Rec. zool. Surv. India: Vol. 117(4)/ 315-325, 2017
DOI: 10.26515/rzsi/v117/i4/2017/122298

ISSN (Online) : (Applied for)
ISSN (Print) : 0375-1511

Waterbirds of Arunachal Pradesh with special reference to high altitude rivers and wetlands

Gopinathan Maheswaran* and Imran Alam

Zoological Survey of India, M-Block New Alipre, Kolkata – 700053, West Bengal, India; maheswaran@zsi.gov.in, imranalam27@gmail.com

Abstract

Arunachal Pradesh, a state of India is one of the world's most difficult mountainous regions, extremely precipitous and highly jagged, measuring an area of about 83,500 km^2. The NE India has the highest avian diversity in India, with around 900 species (Choudhury 2000; 2001a). Many of these are threatened. Of the 15 Critically Endangered species of bird listed in India, seven have been recorded in this region. Of the 18 endangered species of bird in India, 12 have been recorded in the North-east. Of the 53 vulnerable species of birds in India, 33 have been recorded in the North-east. Overall, 60% of the threatened birds in the country have been recorded in the North-east. Surveys were carried in Namdapha Tiger Reserve and National Park, Pakke Tiger Reserve, Eagle Nest and Sessa Wildlife Sanctuaries, Anini district of Arunachal Pradesh (part of Dihang-Dibang Biosphere Reserve, Mehao Wildlife Sanctuary and Tawang district of Arunachal Pradesh in 2005, 2006, 2009, 2013, 2014 and 2015 to find out the waterbird diversity with special reference to White-bellied Heron *Ardea insignis*.

Keywords: Arunachal Pradesh, Rivers, Waterbirds, Wetlands

Introduction

The Arunachal Pradesh a state of India is situated between 26°28' and 29°30' N latitudes and 91°30' and 97°30' E longitudes. It covers a geographical area of 83,743 km^2. It is the largest state in the north-eastern part of India among seven sisters. It is flanked by China in the north and northeast (1080 Km) separated by McMohan line, by Bhutan 9160 Km) in west, by and Myanmar (440 Km) in east, and in south by the India states of Assam and Nagaland. In 1972 it was renamed as Arunachal Pradesh and was administered as a union territory till 1987. The present Tawang (2,172 Sq. km) district was a part of large Balipara Frontier Tract of Assam along with the present day West Kameng, East Kameng, Upper Subansiri, Lower Subansiri and Papum Pare districts Arunachal Pradesh.

Arunachal Pradesh is one of the world's most difficult mountainous regions, extremely precipitous and highly jagged, measuring an area of about 83,500 km^2, rises in mighty convulsions of ridges and spurs from the foothills across the north bank of the Brahmaputra, also known as Sri Lohit in ancient literature. Arunachal Pradesh being a part of North East India, is also part of two global biodiversity hotspots (Mittermeier *et al.*, 2004) as well as two 'Endemic Bird Areas', i.e., the Eastern Himalaya and the Assam Plains (Stattersfield *et al.*, 1998). Physiographically, the region has six main components, the Himalaya in the north, the hill ranges in the east, the Meghalaya Plateau, the plains of the Brahmaputra and Barak rivers and the Manipur Valley. The highest peak is Mt. Kangchendzonga (=Kanchenjunga), 8598 m high, in western Sikkim. NE India has diverse habitat types, ranging from tropical wet evergreen 'rain forests' to snow-capped mountains. There are swamp forests, tropical semi evergreen forests, tropical moist deciduous forests, subtropical forests and temperate forests (both broadleaf and conifers), and above the timberline, one finds alpine vegetation. Grasslands and wetlands form

* *Author for correspondence*

Article Received on: 15.10.2016

Accepted on: 22.03.2018

important habitat types in the region, most of which are found in the valleys.

The NE India has the highest avian diversity in India, with around 900 species (Choudhury 2000a, 2001a). Many of these are threatened. Of the 15 Critically Endangered species of bird listed in India, seven have been recorded in this region. Of the 18 endangered species of bird in India, 12 have been recorded in the North-east. Of the 53 vulnerable species of birds in India, 33 have been recorded in the North-east. Overall, 60% of the threatened birds in the country have been recorded in the North-east. Of the six Critically Endangered species of waterbird listed for India, four have been recorded in this region. All the seven endangered species of waterbirds in India have been recorded in the North-east. Similarly, all the 11 vulnerable species of waterbirds in India have been recorded in the North-east. Overall, 91% of the threatened waterbirds in the country have been recorded in the North-east. A list of threatened waterbird species in NE India is provided in Table 1.

