HABITAT ASSESSMENT OF THE CRITICALLY ENDANGERED WHITE-BELLIED HERON (ARDEA INSIGNIS) IN PUNATSANGCHU RIVER BASIN, BHUTAN.

Supervisor:
Dr. Gopi, G. V.
Scientist D
Member, IUCN-SIS Specialist Group
Department of Endangered Species Management
Wildlife Institute of India

Co-Supervisor:
Dr. J. A. Johnson
Scientist D
Department of Habitat Ecology
Wildlife Institute of India

Presenter: Chhimi Dorji
chhimid10@gmail.com

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- Food abundance and Availability
- WBH-Environmental Association

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- ??????????????????????????????

Introduction (Species Background)

- White-Bellied Heron (WBH) known as the Imperial Heron, Great WBH or Gentle Giant

- scientifically known as *Ardea insignis*

- second largest species of heron in the world exceeding its size only by the Goliath heron (*Ardea goliath*)

- Family: Ardeidae

- WBH has been rated as the rarest heron in the world in 2012 in the Guinness Book of World Records

Introduction-Species Background

- categorized as *Critically Endangered* species by the International Union for Conservation of Nature nad Natural Resources (IUCN) red list (IUCN, 2016) owing to its total population estimates of 50-200 individuals in the world.

- listed among top 100 Evolutionary Distinct and Globally Endangered species

- 28 WBH in Bhutan

Why this Species?

Why this topic?

Why this Area?

Introduction-Problem Statement

- WBH is a *Critically Endangered* species with a global estimate of 50-200 mature individuals

- conservation efforts are put into questions as little is known about their habitat: the single most important variable for the species long term survival

- Global range of the WBH is restricted to Bhutan, India and Myanmar with report of 28 mature individual from Bhutan.

- 26 are reported from the Punatsangchu river basin making this river basin the most preferred habitat.

- This river basin is earmarked for massive multiple hydropower construction
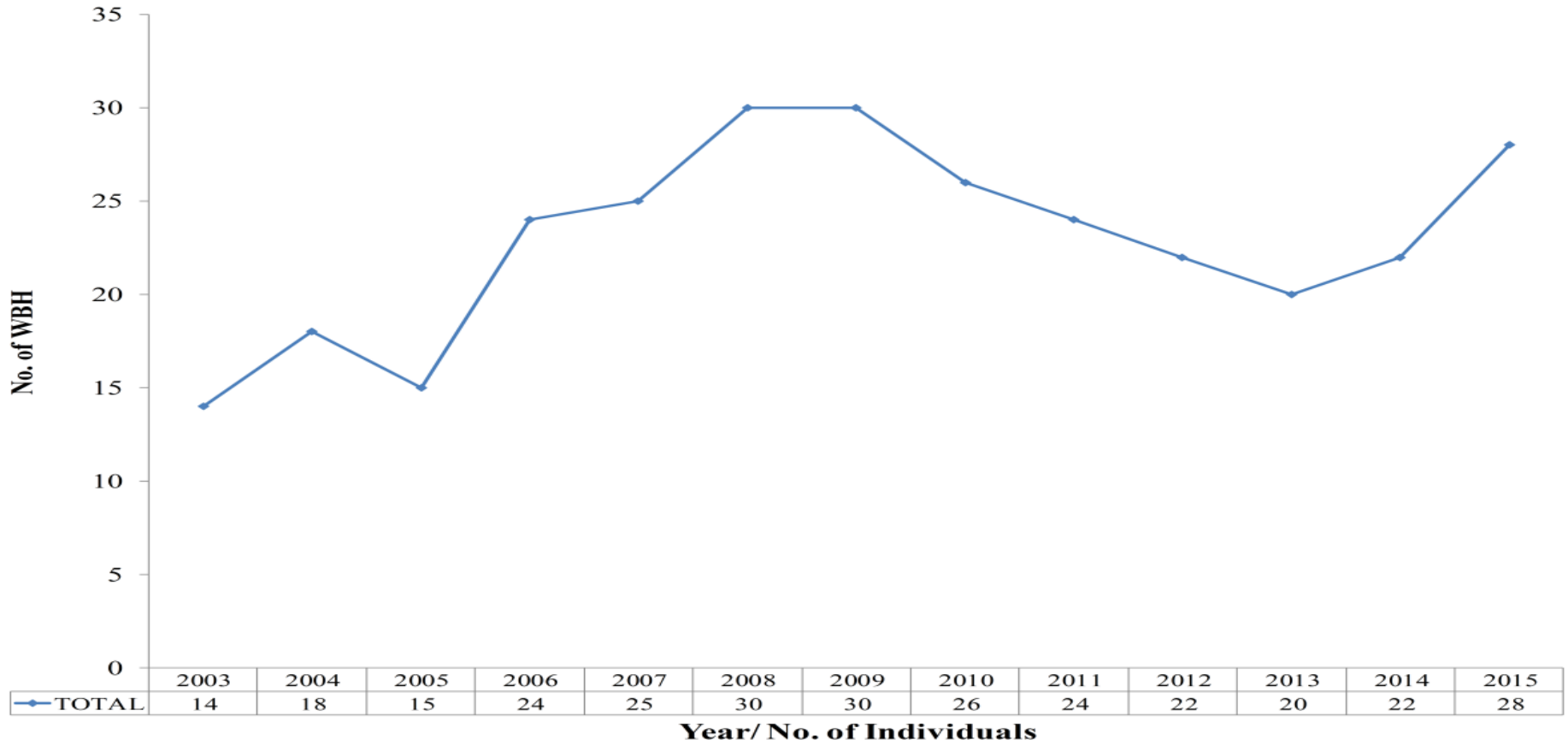
Introduction-Objectives

- **General Objectives:** To assess the White-bellied Heron habitat in Punatsangchu river basin.

- **Specific Objectives:**

- To study the physical characteristics of the riverine stretches along with its floristic diversity.

- To study habitat selection, food abundance and availability in Punatsangchu River Basin

- To examine the potential threats and disturbances to the survival of the White-bellied Heron in Punatsangchu river basin.

