). The species has also been reported from the Thim Chhu, Lungtenphu (C. Feijen *in litt*. 2009). A massive hydroelectric scheme was suspected of causing the extirpation of WBH from the Sunkosh Valley (K. D. Bishop *in litt.* 2012) but RSPN's February to March 2015 survey records two WBH (R. Pradhan pers. comm. to G. Goodman, 30 April, 2015).

In 2014, two herons were seen at each of two new sites: Walkletar and Phipsoo. Occasional sightings have been recorded in Dagachu, on which a 126 MW hydroelectric project is underway, including in 2008 and 2014 but each sighting has been for one to two hours at a time suggesting WBH may be a vagrant visitor to the area only. Eleven years of surveying by RSPN has covered 353 small lakes and streams, it is therefore felt that Bhutan has been comprehensively covered, although survey effort has been less along rivers in the east of the country. However, over 50% of the country would appear suitable habitat for the WBH, as such its distribution in Bhutan defies easy explanation: some areas superficially similar in habitat to those that have WBH, apparently lack WBH. One main river appears to lack large fish-eating species almost entirely, suggesting poor prey availability. Because of the above survey effort, the observed distribution suggests this is not a misleading pattern of chance recording. Understanding what is driving this situation could help in (a) predicting which un-surveyed or under-surveyed areas are priorities for survey (b) predicting environmental limiting factors for WBH, possibly enabling improved estimation of carrying capacity and even guiding (c) conservation interventions.

China

A juvenile WBH was captured on the east side of Nujiang River (Salween) in Gaoligong Mountains National Nature Reserve, Yunnan Province, China, in August 2014.

The bird was found being sold along the roadside around 2,500 m a.s.l (although the local terrain is predominantly 800-1,800 m a.s.l); it was kept for two days in a home, then reported to the authorities and transported to Yunnan Wild Zoo where it died within three to four days. The suspected cause of death was overfeeding, stress, and weakness; it was confirmed as a young WBH from photographs.

Despite an indication the species might occur in China (BirdLife International, 2013a), this was the first sighting of the species in China since 1938. WBH was reported from the night market in Huarong town, E'zhou, Hubei Province, Central China, in 2003 but its identification was not formalised (cnhubei news, 2003). Since the juvenile heron was captured and died in 2014, reports have come in from villagers and the reserve director of Tengchong about WBH sightings. However, none have yet been confirmed (A.W. Tordoff, pers. comm. to G. Goodman, 19 March 2015; Han Lianxian pers. comm. to G. Goodman, 14 March 2015; B. Chan pers. comm. to G Goodman, 7 October 2015).

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India

It has been suggested that India may host the largest population of WBH (BirdLife International, 2001), but there have been limited population surveys and recent recorded sightings are few, and the important population in the HVWS, Myanmar, had not at that time been discovered.

Namdapha Tiger Reserve, in the north-east of the Indian state of Arunachal Pradesh, has been noted as a strong-hold for the species. See Table A4.2 and text below for all known and recorded sightings.

- Sightings of WBH in Namdapha from 1986 to 2008 include 10 separate records (Srinivasan *et al*., 2010), including those of Table A4.2.

- In September–October 2011 a WBH was sighted twice in Namdapha Tiger Reserve on the banks of Noa–Dehing River (27°31′44.6N, 96°23′24.7E) at Naharbadi. It was sighted on a river bank with sand and gravel surrounded by tropical forests at an altitude of 360 m a.s.l, which is usually described as the perfect habitat for this bird (Krishna *et al*., 2012).

Current research in Namdapha Tiger Reserve (funded for three years, commenced in July 2013) under the Zoological Survey of India is focusing on the feeding behaviour of WBH. The following sightings, associated with this study, have been reported:

- Two birds were seen together, and on one occasion six individuals were seen together (Mondal & Maheswaran, 2014).

- Over three hours, three birds were seen not very distant from one another (Jainy Kuriakose, pers. comm. to G. Goodman, 2014).

- A pair were sighted in March 2015 (G. Maheswaran pers. comm. to G. Goodman, 2015).

This study and previous work by Maheswaran *et al.* and further incidental sightings in Namdapha 2005-2009 suggest consistent use by WBH of the Noa-Dehing River.

It should be considered possible that the birds seen in Namdapha are also going to Myanmar.

Records from other sites are sporadic and, until recently, there have been no recent sightings from a number of former sites including Jamjing Reserved Forest, Dibru Saikhowa National Park and Pabitora Wildlife Sanctuary (A. Choudhury *in litt.* 2012). However, in October 2015 a WBH was sighted and photographed in Maguri Beel of Tinsukia, part of the Dibru Saikhowa IBA, just outside of the National Park (this sighting is not recorded on Fig.1 of the WBH Conservation Strategy).

Two WBH were seen in Subankhata Reserved Forest, Baksa district (approximately 70 km northwest of Guwahati) in 2010 (A. Choudhury *in litt.* 2012).

During surveys in Manas Tiger Reserve between October 2013 and June 2014, two WBH were seen twice on the Phibsu River, adjacent to Bhutan (Rabha & Das, 2014).

Six sites have been surveyed for WBH in Manas Tiger Reserve between 2013 and 2014. Survey work was combined with efforts by grass-roots groups (Green Forest Conservation, New Horizon and Green Earth) to increase environmental awareness. But, security problems prevented access to all sites; two zones were completely inaccessible for surveying.

Since 2007, herons have been seen on the Koilamoila, Pagladiya and Pibsu Rivers. In 2013 two birds were seen on Phibsu River from 30 stream-surveys. These may have been amongst the three birds seen on the Bhutan side of the border.

It is acknowledged that there are huge gaps in the areas of potential WBH range in India that have not been surveyed, although efforts have improved since the 2014 workshop.

Table A4.2: sightings of WBH in Namdapha Tiger Reserve, Arunachal Pradesh 2005: 2006

Date	River	Place	Locality	Number of birds
18/09/2005	Namdapha	Firmbase	27°31.58'N 96°31.13'E	1
19/09/2005	Namdapha-Noa-Dehing	Embyong	27°29.32'N 96°29.42'E	1
19/11/2006	Noa-Dehing	27 Mile	27°29.21'N 96°26.64'E	1
20/11/2006	Noa-Dehing	40 Mile	27°29.54'N 96°32.29'E	1
30/11/2006	Namdapha-Noa-Dehing	Embyong	27°29.25'N 96°29.32'E	1

Source: Maheswaran (2007)

Myanmar

While historical reports suggest WBH were previously common in Myanmar, survey records and reports from local people (D. Wilson *in litt*. 2006) clearly indicate the species' population is now much reduced.

Historical sightings include Rakhine State (south-west Myanmar), northern Chin State (west Myanmar), Mandalay Division (Central Myanmar), Bago Yoma (Bago Division, south Myanmar) and Kachin State (North Myanmar) (Smythies, 1986).

The 21,700 km^2 Hukaung Valley Wildlife Sanctuary (HVWS) is the largest area of remaining suitable habitat in Myanmar, where WBH are known to reside year round. In 2005 it was suggested to support approximately 30-40 individuals based on one incomplete winter survey (W. Duckworth, *in litt*. 2006 in BirdLife International 2013a). However, the most recent surveys, carried-out by WCS, found only 16 individuals, but survey coverage of apparently suitable habitat was by no means complete. WBH have been recorded in February in Hponkanrazi Wildlife Sanctuary and during April to June in Naungmung, just outside of Hkakaborazi National Park (Than Zaw pers. comms. to G. Goodman, 23 October 2015). These areas are thought to hold small, seasonal populations of WBH; the latest survey found just two individuals. WBH have been recorded along rivers elsewhere in Kachin State such as the Nat Kaung, although little is known about its current status in these areas (A. W. Tordoff *in litt*. 2006).

More detailed information on WBH distribution in HVWS and Hponkanrazi Wildlife Sanctuary is available in an unpublished paper by WCS based on its 2009-2011 surveys. In HVWR, a total of 16 birds were sighted. Sightings included: eight at Tawang stream (including one juvenile), three at Tarong stream (including one juvenile), two at Lauk Lai and one at each of Sakse stream, Sanip stream and near Khine Lung.

In Hponkanrazi two birds were recorded near Ziyar Dam village at N27°34.240' - E97°06.277' and N27°35.916' - E96°59.920'.

Between 30 January and 1 February 1998, four sightings were obtained in the Hponkanrazi Wildlife Sanctuary but it was not known if these were the same or different individuals (King *et al*., 2001). In November 1999, in the same small area of Hponkanrazi Wildlife Sanctuary, two WBH were sighted together and two further single birds were sighted over the following two days (King *et al*., 2001).

Stanford (1935) and Stanford & Ticehurst (1935) recorded WBH at Putao plain and Smythies (1986) also listed this species along the Mali Hka River near Putao but precise locations were not recorded. Between 2009 and 2011,

WCS also surveyed Putao Plain and along the Mali Hka River between Machan Baw and the confluence of Mali Hka and Nan Yin River but no WBH were seen. Htamanthi has also been surveyed but no WBH have been recorded in recent years (R. Tizard pers. comm. to J. W. Duckworth, 31 July 2014). Two heron were seen and photographed in Shweli River in the East Myanmar Ornithological Region, though the date is unknown but assumed relatively recent (R. Tizard pers. comm. to J. W. Duckworth, 31 July 2014).

"Kachin State as a whole is unquestionably of huge global importance for the conservation of the species. Currently there is insufficient information on the species' status at individual sites to permit an assessment of their relative importance for it"

Sixty-six days of winter surveys in 2003 and 2005 on the rivers, lakes and waterways of lowland Kachin State yielded only one sighting of a WBH, on two days, on the Nat Kaung River, in the vicinity of Warazup village (Tordoff *et al*., 2008). The river here is "up to 100 m wide, with numerous sand and gravel bars and sandy banks" (Tordoff *et al*., 2008).

Other sightings of WBH in Kachin State include along the Ayeyarwady/Irrawaddy River south-west of Bhamo in Dec 1999 (Van der Ven, 2000, in Tordoff *et al*., 2008). However, 14 surveys have been carried out between 1999 and 2011 with just a single recording (Thet Zaw Naing *et al*., *in litt.*), while in comparison there were several historical sightings. Other sightings include: along the Tanai River and its tributaries (e.g. Van der Ven, 2002, in Tordoff, 2007). Tordoff (2007) concluded "Kachin State as a whole is unquestionably of huge global importance for the conservation of the species. Currently there is insufficient information on the species' status at individual sites to permit an assessment of their relative importance for it."

There is a clear need for repeat and up-to-date survey work in these areas.

Nepal

There are no recent records of WBH in Nepal (Hem Baral, pers. comm. to M. Stanley Price, 6 November 2014) and only two known early nineteenth century records: Hetauda (Hetaura) and an unspecified location of the "lower hills" (Hodgson, 1829a, 1844 in BirdLife International, 2001).

Surveyed Areas

Fig. 2 (p 19, Conservation Strategy) shows the areas that have been surveyed for WBH in recent years in Arunachal Pradesh, Assam, Bhutan, China and Myanmar, which led to the following observations:

- These show that there are large un-surveyed areas of potential and past WBH habitat; hence, it is not possible to make any conclusions about the absence of WBH. In some cases, political sensitivities may have prevented access for surveys.
- There is evident need for further surveys in Myanmar, Arunachal Pradesh and elsewhere in eastern India; it might be a priority to concentrate on areas of low human density within these larger areas.
- Although the eastern side of Bhutan was surveyed in all seasons over four years, it has received less monitoring effort than areas to the west where WBH are mostly found.
- The maps suggest that original range was either in hilly areas, or on floodplains outside such areas.
- The nature of the relationship between the herons of Bhutan and western Assam, India is unknown: the possibility remains that they form a single population; the same could be true of herons in eastern Arunachal Pradesh, India, and Kachin, Myanmar, as well as Myanmar and China.

Historical sightings (pre-2000), and recent (2000 to present) sightings of WBH are shown in Fig. 1 of the WBH Conservation Strategy (p 17).

Conclusions

Comparison of recent proven sightings of WBH and the presumed original range shows that there has definitely been a reduction in WBH range.

2. Created by BirdLife International, based on data complied by A. W. Tordoff and participants at the planning workshop.

White-bellied Heron numbers

Bhutan

RSPN estimates that the total population in Bhutan is unlikely to exceed 50 individuals (www.rspnbhutan.org, accessed 12 Dec 2013); the recorded number of WBH has never exceeded 30 (Fig. A4.1). However, based on the fact that 44 nests were monitored between 2003 and 2014, with an assumed survival to adulthood of just one chick per nest, then the population should exceed 50 herons. The fact that this appears not to be the case suggests considerable mortality at unknown life stages.

A decrease in WBH numbers has been attributed to the start of construction of the Punatshangchu Hydropower Project (PHP) in 2010 (Wangdi, 2014). A recorded decline of four birds between 2009 and 2010 (26 and 30 respectively) (assuming the same survey effort) may not seem particularly high but numbers of WBH appeared to continue to decline each year, dropping to just 20 birds in 2013. However, according to RSPN's January-March 2015 surveys, numbers are

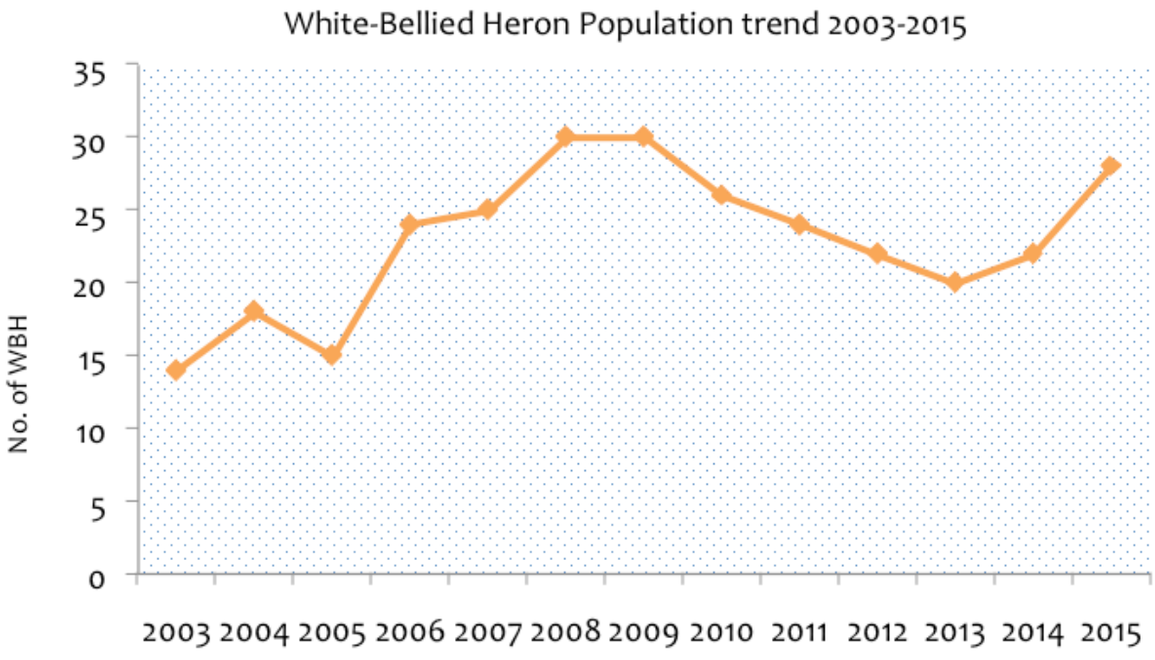

Figure A4.1: White-bellied Heron numbers in Bhutan from 2003-2015, provided by RSPN

Table A4.3: recorded WBH mortality in Bhutan

Casualty statistics				
No.	Year	Location	No. WBH dead	Cause of death
1	2008	Basochhu	1	Electrocuted on electric cable
2	2011	Phochhu	3	Predated
3	2012	Kamechhu	1	Electrocuted on electric cable
4	2013	Hararongchhu	1	Wing injured
5	2014	Hararongchhu	2	Unknown
6	2014	Kamechhu	1	Electrocuted on electric cable
7	2015	Burichhu	1	Chick fell off the nest

Provided by RSPN

now back up to 28. The 2015 survey identified two individuals in Berti and 26 in Punatsangchu Basin (R. Pradhan, pers. comm. to G. Goodman, 30 April 2015; 27 October 2015).