India has 157 km. of border with Bhutan, cutting across almost north to south and forming the western extremity of Arunachal Pradesh. The heights gained by the mountain peaks as one follows crestline from the extreme western end to the easternmost corner, shows a great variation, ranging from 6400 meters to 1829 meters. The main ridges and spurs of what has sometimes been described as 'the Sub-Himalayas' fan out to the plains mostly in transverse directions, i.e., in the north-south direction, rather than parallel to each other, except possibly in the present West Kameng and Tawang districts, where the prominent ridges run more

Table 1. List of threatened waterbird species in North East India (after Choudhury, 2015)

Critically Endangered	
Ardea insignis	White-bellied Heron
Aythya baeri	Baer's Pochard
Eurynorhynchus pygmeus	Spoon-billed Sandpiper
Endangered	
Ciconia boyciana	Oriental White Stork
Leptoptilos dubius	Greater Adjutant
Branta ruficollis	Red-breasted Goose
Cairina scutulata	White-winged Wood Duck
Oxyura leucocephala	White-headed Duck
Heliopais personatus	Masked Finfoot
Sterna acuticauda	Black-bellied Tern
Tringa guttifer	Nordman's or Spotted Greenshank
Vulnerable	
Pelecanus crispus	Dalmatian Pelican
Leptoptilos javanicus	Lesser Adjutant
Anser erythropus	Lesser White-fronted Goose
Marmaronetta angustirostris	Marbled Teal
Clangula hyemalis	Long-tailed Duck
Grus monacha	Hooded Crane
Grus antigone	Sarus Crane
Grus nigricollis	Black-necked Crane
Gallinago nemoricola	Wood Snipe
Calidris tenuirostris	Great Knot
Rynchops albicollis	Indian Skimmer

or less parallel to each other, from west to east. At the foot of the Thagla La ridge, at an altitude of about 3048m, the great Buddhist Lamasery of Tawang, reputed to be the biggest in India, comes to the view of a traveller. Arunachal Pradesh is ranked second among the states and Union Territories in terms of area under forest cover (Ministry of Environment and Forests, 2001). The state has broadly six types of forests, Tropical Wet Evergreen (Rain Forest), Subtropical Broadleaf, Subtropical Conifer, Temperate Broadleaf, Temperate Conifer and Sub-Alpine Forests/Alpine Scrub, Small Savanna Grassland patches occur along the major rivers. Recently, the State and the Central Governments have decided to create yet another Biosphere Reserve (Tsangyang Gyatso) in the western part of the State particularly in Tawang district. As per the Forest Survey of India report of 2003, the forest cover area is 68,019 km^2 constituting 61.5% of the total geographical area of the state and 6.7% of the country's area.

History

Arunachal Pradesh attained its statehood on 20 February 1987 and the people of the State are predominantly tribal, with Scheduled Tribes forming 65% of the population. There are 26 main tribes and numerous subtribes, each with a specific geographic distribution and distinct linguistic, cultural and social identities. However, the larger West Kameng and Tawang districts have a lower human density with the people belonging to 5 tribes: *Monpa, Sherdukpen, Khowa, Aka and Miji*.

Faunal Diversity

The state has not less than 213 fish species comprises of 143 species under 61 genera, 21 families and 8 orders representing Indo-Gangetic, Myanmarese and south Chinese regions; of which 3 are Endangered and 14 are Vulnerable species. A ZSI study has documented a list of 55 species of amphibians belonging to 21 genera, 6 families and 2 orders.

Similarly, the discovery of new vertebrate species like the Arunachal Macaque *Macaca munzala* and Bugun Liocichla *Liocichla bugunorum* and records of previously unknown species to the State (range extensions) such as the Chinese Goral *Nemorhaedatus caudatus*, Leaf Deer *Mentiacus putaoensis* and Black Barking Deer *Muntiacus putaoensis* highlights the dire need for more extensive research and systematic documentation of biodiversity of the North-east India in general and Arunachal Pradesh in particular. As a part of the Endemic Bird Areas (EBA) of Eastern Himalayas, the whole region boasts with a rich array of 'Restricted Range Species'. Arunachal Pradesh has five Critically Endangered species such as Oriental White-backed Vulture *Gyps bengalensis*, Slender-billed Vulture *Gyps tenuirostric*, Long-billed Vulture *Gyps indicus*, White-bellied heron *Ardea insignis*, and Bengal Florican *Houbaropsis bengalensis* and one Endangered species i.e., White-winged Duck *Cairina scutulata*.