Review of Literature- Population status

- Global population estimates of 50-200 mature individuals
- Bhutan: 28 individuals

White-Bellied Heron Population trend 2003-2015

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL	14	18	15	24	25	30	30	26	24	22	20	22	28

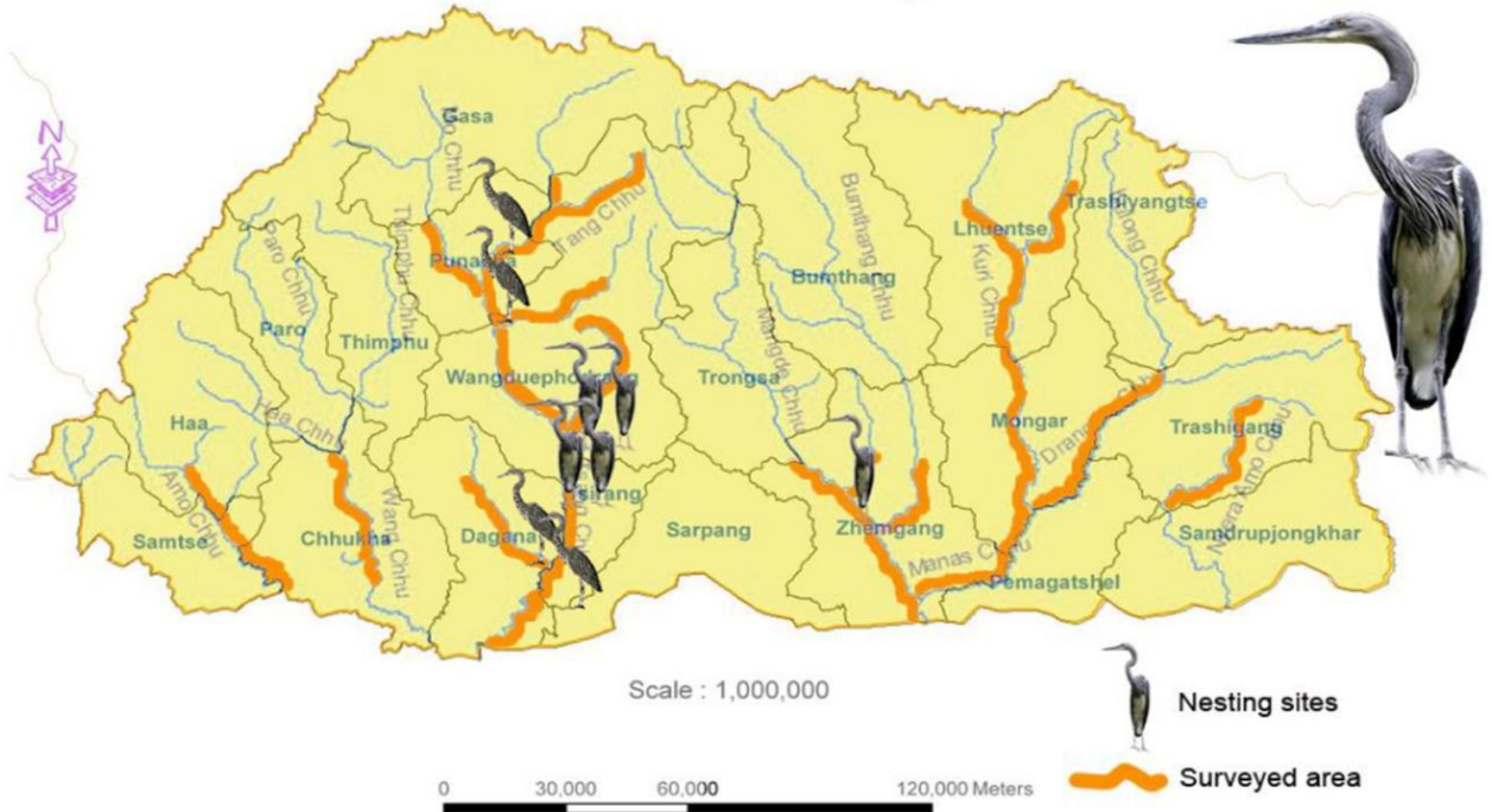No. of WBH

Year/ No. of Individuals

Review of Literature-Distribution

- narrow distribution in three of the world's Biodiversity hotspots viz. the Eastern Himalayas, Indo-Burma, and South-West China
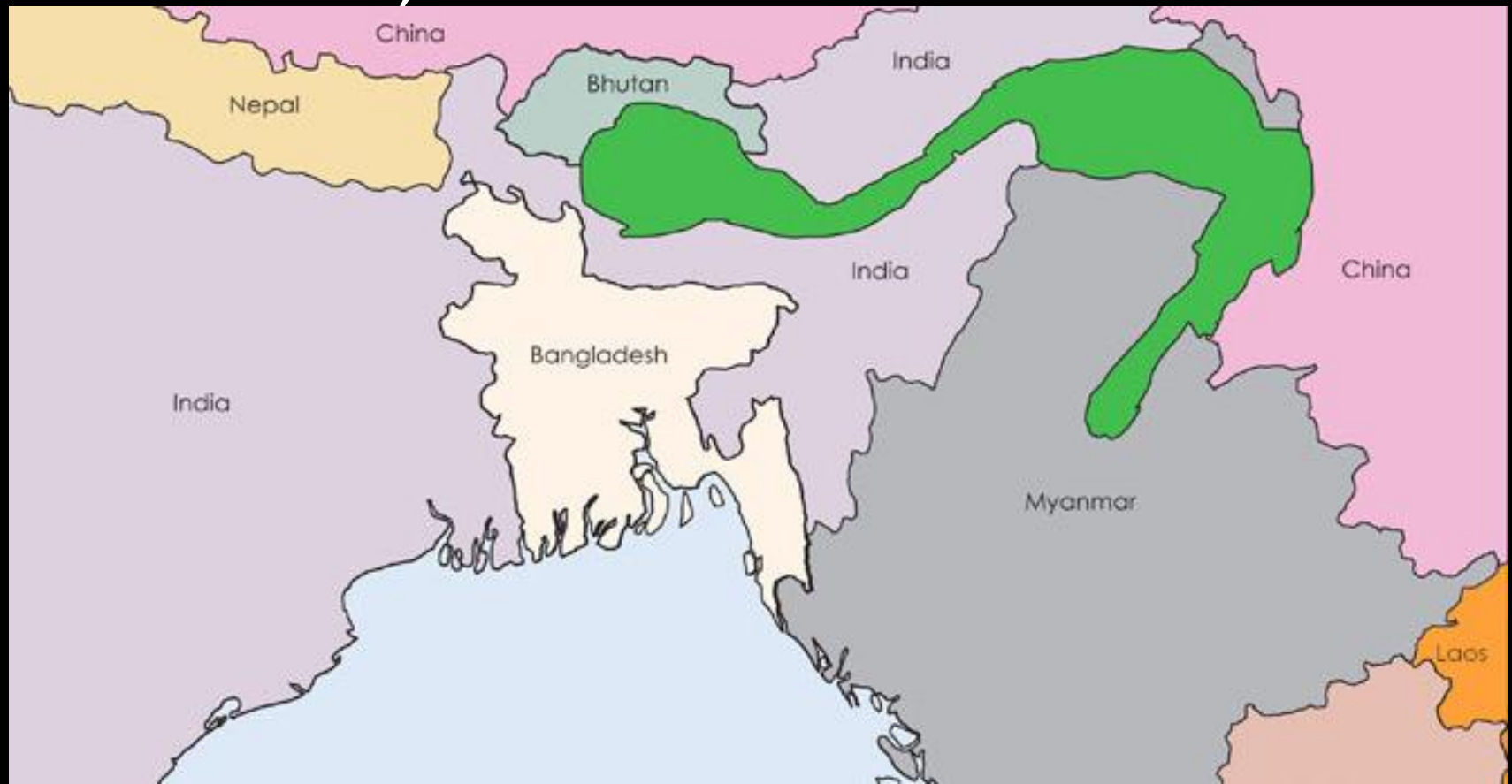
Review of Literature-Distribution

White-bellied Heron Surveyed Areas

Literature Review- Habitat Ecology

- Roosting: 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.