Currently, five breeding sites are known in Bhutan but nest abandonment rates appear to be significant. Other causes of mortality include electrocution by powerlines, predation and other injury (see Table A4.3 for a record of known casualties). Given that on average, RSPN estimates 20 chicks hatch annually, there are presumably numerous unrecorded mortalities.

Six active nests were recorded in Bhutan in 2007, two from a new site. By 26 July 2007 these nests held six chicks in total. However, due to natural forest fires, three nests were abandoned, resulting in a likely 50% survival rate to fledging (leaving the nest) at best. In 2009, three active nests with five chicks were recorded on a subsequent visit just three chicks remained (Anon 2009). In 2010, 10 WBH were recorded as fledging from five nests, yet by the 2011 population survey, RSPN found that WBH numbers had reduced by two from 26 in 2010 to 24 in 2011. While three birds were recorded as predated, there is still seemingly an unaccounted loss of nine birds.

China

The 2014 record of one young bird in Yunnan province provides ample motive for further surveys, but the single record clearly cannot be extrapolated to a national population estimate. However, given the scarcity of sightings from this part of China it can be reasonably assumed that WBH numbers are low.

India

Sightings in India are too sparse to translate into any valid population estimate. In Namdapha: estimates thus far are of just five to six individuals (G. Maheswaran, pers. comm. to G. Goodman, 22 Jan 2014).

Myanmar

Surveys by WCS in 2011 in northern areas of HVWS, and Hponkanrazi Wildlife Sanctuary produced sightings of 18 herons, two of which were juvenile, suggesting some successful breeding.

While more remote areas might support further individuals, they are estimated to hold no more than four to five additional pairs (R. Tizard pers. comm. to G. Goodman, 19 August 2013; 17 January 2014). Thus the population estimate for northern Myanmar is 26-28 birds. All other sparse sightings in Myanmar make no significant difference to this estimate.

The findings of field surveys have also been supported by reports from local people which suggest that the species has declined in the region in recent years (D. Wilson *in litt*. 2006).

"It is realistic to conclude that the WBH is at dangerously low numbers with high risk of local or total extinction in the wild"

Conclusions

It is most likely that the species has suffered a reduction in numbers, in parallel with a reduction in area occupied (above). On the other hand, historical records suggest that it has never been a very common bird (see Fig. 1 in WBH Conservation Strategy).

The Red List entry for *A.insignis* states "Though a complete population census is yet to be conducted, the current population size is thought to be best placed in the band 50-249 mature individuals (D. Wilson and J. Eames *in litt.* 2006). This equates to 75-374 individuals in total, rounded here to 70-400 individuals" (BirdLife International, 2013a). There is a lack of comprehensive data on which to base any realistic estimate of total WBH population.

Based on the large but fragmented range, despite large portions of this range having no recent survey data (or none at all), with the apparently high level of mortality, growing levels of threat and the paucity of sightings, it is realistic to conclude that the WBH is at dangerously low numbers with high risk of local or total extinction in the wild.

Identifying populations

Given the paucity of sightings, the large range, and ignorance of the extent of movements by individuals, there can be no presumption over the existence of any sub-population structure.

Whereas there is no evidence, it can be surmised that Bhutan and Assam have an interacting population of WBH, with Bhutan possibly acting as a source. Similarly, the herons of Namdapha and elsewhere in eastern India may interact with those of Myanmar, and those of Myanmar and China may interact. However, these observations must be tentative in the absence of any evidence and bearing in mind the large areas across original range that have not been surveyed either recently or at all.

Potential population growth rates

Data are inadequate to allow any estimate of potential rate of increase, though data from Bhutan suggest relatively high levels of mortality may be minimising population growth there. The species is credited with a generation length of 10.5 years (BirdLife International, 2013a).

Habitat and resource assessment

Little is known about the ecology and behaviour of the WBH, including its feeding, breeding or migratory habitats, although it is largely considered a non-migratory bird (BirdLife International, 2013b; Maheswaran, 2007). It has been suggested that the bird responds to the seasonal dynamics of rivers and fishes (Maheswaran, 2007); this may be evident in Myanmar where WBH are thought to be found seasonally in Hponkanrazi Wildlife Sanctuary and Naungmung, just outside the boundary of Hkakaborazi National Park (Than Zaw pers. comm. to G. Goodman, Oct 2015). The reason for and extent of seasonal occurrence are unknown.

WBH was sighted twice in Namdapha in 2011 on the banks of the Noa-Dehing River at Narbadi, where "It was sighted on a river bank with sand and gravel surrounded by tropical forests at an altitude of 360 m a.s.l, which is usually described as the perfect habitat for this bird to survive" (Krishna *et al*., 2012).

G. Maheswaran estimates that each WBH needs 2-7 km^2 and that the species is territorial (pers. comm. to G. Goodman, 22 January 2014). On the other hand, RSPN documented: "We never saw agonistic interactions among herons, even those foraging as close as 25 m, suggesting that these birds are not territorial during the nonbreeding season. However, with the small number of individuals observed simultaneously, it is also possible that all the birds were members of a single family (see Identification of age groups). We have observed apparently agonistic interactions at breeding sites involving displays, approaches and chases. It is therefore impossible to distinguish between the two interpretations that wintering birds on the Pho Chu were non-aggressive because they were closely related, or that wintering birds are simply not territorial" (RSPN, 2011).

WBH is seen along rivers in forest, wetland, grassland, in small or large rivers usually with sand or gravel bars and also in areas covered in cobbles and pebbles, often within or adjacent to subtropical broadleaved forest, from the lowlands up to at least 1,500 m a.s.l (Ali & Ripley, 1983, A. W. Tordoff *in litt*. 2006), although unsubstantiated claims by local people in Tengchong County of Gaoligongshan, Yunnan Province in China are of WBH in areas at approximately 2,100 m a.s.l. Several sightings in Myanmar in 1998 were of birds invariably in rivers with beds of 'large shingle stones' (King *et al*., 2001). Recordings of WBH in Myanmar have included birds at elevations of just 110 m a.s.l in Shweli River of Shan State; approximately 300 m a.s.l in HVWS and from 563 m a.s.l to 1,500m a.s.l in Hponkanrazi Wildlife Sanctuary and Naungmung.

Large rivers and lakes with Chir pine trees (*Pinus roxburghii*) nearby are found to be preferred habitat for WBH in Bhutan. In Bhutan WBH roost and nest only on tall Chir pine trees (Jigme Dorji to Rufford) (see below).

The literature suggests a strong association of this species with riverine broadleaf forests, and it is unclear whether sightings outside of this habitat are birds temporarily in suboptimal habitat, or if grasslands, lakes and wetlands of flat country can also support the species (RSPN, 2011).

RSPN (2011) "However, at the outset it should be noted that much of the range in Bhutan is quite different from most of the bird's current and former range, and that these conclusions may apply only to Bhutan. Most of the habitat in Burma, Assam, and Arunachal Pradesh, for example, is broadleaved forest, and many of the locations the species has been reported from in the past were on relatively low gradient rivers, often with slow moving water. These characteristics are quite different from those used by WBH in Bhutan."

In the vicinity of the WBH sightings in Manas Tiger Reserve (India) in 2013-2014, the average depth of the stream in November 2013 was 30 cm, with a width of 20

m and an average river bed width of about 80 m. The water was crystal clear and the velocity of the water current was 56 m/sec. The pH of the water was slightly basic (pH 8). Fish fingerlings were observed in the river during the survey, indicating presence of a fish population. The land cover was mixed moist-dry deciduous and semi-evergreen forest (Rabha & Das, 2014).

Conclusions

The areas in which WBH have been sighted suggests a wide-range of habitats are used: they have been found up to 1,500 m a.s.l in Bhutan (possibly higher in China) and as low as 110 m a.s.l in Myanmar. While they feed in fast-flowing rivers in Bhutan and Myanmar, they use much slower rivers in Arunachal Pradesh and Myanmar, and have even been observed feeding at a non-flowing man-made site. They nest along broad rivers as well as narrow ones (see below).

They are commonly seen on broad rivers, but not invariably, as shown via camera traps placed inside HVWS (for tigers), which caught an image of the WBH on a small stream (A. J. Lynam, pers. comm. to J. W. Duckworth, 2014), albeit only a few hundred metres from a main river: this perhaps challenges the assumption that they live only on big rivers; on small forest streams, it would be very difficult to find birds using typical survey techniques.

Many heron species are regarded as eclectic in their habitat use and selection with prey availability and proximity of nesting sites, at least in part, dictating habitat preference (Kushlan & Hancock, 2005). Therefore, whereas WBH, in some cases may be driven to use sub-optimal habitat due to destruction of primary sites, it is possible that they are indeed generalist in their requirements.

Roosting sites

From RSPN (2011): "This roost site was approximately 1 km (straight line) from the closest edge of the river, and approximately 200 m from the edge of open paddy fields that adjoined the river on slopes that ranged from 30 – 40 degrees. Roost trees were located in an open heavily grazed forest dominated by Chir Pine (*Pinus roxburghii*) and roost trees were clearly the tallest trees in the stand, located approximately 300 m from the top of a ridge. The three roost trees were 10, 14, and 16 m in height, and inter-roost tree distances ranged between 52 and 105 metres, with little or no mid-story or understory vegetation. The site is regularly grazed by cattle, and, based on local information and fire scars on trunks, is subject to fires of unknown frequency. Distances from roost trees to nearest overstory trees ranged between 8 and 14 m, (x = 10.03, s.d. = 2.96, n = 13). Based on whitewash locations, most birds were roosting near the ends of relatively large lateral branches between 8 and 10 m above ground level."

No other information is known to be available on roosting sites for WBH.

Seasonal movements and dispersal

There is no quantitative information on daily or seasonal movements or dispersal.

WBH seen at lower altitudes and on the Brahmaputra flats in winter might be either residents or visitors from higher, colder altitudes.

The extent of seasonal movements is not clear despite the suggestion that WBH is not migratory, based on sightings in Namdapha in September to December and in August and in January across several years (Maheswaran, 2007). In the HVWS, Myanmar, the WBH do not disperse seasonally, staying on the same rivers all year (Thet Zaw Naing pers. obs.). However in Hponkanrazi Wildlife Sanctuary and in Naugmung just outside Hkakaborazi National Park, WBH have only been observed seasonally, in February and April to June respectively (R Tizard pers. comm., to G Goodman, 19 Feb2014; Than Zaw pers. comm. to G. Goodman, 26 Oct 2015).

In Bhutan, season is significant in determining WBH distribution: in February, nesting WBH will be on the smaller rivers, as no nesting takes place along large rivers; in September the birds have returned to the large rivers. The roles of water temperature and flow rates are not known but however believed to be important. There are many areas of apparently suitable habitat without WBH (R. Pradhan pers. obs.).

Low water levels may be the critical factors in Bhutan, because as water levels rise, WBH are seen to leave; however, as water level rises flow rate and turbidity also increase. The relative importance of these factors is unknown (Jigme pers. obs.).

If WBH in general move about much between seasons, critical observations may be lacking because a lot of their habitat is inaccessible, for example, during the monsoon season.

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Feeding habitat

In Myanmar observations of feeding have mainly been of WBH in rapids in clear, shallow waters, 12-30 cm deep, with some blue-green algae and with stone beds and sand bars (Thet Zaw Naing *et al.*, *in litt.*; King *et al.*, 2011).

The most detailed analysis, based on observations, comes from Bhutan (RSPN, 2011):

"These rivers are in general 75 – 250 m in width, and up to 3 m in depth, though 0.1 - 2 m is much more common. Rapids vary between class 1 – 3 with turbid, greenish blue water. The rivers varied between having 1 and 4 channels depending on location and stage, with multiple channels being much more common than single. Substrate was rounded cobbles, rocks and boulders of up to 1.5 m in size; river bars were usually composed of both rocks and sand, with logs and driftwood common. Islands were usually less than 300m long and less than 100m wide; vegetation on islands varied between none, tall grass and in some cases large (10m height) trees. Foraging herons were found far more commonly on braided sections of these rivers than on sections with only a single channel. Of the 68% observations, only one was on a single channel and the median number of channels where herons foraged was three. River sections with foraging herons were approximately 200 m wide (range 150 – 200). Herons foraged most commonly either in shallow ponds that occurred within islands (32% of observations), or on edges of islands (82% of edges). Cobble and gravel islands and multiple channels within the river therefore seemed to be strongly preferred by herons. This preference probably has several sources. First, when the river is divided into multiple channels, the strength of flow and depth in any channel is reduced. This satisfies the need for foraging in relatively shallow water – 86% of foraging observations were of herons in water that did not exceed the tarsometatarsal (TMT) joint. In addition, herons seemed to prefer smooth water (69% of observations) and riffles (29%), and rarely ventured into main flow-ways or even the edges of major rapids. It seems likely that this preference is related both to the need for relatively shallow water, and the need for conditions that allow visual sighting of prey in water. (WBH picture at VTI) Smooth, shallow water was only available in ponds and

> "Foraging habitat and microhabitat for herons seems to be related to multiple channels and associated islands, probably for reasons of preferred water depth, availability of prey to herons, and predator avoidance"

pools contained within bars, and in backwaters and oxbows on the river edges. Herons seemed to avoid mainstream river edges strongly, probably because river edges may allow the close approach of potential mammalian predators. Islands therefore probably offer the additional advantage of a clear field of view of potential predators, and large distances between herons and potential predators and disturbances.