Avifauna of Arunachal Pradesh

Arunachal Pradesh is one of the topmost birding areas in the world. More than 700 species of birds have been identified. It is one of the areas in India where there are chances of discovering new species. For instance, in 1998 a new taxon of Monal Pheasant (*Lophophorus* sp.) was discovered (Kumar and Singh 1999). In 2006 a new species of *Liocichla* (Aves: Timaliidae) from Eaglenest Wildlife Sanctuary was described by Athreya (2006) and he named the species as *L. bugunorum*. Arunachal Pradesh is still an unexplored area and a group of bird researchers has produced a combined list of 430 species (Islam and Rahmani, 2004). Arunachal Pradesh has five Critically Endangered species such as Oriental White-backed Vulture *Gyps bengalensis*, Slender-billed Vulture *Gyps tenuirostric*, Long-billed Vulture *Gyps indicus*, White-bellied heron *Ardea insignis*, and Bengal Florican *Houbaropsis bengalensis* and one Endangered species i.e., White-winged Duck *Cairina scutulata*. According to them, India has 17 species out of the total of 51 species of pheasants, and Arunachal Pradesh has 11 species, i.e., 2/3 of India's total pheasants.

Study Areas

Surveys were carried in Namdapha Tiger Reserve and National Park, Pakke Tiger Reserve (27°19'07"N, 92°51"37"E) Eagle Nest and Sessa Wildlife Sanctuaries (27°08'00"N, 92°21'47"E), Anini district of Arunachal Pradesh (part of Dihang-Dibang Biosphere Reserve, Mehao Wildlife Sanctuary (28°12'30"N, 95°49'11"E) and Tawang district of Arunachal Pradesh (27°23' 30"N to 27°39' 40"N and 96°15' 20"E to 96°58' 33"E) in 2005, 2006, 2009, 2013, 2014 and 2015 to find out the waterbird diversity with special reference to White-bellied Heron *Ardea insignis*.

District-Wise Wetland Areas in Arunachal Pradesh

The state as on 2009 has had 13 districts. Lohit district has highest concentration with around 45719 ha area under wetland. This is mainly due to the large number of rivers/streams area. The other two districts are: Dibang valley and East Siang with around 37,602 ha and 25,512 ha area under wetland. Tirap district has the lowest area under wetland (around 1,262 ha). Wetland category of High Altitude lakes was observed in Dibang Valley (443), Lohit (204) and Tawang (204) districts. Few high altitude lakes are observed in West Kameng, East Kameng, West Siang Lower subansiri, Upper Subansiri and Upper Siang districts also. There are no major reservoirs exists in the state. District-wise wetland area estimates is given in Table-2 shows district-wise graphical distribution of wetlands.

The districts with very high concentration of small wetlands (< 2.25 ha) are Dibang Valley and Lohit with 266 and 240 numbers respectively, while East Kameng district has lowest with 12 such wetlands. Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district.

Namdapha

Namdapha Tiger Reserve has a rich aquatic bird fauna, mostly because of many freshwater lakes/ponds located at higher altitudes as well as within the evergreen forest patches and the complex river system it has. While surveys were carried out by the research team of the Zoological Survey of India (Ghosh, 1987) from March 1981 to March 1987, the following prominent waterbirds were recorded from Namdapha: Goliath Heron *Ardea goliath*, Large Egret *Casmerodius albus*, Chinese Pond Heron *Ardeola bacchus*, Little Egret *Egretta garzetta*, Common Merganser *Mergus merganser*, Eastern Marsh Harrier *Circus spilonotus*, and at least seven species of kingfishers, beside the migrant Common Teal *Anas crecca*. However, the team did not record any White-bellied Heron. Interestingly, I did not record Goliath Heron during my surveys in two years, which the team did so. The White-bellied Heron *Ardea insignis* (Family: *Ardeidae*) is a little known species occurring in swamps, marshes and forests from Nepal through Sikkim, Bhutan and northeast Assam in India to Bangladesh, Arakan and north Burma (Walters, 1976). According to Ali and Ripley (1983), it is a highly endangered species and restricted to undisturbed reed beds and marshes in eastern Nepal and the Sikkim *terai*, Bihar (north of

Table 2. District-wise wetland areas in Arunachal Pradesh (as on August, 2009)