- Chir Pine (*Pinus roxburghii*) and roost trees were clearly the tallest trees in the stand

- roosting near the ends of relatively large lateral branches between 8 and 10 m above ground level

- No other information is available on roosting

Literature Review- Habitat Ecology

- Feeding:in rapids in clear, shallow waters, 12-30 cm deep, with some blue-green algae and with stone beds and sand bars

- rivers are 75 – 250 m in width, and up to 3 m 15 in depth, though 0.1 - 2 m is common.

- 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.

Literature Review- Habitat Ecology

- Nesting: breed and roost in Chir pine forest
- solitary and located in large Chir pines on ridges or steep slopes at 500-1,500 m a.s.l
- sparsely dispersed large, tall Chir Pines with no understory touching the tree, and a very sparse to non-existent shrub and small tree layer
- Nest trees were usually rooted on particularly steep parts of hillsides (42 –680 slope)
- Nests were located on large (> 10 cm diameter) middle branches or crotches of the tree, rather than at the top.

Lit. Review-Conservation Status

- Listed as *Critically Endangered* by IUCN Redlist in 2007 based on criteria CR C2a(i).

- Estimated individuals 50-200 globally.

- **Bhutan:** Phochu is declared as White-bellied Heron Habitat. Enlisted WBH in Schedule I of the Nature and Forest Conservation Act 1995.

Lit.-Review Conservation Status

- **India:** Schedule IV of the Indian Wildlife Protection Act

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

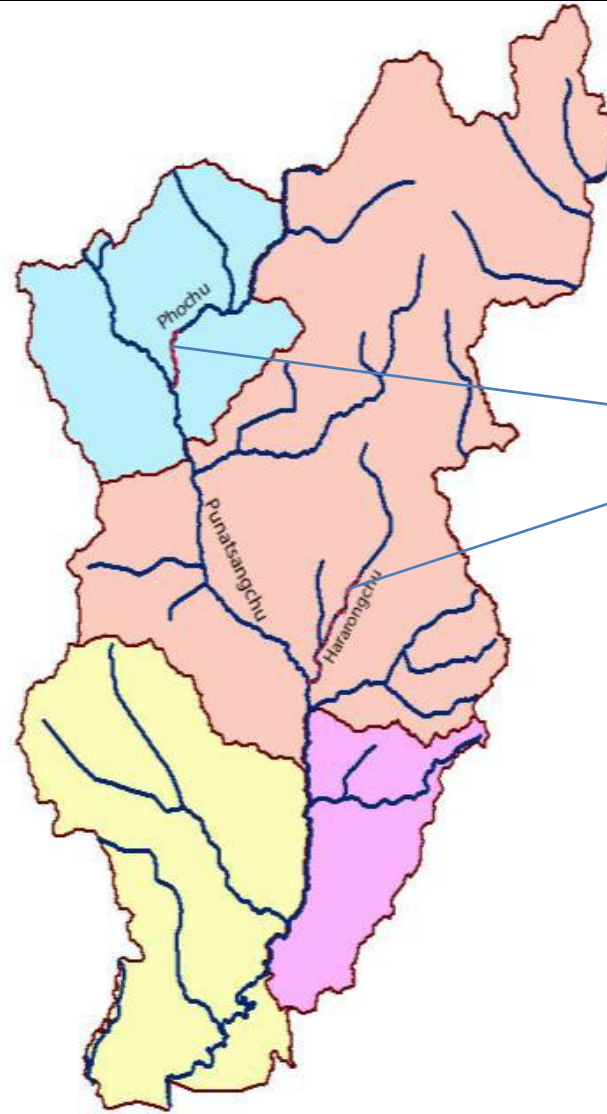- **China:** WBH is not protected under any law within China

Review of Literature-Threats

- **Small gene pool**
- **Habitat loss**
- **Disturbance**
- **Hunting**
- **Developmental Activities**
- **Fishing**
- **Forest Fire**

Sl. No	Year	Location	No. of Death	Remarks
		White-bellied Heron casualty statistics		
1	2003	Taberongchu	1	Dead, floating on river bank
2	2008	Basochhu	1	Electrocuted on electric cable
3	2008	Nangzhina	1	Burnt by forest fire
4	2011	Phochhu	3	Predated
5	2012	Kamechhu	1	Electrocuted on electric cable
6	2013	Hararongchhu	1	Wing injured
7	2014	Hararongchhu	2	Unknown
8	2014	Kamechhu	1	Electrocuted on electric cable
9	2015	Burichhu	1	Chick fell off the nest

Materials & Methodology-study area

Legend

Agriculture	Landslips
Bluepine	Marshy Areas
Broadleaf	Meadows
Broadleaf with Conifer	Mixed Conifer
Chirpine	Plantations
Fir	Rock Outcrops
Glacier/Snow	Scrub forest
Horticulture	Settlements
Improved Pasture	Water Spreads

Surveyed sites

Legend
— Rivers

Dzongkhag
- Dagana
- Punakha
- Tsirang
- Wangduephodrang
····· Survey points
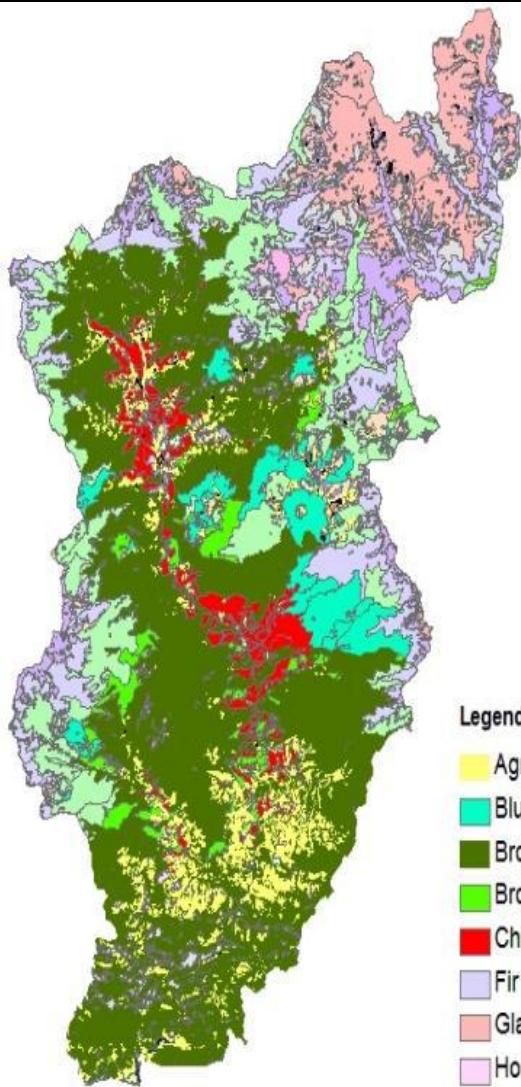
Methodology

- **Reconnaissance:** Informal discussions with RSPN were carried out before the start of the study work.