In sum, foraging habitat and microhabitat for herons seems to be related to multiple channels and associated islands, probably for reasons of preferred water depth, availability of prey to herons, and predator avoidance".

There is only one assessment of the ranging behaviour of nesting WBH: "Based on our observation of foraging birds, we estimated that reproductive birds were foraging up to 5 km from the nest on small streams and along the Punasangchu" (RSPN, 2011).

Additional observations have also been made:

- WBH are able to feed in faster flowing water than many other birds that feed in a standing posture; thus, WBH prey species might overlap more with birds that are swimmers (e.g. cormorants and Oriental darters) than with other river-margin stalkers (other herons, storks etc.).
- The behaviour of WBH is different between Bhutan, India and Myanmar even in terms of timing of foraging.
- In Bhutan (with the exception of Lake Ada) and India (Manas), fast flowing rivers are occupied; in Myanmar, both fast and relatively slow-flowing rivers are used.
- In the HVWS, Myanmar, there is huge variation in water flows throughout the year, and WBH are seen on the same rivers throughout the year.
- While the consensus is that in India and Myanmar, WBH requires clear water for feeding, in Bhutan WBH has been seen feeding in turbid water made murky by hydropower infrastructure development.
- In Lake Ada, Bhutan, green algae are prolific, with high fish numbers due to the provision of food for religious purposes; herons feed in the shallows here, possibly with larger than usual feeding efficiency, and on streams nearby; nearby cattle seem no deterrent.
- In Namdapha WBH have only been seen on rivers with broad banks, although they are frequently seen elsewhere in wide, fast-flowing rivers with boulders and cobbles; they also feed in lakes and in waterbodies in grasslands.

Such observations suggest WBH may have a wide range of feeding habitats as is common for herons. Some habitats may be sub-optimal, raising the questions of what is optimal habitat for feeding, and to what extent, and where does such habitat remain.

Feeding and diet

According to RSPN (2011) WBH are "Thought to eat mostly large fish (Hancock and Kushlan 1984), the only quantitative report of food habits is from a single stomach that contained only crayfishes (Baker 1922 – 1930 in Birdlife International 2001). Our observations for over eight years suggest that the WBH feed on any type of fish."

In undisturbed habitat, herons were said to catch two to three fish per hour, but this rate is less in areas where civil infrastructure development was taking place (RSPN, 2011).

"Captures by WBH were infrequent, with only 11 captures seen in 4,385 minutes (x = .0057/min, s.d. = 0.0156, n = 40 observation sessions). Striking efficiency was high, (x = 1.2 strikes/capture, s.d. = 0.121, n = 10 observations). This rate of capture (0.342/hour) was quite similar to the hourly rate reported for Goliath Herons (0.332), though WBH captured considerably smaller prey. For example we observed a breeding adult foraging on the shores of Ada Lake, where fish are very abundant, partly due to high nutrient status as a result of frequent inputs of rice as religious offerings. On April 29, 2009, we recorded this individual capturing 9 fish in 3.75 hours, or 0.040 captures/min. This was 7 times as fast as the capture rate recorded for non-nesting birds during winter on the Pho Chu (0.0057 captures/min). All captures were fish, and no invertebrates or anurans were seen. Based on a reported midpoint of bill sizes of 152 mm (Ali and Ripley 1978), captured fish ranged in size from an estimated 7.7 to 30.8 cm in length (mean 16.2, s.d. 10.53, n=7).

Using a cast net with mesh size of approximately 2 cm (stretched dimension), despite repeated sampling, we found only two species large enough to be captured using this technique, Brown Trout and Snow Trout. We therefore assumed that these species were the two most commonly captured by the herons. We did identify both species as being taken in one or more foraging observations involving large captures, but we were able

to make no quantitative estimates of the relative use of either species by the herons.

In Bhutan, we have recorded birds foraging on two major rivers (Punatsangchu and Bertichu) and their tributaries, varying from approximately 15 – 300m in width. We have also recorded WBH foraging very successfully at a small lake (Ada) of approximately 200m diameter with flat water and extremely low water clarity" (RSPN, 2011).

"The river and streams of slow to mild flowing current are preferred feeding grounds in Bhutan. They also feed in still water bodies like lakes, marshes and ponds" (Dorji, 2014).

The Zoological Survey of India has a three-year grant to carry out work on the species' feeding behaviour in Namdapha. This work commenced in July 2013 (G. Maheswaran, pers. comm. to G. Goodman, 22 January 2014).

A progress report from this study (Maheswaran, 2014) reports on fishing bouts by WBH: between November 2013 and March 2014, 274 hours of observation were made. Fishing bout duration ranged between one and 38 minutes. Of the 1,497 fishing bouts recorded, 488 were 30 minutes long. Fish taken were 5-27 cm in length, but the majority were between 7-18 cm long. No night-time feeding was observed (Maheswaran pers. obs.).

Maheswaran reported that "The reason why male and female returned to the nest late in the evening might be related to their long foraging trips (sometimes observed moving up to 30 km in Bhutan) though it still needs to be corroborated with data here in Namdapha".

Further work will explore preferred water depth and flow rate, success rates and the identity of fish species taken. More than 80 species of fish are found in Namdapha. Permission to collect specimens is being sought; if not successful, then villagers outside the park will be asked to collect fish. This information will be used to learn about prey species and how the WBH optimises foraging effort (Maheswaran, pers. comm. Dec 2014).

In Myanmar, observations have been made of WBH feeding on fish ranging in size from 2 cm to 50 cm, suggesting a wide range of species and sizes are consumed. They recorded success rate of 45% (Thet Zaw Naing *et al*., *in litt*).

Bhutan's limited head-starting programme indicated no preference between fish species; size and abundance of species are considered to determine diet. Relevant to the situation in the wild, it is evident that capture of larger fish required longer times for digestion and presumably a delay in further foraging.

In terms of activity pattern, WBH are relatively inactive between 0900 and 1330-1430 h., but then forage until nightfall (Pradhan, pers. obs.), although feeding until as late as 2015 hours have been observed on moonlit nights (Thet Zaw Naing *et al*., *in litt.*). Inactivity in the morning from 0900 presumes a lack of earlier observations on a likely feeding phase from dawn.

Nesting habitat requirements

The species is known to breed and roost in Chir pine forest (A. W. Tordoff., *in litt*. 2006, D. Wilson *in litt*. 2006); four nests located in Bhutan in 2003-2007 were solitary and located in large Chir pines on ridges or steep slopes at 500-1,500 m a.s.l, near the confluence of a small forest stream with a larger river (Pradhan, 2007; Pradhan *et al*., 2007).

RSPN (2011): "The herons appeared to prefer areas with sparsely dispersed large, tall Chir Pines with no understory touching the tree, and a very sparse to non-existent shrub and small tree layer. For example, at two nests on the Zawa Chu, we measured a mean nearest Chir Pine tree distance of 15.5 and 19 m, respectively. Mean distance to the nearest 6 neighbouring trees (>10 cm dbh) was 16.5 and 14.7 m, respectively.

Nest trees were usually rooted on particularly steep parts of hillsides (42 –68° slope), and had an average diameter at breast height of 67cm and were 27 – 43 m tall. Nests were located on large (> 10 cm diameter) middle branches or crotches of the tree, rather than at the top. This may be because middle branches offered a more open aspect that helps with take-off and landing of these large birds. It may also be that middle heights are preferred because of the strong winds that are frequent in the afternoons in the Punatsangchu valley. Nests were located 12.7–22 m from the base, and the closest branch to the base was at least 12 m from the ground. This suggests that WBH are attempting to nest well above the ground in large trees that are difficult for mammalian predators to climb.

Nests along the Punatsangchu were 1.55 to 9 km away from each other (flight distance) though they could be along the same river or stream."

In Namdapha, Assam, in 2014, a nest was located about 18 m above the ground on a *Terminalia myriocarpa* tree in riparian forest adjacent to the dry river bed, which

was covered in tall grass and small shrubs. The nesting tree was visible from a long stretch of the meandering main river. It is possible the birds selected the site because the nearest human track between the villages of Gandhigram and Vijayanagar lay on the south side of the river a long distance away. Although there were many tall trees in the vicinity, the herons selected a tree of moderate height and constructed their nest on the outer branches, easily accessible for birds of their size and affording a clear view of the river for several km to both east and west and also a clear view of the southern bank—here the width of the river bed varies from 500 to 800 m (Mondal & Maheswaran, 2014).

In contrast to the Bhutan situation, the WBH nests at 400 m a.s.l in Namdapha and below 200 m a.s.l in Myanmar. In the latter, nests are found in low elevation broadleaf forest.

RSPN (2011): "We found herons nesting no closer than about 3 km from one another, and many of the closer distances were from pairs of nests separated by a major drainage or ridge. White-bellied Herons therefore seem to need large territories for nesting. These territories may be along the same tributary as in Kisonachu I and II, and birds from one territory seem to freely move upstream and downstream through neighbouring territories. The need for large territories suggests that the density of nesting in Bhutan will always be quite low, and large spaces will be needed for a sustainable population".

Nesting

RSPN (2011) reports: "Some nest structures were used up to three years in a row before being abandoned. Of 15 nest initiations studied, 4 failed prior to fledging young (27%). This suggests a relatively high rate of nest success relative to other herons and storks. Of the four failures, one (in Hararongchu, 2007) was due to a forest fire that burned up to the nest, though the nest tree and nest itself was not consumed. Another two (in Ada & Hararongchu, 2009) were abandoned during a period of unseasonably heavy rains in May. During the storm, two nests at Kisonchu lost a chick each. No particular cause of failure could be attributed to the fourth case (Zawa in 2007), in which an empty nest was found on 29 March 2007. It was unclear whether the abandonment was before or after the disappearance of eggs, and therefore difficult to authenticate whether the disappearance of eggs was due to a predator or scavenger. The Zawa nest is surrounded by relatively dense vegetation and mid-story trees as compared to other nests, and it is possible that this facilitated access to the nest by a climbing predator.

Between one and four eggs were laid in nests, and since young hatched asynchronously, incubation is inferred to begin at the laying of the first egg, as is typical for Ciconiiformes. Mean chicks hatched per nest was 1.75 (s.d. 0.683). Fledglings per nest start varied between 0 and 3, and averaged 1.25 (s.d. 0.931, n = 15). The difference in these two measures suggests that approximately 0.5 chicks may be lost on average between hatching and fledging, which may occur because the entire brood is lost (Zawa 2007), or because a single chick dies (Kisonachu 2007, 2009). As is typical for herons, the youngest or at least the smallest chick seemed most likely to die during this time.


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Nest building is begun as early as the last week of February, though there is clearly considerable variation in initiation date, with first and last nest initiation dates spanning 94 calendar days. Mean hatching date for young was May 2nd (s.d. 34.38 days). Mean time from hatching to fledging was 50 days (s.d. 21.48 days).

Incubation takes thirty to thirty one days. Both adults incubate, taking turns, and eggs are typically rolled and examined at nest exchanges. Hatching is asynchronous, with 1–3 days between the hatching of successive eggs.

As with other herons, attendance at the nest changes markedly with age of chick, with near complete brooding in the first week. Feeding frequency is variable, probably depending on the time it takes parents to catch fish. When the chicks are five weeks old, adults spend much less time on the nest and chicks are typically fed only once per day. By seven weeks, chicks are left alone in the nest while both the parents feed in the nearby stream or river. Nestlings become flight-capable and leave the nest within 72–74 days of hatching. In 2004, one brood fledged in 62–64 days. Parents did not permanently leave the nest until all chicks have fledged (left the nest).

We were unable to collect observations of movements, or of concentrations of fishes in small rivers and streams during the nesting season. Nonetheless, the timing of nesting is coincidental with the season of fish movement and breeding, and we suggest that understanding fish availability may be critical to understanding both the timing and the foraging ecology of nesting in the White-bellied Heron."

In Bhutan in 2014, three to four eggs were laid in one nest in late March, hatching in late April; fledging occurred in early-mid July (RSPN, 2014).

Mondal and Maheswaran (2014) describe WBH courtship in detail, based on observations in Namdapha, India of a single courting pair. The pair occupied their nest from 15th March 2014. In March 2015, a pair (possibly the same pair but unknown) were observed nesting near to this location (approximately 1km away) (G. Maheswaran pers. comm. to G. Goodman, 11 May 2015).

There is currently no evidence of breeding in Manas, India. Several juveniles have been sighted in Myanmar, suggesting successful breeding there.

Proximity to humans and susceptibility to disturbance

"Based on flush distance, this species seems to be exceptionally sensitive to approach by humans"

RSPN (2011): "White-bellied Herons have been reported to be both unusually tame, and unusually sensitive to human disturbance. This apparent contradiction may have an historical explanation, with a formerly tame species becoming extremely wary as a result of human hunting and persecution (see BirdLife International, 2001), and some birds remaining tame in places that they have not been persecuted. However, it is not clear what forms of disturbance are important for this species, and how disturbance may affect movements, reproduction and energetics.

Based on flush distance, this species seems to be exceptionally sensitive to approach by humans." But, this conclusion has to be made without knowing the previous experience of such birds with humans and other species, or with any other potential sources of disturbance.

In Bhutan, people and WBH overlap in their use of habitats. Local people are aware of the WBH's occurrence along Punatsangchu and Mangdechhu Rivers mainly in winter (pre-monsoon and post-monsoon), and WBH population decline is seen in the same areas. But it is felt (Jigme Dorji, pers. obs.) that local people are not generally a direct threat. However large-scale hydropower and infrastructure development may pose significant threats to WBH. Furthermore, direct disturbance is thought to increase during infrastructure development with the hiring of foreign staff who may hold different values and attitudes towards wildlife.

The species has been documented as elusive and private, avoiding people and preferring relatively undisturbed habitats, as well as being primarily solitary (Kushlan, 2007). Those involved in research and monitoring of the species have reported difficulties due to the widely dispersed and sparsely distributed nature of the birds, as well as being located in difficult to reach terrain (RSPN, undated; N. Kakati, pers. comm. to G. Goodman, 5 December, 2013). On the other hand, others have encountered the bird incidentally in northern India (U. Srinivasan, pers. comm. to G. Goodman, 16 January 2014) and nesting birds have reportedly coexisted in relatively close proximity to villages in Bhutan. Unusually, at Ada Lake, Bhutan, herons nested close to (and fed at) a man-made pond, only 200m from a walking trail and 500m from a village. The pond has a large numbers of easily caught fish (RSPN, 2011, and P. Frederick pers. comm. to M. Stanley Price, 2014).