Sr. No.	District	Geographic Area	Wetland area	% of total wetland area	% of district geographic area
1	Tawang	2172	1822	1.17	0.84
2	West Kameng	7422	3825	2.46	0.52
3	East Kameng	4134	5443	3.50	1.32
4	Papum Pare	2875	2718	1.75	0.95
5	Lower Subansiri	10125	3607	2.32	0.36
6	Upper Subansiri	7032	3365	2.16	0.48
7	West Siang	8325	6147	3.95	0.74
8	East Siang	4005	25512	16.38	-
9	Upper Siang	10113	6686	4.29	0.66
10	Dibang Valley	13029	37605	24.15	2.89
11	Lohit	11402	45719	29.36	4.01
12	Changlang	4662	12017	7.72	2.58
13	Tirap	2362	1262	0.81	0.53
	Total	**83653**	**155728**	**100**	

Source: National Wetland Atlas: Arunachal Pradesh, SAC/RESA/AFEG/NWIA/ATLAS/06/2009, Space Applications Centre (ISRO), Ahmedabad, India, 98p.

the Ganges river), Bhutan *duars* to northern Assam, Bangladesh, Arakan and north Burma (= Myanmar). In Assam, it has been reported from Kaziranga National Park (Barua and Sharma 1999), Jamjing and Bordoloni of Dhemaji district (Choudhury, 1990; 1992; 1994), Dibru-Saikhowa Wildlife Sanctuary and Biosphere Reserve (Choudhury, 1994), Pobitara Wildlife Sanctuary (Choudhury 1996a, Baruah *et al*., 2004) and also in Namdapha Tiger Reserve, Arunachal Pradesh (Choudhury 1996b).

In January 1997, 16 White-bellied Herons were counted from Pobitara Wildlife Sanctuary, Assam- the biggest count for this species in Assam to date (Baruah *et al*., 2004). However, it has not been recorded from Nepal since 19th century, and is considered to be 'extirpated' (Baral and Inskipp, 2004). The White-bellied Heron is restricted to the southern foothills of the Himalayas, southwards at the eastern end through Bhutan and Assam, to northeast and northwest Burma. The only localities where the White-bellied Heron had been described as common were in northern Burma, for example along the Mali Kha river in Putao (Smythies, 1953) and in the Irrawady river (Stanford and Ticehurst, 1939). Since many years have passed by, no detailed accounts about the number of birds present in these areas are available, until King *et al*., (2001), had recorded a breeding-plumaged individual near the village of Ziyardum (1,000 m elevation) on 30 January 1998 in northern Myanmar (King *et al*. 2001). The team had also recorded few more individuals around Ziyardum in 1998 and 1999 and eventually these were the first sightings of this species for many years and also a handful of recent sightings in Myanmar. However, records in Myanmar as far southeast as Toungoo and Pegu suggest a migration or post-breeding dispersal (Hancock and Kushlan, 1984).

There have been a number of recent records from an area comprising north-eastern Bangladesh, Assam (India), and notably Bhutan (Inskipp and Inskipp, 1993a; b). From Bhutan's forested rivers have come repeated sightings of solitary individuals. In Bangladesh, one solitary individual was seen on a reservoir (Harvey, 1990) and a pair flushed from a forested lakeshore in the north-east (Thompson *et al*., 1993), and a solitary bird was seen in Namdapha Tiger Reserve in Arunachal Pradesh (Anon., 1994). An unusual record of a solitary individual at Chilika Lake (Orissa), south-west of the Sundarbans (Jepson, 1987) may be linked to a population reported in the Sundarbans (Scott, 1989). The species is undoubtedly very rare and is considered to be globally threatened and categorized as Endangered A2c;C1 Vulnerable D1 (IUCN, 1996). However, since there is no justification for a population estimate of over 250 mature individuals, the scarcity and the combined known degree of habitat destruction and degradation over this species' range justifies classification as Critically Endangered (Kushlan and Hafner, 2000).

Table 3. Areas surveyed within Namdapha Tiger Reserve (in 2005, 2006, and 2009) and their coordinates.

Date	River	Place	Locality
05/09/2005	Noa-Dehing	Miao	27° 31.58'N
			96° 31.13'E
05/09/2005	Noa-Dehing	Embyong	27° 29.32'N
			96° 29.42'E
05/09/2005	Noa-Dehing	7Km from Miao	27° 30.50'N
			90° 08.28'E
07/09/2005	Noa-Dehing	Manabhum	27° 30.03'N
			96° 14.29'E
09/09/2005	Noa-Dehing	Deban	27° 30.06'N
			96° 23.42'E
09/09/2005	Debannala	Deban Junction	27° 32.96'N
			96° 23.70'E
10/09/2005	Noa-Dehing	Deban to Miao	27° 30.15'N
			96° 20.99'E