- Interview and questionnaires survey with local peoples were done in the villages where WBH habitat falls

- to find out local people"s knowledge about the species, their habitat and perceptions on the conservation importance

- Results were analysed using microsoft excel and presented in form of graphs, tables and figures.

Methodology

- **Physical Environment:** physical environment parameters such as temperature, slope, aspect, elevation and topography were assessed in each study sites and recorded.

- **Vegetation:** 10X10 m plots were laid in random location within the area to assess and tree species are recorded along with their DBH. Dominant vegetation type was analyzed on three vegetation classes: Chirpine forest, broadleaf forest and mixed forest. The tree density per hectare for the study sites was calculated. Mean tree per plot were analysed using descriptive statistics in Excel.

Methodology

- **Food abundance and availability:** Fish sampling was performed in selected stream/ river stretches using different types of fishing gears like gill net of varying sizes (16mm, 22mm, 28mm and 32mm), cast net, drag net and scoop net and hooks in different habitats like run, riffle and pool in 100 meters reach of all study sites based on the methods of Johnson and Arunachalam (2009) at each sites for 2 hours and based on the catch recorded the relative abundance of fishes was estimated based as catch per unit effort (CPUE).

- All collected fishes were identified to species level. After collection, fish were examined, counted and released in river after 2 hours to avoid double counting.

- Along with fish sampling a set of environmental variables and habitat variables was taken at each study site such as water temperature, air temperature, dissolved oxygen, conductivity, turbidity, TDS, pH, riparian cover, land use pattern, human disturbances and water depth, width of the stream for comparing fish abundance with site variables based on.

- Information about the structure of assemblage was extracted by adopting different univariate indices, namely Shannon diversity index, Margalef''s species richness index and Shannon evenness index.

Methodology

- **Potential threats and disturbances:** Distance from WBH habitat to disturbance factors was recorded using Nikon prostaff rangefinder.

- Disturbance factors considered were road, foot path, bridges, agriculture land, settlement, transmission lines and cattle grazing.

- Developmental activities were also recorded along with their scale (1-3) and distance at which it is taking place from WBH habitat.

- Threats such as fire incidence and fishing intensity were recorded by direct observation and through questionnaires surveys. All these data are analysed in excel and presented in figures and tables.

Methodology

- **WBH and Environment Associations:** WBH sightings and habitat variables with separated sites were submitted to Canonical Correspondence Analysis (CCA)

- In order to reduce the complexity of ordinance biplot, only five habitat variables (water depth, water temperature, flow, disturbances, fish biomass) were included in CCA and before analysing the raw data were transferred into log10 values

- The CCA was obtained with STATISTICA (version 7) programme.

Data Collections

Neolissochilus hexagonolepis

) *Schizothorax progastus*

Schizothorax richardsonii

WBH Feeding site
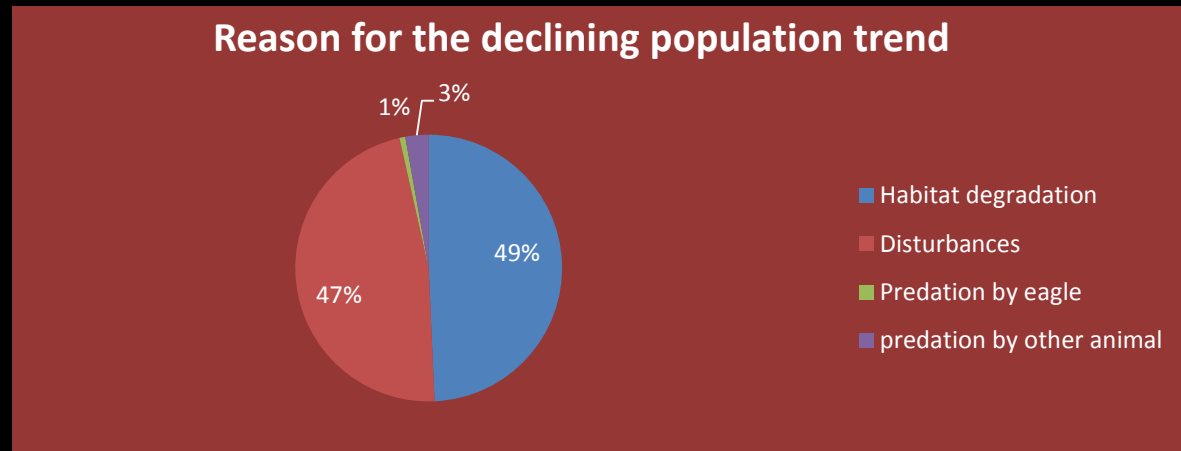
Result and Discussions

- **Household survey:**

Demographic characteristics of respondents : Out of 100 respondents, 59% were males (n=59) and 41% were female (n=41). The mean age of the respondents were 47.42 (SD=17.05, N=100). Majority of the respondents falls under age category of >42 years (49%).

Knowledge about WBH: 99% (n=99) said they have knowledge about WBH. 4% of the respondent said they have sighted WBH for the first time in 1-5 years ago, 26% for 5-10 years ago, 17% for last 10-20 years ago and 53% says they have seen more than 20 years ago.

72% saw around 3-5 WBH when they first saw but when asked about the present population status 97% of respondents says they have seen only 1-3 mature WBH individuals.
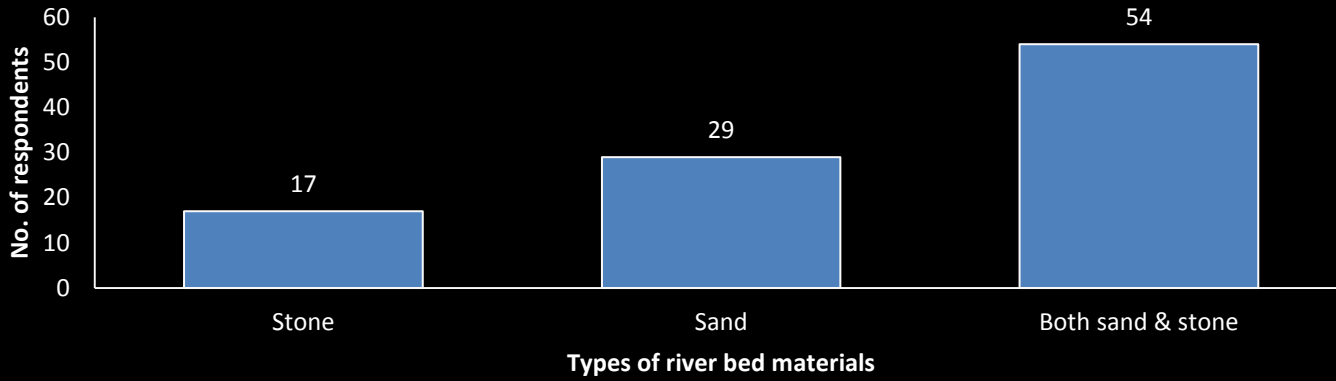
- 86% feels WBH population trend is decreasing, 14% feels the trend is same but none said that the population is increasing.