In Namdapha, after a ground-level blind was set up 100 m from a nesting pair, the birds flew off as the observers left the blind and neither bird returned for 48 hrs. This indicates a wariness and aversion to human presence (Mondal & Maheswaran, 2014), at least in this pair of herons.

Krishna *et al*. (2010) also reported that on both their sightings in the same park, the bird flew away at the slightest disturbance.

It is speculated that in general the WBH select secluded river systems with low levels of human disturbance; this may be decreasingly possible, especially given the extent of illegal fishing even in protected areas such as Namdapha.

RSPN (2011): "Mining took place in a shallow, braided part of the river, and frequently created new streams, braids and islands as materials were moved and removed. Herons often foraged in the site of this mining when work was not in progress, often less than 100 m from inactive heavy equipment. While mining operations were in progress, we observed herons foraging and roosting at various distances as close as 110 m. While the actual distance to nearest human habitation varies hugely (130 metres at Basochu to over 5 km on Kisonachu),

the perception of being inaccessible is probably more important to the herons than straight line distance. The Ada Lake nest is less obvious in supporting these generalities. At this site, the birds were nesting on a steep slope that was less than a half kilometre from a medium sized village, and less than 200 metres from a very commonly used walking trail. It may be that the birds were willing to nest in this location because of the extremely productive foraging site (Ada Lake) nearby, and a presumed lack of persecution by local or other people. This solitary example gives weak support to the notion that in the absence of persecution and in the presence of high quality foraging sites, herons may be able to nest in relatively close proximity to low density human habitation".

"The apparent shyness of most herons that are seen may be the consequence of learning from adverse encounters"

In summary, the co-occurrence of WBH and people, or their physical separation, causes contradictory views on the heron's tolerance to disturbance. The level of disturbance caused by people or human activities may be a response to persecution. On the other hand, the close proximity of herons and people at Lake Ada suggests the opposite is possible if a large and easily available food source is present and there is no history of persecution or overt disturbance. In western Assam it was noted that all riverine birds flew away when people were present (Anon., pers. obs.). In Namdapha, WBH flew away when people arrived. This was ascribed to the herons not being accustomed to seeing people, rather than being persecuted[3].

Conservation of the WBH would be helped by resolution of these questions or at least greater understanding of the variety of relationships between people and herons. The default position should be that WBH is intrinsically no more susceptible to human presence than any other large waterbird; based on their experience, or lack of adverse experience, individual herons may not have large flight distances. The apparent shyness of most herons that are seen may be the consequence of learning from adverse encounters.

Human disturbance might explain the absence of WBH from apparently suitable rivers (though this is less likely in Bhutan where the bird is not heavily persecuted and has been observed feeding at man-made systems), but currently there can be no definitive answer due to gaps in monitoring coverage and restrictions on access to much of WBH potential range.

Non-human competitor species

In the HVWS, Myanmar, the WBH shares rivers with many other large birds such as the Asian woollyneck (*Ciconia episcopus*), lesser adjutant (*Leptoptilos javanicus*), great cormorant (*Phalacrocorax carbo*) and grey heron (*Ardea cinerea*); demonstration of competition with WBH would require detailed study of the prey taken by each species and comparison of their feeding habitats and feeding techniques (J. W Duckworth, pers. comm. to M. Stanley Price, 6 November 2014).

RSPN (2011): "We observed two instances in a single day of herons foraging in close contact with Great Cormorants (*Phalacrocorax carbo*). Later both herons were apparently displaced from the pool after being repeatedly approached closely by a cormorant."

WBH has been observed being mobbed by small birds such as small birds such as drongos, crows and Himalayan bulbuls (S. Dalvi, n.d.).

Namdapha is known to have egrets, storks, cormorants, but other waterbirds seem scarce, perhaps as a result of short-term observations only.

Otters are cited by Dorji (2014) in a video clip as competitors with WBH for fish in Bhutan.

It would seem that, given the WBH's apparently wide diet, competition with other fish-eating birds in its range may not be important.

Predators

Apart from suspected deliberate hunting by humans, and accidental mortalities (for example, on power lines), there are no records of predation on adults, although three WBH have been recorded as predated upon in Bhutan in 2011, presumably all juveniles.

It is claimed that young herons in the nest are susceptible to predation by serpent eagle, (*Spilornis cheela*), Pallas's fish eagle (*Haliaeetus leucoryphus*), osprey (*Pandion haliaetus*), yellow-throated marten (*Martes flavigula*) and small cats (Business Bhutan, 2011). The risk of predation increases when parent herons have to be away from the nest for longer if human development activities have reduced the fish population and/or the birds have to travel further to fishing areas.

RSPN (2011): "We saw no predation attempts on herons during our observations, but did note several interactions

3. After workshop comment: acknowledging that it is not known if such WBH were resident, nor their ranges and experiences post-fledging

with raptors that suggested predation or food piracy by raptors might be a risk for herons. On 8 different days we observed either Pallas's Fish Eagle (*Haliaeetus leucoryphus*) or a Crested Serpent Eagle (*Spilornis cheela*) flying over herons, or approaching them on the ground. In all cases, the herons performed an apparently aggressive display."

Social structure and behaviour

The WBH is generally solitary but may aggregate into small flocks and family groups during winter (D. Wilson *in litt*. 2006, Pradhan, 2007). At Namdapha, India, in early January 2014, two or more adult birds—once up to six individuals—were observed together in one place on several occasions, indicating that possible mate selection had started, and after that bonded pairs separated from the group and selected their separate territories (Mondal & Maheswaran, 2014).

One possible corollary of the WBH not being seen in flocks is that it may naturally occur at low density.

Threat analysis

In any consideration of threats to a species, especially if it occurs at low densities and there is little information on it, it is essential to bear in mind that the threats seen or inferred today may not be those that affected the species in the past or were responsible for its decline, range fragmentation or reduction in density.

Much of the WBH's current range lies in the lower-medium altitudes of the Eastern Himalayas. Here the species is subject to direct threats at the local level and in current time, as well as to major global and regional changes that will impact biodiversity more broadly in the future.

Large-scale impacts on the region's biodiversity will derive from three main factors. The first is human demography. The second is climate change, which is predicted to affect the Eastern Himalayas more than the global average (Shresta *et al*., 2012). The third factor is the rapid development of hydropower in many of the rivers flowing from the Himalayas. This will affect not only river flow and characteristics, spatially and temporally, in many ways, but is also predicted to have large impacts on terrestrial biological diversity (Pandit & Grumbine, 2012) and hence on people living in the region. No study of the expected impact of dam-building on aquatic communities, including WBH prey species, is known.

Dams require other infrastructure to function (including roads, power lines and associated reservoirs), and will therefore cause increased loss of terrestrial habitats, as well as knock on impacts such as increased forest exploitation by workers brought in for construction, as well as those seeking alternative livelihoods and sources of protein due to loss of fisheries, agricultural lands etc. Dams also increase fragmentation of forest habitats, sedimentation and soil erosion, thereby impacting water clarity, temperature and the overall ecosystem composition.

"While there may be causes specific to any range state or area, the decline across the entire range may be due either to universal threats or to local factors, or to a combination of both"

There are many unknown and unpredictable aspects to the nature and impacts of both climate change and structural changes in river regimes, and even less assurance as to how they will interact and cause cumulative impacts. However, WBH have been assessed as highly vulnerable to the impacts of climate change (Foden *et al*., 2013) based on a trait-based assessment. WBH may therefore face both immediate, direct threats and longer-term, large-scale threats that are both direct and indirect. On the other hand, evidence indicates that WBH takes a wide range of fish species, probably according to availability (RSPN, 2011). If this is the case, although dam building will alter habitats and impact resource availability, there may be alternative fish species available for WBH. However, the construction of dams will inevitably change the periphyton and macroinvertebrate communities which will impact the overall composition of fish species, in particular predicted to impact species such as snow trout (*Schizothorax nepalensis*) (identified by RSPN as likely to be a common source of food for WBH) who prefer shallower, faster moving waters (J. A. Johnson, pers comm. to G. Goodman, 16 Oct 2015). Traditional, riverine nesting and roosting sites could also be at risk as riparian forests along the river are submerged or degraded due to dam developments.

While sightings and research suggest that WBH is declining, the causes of the decline are not verified. While there may be causes specific to any range state or area, the decline across the entire range may be due either to universal threats or to local factors, or to a combination of both.

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Furthermore, while there are plenty of hypotheses about the cause of decline, very few can be objectively tested.

In addition, since ecological and biological requirements for the species are not well understood, it is not known where and how much viable habitat might remain. There has to be a further proviso in that the last places in which a species with a reduced population is found may not be its preferred or optimal habitat: such places may only be refuges, because the threats there are least. The status and trends of the WBH requires in-depth study of the advantages and disadvantages of medium altitude versus lowland river systems as habitat, and the opportunities that each offers the heron and the pressures that each habitat faces.

"Furthermore, while there are plenty of hypotheses about the cause of decline, very few can be objectively tested"

While the species has undoubtedly undergone range contraction (see 'Distribution'), there are no records indicating that it has ever been abundant. Therefore, either the species has always existed in low numbers at low density or it has been subject to major threats and causes of reduction from before records started and before the present conditions of human demography, land transformation and resource use.

Various specific threats have been observed or suggested, falling into several major categories:

Disturbance

This section contains observations and conclusions that WBH are especially sensitive to disturbance. However, this does not prove that individual herons are naturally shy when they have had no reason to maintain considerable distance from people and their activities. There is a clear need to explore the nature of shyness in WBH, and surveys in areas of low human occupancy or activity could be rewarding.

In the Punatsangchu area of Bhutan, the WBH population is thought to be affected by disturbance by bird watchers, mostly conservationists and tourists, who come to the area on a regular basis to take photographs and monitor the nesting site (Dorji, 2013).

The eggs in the nest at Burichu did not hatch despite the breeding pair sitting on the nest until the end of June 2013. The reason for the failure was assumed to be the disturbance by vehicular noise. This was claimed to have caused stress to the bird incubating the eggs so that she was unable to maintain the constant temperature required for effective incubation (Wangdi, 2014).

Based on flush distance, this species seems to be exceptionally sensitive to approach by humans (RSPN, 2011). RSPN (2011) concludes that, in general, human activity within 200 m is likely to cause a heron to fly away, and this should be the minimum distance for acceptable approach. Observations of feeding bouts in Namdapha Tiger Reserve were conducted at 200 m distance for any herons on account of their being shy (Maheswaran, 2014).

The sensitivity of a nesting pair in Namdapha, Arunachal Pradesh, is well demonstrated here:

"Unfortunately the first hide was constructed too far away and at about 08h30 on 12 March, we approached to within 100 m of the nest tree to construct a new hide. Both the birds immediately left the nest. In the next 40 minutes a hide made of sticks, leaves and grasses was constructed on the ground as there were no large trees close to the nest tree. GM stayed in the hide the whole day but neither of the birds returned, even after dusk. Around 22h15 a bird was heard calling, indicating that one of them had returned, probably well after 19h00. GM and an assistant stayed in the hide all night and at about 05h15 in the faint morning light two adult birds were seen standing on the nest directly facing the hide, but to our satisfaction we were well concealed from their sight. The birds were watched and photographed from the hide until 08h15 but during the melee of leaving the hide after 24 hours, the birds became alarmed and flew off in an easterly direction taking an unusually high flight path. Neither bird returned for 48 hrs, a clear indication that this species is very wary and once disturbed does not return to a site until satisfied that a threat no longer exists there. It was a great relief to see the birds on their nest in the early morning of 15 March. In the meantime, it had been decided not to disturb the birds any longer and the plan to stay inside the hide every day was dropped for fear that the birds might abandon the nest permanently" (Mondal and Maheswaran, 2014). However, it is not certain whether the birds' absence for 48 hours was due to the appearance of the two people or to an implied cause of their alarm during departure from the nest.

The impacts of dam-building are several (below), but include an additional disturbance effect due to the heron's enforced proximity to people.

The impact of development works on WBH presence is evident in one year's census work (Wangdi, 2014) in the Punatsangchu hydropower project area as shown in Table A4.4, where undisturbed sites were more often occupied by WBH than disturbed sites.

Table A4.4: Number of WBH found at disturbed and undisturbed sites in the Punatsangchu hydropower project area

	Disturbed	Not disturbed
Number of sites	12	8
Number occupied by WBH	3	8

However, this obvious interpretation depends on an assumption that all sites were equally attractive to WBH before any disturbance started, and that no mortality was caused by persecution, or collision with, for example, powerlines, or through other causes. The related issue of shyness is discussed in the section 'Proximity to humans, susceptibility to disturbance' above.

The situation at Lake Ada requires dedicated research to understand the behaviour of both the WBH and the local villagers. Other heron species have demonstrated they can become trusting and unafraid of humans if the risk of doing so is less than the cost of avoidance behaviour (J. W. Duckworth, pers. comm. to M. Stanley Price, 6 November 2014).

Rivers also act as busy transport routes for the human population, exacerbating disturbance of this species (J. W. Duckworth *in litt*. 2006, D. Wilson *in litt*. 2006). This impact will depend on the use made of the river by people, and this will be greater when the river is navigable.

Infrastructure and hydropower development along rivers are considered to impose another problem for WBH conservation: the presence of short-term, non-local or

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expatriate labourers, who are likely to be unaware of the WBH and its conservation status, or wild species in general, and may have very different attitudes to them, possibly viewing them as potential food, pests or competitors (for fish). This puts an onus on contracting companies to provide adequate working conditions, improve awareness and insist on responsible behaviour.

Mining

High sediment loads due to gold-mining may be a key threat in the remaining habitat in Myanmar (R. Tizard, pers. comm. 19 August, 2013, to G Goodman) through increasing water turbidity and presumably reducing productivity of relevant water bodies, which in turn reduces available prey and therefore fishing success both due to reduced fish density and lack of clarity for fishing. Direct disturbance through human presence is also likely to impact WBH. Herons returned to areas where gold-mining had been stopped, although it took three years for water clarity and the associated aquatic community to "recover". If gold-mining continues, heron habitat will be restricted to areas further upstream (R. Tizard, pers. comm. 19 August 2013, 17 Jan 2014 to G. Goodman). Sediment loads could also be increased due to heavy boat traffic, the effects of soil erosion due to upper catchment deforestation, and poor quality road construction.

RSPN (2011): "Mining therefore could be an important conservation threat, or tool. If, for example, mining can be used to break up particularly large, vegetated bars that are connected to land, create multiple channels where there was only one or two, and create holes and shallow depressions, it may result in an enhancement of habitat for herons and might offer a win-win for industry and conservation. However, the outcome depends strongly on the extent and duration of mining, and whether it is indeed creating more habitat than it destroys. The sustainability of mining is also an important question - is mining removing more bar material than is typically produced by the river? As above, it is also unclear whether mining creates truly productive habitat, or merely the appearance of it".

Mining for gold, and possibly other minerals along or in river courses will have other impacts: the numbers of human residents can greatly increase, and gold-mining may result in mercury release into the environment with potentially major deleterious consequences for aquatic ecosystems and their component species, intensified by Biomagnification. Furthermore, mercury can impact reproductive success of aquatic birds such as WBH (J. A. Johnson pers. comm. to G. Goodman, 16 Oct 2015).

Hunting

Table A4.5: BirdLife International lists direct utilisation of WBH under threats and impacts

Purpose	Primary form used	Life stage used	Source	Scale	Level	Timing
Food (human)	Whole	Adults and juveniles	Wild	Subsistence, National	Non-trivial	Recent

Source: BirdLife International (2013b)

"The distinction between a bird that is inherently shy and therefore needs wilderness and one that is potentially excluded from suitable habitat through persecution and consequent shyness is highly significant for conservation and management purposes"

Current WBH range largely coincides with areas occupied by diverse ethnic groups with strong tendencies to hunt and eat wildlife. Hunting could result both in low numbers of large birds, and extreme shyness. Similar effects have been seen with large water birds in northern Lao PDR. The distinction between a bird that is inherently shy and therefore needs wilderness and one that is potentially excluded from suitable habitat through persecution and consequent shyness is highly significant for conservation and management purposes (J. W. Duckworth, pers. comm. to M. Stanley Price, 6 November, 2014).

Both subsistence and commercial-scale hunting has been recorded in Manas Wildlife Sanctuary (World Heritage Outlook, 2015). In Arunachal Pradesh, India, there are thought to be 26 major tribes and 110 sub-tribes (Muthamizh *et al*., 2013), most of whom are meat-eaters with many still dependant on natural resource livelihoods, including hunting.

Given the size of Bhutan and the possible seasonal or post-fledging movements of WBH, it is plausible that threats to WBH from Bhutan include the killing of individuals outside of Bhutan.

Hunting levels are high to very high in most areas used by WBH in Myanmar. Whether this affects WBH specifically seems not to be documented. Local residents hunt extensively for their own use, and might take WBH (by comparison, overwintering large herons were almost hunted out of most of Lao PDR by the early 1990s (J. W. Duckworth, pers. obs.). According to Zöckler *et al.* (2010), in Myanmar, large-mesh mist nests are used for catching large bird species, including *Ardea*. In addition, poison baits are used, particularly for larger birds, including herons (especially Indian pond heron (*Ardeola grayii*) and egrets).

Most significantly, WBH live at such low density that even a low level of offtake might drive population declines. Opportunities for such offtake are enhanced by the species' propensity to feed and linger beside large navigable rivers. The frequent descriptions of extreme shyness by WBH towards people, although there is evidence that this is not universal, suggest shyness as a learned response to persecution (J. W Duckworth, pers. comm. to M. Stanley Price, 6 November 2014).

Hydropower development and damming

Each country of the Eastern Himalayas has ambitious plans to harness the flow of rivers from the south side of the mountain range through installing hydropower generation systems, both run-of-river and following impoundment. India alone has plans for 200 megadams plus 700 smaller, run-of-river dams. Bhutan plans to generate more than 10,000 MW by 2020, with most of the produced energy to be sold to India. To reach this target, ten projects were identified, three of which are underway (and expected to be commissioned by 2018) and others have since been identified as potential sites (International Rivers, 2015). India's Central Electricity Authority has identified a potential 76 hydropower dam locations in Bhutan (International Rivers, 2015). Thus far, just two of Bhutan's dams have publically available Environmental Impact Assessments (S. Mehta, pers. comm. to G. Goodman, 9 April, 2015).

There are thought to be plans to build dams on the periphery of Namdapha Tiger Reserve in India (G. Maheswaran, pers. comm. to G. Goodman, 23 Jan 2014), as well as in Bhutan where dams threaten much remaining habitat (R. Pradhan, pers. comm., 2 September, 2013; P. Frederick, pers. comm. Jan 10 2014 to G. Goodman). The final demise of the WBH in the Sunkosh Valley in Bhutan coincided with the development of dams there, and the two events were felt to be causally linked (K. D. Bishop *in litt.* 2012, as cited in BirdLife International, 2013a).

In Bhutan, hydroelectric power developments and road improvements have resulted in significant habitat degradation. This has been assessed and monitored

in litt. 2012, as cited in BirdLife International, 2013a).

In Bhutan, hydroelectric power developments and road improvements have resulted in significant habitat degradation. This has been assessed and monitored at the Punatsangchu site, Bhutan, by RSPN, where the 1,200 MW dam will require 3,500 ha of land (Wangdi, 2014), much of which would have been used by WBH. Between 2006 and 2014, an average 160 ha/year were subject to major land use change. On disturbed sites, grasses and shrubs became the dominant ground vegetation. The density of Chir pine trees was slightly less than on undisturbed sites, but not significantly so (RSPN, 2014). On the other hand, on disturbed areas the regeneration of Chir pine was less, surmised to be due to development activities and cattle grazing (Wangdi, 2014).

The development of the Mangdechhu dam (currently under construction) in Bhutan is also of concern as the Mangdechhu river flows through Manas National Park. The dam will result in fluctuations of water flows and there are concerns that there will be cumulative impacts on Manas National Park and its biodiversity with this and the Kurichhu hydropower project (International Rivers, 2014).

The effects of dam construction are complex and specific to each dam and river system. However, immediately upstream of any dam, river habitats will be lost through impoundment of water. Changes in sediment load are likely to impact the freshwater environment as well as the ability of the dam to function long-term. Fish that survive and thrive must be able to adjust to deeper, slower-moving water, with a different temperature profile and chemistry, including its oxygen content etc. However, according to fish biologist Dr J. A Johnson (pers. comm. to G. Goodman, 16 Oct, 2015), many rheophilic specie such as snow trout (*Schizothorax* spp.), stone suckers (*Garra* spp.), loaches (*Schistura* spp.), barils (*Barilius* spp.) and danio (*Devario* spp.) cannot adapt to such stagnant and deep water bodies, as such they either avoid such new impoundments or may be eliminated from the system altogether. Similarly, downstream, altered flow will impact the biotic community of the river, especially periphyton and macroinvertebrate assemblages.

> "Dam construction will also impact fish populations by preventing migration and access to spawning and nursery grounds"

Dam construction will also impact fish populations by preventing migration and access to spawning and nursery grounds. Mechanism to help fish pass through to their necessary spawning ground, include fish ladders and bypasses but these are claimed to be largely ineffective. This is especially the case for local migrant species in the Himalayas who are often unable to withstand sudden changes from swift moving shallow waters to slow moving stagnant waters (J. A. Johnson pers. comm. to G. Goodman, 16 Oct 2015).

According to RSPN (2011): "All but the lowest dams effectively block the passage of migratory fishes in both

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directions, since adults cannot pass through outlets going upstream or downstream, and juveniles and larvae do not survive passage through turbines going downstream. Fish can only be moved around dams by trapping and lifting mechanically, or on low dams through the use of fish ladders or flow ways. Thus it seems nearly certain that in the absence of elevators or mechanical movement, migratory fishes will be effectively blocked from movement up or downstream in between the dams. Since fishes are often migrating because of spawning opportunities upstream, this also means that recruitment to the population will be muted, perhaps catastrophically. Land or reservoir-locked breeding populations of some migratory species do exist in the world but they are relatively rare; it is unknown whether the species of interest to WBH will survive and reproduce in reservoirs".

Again, RSPN (2011): "The distinction between long-distance migratory and truly sedentary fishes is an easy concept to portray. In practice, there are probably many riverine fishes that migrate short distances seasonally, and use floodplains and smaller streams during periods of floods or during spawning. While short distance movements might make fishes somewhat less vulnerable to the blockage of movements imposed by dams in comparison to true long distance migrants, there remain a number of dam effects that may be quite detrimental to locally moving fishes. Dams create stable pools (reservoirs) above the dam and highly pulsed and unnatural releases of water into river reaches below; both conditions may be unsuitable for non-migratory river fishes. For example, reservoirs would offer a lower oxygen environment, greater thermal gradient and stratification, less cover and a much greater volume to surface ratio than the original river bed especially in the shallow, high gradient rivers of Bhutan."

"Changes in river regime could lead to increased and altered species interactions and competition; as well as possible replacement of species.... and changes to overall ecosystem composition"

Most frequently, dam operations cause river flow downstream to be greater in the dry season and less in the wet season: thus, upper areas of river profiles that should be submerged by floods are exposed in both wet and dry seasons, while lower levels that should be exposed in the dry season are permanently submerged; such changes have great ecological impacts, such as the loss of sand banks and shallow water shoals. Where there is a reduction or change in the amplitude of river flow, breeding may not be triggered in some fish species and many Himalayan fish species prefer substratum that are made up of pebbles, cobbles, boulders, gravel, and sand (J. A. Johnson, pers. comm. to G. Goodman, 16 Oct 2015). Furthermore, the disappearance of shallow sand bars and banks of boulders, the feeding habitat of WBH, is thought to be a result of dam construction (Pradhan, 2007).

In general, the tolerance of fish species to altered conditions is not known. However, it is suspected that changes in river regime could lead to increased and altered species interactions and competition; as well as possible replacement of species (including with invasive species) and changes to overall ecosystem composition. It is not, however, well understood how these changes will directly impact the heron and whether, as a generalist feeder, the WBH will simply adapt to alternative prey species that are more suited to these conditions. It is reasonable to assume, that there might, at least, be a temporary decrease in available prey species for WBH.

Fishing

In Bhutan, according to Pradhan *et al.* (2007), one of the main threats to the WBH is the intense level of fishing. In India, illegal fishing in Namdapha National Park may be placing increased strain on the heron (Maheswaran, 2007). However, none of these suggestions has been objectively demonstrated and remain merely opinions.

Amongst the many constraints and challenges for conservation of these birds, the practice of poachers setting fish traps, especially along the Pho Chu, Punatsangchu and below Burichu Sunkosh Confluence, in Bhutan, needs urgent attention (Pradhan, 2007). Whether the cause for concern is disturbance to WBH or unsustainable offtakes of fish or other impacts is not stated.

Forest fires

Chir pine forest is both created and maintained by fire, and trees show evidence of repeated burn events. "Coupled with the marked wet or dry season, apparent lightning regime and steep slopes, fires seem endemic to this ecotype even in the absence of human pyrogenic activities. All nesting areas had strong evidence of fire history such as fire scars on trees, lack of woody debris on the ground, and lack of mid-story trees. All evidence suggests that frequent fires can typically consume nearly all of the ground cover and that flame heights are often as high as 15 metres in these forests. Fire intensity probably varies hugely with fuels, slope, and winds" (RSPN, 2011).

"Fires .... seem to be essential in creating the low canopy density and lack of mid-storey that herons require. Fires may also be a direct threat to heron

nests, and we documented at least two cases of nests being destroyed or abandoned following wildfires. Fires of low intensity therefore seem beneficial for heron habitat, while those of high intensity are destructive" (RSPN, 2011).

Whether such fires are set by people, accidentally or deliberately, or are natural, is not stated. There is a clear need to research nests in areas beyond Bhutan to see whether these same factors operate.

However, forest fire might locally be one of the prevalent threats to WBH as trees with WBH nests have been burnt, causing abandonment (R. Pradhan, pers. comm. to G. Goodman, 27 Oct, 2015).

Conclusions

In conclusion, while hydropower (and other) dams may well have the potential to extirpate populations locally, they cannot be the underlying cause of range-wide problems given that declines are evident in areas without them and before the major phase of their construction. Thus, underlying factors would presumably continue to operate in the absence of such planned dams and might in any case lead to the same result, that is, local extirpation (J. W. Duckworth, pers. comm. to G. Goodman, 23 Jan 2014). A series of local extirpations could result in extinction of the WBH.

However, hydropower does seemingly pose one of the greatest immediate threats to the conservation of the WBH in certain areas. In conjunction, roads and infrastructure facilities are concentrated along the river, increasing human settlements and related economic activities are already looming threats to the habitat of this endangered bird.

But, given the abundance and diversity of Bhutan's river systems, and despite the challenges to natural rivers of infrastructure development, "It is unclear to us why so many rivers in Bhutan seem to be unoccupied by herons and other migratory water birds" (RSPN, 2011). This argues for detailed examination of lowland areas where the WBH used to exist (for example in Myanmar and Bangladesh) to see which other waterbirds have declined similarly or are thriving. The main area of interest will be other large species that are resident or short-distance migrants, such as storks, pelicans, ibis and Sarus crane; these species have declined in numbers over large areas (J. W. Duckworth, pers. comm. to M. Stanley Price, 6 November 2014).

WBH knowledge base

Given the scarcity and low density of the WBH, our knowledge of the WBH relevant to its effective conservation comprises a mixture of certain facts, suspected facts, hypotheses about the heron, and areas of ignorance.

Key aspects of these are covered in Appendix 6, which can be used as a checklist against the Actions contained in the Conservation Strategy.

Current and recent past conservation measures for WBH

- The Royal Society for the Protection of Nature in Bhutan has been working on the WBH since 2003. This work has been supported by WWF, the Felburn Foundation and the International Crane Foundation. RSPN's current partners are the National Environment Commission, the Department of Forest and Park Services, the Department of Livestock, Punatsangchu hydropower projects and local communities. The overall goal of the project is to maintain the significance of Punatsangchu as the habitat of the Critically Endangered WBH as a contribution to the global conservation of the species.

The objective of RSPN's WBH Conservation project is to develop an appropriate management framework and foundation of biological and socio-economic knowledge for the conservation of the WBH population. More information can be located on their website.

- RSPN conducts population and observation surveys on WBH on an annual basis.

- RSPN is actively seeking funding for further genetic studies.

- A joint initiative with RSPN and its partners, with technical assistance from San Diego Zoo Global, enabled two eggs to be taken from a nest to be hatched in captivity in 2011. One egg was not viable but the other hatched and the chick survived, fledging at 71-73 days old. The bird was successfully released into the wild at Bumitsawa, Pochu, Punakha at 103

days old. However, despite radio-tagging the bird, it was lost quickly and it is unknown if it continued to survive (R. Pradhan, pers. comm. 2 September, 2013; M. Mace, pers. comm., 17 May, 2013 to G. Goodman).

- RSPN held a preliminary stakeholder meeting in November 2012. This resulted in a draft strategy for the conservation of the WBH in Bhutan. Participants included the Renewable Natural Resource Research and Development Center, Yusipang; Wildlife Conservation Division in Bhutan and San Diego Zoo. The extent of implementation of this plan is unknown.