Reason for the declining population trend

1%   3%

49%

47%

- Habitat degradation
- Disturbances
- Predation by eagle
- predation by other animal

- Threats information from locals

Type of Chemicals	% respondent	Avg. quantity (g)	Avg. area (Acre)	Frequency/yr
Fertilizer	79%	6725.69	2.33	1
Weedicide	67%	489.33	2.33	1
Pesticide	52%	362.11	2.33	1
Herbicide	21%	98.62	2.33	1

Types of river material collected

Chart: No. of respondents vs Types of river bed materials

Types of river bed materials	No. of respondents
Stone	17
Sand	29
Both sand & stone	54

Fishing frequency

	everyday	Once a week	Once a month
No. of respondent	2	29	61
Percentage	2.17	31.52	66.30
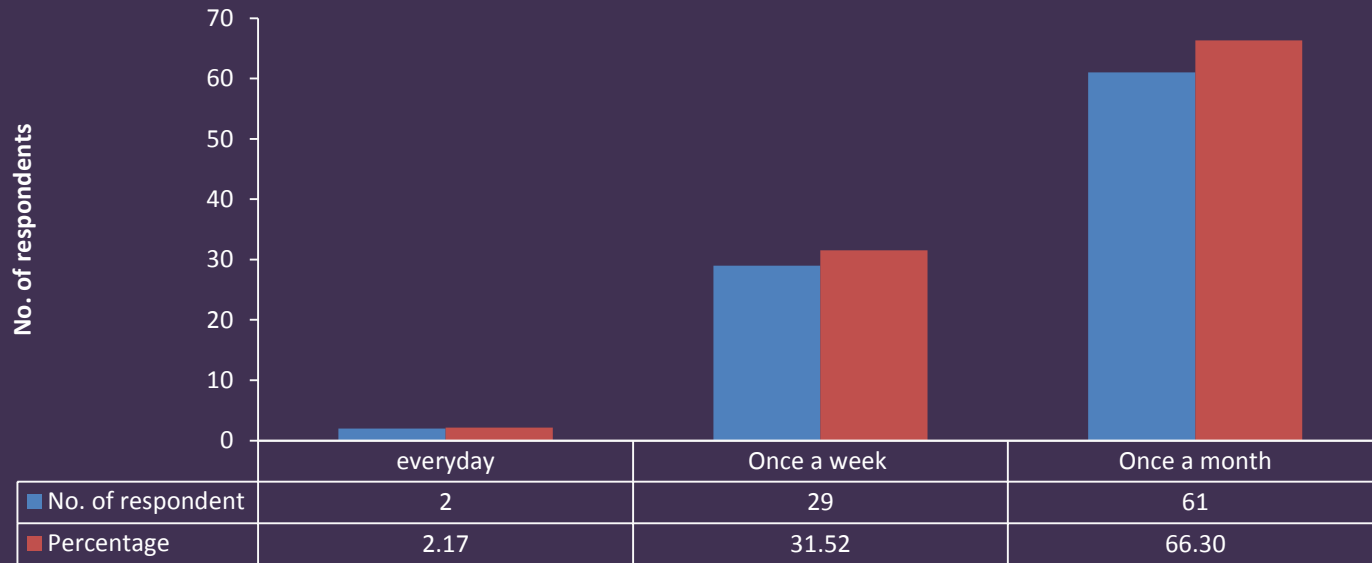
Agreement to disturbance factors
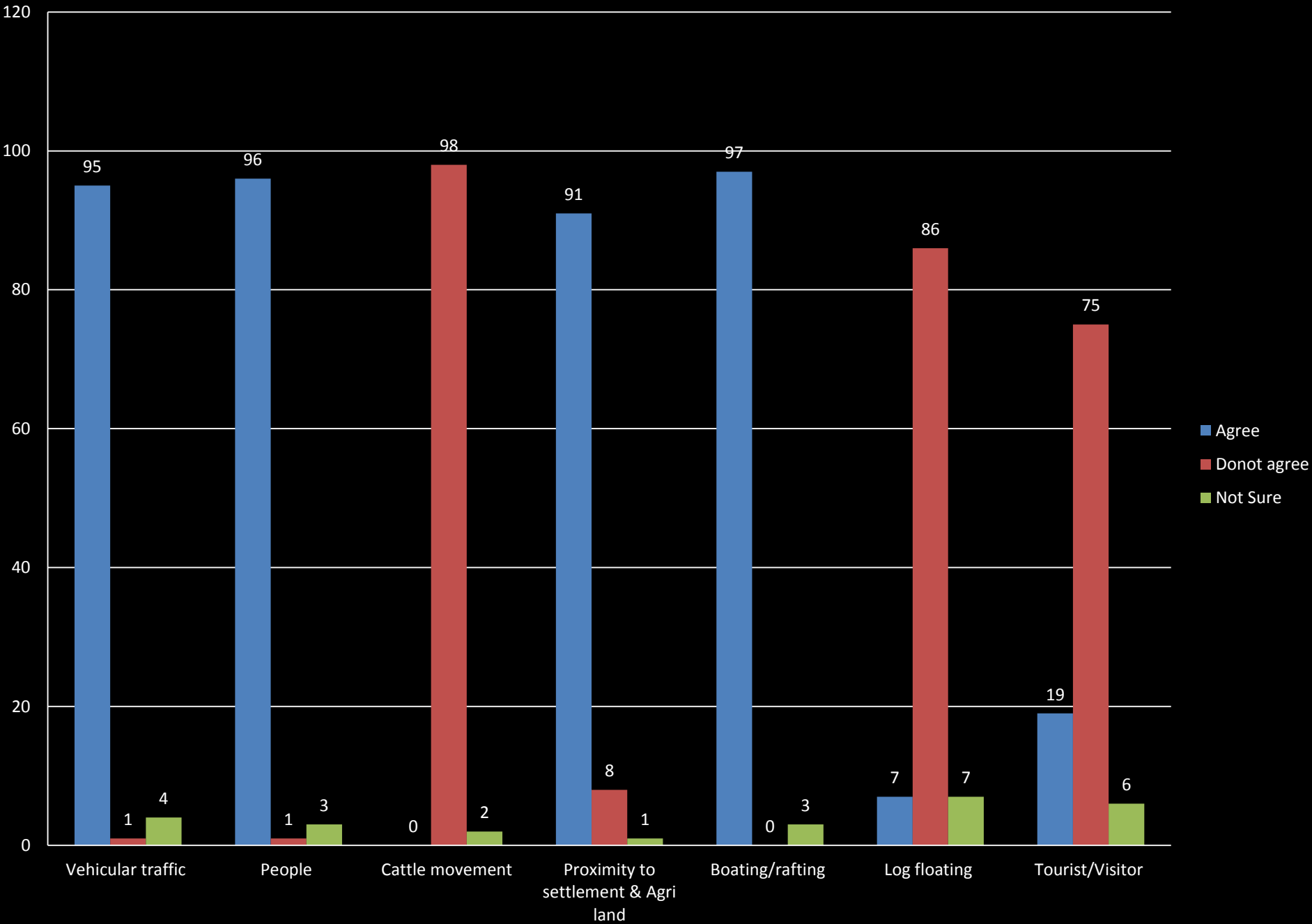
Should Govt. declare WBH Habitat as PA?