- The government of Bhutan has recognised the importance of the river bed in Punakha-Wang-due as a primary feeding site for WBH by declaring the area as protected habitat for the species (BirdLife International, 2013a).

- RSPN is conducting awareness campaigns in WBH areas; communities in these areas have agreed to collect building sand and stones only by hand and not to fell trees for building materials in WBH areas (RSPN, 2014).

- At Berti, Bhutan, two communities and two households have constructed and stocked fish ponds to improve livelihoods and reduce dependence on river fish, with an adjacent, smaller pond for the WBH. If successful, this scheme will be expanded in WBH areas (RSPN, 2014).

- An MSc student at the Forest Research Institute of India, will include as part of their study, an "Assessment of White Bellied Heron Habitat in Punatsangchu river basin in Bhutan". The study will look at habitat utilisation by WBH, food abundance and availability and disturbances to the bird.

- A Conservation Action Plan for herons of the world was produced by the Heron Specialist Group (2007), covering 62 extant species. This identified nine species of heron as threatened and for which specific conservation action plans and programs were/are needed, including the WBH. This Conservation Strategy should meet that need.

- Ashoka Trust for Research in Ecology and the Environment (ATREE) in India were provided with a Save Our Species[4] (SOS of IUCN/GEF/SSC) grant to carry-out research, community engagement and capacity building and protection of key sites in Manas Tiger Reserve in Assam (N. Kakati, pers. comm. 5 December, 2013; S. Khaling, pers. comm., 24 Jan 2014 to G Goodman). This also involved the recruitment and training of 'heron guardians' along the Assam-Bhutan border.

- ATREE has recently provided a small grant (April, 2015) to enable survey work in Arunachal Pradesh.

- ATREE organised a national meeting on WBH in India in September 2015.

- The Zoological Survey of India has a three-year grant to carry out work on the species feeding behaviour in Namdapha, this work commenced in July 2013 (G. Maheswaran pers. comm. 22 Jan 2014 to G. Goodman).

- WCS has been monitoring the species in the most accessible parts of northern Myanmar and is considering expanding its work on the species (R. Tizard pers. comm. 19 August 2013, 17 Jan 2014 to G. Goodman).

- The Chinese Forestry Department is launching the second nation-wide wildlife survey program, which will include any recording of WBH if applicable.

- Kadoorie Farm Botanic Gardens are surveying Tengchong County of Gaoligongshan, Yunnan Province, China (at approximately 2,100m) for WBH where there have been unconfirmed reports of WBH from locals. Other rare or new species will also be recorded. At the same time they are trying to engage more community rangers (up to 100) to join the search for WBH.

- The Southwest Forestry University in China have a small grant to carry our five awareness raising workshops in order to help identify WBH in China and to promote interest and awareness of the species and its needs

- A MacArthur-funded project will commence in 2015 in Biluo Snow Mountain Range using rapid assessment methodology which will also capture any WBH presence.

4. http://www.sospecies.org/sos_projects/birds/white_bellied_heron

The context for effective WBH conservation

WBH range has reduced over recent decades, and its contemporary range is subject to many challenges which must be overcome or accommodated for effective conservation of the WBH.

This context for WBH conservation is outlined in Appendix 7 through four factors:

- human demography,
- land use transformation,
- climate change, and
- hydropower development.

"WBH range has reduced over recent decades, and its contemporary range is subject to many challenges which must be overcome or accommodated for effective conservation of the WBH"

© WCS

Appendix 5

Threats to WBH identified by each working group at the planning workshop

Group 1:

Theme 1: Research/knowledge

WBH Biology:

- a low reproductive rate (K-strategy) with possibly a low survival rate,
- a presumed low population density, and birds restricted to linear landscape features (rivers),
- predation by various wild mammals,
- adverse impacts on fertility through use of agricultural chemicals,
- particular sensitivity to high mortality rates from e.g. hunting, powerline collisions, and
- uncertainty over sites used despite confirmed sightings in Assam at Phibsu, Koilamoila, Chowki (Subankhata); with potential habitats at Phekua, Jamduar, Saralpara (Ultapani), Kuklung and Khalingduar.

Political:

- uneven governance, civil unrest,
- military/security camps established in habitat areas,
- inadequate national legal conservation measures,
- inadequate conservation protection actions,
- sensitive political, and law and order situations in the entire WBH range areas of eastern Himalayas, and
- low-level political awareness of WBH and its conservation situation outside Bhutan.

Poor law enforcement (in connection with the above):

- the appropriate legal status and consequent policies need upgrading,
- weak law enforcement, and
- lack of legal protection for those enforcing laws or regulations.

Lack of funding/capacity:

- inadequate conservation resources.

Continued overleaf

Lack of knowledge/science:

- lack of knowledge about the WBH population size and distribution, compounded by loss of possible habitat areas before they are surveyed,
- inadequate programmes of Communication, Education, Participation, Awareness across WBH range,
- lack of essential information on WBH including on feeding ecology, behaviour and territoriality, breeding biology, population ecology,
- limited knowledge of what threats drive declines in populations,
- lack of knowledge makes targeted conservation interventions difficult, and
- lack of research and understanding of WBH mean potential and financial support for targeted actions is near impossible to obtain.

Lack of Coordination:

- inadequate institutions for effective conservation,
- limited coordination among different stakeholders, and
- institutional setups are not capable of enhancing a participatory approach to conservation, for example through payment for environmental services to offset opportunity costs.

Climate change:

- receding glacial lakes could lead to drying up of streams,
- greater rainfall could lead to glacial lake outburst floods and other flooding, and
- siltation of wetlands due to developmental works and/or climate change.

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Group 2:

Theme 2: Healthy Heron Habitat and Habitat-based Threat reduction

Mining and Quarrying:

- mining for sand, boulders, or rock in river beds or along river banks causes destruction of WBH habitat and disturbance to birds and may pollute river water,
- sand mining spreads along rivers as rural areas develop and villagers go to the nearest sand or gravel bars which may be WBH feeding ground,
- large scale mining can destroy whole mountainsides and poison the river,
- over extraction of sand and stones may cause subsequent land use change,
- mining for valuable minerals such as gold, or coal,
- severe human disturbance due to stone quarrying, sand mining, fishing, grazing, and mere presence of people, and
- use of river banks and margins for recreational use, including down time by workers.

Deforestation:

- illegal felling by communities,
- conversion of native forest to plantation,
- lack of comprehensive land use policy and planning,
- weak environmental safeguards of policy and enforcement,
- deforestation for construction of dams, and
- natural calamities leading to shrinking of habitat for WBH,
- indirectly, the consequences of forestry operations bringing in non-local labour.

Dams, rivers and flows:

- Dams are planned or being constructed over large extents of WBH range, especially in Bhutan, Arunachal Pradesh (India) and Myanmar.
- In the absence of adequate and accurate information about the impacts of these dams and associated works, the following threats to WBH are identified as likely:
    - the destruction of WBH habitat including feeding sites, both along rivers and in adjacent forested hillsides,
    - tunnelling affecting river flows, and
    - changes in water demand and use through irrigation and other new agricultural practices, and human lifestyle changes.

Continued overleaf

- Changed river flow regimes working through:
    - changes in fish habitats upstream and downstream of dams,
    - Impacted aquatic biodiversity, including less diverse or altered fish community structure,
    - reduction in fish productivity,
    - prevention of fish migrations,
    - lack of effective fish ladders at dams,
    - altered ecosystem services, and
    - the sudden release of large amounts of stored water (which may be cold, anoxic and polluted) to produce electricity during electricity generation periods.
- Floods that change the course of water flow. This is a natural process, which may create prime WBH foraging habitat which persists only until the next floods which again change the river structure; an artificially regulated river regime may not provide such temporary habitat.

The ability of the WBH to adapt to such changes to its environment is unknown.

Fishing:

- Direct threat to fish populations as WBH food resource through:
    - over-fishing,
    - use of dynamite,
    - use of poisons,
    - use of electric fishing,
    - use of small meshed nets, and
    - illegal fishing in protected areas / WBH habitat.
- Direct threats to WBH through disturbance from:
    - fishing,
    - dynamiting, and
    - human presence,
- Indirect threats include:
    - lack of awareness of WBH conservation issues, and
    - low grass roots support for conservation.

Continued overleaf

Pollution in rivers:

- currently normal operation of industrial corporations,
- potentially accidental but catastrophic release of industrial chemicals, and
- the increase of industries moving up river systems, with increasing pollution of WBH habitat, including through making river water more turbid and polluted through effluent discharge.

Forest fires:

- habitat loss and nest/roost damage.

Fires are harder to control in steep terrain.

Power lines

- mortality via electrocution, and
- mortality or injury via collision with pylons or cables.

In future, further mortalities can be expected through:

- progressive rural electrification increasing the density of power lines, and
- more cables obstructing WBH flyways.

Increased roads

In association with:

- dam developments,
- development of new farmlands and industry,
- expansion of subsistence agriculture, and
- increasing human occupation of once pristine riverine areas.

Causing:

- habitat loss,
- habitat fragmentation,
- pollution,
- sedimentation in water courses,
- increased human disturbance, and
- increased edge effects.

Continued overleaf

Flooding:

- increases in natural flooding (from climate change) may reduce WBH habitat including feeding sites, and
- any reduction of natural flooding may depriveWBH of seasonal feeding sites, for which frequent, artificial floods are not an alternative.

Habitat Loss/degradation:

- loss of breeding, roosting and feeding sites,
- increased exposure to humans, and
- obstructions to WBH prey migratory movements

Agricultural / Land use practices/change (see above – habitat loss):

- conversion of forests to farmlands and for other uses,
- expansion of agriculture in both wetland areas and on to hill slopes, both WBH habitat,
- use of pesticides in agriculture and their drainage down into rivers,
- unsustainable land use practices, and
- inadequate land use policies,

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Group 3:

Theme 3: Human Communities

Hunting of WBH:

- beyond a certain level, hunting of WBH will affect behaviour and performance of individuals and their population,
- direct persecution of WBH impacts flight behaviour, and hence research opportunities and consequent knowledge,
- WBH may be hunted for food because of lack of adequate livelihoods in much of WBH range,
- some parts of WBH range are occupied or used by traditional hunters (for example Namdapha, Assam); direct persecution or disturbance is a threat,
- successful hunting of WBH depletes already small populations, and
- hunting WBH will negatively influence behaviour by making them reluctant to use preferred sites and the resources they require.

Human encroachment:

- increased encroachment of people into WBH habitat as a result of infrastructure development, human population growth and possibly poor enforcement of land-use plans or restrictions, cause disturbance, changes in behaviour and exposure to man-made threats.

Tourism:

- disturbance.

Lack of awareness:

- Awareness is poor in the following areas:
    - knowledge of the conservation status of WBH,
    - its legal protection status,
    - rare species should not be persecuted including through hunting or stone-pelting,
    - how local communities can help in effective conservation of WBH,
    - general understanding of the nature and importance of conservation, and
    - the costs of environmental destruction.
- Awareness is poor in the following groups:
    - governments, their agencies and decision-makers,
    - general public, resulting in hunting of rare species such as WBH, and
    - local residents of WBH range.

Continued overleaf

Growing human populations:

- increasing human population will drive development of riparian and riverine habitats of WBH, shrinking the range of the birds further,
- human settlements will increase in number and size,
- resource use will increase, often to unsustainable levels,
- increasing human numbers will bring the WBH more into contact with people on the broad, navigable rivers that it seems to prefer (subject to future survey findings that smaller streams in forested areas are not used heavily or preferentially) and
- growth of human populations increases unemployment, which can lead to activities such as overfishing, hunting and deforestation.

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Appendix 6

Facts and uncertainties regarding WBH ecology, biology and behaviour

What is known?

Distribution

The range of the WBH has contracted greatly since published records started some 100 years ago.

Its current Extent of Occurrence as a breeding / resident species is said to be approximately 56,300 km^2, but this includes areas of known use, areas of known no use, areas where there have been no surveys (or no recent ones) and/or where human access is impossible.

Confirmed records show WBH at 110 m a.s.l above sea level in Myanmar to 1,500 m a.s.l in Bhutan.

Population Size

Despite no useful total population estimate (below), there is ample evidence that the population of WBH is currently too small to guarantee its continuing existence in the wild.

Habitat

It is known that herons in general can often utilise a wide range of wetlands habitats and it is apparent that WBH do so, though the circumstances under which this occurs are not fully understood.

Heron habitat needs are complex due to the requirement for suitable nesting, roosting and feeding sites all within a certain range, this may go some way to explaining the different habitat types in which they are found. Presumably all have a sufficient prey base.

Feeding and Diet

WBH use fast-flowing mountain rivers as well as slower rivers, and even one still lake for feeding. However, they are most often observed on relatively large, and often braided, rivers.

WBH diet contains a wide variety of fish; perhaps any fish that lies within the size range of 5-27 cm. Crayfish are also known to be taken.

Ardea herons are usually territorial feeders.

Nesting

WBH will nest in pine trees and in lower-altitude broadleaf forest. Nesting may be in tall trees with good views (to avoid potential predators) and also at lower height above ground at relatively secluded sites.

Nesting takes place on relatively narrow rivers.

In Bhutan, nesting starts usually in March and hatching around April and May. Information obtained from Bhutan suggests nestlings usually fledge at 72-74 days. Number of eggs recorded per nest in Bhutan, range from one to four.

Longevity/mortality

BirdLife International has estimated a generational length of 10.5 years.

Mortality in the nest pre-fledging is quite high given the tiny size of the known population: in nests monitored between 2003 and 2010 in Bhutan, 28% hatched chicks died before fledging (recalculated from Pradhan, Norbert & Frederick, 2011). The population trend in Bhutan also indicates considerable post-fledging mortality.

Social Structure and Behaviour

The WBH has occasionally been seen in small groups, but is largely solitary.

Its current low density and solitary nature mean that it may never have been abundant, possibly in contrast with other herons.

It is known that WBH often display flight behaviour around humans but that this behaviour can differ depending on the specific scenario.

Threats

Collision with power lines is the only evident man-made cause of death, but it is not known how significant this is quantitatively.

There are, however, a number of threats to the species which are known but the severity of each needs further exploration.

What is not known with certainty?

Distribution

An accurate and current Extent of Occurrence for WBH is not known due to gaps in surveying effort and issues around accessibility. Most significantly, it is not known if and to what extent, China holds populations of WBH. However, the first official record of WBH was recorded as a captive specimen in 2014. It is also possible that some specimens may still occur in Bangladesh, where WBH is currently listed as possibly extinct but no evidence has been found to support this.