- Agree
- Donot agree
- Not sure

2%
6%
92%

Reason for conservation support for WBH

- Rare
- Endangered
- Banlanced Ecosystem
- National tressure
- Brings foreign doner
- Unique animal
- Religious belief
- For ecotourism

11%
4%
8%
31%
5%
3%
23%
15%
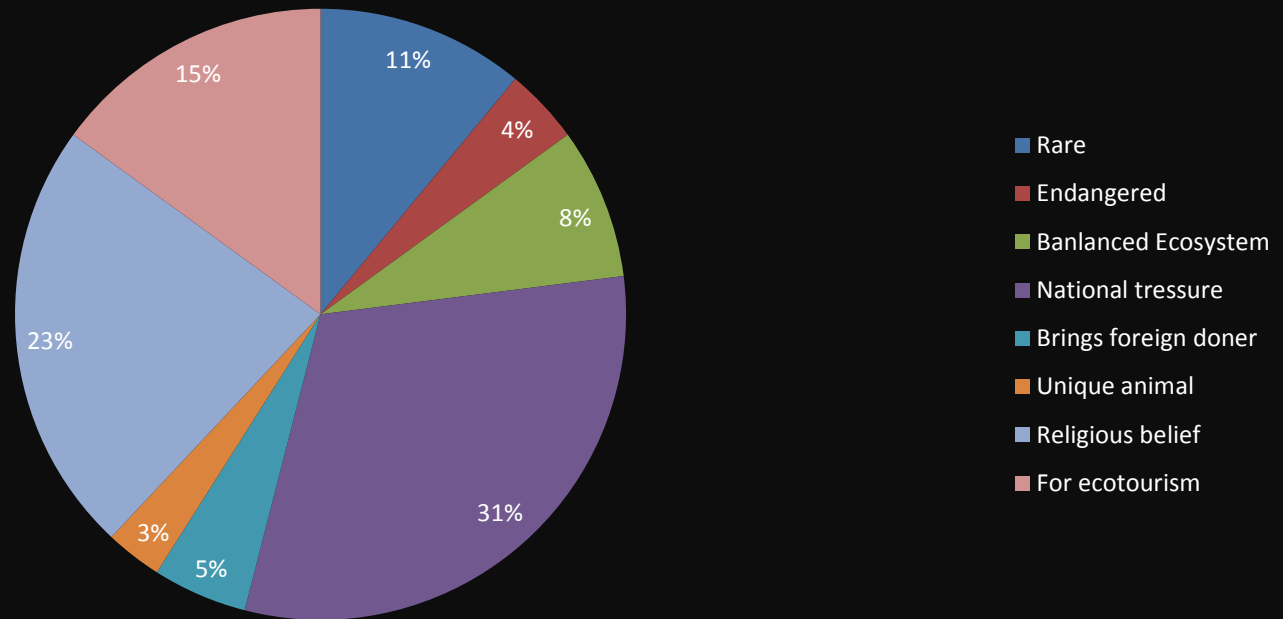
Results and Discussions

- 10 km stretch was taken along the river and WBH encounter rate in both the sites was found out to be 0.3 WBH/km.

- **Floristic characteristics of WBH habitat:** After consultation with RSPN, the study was done only for the tree diversity and density. Other understory vegetation does not affect much to the nesting habitat whereas as feeding habitat needs open and wide area

- study found only *Pinus roxburghii* in the sampling plots.

- Statistically, there was no difference on the mean value of tree density between Phochu (*M* = 4.09, *SD* = 1.76) and Harachu site (*M* = 5.43, *SD* = 1.80); *p* > .05.

- The mean tree density in the Phochu site was found less by 1.35 when compared with the Harachu site. This could be due anthropogenic activities in and around Phochu site. The site has motor road and developed much more than Harachu site.