Range contraction within Myanmar is likely but is yet to be scientifically verified.

Population Size

Accurate data on sightings are too few and scattered to allow any useful population estimate. It is not known if populations are surviving independently or if they are viable only in connection with another range state. That is to say that the relationships between WBH in Bhutan and western Assam, and between the WBH of Namdapha, (Arunachal Pradesh), northern Myanmar and western China is not yet established.

Habitat

Despite many observations on river morphology, extent of braiding, width of banks, substrates of stones, cobbles, pebbles and sand linked to WBH sightings, there is no conclusion on the preferred (micro-) habitats of WBH. It is not known if differences in habitat "preference" are a result of forced occupation of sub-optimal habitat or if there are other reasons for observed differences.

Surveys for WBH have taken place on larger rivers that are either navigable or can be walked in or alongside. Based on one camera trap image and reports of the heron's almost vertical take-off, it is possible that small streams in closed forest may be suitable habitat.

Feeding and Diet

It is not known what or if certain fish species are preferred, which make up the majority of their diet and where or which may have the most nutritional value to the species.

The extent to which WBH already do feed in lakes and ponds, or could be trained to feed in artificial environment is not known but there is evidence of them doing so in Bhutan.

Nesting

The range of number of eggs laid in the wild is not known.

Longevity/mortality

No birds have been successfully tracked throughout their lifetime and no field observations regarding longevity are available.

Social Structure and Behaviour

It is not known to what extent the species competes with other species.

The size of territory required for a single individual is not known.

It is not known with certainty if observed flight behaviour in the presence of humans can be attributed to human persecution.

Threats

A range of threats have been identified and assumed but little is known about the severity of these threats within each range-state. Hunting of many other species of waterbird in Myanmar suggest WBH would be taken as bushmeat opportunistically, as does flight behaviour among human presence, but the level to which this is true, is unknown. Bhutan's rivers are much used by non-Bhutanese labourers on development projects, without any cultural knowledge or awareness of the WBH. We do not know the extent of human predation on WBH, which even at low levels could have serious impact on a small population.

There is no consensus or conclusion on the extent to which the WBH is naturally shy and avoids human presence; more likely avoidance is a learned response to disturbance, persecution or predation. Both phenomena may occur in different places and at different times; proximity to humans and their activities is not necessarily adverse for WBH.

What are the main threats?

Locally:

- power lines,
- dam construction,
- fishing,
- forest loss/degradation,
- modification of riverine morphology through mining, and
- disturbance from human activities, including infrastructure development, resource extraction, and tourism/bird watchers.

Range-wide:

- human predation,
- climate change,
- changing rural life styles/livelihoods, and
- human demography.

What are the main needs?

Note: these needs are largely represented in the Actions of the Conservation Strategy (pages 32 to 42).

Conduct systematic, standardised surveys to establish WBH occurrence and population level, or likely absence, in:

- areas of known range,
- areas deemed potential range through habitat suitability assessment, and
- areas that may not comprise 'assumed' good habitat, such as smaller streams.

Detailed scientific studies to better understand the biology and ecology of the species in:

- areas of known range and where they are or can easily be habituated to people, and
- areas which are accessible year round.

Assessment of the costs and benefits of intensive management through:

- establishing a captive population using eggs taken from wild nests, and/OR
- head-starting young birds either from wild eggs or captive-bred eggs for release into the wild, OR
- a combination of these, AND
- assessment of threats and confidence that these are removed or mitigated before any releases, and
- increase understanding about the costs and benefits, as well as the feasibility and necessity of artificial feeding sites for WBH.

Further needs:

- tag some birds to record their movements and habitat selection,
- improve protected area management and monitoring capability through training and provision of equipment,
- political will and commitment to conserve the WBH and co-occurring biodiversity, with the necessary authority and resources to combat the major threats of habitat loss, unsustainable use and illegal trade,
- reach a consensus on what is habitat for the WBH and the extent of its tolerance of multiple conditions
- research impacts of changed water regimes due to dam building and flow management on fish faunas, their ecology, productivity and behaviour, river course structure and flow dynamics, water quality all with respect to habitat suitability for WBH,
- explore the potential for habitat enhancement following major changes to the physical environment,
- understand the likely impacts of climate change on WBH and its range,
- better understand causes of mortality of WBH,
- learn about, and introduce, best practice on preventing bird deaths due to power lines and pylons,
- conduct genetic studies to identify population separation and for captive breeding purposes,
- improve protection status where applicable, and
- improve awareness.

Annex 7

The context for WBH conservation in the future

The threats to the WBH, as far as they are known, are listed above. However, effective conservation of the species must take place in a fast-changing environment, which will yield further challenges.

These challenges are described here briefly in the context of:

- human demography,
- land use transformation,
- climate change, and
- hydropower development.

Human demography

The immediate threats to the WBH include loss of habitat, which is clearly related to the future of rivers and adjacent areas, which in turn will relate to human use of riverine areas in multiple ways.

Table A7.1: Human population size in WBH range states

Range country	China	India	India	India	Bhutan	Myanmar
State	Yunnan	Arunachal Pradesh	Assam	A/Pradesh + Assam		Kachin
Area, km²	394,000	83,743	78,550	162,293	38,394	89,041
Population	45,700,000	1,382,611	31,169,272	32,551,883	743,737	1,689,654
Density /km²	120	17	400	200	18	19

Source: Wikipedia, 2014

As can be seen in Table A7.1, human population density varies significantly within and between WBH range countries. In very simple terms, those areas that are predominantly mountainous, with fast-flowing rivers (Arunachal Pradesh, Bhutan and Kachin State), have densities of 17-19 persons per km². On the other hand, Assam which lies predominantly along the Brahmaputra flood plain has densities of 400 per km². Yunnan is intermediate, presumably because it comprises areas of both low-lying intense agriculture and forested highlands.

Table A7.2: Human population growth in WBH range states

	China	India	Bhutan	Myanmar
Population growth %/year	0.49	1.24	1.62	0.87
Urban population %	53	32	37	33
Urban population growth %/year	2.9	2.4	3.7	2.5
Rural population %	47	68	63	67
Rural population growth %/year	-2.2	0.7	0.4	0.07
Rural population in 2035 %	29	57	49	53

Source: World Bank, 2015.

Relevant to the heron are the growth rates of these human populations and other factors such as the rate of urbanisation. These are shown in Table A7.2 for each range state (finer-scale data at the level of province or State are not available).

China is already the most urbanised country in the region and it is likely to become more so. In 2015 only 29% of the population live in rural areas. In the other three countries, rural populations will grow at far slower rates than the urban populations. The impact of increasing rural populations on the heron will depend greatly on the lifestyles of rural people in the future, but much anticipated direct anthropogenic pressures are potentially mitigated by expected urbanisation.

The low figure (0.07% per year) for the growth in the rural populations of Myanmar, shown in Table A7.2, suggests the human population in the Northern Landscape Area is relatively stable (S. Renner pers. obs. in Renner *et al.*, 2007), although there has been considerable immigration since the data were acquired.

Table A7.3: GDP (USD per capita) in each range state and change in GDP over time

	China	India	Bhutan	Myanmar
GDP $ per capita 1993	374	309	453	195 (2004)
GDP $ per capita 2013	6807	1499	2498	824 (2012)
% change	+1820	+400	+551	+422
No. years	20	20	20	9
% change/year	122	20	28	47

Sources: China, India, Bhutan: Word Bank, 2015.
Myanmar: Trading Economics, 2015.

As can be seen in Table A7.3, each country shows high levels of average annual growth in GDP. China's growth has been especially large despite starting from a relatively low level in 1993. Myanmar's GDP in 2004 was very low, but has shown considerable average growth over the nine years between 2004 and 2013 and is expected to continue to grow. Nonetheless, its GDP was only 55% of India's in 2012/2013.

The great growth in China's GDP is a useful proxy for its physical and social development and the increase in consumer lifestyles. As this will equate roughly to the need for electric power, it will explain China's regional efforts to develop or access greater supplies of energy, including in the form of hydropower.

Land-use transformation

The areas observed to be used by the WBH fall into the broad categories of either mountainous areas with fast-flowing rivers or flat lowlands with meandering rivers. Most observations fall into the former. But, as pointed out above, the lowlands may originally have been more optimal habitat but have been subject to intensive land transformation for far longer, reducing their suitability and carrying capacity for WBH.

Because the lowlands are rich in nutrients, they have been heavily cultivated for centuries or even millennia and there probably remains little land to be converted from anything like the original natural vegetation. Therefore, changing threats levels here are more likely to be due to changing agricultural practices and effects of upstream activities on incoming watercourses.

Bhutan

Under its Constitution, at least 60% of the land area of Bhutan must remain forested. Currently about 75% is defined as under forest cover (WDPA, 2015).

The forestry and logging sector accounted for only 3.1% of GDP in 2012. However, this figure does not represent the importance of the sector in the livelihoods of the rural poor who strongly rely on forests for subsistence goods, including fuelwood, non-wood forest products (NWFP), construction timber, etc. In Bhutan, firewood constitutes about 57% of total energy consumption; households account for 95 % of total fuelwood consumption, while the government, commercial sector and industry consume the balance (Uddin *et al*., 2006).

Although deforestation is not considered to be a major problem in Bhutan, urban expansion and the establishment of new infrastructures such as roads and hydropower projects have had an effect on forests. Over 8,900 ha of Government Reserve Forests (GRFs) land was allotted for such activities by the Department of Forest and Park Services (DoFPS) between 2008/2009 and 2010/2011, with an increasing trend. Forest fires also contribute to deforestation. Records show an average of 62 forest fire incidences per year over the last 15 years, leading to damage of approximately 7,366.2 ha of forest land a year.

The relationship between WBH and Bhutan's forests depends on the quality and quantity of forested land especially of riverine forests which are subject to use by livestock, causing potential disturbance to herons even if structurally suitable as WBH habitat.

Arunachal Pradesh and Assam, India

Despite a Supreme Court ban on clear felling in northeast India in 1986, forest clearance has continued. In Arunachal Pradesh and Assam, tropical moist forest which occurs at lower altitudes than tropical evergreen and sub-tropical evergreen forest, and which is the most biodiverse, decreased at 1.38% per year between 1994 and 2002 (Kushwaha & Hazarika, 2004).

Myanmar

In contrast, assessment of the land cover in the 22,000 km^2 Northern Forest Complex of Myanmar, which includes all of Hkakaborazi National Park and parts of Hponkanrazi Wildlife Sanctuary, concluded that only 1.4% of the area was affected by human activities, and that deforestation between 1991 and 1999 had affected less than 1% of the area (Renner *et al*., 2007). This situation was attributed to the remoteness and inaccessibility of the area, and the fact that its people lived in a pre-cash society in which wildlife fur and meat was the usual currency. This, of course, encouraged a trade in wildlife with both India and China.

However, a little to the south and east, the picture now seems different:

"The contrast in the condition of the forests along the border was striking; while forests in the mountainous region on the Chinese side of the border are relatively intact, with large areas protected in the Gaoligong Nature Reserve, across the border in Kachin the devastation wreaked by logging is clearly visible. Chinese wood traders confirmed that supplies were coming from further inside Kachin, as timber within a hundred kilometers of the border has been logged out, and told how deals are done with insurgent groups to buy up entire mountains for logging. One local community elder in Kachin interviewed by EIA summed up the situation: "Myanmar is China's supermarket and Kachin State is their 7-11." (Facts and Details, 2015).

This suggests that the persistence of WBH habitat and range in Myanmar will increasingly depend on effective protection of the national park and wildlife sanctuary in the northern forest landscape.

Yunnan, China

Until the late 1990s, timber extraction was the most important source of income for villagers and as a source of local taxes. At that time, it seemed that logging for commercial purposes was less than for local house building and for firewood, with each household using up to 30 m^3/year (Xu & Wilkes, 2004). However, following the disastrous floods on the lower Yangtze River (which rises in Yunnan), new nature reserves were established and a total logging ban introduced.

Despite these conservation measures, pressure on forests will have increased due to human population increase from 20 million in the 1950s to over 42 million in 1999, with the majority being rural dwellers (Xu & Wilkes, 2004). The Yunnan forest suffers also from high frequency of fires, mostly anthropogenic, and forest loss from insect pests has had an impact equivalent to 25 years of logging.

As with much of China, dams in potential WBH habitat in China are commonplace, yet there are still some relatively intact areas.

Climate change

No responsible species conservation planning exercise can ignore the present reality and future implications of climate change.

While there are developing mechanisms for assessing the vulnerability of species to climate change, knowledge of precise climate change at a physical scale that is meaningful for many species makes predictions of those species' responses difficult. Furthermore, poor data on the biological traits of WBH make trait based assessments of vulnerability to climate change less reliable.

IPCC predicts that average annual mean temperature over the Asian land-mass, including the Himalayas, will increase by about 3°C by the 2050s and about 5°C by the 2080s. Similarly, average annual precipitation in this region will increase by 10– 30% by 2080. During the last few decades, the Himalayas have experienced increasing temperatures. However, data on precipitation are not consistent; the precipitation has increased in some areas but decreased in other areas.

By analysing temperature and rainfall data, and Normalized Difference Vegetation Index values from remotely sensed imagery, Shrestha *et al*. (2012) reported significant changes in temperature, rainfall and vegetation phenology across the Himalayas between 1982 and 2006. The average annual mean temperature during the 25-year period increased by 1.5° C with an average increase of 0.06° C per year, considerably higher than the global average for the comparable, but longer period of 1975–2005. The rate of warming varied across seasons and ecoregions: the Brahmaputra Valley semi-evergreen forest ecoregion has experienced the greatest rate of warming of 2.0°C (0.08° C per year).

Over the whole Himalayan region, the average annual precipitation has increased by 163 mm or 6.52 mm per year. However, the Brahmaputra Valley semi-evergreen forest ecoregion had the greatest increase in rainfall, at 269.25 mm (10.77 mm per year) (Shrestha *et al*., 2012).

While the same study examined and showed considerable consequent changes in plant phenology, the main impact on the WBH of climate change is likely to be the impact on river flows and their seasonality. In Bhutan, a report from International Centre for Integrated Mountain Development stated that Bhutan had already lost 23.3 per cent of its glacier area between 1980 and 2010. Such direct effects on natural rivers will be compounded or complicated by the increasingly prevalent impounding of rivers in the WBH's range, and compounded further by cascade dams (see below).

Hydropower development

Nowadays, the WBH predominantly uses and lives along fast-flowing rivers in mountainous terrain. Such river systems in all four range states are subject to increasing damming, and all four countries have ambitious plans for generating hydro-electricity either for their own use and/or for export to neighbouring countries.