- The overall tree density per hectare was estimated to be 4090 trees/ha in Phochu site and 5430 trees/ha in Hararongchu.
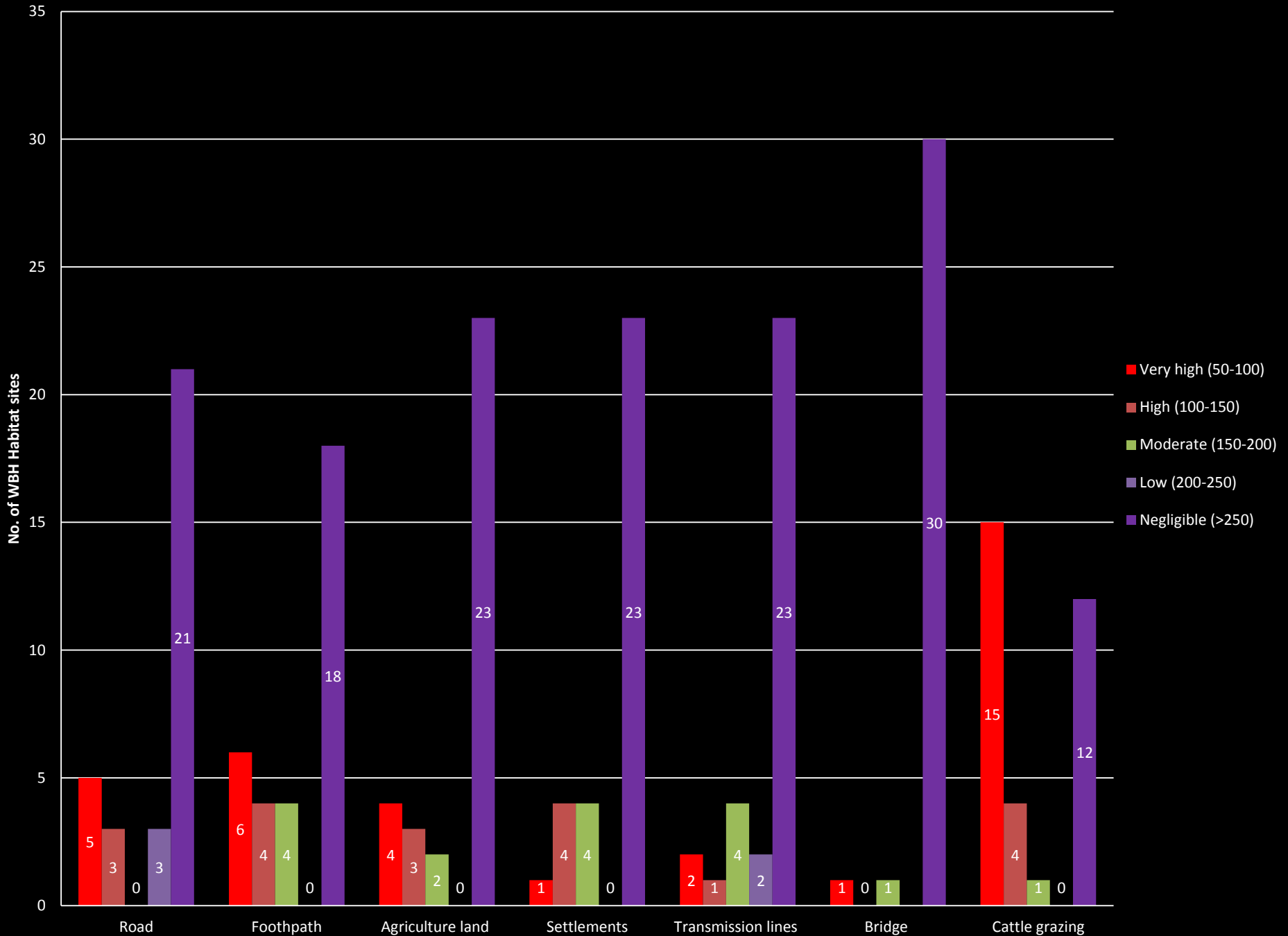
- **Foraging Habitat:** WBH is foraging on the low reaches of Phochu and Harachu.
- Phochu flows through agriculture land on one side and forested land on other side. Harachu flows through forested land
- width of 64.5 meters (SD=51.76) and mean depth of 42.70 cm (SD=9.62).
- flow rate at the feeding site is 0.93 m/s (SD=0.04)
- water turbidity in all the sites at 0 JTU
- rivers varied with 1 to 4 channels with more channels in Phochu site
- Substrate was mostly cobble followed by boulders and gobbles.
- River bars are mostly composed of rock and sand, with logs and driftwood common in Phochu site

- **Nesting Habitat:** based on four nest observed
- very steep slope of 53-670 facing in east aspect
- All the nests were made on tall Chirpine trees
- The nesting tree has average height of 28.25 m (SD=5.11) and mean DBH of 202 cm (SD=2.20)
- very sparse understory and low density of large trees
- mean distance of nest to 5 nearest trees is 9.66 m (SD=5.40). These features seem to provide 2 important purposes - First, the open canopy is much need for the WBH to fly through without much danger; second, lack of understory leaves potential nest predators few or no to access to nest.

Threats assessments

- no evidence of logging
- 100% fire occurrence records with evidence of fire scar in each sampling point.
- Though 81% respondent collects riverbed materials from the WBH habitat, the intensity is not high enough to notice in the field during survey.
- Factors considered as disturbances are presence of road, footpath, bridges, agriculture land, settlement, transmission line and cattle grazing.
- Hararongchu has least disturbances factors such as absence of transmission lines, motor vehicle roads, bridge and agriculture land from the heron habitat but in heron feeding sites, there is lots of legal fishing activities going poising threat.

Disturbances intensity in WBH habitat

No. of WBH Habitat sites

Legend:
- Very high (50-100)
- High (100-150)
- Moderate (150-200)
- Low (200-250)
- Negligible (>250)

Category	Very high	High	Moderate	Low	Negligible
Road	5	3	0	3	21
Foothpath	6	4	4		18
Agriculture land	4	3	2	0	23
Settlements	1	4	4	0	23
Transmission lines	2	1	4	2	23
Bridge	1	0	1		30
Cattle grazing	15	4	1	0	12

Food abundance and availability:

Name of species	PHOCHU				HARARONGCHU			
	Samdingkha	Khawabjara	Tshekhathang	Gobji	Harachu 1	Harachu 2	Harachu 3	Harachu 4
Amblyceps mangois	0	0	0	0	3	4	0	2
Barilius bendelisis	0	0	0	0	18	1	5	0
Crosssocheilus lattius	0	0	0	0	14	2	0	0
Garra annandalei	0	0	0	0	9	13	0	13
Glyptothorax cavia	0	0	0	0	8	7	1	6
Neolissochilus hexagonolepsis	15	13	11	12	16	13	8	10
Oreinus molesworthi	23	18	19	21	14	18	11	8
Salmo trutta	24	17	18	25	16	4	11	19
Schizothorax progastus	0	6	8	6	11	5	8	12
Schizothorax richardsonii	7	5	8	9	13	7	5	17

Study site	PHOCHU				HARARONGCHU			
	Samdingkha	Khawabjara	Tshekhathang	Gobji	Harachu 1	Harachu 2	Harachu 3	Harachu 4
Taxa	4	5	5	5	10	10	7	8
Individuals	69	59	64	73	122	74	49	87
Cyprinidae abundance	45	42	46	48	95	59	37	60
Cyprinidae percentage(%)	65.22	71.19	71.88	65.75	77.87	79.73	75.51	68.97
Shannon indx	1.30	1.50	1.54	1.49	2.23	2.05	1.81	1.95
Margalef	0.71	0.98	0.96	0.93	1.87	2.09	1.54	1.57
Equitability	0.94	0.93	0.96	0.92	0.97	0.89	0.93	0.94

Site	PHOCHU				HARARONGCHU				Total
	Samdingkha	Khawabjara	Tshekhathang	Gobji	Harachu 1	Harachu 2	Harachu 3	Harachu 4	
Amblyceps mangois	0	0	0	0	246	276	0	144	666
Barilius bendelisis	0	0	0	0	1776.06	106	495	0	2377.06
Crosssocheilus lattius	0	0	0	0	1092	124	0	0	1216
Garra annandalei	0	0	0	0	918	1599.00	0	1412.84	3929.84
Glyptothorax cavia	0	0	0	0	1338.40	1484	230	1013.4	4065.8
Neolissochilus hexagonolepsis	3480	3276	2221.01	1308	7232	7033	3328	4110	31988.01
Oreinus molesworthi	8303	5370.66	3811.21	4128.39	5894	7398	3619	3220.8	41745.06
Salmo trutta	14400	9231.00	7205.58	8816.75	7280	1284	3861	7381.88	59460.21
Schizothorax progastus	0	2166	3739.52	2700	4637.16	1705	3608	5364	23919.68
Schizothorax richardsonii	6300	3250.00	6888.87	6017.68	7293	4557	2155	9655.66	46117.21
Total	32483	23293.66	23866.19	22970.82	37706.62	25566	17296	32302.58	215484.9

- All captures by WBH were fish and no invertebrates or anurans were recorded (RSPN, 2011)

- Based on reported midpoint of bill sizes of 152 mm, RSPN (2011) reported that captured fish ranged in size from an estimated 7.7 to 30.8 cm in length.