India suffers a massive electricity deficit (International Rivers, 2008), both now and in relation to its social and industrial development aspirations. The rivers of Arunachal Pradesh are a source to help meet the need for power. Table A7.4 shows the dams under construction or in existence.

If implemented, dams in the Brahmaputra basin will have a density of 0.5825 per 1000 km^2, which would be 110 times higher than the global average, equivalent to one dam every 35 km of river (Pandit & Grumbine, 2012).

Table A7.4: Status of hydroelectricity demand and potential for India and Bhutan

	Himalayan India	Bhutan
Total claimed potential, MW	118,210	23,760
Capacity already developed, MW	26,376	1,488
% capacity to be developed	78%	94%
No. hydropower projects completed	74	5
No. under construction	37	-
No. planned	318	16

Source, International Rivers (2008)

It has been estimated that, in Bhutan, the hydropower sector directly contributes 12.5% of GDP, and up to 30% if one includes indirect impacts including construction. The contribution of hydropower to the economy is expected to grow over time as Bhutan faces increasing demands for hydropower exports to other countries in the region (in particular India). As shown in Table A7.4, Bhutan still has significant untapped hydropower potential.

Hydropower is also an important foreign exchange earner for the country. In 2012, Bhutan exported 4,924 MU of electricity to India and imported 36.75 MU (Statistical Yearbook of Bhutan, 2013) and has plans to increase its export of hydropower.

With regard to WBH conservation, the conclusion must be that river systems in its current range are already subject to dam construction, or are very likely to become so in the coming years.

The impact of climate change on rivers that have been dammed is of concern in some quarters, in that it may have been inadequately considered in dam design, management and economics. For example, there is a major concern over the impact of warming on glacier melt. Meltwater contributes 5-45%, and up to 75% of the water volume of Himalayan rivers (International Rivers, 2008). Warmer climates are likely to lead to flash floods and higher peak flows. There is also increased risk of glacial lake outburst floods, which might overrun dams. The melting of hitherto permanently frozen ground and increased erosion from more intense rainfall will also lead to greater sediment loads in rivers, both affecting the performance of dams and the chemistry of rivers, with consequent impacts on their plant and animal communities.

From the point of view of WBH conservation, there needs to be adequate understanding of:

1. the impact of single dams on river flows, water quality and clarity both upstream and downstream, and the associated fish fauna which provide prey for WBH,

2. the cumulative impacts of sequential or cascading dams on the same river, and

3. the impacts of climate change on rivers, and how these impacts will interact with those in points 1 and 2.

To ensure a reliable supply of water, there is likely be a need to increase reservoir storage to combat increased hydrologic variability from climate change. Shifting to reservoir based facilities rather than run-of-the-river will however increase the potential environmental impacts and these will then have to be managed. Sedimentation management technologies will also need to be introduced, both in the catchment of the hydropower facility and within the facility to manage the impacts of climate change (World Bank, 2014).

Appendix 8

Recent WBH records

Country	Location	LongLat	Site Type	Time of Year	Year	No.*
Bhutan	Sonagatsa, along Mochu Punakha Punakha Dzongkhag	27°36'30.67N 90°50'53.46 E	Feeding	Autumn/ Winter	2004-2012	
Bhutan	Gubzithang & surroundings along Phochu Punakha Dzongkhag	27°36'33.17N 89°52'2.3 E	Feeding	All Year	2006-2014	2
Bhutan	Satem (near Geunsari Pry. School), Punakha Dzongkhag	27°42'42.54N 89°50'53.28E	Feeding	Autumn/ Winter	2005-2010	
Bhutan	Tsotchasa /Tshosaba/Walathang & surrounding Punakha Dzongkhag	27°40'36.69N 89°54'30.52E	Nesting & Feeding	All Year	2010-2014	
Bhutan	Tshekathang, viewpoint, along & surroundings (Phochu), Punakha Dzongkhag	27°36'46.52N 89°52'25.28E	Feeding	All Year	2006-2014	3
Bhutan	Tshekathang, viewpoint across river, Punakha Dzongkhag	27°36'33.17N 89°52'2.3E	Nesting	February to May	2011	
Bhutan	Phochu Mochu confluence, Punakha Punakha Dzongkhag	27°34'46.53N 89°51'52.97E	Non-breeding	October to May	2006-2014	
Bhutan	Ada lake & along streams, surroundins Wangdue Prodrang Dzongkhag	27°17'34.92N 90°6'33.38E	Nesting	All Year	1991-2014	
Bhutan	Basachu & surrounding Wangdue Prodrang Dzongkhag	27°18'18.81N 90°0'6.83E	Nesting & Feeding	All Year	2007-2009	
Bhutan	Harachu, along & surrounding Wangdue Prodrang Dzongkhag	27°12'19.44N 90°7'3.29E	Nesting & Feeding	All Year	2006-2014	
Bhutan	Kamechu (along Digchu), Wangdue Prodrang Dzongkhag	27°16'50.15N 90°2'26.72E	Feeding	All Year	2003-2010	
Bhutan	Nangzhina & surroundings (Gewarongchu & Kishonachu), Wangdue Prodrang Dzongkhag	27°14'34.92N 90°5'36.85E	Nesting & Feeding	All Year	2006-2011	
Bhutan	Zawa & surrounding Wangdue Prodrang Dzongkhag	27°17'48.49N 90°2'47.99E	Nesting	All Year	2003-2011	
Bhutan	Burichu & surroundings Tshirang Dzongkhag	27°4'33.6N 90°4'31.28E	Nesting & Feeding	All Year	2006-2014	2
Bhutan	Burichu & surroundings, along Punatsangchu Tshirang Dzongkhag	27°4'33.08N 90°4'26.7E	Nesting & Feeding	All Year	2006-2014	2
Bhutan	Along Burichu & surrounding Tshirang Dzongkhag	27°3'49.72N 90°3'59.6E	Feeding	All Year	2006-2014	
Bhutan	Cangche Dovan,Tshirang Dzongkhag	27°1'56.46N 90°4'46.08E	Feeding	All Year	2014	
Bhutan	Sunkosh goan & surroundins Tshirang Dzongkhag	26°59'51.92N 90°4'8.09E	Feeding	Autumn/ Winter	2010-2014	
Bhutan	Walkley Tar & surroundings, along Punatsangchu Tshirang Dzongkhag	25°5'6.66N 90°4'18.9E	Nesting	All Year	2014	5
Bhutan	Berti, Zhemgang Dzongkhag	27°9'46.57N 90°39'36.63E	Nesting & Feeding	All Year	2005-2014	2
Bhutan	Mangdechu (along), Zhemgang Dzongkhag	27°10'20.54N 90°39'26.46E	Feeding	All Year	2005-2014	

Continued overleaf

Country	Location	LongLat	Site Type	Time of Year	Year	No.*
Bhutan	Longa Khola (Phibsoo Wildlife Sanctury,) Sarphang Dzongkhag	26°45'13.39N 90°11'18.48E		February	2014	2
China	Gaoligong Shan NNR, Lushui County Found in a local person's home	25°47'N 98°46'E		August	2014	1
India	Koilamoila, Chirang district,BTAD, Assam	26°41'28.6N 90°33'7E		August	2007	1
India	Subankhata Pagladia river, Subankhata, Baksa District, Assam	26°49'50.81N 91°24'39.03E		October	2009	2
India	Phibsu River Phibsu, Kachugaon RF, Kokrajhar, BTAD, Assam	26°43'19.64N 90°9'45.3E		October	2009	1
India	Phibsu River Phibsu, Kachugaon RF, Kokrajhar, BTAD, Assam	26°44'11.3N 90°8'28.2E		November	2013	2
India	Phibsu River Phibsu, Kachugaon RF,Kokrajhar,BTAD,Assam	26°44'11.3N 90°8'28.2E		November	2013	2
India	Dihing-Patkai Wildlife Sanctuary Tinsukia and Dibrugarh	27°30'N 95°22'E		December	2004	
India	Firmbase, Namdapha Arunachal Pradesh	27°31'58N 96°31'13E		September	2005	1
India	Embyong, Noa-Dehing River, Namdapha Arunachal Pradesh	27°29'32'N 96°29'42E		September	2005	1
India	27 mile, Noa-Dehing Arunachal Pradesh	27°29'21N 96°26'64E		November	2006	1
India	40 mile, Noa-Dehing Arunachal Pradesh	27°29'54N 96°32'29E		November	2006	1
India	Embyong, Noa-Dehing River, Namdapha Arunachal Pradesh	27°29'25N 96°29'32		November	2006	1
India	Deban Guesthouse, Noa-Dehing River, Namdapha Arunachal Pradesh	27°90'06N 96°24'27		August	2005	1
India	Pagladova marshland, Pobitora Wildlife Sanctuary Morigaon, Assam	26°13'22N 92°4'E		January	1997	16
India	Tamulidova marshland, Pobitora Wildlife Sanctuary Morigaon, Assam	26°13'58N 92°4'10E		Unknown	1997	
India	Urpad Beel Goalpara District, Assam	26°6'54N 90°35'36E		Unknown	2001	1
India	Koilamoila Near Bhutan foothills of Manas Reserve Forest, Manas Biosphere Reserve	26°41'29N 90°33'75E		August	2007	1
India	Pagladiya River, Subankhata Reserve Forest	26°49'50.81N 91°24'39.03		October	2009	2
India	Phibsu River, Kachugaon Reserve Forest	26°43'19.64N 90°9'45.3E		October	2009	1
India	Naharbadi, Noa–Dehing River, Namdapha	27°31'44.6N 96°23'24.7E		September	2011	1
Myanmar	Ma Li Yang Sumprabum	26°34'40N 97°41'20.7E		April	2009	2
Myanmar	Gawleihtu Nawngmung area	27°36'35.3N 97°54'13.1E		May	2009	2
Myanmar	Gawleihtu Nawngmung area	27°36'35.3N 97°54'13.1E		June	2011	1
Myanmar	Lansarhtu Nawngmung area	27°31'9.18N 97°56'53.7E		May	2011	1
Myanmar	Ziyar Dam Hponkanrazi WS area	27°34'14.4N 97°6'16.62E		February	2011	1
Myanmar	Camp I (Hponyin) Hponkanrazi WS area	27°35'55N 97°59'55.2E		February	2011	1
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	1
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	3

Continued overleaf

Country	Location	LongLat	Site type	Time of year	Year	No.*
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	2
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	1
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	2
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		August	2009	3
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		September	2009	5
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		September	2009	3
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		January	2010	3
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		March	2010	3
Myanmar	Tawun Stream Hukaung Valley WS	26°35'24.78N 96°48'54.06E		May	2010	4
Myanmar	Taron Stream Hukaung Valley WS	26°45'18.54N 96°28'24.84E		September	2009	1
Myanmar	Taron Stream Hukaung Valley WS	26°45'18.54N 96°28'24.84E		September	2009	2
Myanmar	Taron Stream Hukaung Valley WS	26°45'18.54N 96°28'24.84E		September	2009	2
Myanmar	Taron Stream Hukaung Valley WS	26°45'18.54N 96°28'24.84E		January	2010	2
Myanmar	Setse Stream Hukaung Valley WS	26°38'31.74N 96°32'54.78E		September	2009	1
Myanmar	Setse Stream Hukaung Valley WS	26°38'31.74N 96°32'54.78E		September	2009	1
Myanmar	Setse Stream Hukaung Valley WS	26°38'31.74N 96°32'54.78E		January	2010	1
Myanmar	Sanit Stream Hukaung Valley WS	26°38'38.16N 96°31'1.5E		September	2009	1
Myanmar	Sanit Stream Hukaung Valley WS	26°38'38.16N 96°31'1.5E		September	2009	1
Myanmar	Hkam Laung Hukaung Valley WS	27°4'45.66N 96°20'19.32E		February	2010	1
Myanmar	Lout Lai Hukaung Valley WS	27°10'11.46N 96°15'28.3E		February	2010	2
Myanmar	Chaune Sone On Shwe Li River	23°16'3.49N 96°33'15.53E		February	2012	1
Myanmar	Tarung Hka, a few hundred yards upstream of its mouth Hukaung Valley	26°29'36N 96°25'E	Feeding	December	2005	1
Myanmar	Upper Shipha Hka, lower reaches Hukaung Valley	26°35'30N 96°48'57E	Feeding	January	2006	1
Myanmar	Lower Tarung Hka Hukaung Valley	26°42'14N 96°28'22E		February	2006	1
Myanmar	Lower Tarung Hka Hukaung Valley	26°44'26N 96°28'22E		March	2006	1
Myanmar	Lower Tarung Hka Hukaung Valley	26°51'34N 96°21'2E		April	2006	1
Myanmar	Lower Tarung Hka Hukaung Valley	26°42'14N 96°28'50E	Feeding	May	2006	1

Historical WBH records

Country	Location name	Longlat
India	Bihar	26°31' N 87°1'E
India	Bihar	26°19'N 86°35'E
India	Bihar	25°25'N 86°40'E
India	West Bengal	27°2'N 88°16'E
India	West Bengal	26°59'N 88°27'E
India	West Bengal	26°44'N 88°51'E
India	West Bengal	276°43'N 89°25'E
India	West Bengal	26°34'N 88°55'E
India	West Bengal	26°32'N 89°7'E
India	West Bengal	26°30'N 88°30'E
India	Arunachal Pradesh	28°10'N 95°40'E
India	Arunachal Pradesh	27°31'N 96°37'E
India	Arunachal Pradesh	25°5'N 93°40'E
India	Assam	27°50'N 95°40'E
India	Assam	27°40'N 95°24'E
India	Assam	27°36'N 94°51'E
India	Assam	27°30'N 95°20'E
India	Assam	27°26'N 94°18'E
India	Assam	27°16'N 94°2'E
India	Assam	27°18'N 94°3'E
India	Assam	26°55'N 93°58'E
India	Assam	26°43'N 90°59'E

Country	Location name	Longlat
India	Assam	26°32'N 93°0'E
India	Assam	26°10'N 92°10'E
India	Assam	26°2'N 89°58'E
India	Nagaland	26°30'N 94°40'E
Nepal		27°25'N 85°2'E
Bhutan		27°37'N 89°52'E
Bhutan		27°20'N 90°4'E
Bangladesh		24°19'N 91°44E
Myanmar		27°21'N 97°24'E
Myanmar		27°11'N 97°35'E
Myanmar		25°23'N 97°24°E
Myanmar		24°46'N 97°3'E
Myanmar		24°40'N 97°5'E
Myanmar		24°16'N 97°14'E
Myanmar		23°30'N 93°50'E
Myanmar		22°22'N 96°19'E
Myanmar		21°35'N 93°5'E
Myanmar		20°19'N 94°30'E
Myanmar		18°8'N 96°4'E
Myanmar		17°38'N 96°8'E
Myanmar		17°17'N 96°18'E

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