- Despite repeated sampling, RSPN (2011) found only two species large enough to be captured, *Salmo trutta* and *Schizothorax richardsonii*

- current study found out that including these two species reported by RSPN (2011), 10 species of fish large enough to be prey of the WBH was found.

- Obervation made by RSPN has similarities with the current study, current study finding *Salmo trutta* and *Schizothorax richardsonii* top most abundant in terms of biomass.

WBH abundance- Habitat variable association
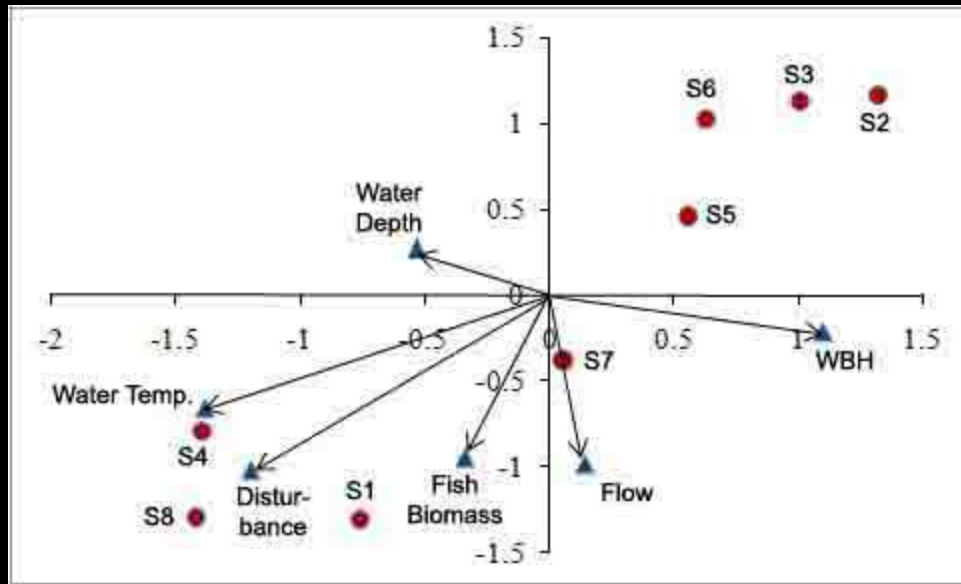
[Site labels: S1-Samdingkha, S2-Khawabjara, S3-Tshekhathang, S4-Gobji, S5-Harachu1, S6-Harachu2, S7-Harachu3 and S8-Harachu-4.]

The biplot of the WBH sightings and site score produced from CCA show the distribution of WBH and sites in ordination space.

In this plot 8 sites and 5 habitat variables have been depicted to provide insight into their composition and distribution

results indicated that WBH presence was highly influenced by the degree of disturbance level.

Depth and Flow are the also most important habitat variables for WBH.

The results of CCA indicated that the WBH frequently used sites such as Khawabjara, Tshekhathang, Harachu 1 and Harachu 2 (site 2, 3, 5 & 6 in Figure) were associated with fast flowing habitat with shallow region of the river, whereas WBH abundance was not influenced by fish biomass and other habitat variables
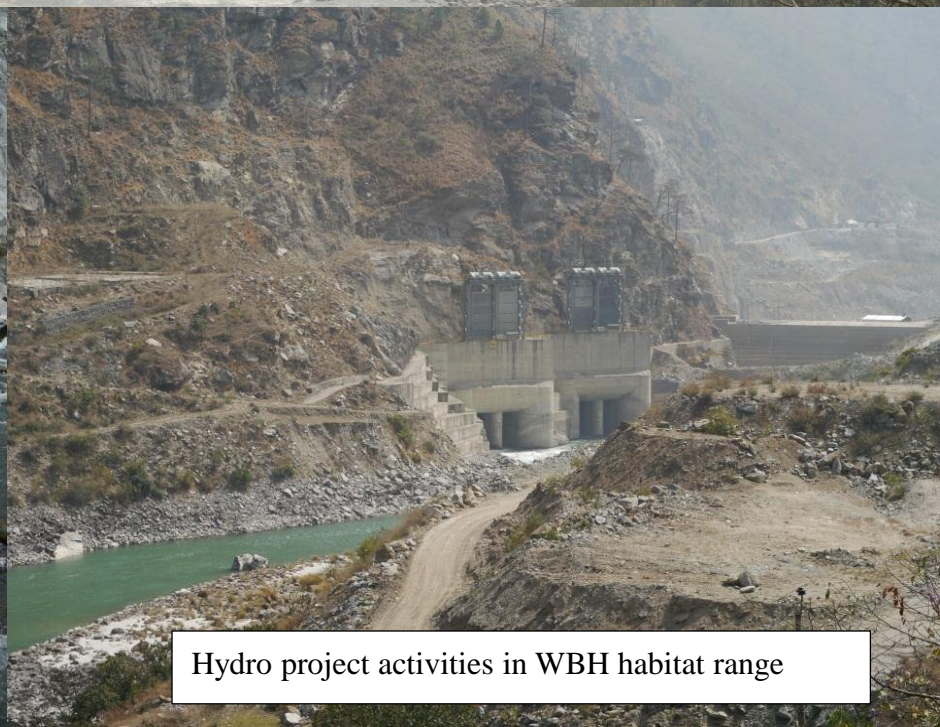
Local people setting fishing trap

Quarrying activities in WBH habitat

Trap set by locals to collect fish in WBH habitat

Hydro project activities in WBH habitat range

Conclusions

- White-bellied Heron is Critically Endangered and rarest heron on the Earth

- Therefore all scientific conservation measures have to be implemented sooner.

- Knowing habitat requirement of the species and conservation measures initiated based on this study will ensure long time survival of the species

- For this reason, the current study entitled Habitat Assessment of White-bellied Heron along Punatsangchu river basin was taken.

- Yet, there are many attributes of WBH habitat not being able to study during this study time due to limited time constrains. The resource utilization pattern is one of the main study future researcher must focus on to reduce pressure of bird finding its prey. Understanding ecological process critical to prey availability for WBH is also another attributes researcher must focus on.

Acknowledgement

Questions Please

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