11/09/2005	Noa-Dehing	Deban to 18th Mile	27° 29.81'N
			96° 24.46'E
12/09/2005	Motijheel	Deban to Motijheel	27° 29.05'N
			96° 19.81'E
15/09/2005	-	Deban to Haldibari	27° 31.46'N
96° 23.92'E			
15/09/2005	-	Hornbill Camp	27° 32.41'N
			96° 26.51'E
16/09/2005	-	Bulbulia Camp	27° 32.05'N
			96° 27.54'E
16/09/2005	Namdapha	Firmbase Camp	27° 30.74'N
			96° 30.21'E
18/09/2005	Namdapha	Firmbase	27° 31.58'N
			96° 31.13'E
19/09/2005	Namdapha	Embyong	27° 29.32'N
			96° 29.42'E
15/11/2006	Miao River	Miao	27° 29.05'N
			96° 23.59'E
17/11/2006	Noa-Dehing	Deban	27° 30.52'N
			96° 23.54'E
18/11/2006	Noa-Dehing	27-Mile	27° 28.81'N
			96° 26.38'E
19/11/2006	Noa-Dehing	Burmanala (40 Mile)	27° 29.54'N
		96° 32.29'E	
20/11/2006	Noa-Dehing	40 Mile	27° 29 54'N
			96° 32.29'E
21/11/2006	-	52-Mile	27° 28.26'N
			96° 35.15'E
22/11/2006	Noa-Dehing	56-Mile	27° 27.35'N
			96° 39.36'E
23/11/2006	Noa-Dehing	62-Mile	27° 25.94'N
			96° 43.45'E
23/11/2006	Noa-Dehing	72-Mile	27° 24.39'N
			96° 46.04'E
24/11/2006	-	Gandhigram IB	27° 16.50'N
			96° 54.88'E
25/11/2006	-	Vijoynagar IB	27° 11.39'N
			97° 00.32'E
30/11/2006	Namdapha-Noa-Dehing	Embyong	27° 29.25'N
			96° 29.32'E

Methods

Surveys were carried in Namdapha Tiger Reserve and National Park (Figure 1), Arunachal Pradesh (27°23' 30"N to 27°39' 40"N and 96°15' 20"E to 96°58' 33"E) in 2005, 2006, 2009, 2013, 2014 and 2015 to find out the waterbird diversity with special reference to White-bellied Heron *Ardea insignis*. In 2005, surveys were conducted from 4-29 September (25 days), whereas in 2006 surveys were carried out from 12 November to 08 December (27 days). Different areas were surveyed within Namdapha to study its waterbird diversity in both the years. Namdapha Tiger Reserve (1,985 km^2) is situated in Changlang district of Arunachal Pradesh bordering Myanmar. It has a wider altitudinal variation which rises from 200m to 4500m. The main river of the area is Noa-Dehing or Diyun which originates from the mountains near the Chokan Pass on the Indo-Myanmar border and flows in east-west direction which finally joins Brahmaputra. The other major river within the Reserve is Namdapha, which originates from the Phonga Pass and runs north-south before joining Noa-Dehing at Embyong near Firmbase. Apart from these main rivers, there are numerous perennial rivers and rivulets and seasonal streams which drain out waters from both Dapha Bum and Patkai ranges to the river Noa-Dehing. The area is well known for excessive rainfall which starts in winter due to 'Western disturbances' and sue to that June, July and August receive 75% of the annual rainfall which is roughly 1991 mm.

Surveys were undertaken to know the distribution of White-bellied Herons within Namdapha as there are reports of this species occurring here, and in northern Myanmar. Due to logistic reasons we did not carry out any survey for this species in Myanmar, instead covered the areas within Namdapha bordering that country. Since most of the Park is very uneven and intersected by rivers and big streams, surveys were carried out by walking along the river Noa-Dehing. At an average around 10 km were covered everyday during the surveys. Sometimes, a total of 15-18 km were covered daily looking for waterbirds including White-bellied Herons along Noa-Dehing river from Miao to Embyong in 2005 and almost the same distance from Miao to Vijoynagar. Often country-made boats of local villagers were used to cross Noa-Dehing, especially where water levels were more. However, while going from Deban to Embyong via Firmbase, circuitous route was taken and passed through Haldibari, Hornbill Camp, Bulbulia and Ranijheel (Figure 1) mainly to avoid the surging river as there was no boat available beyond Deban to cross Noa-Dehing. Field camp was set up for six nights at Firmbase close to a rivulet that was fed by Namdapha river. On certain days, other waterbodies such as Ranijheel and Motijheel were also visited situated inside the rainforest mainly to see other waterbirds, including White-winged Duck *Cairina scutulata* - as the Park is said to have a few remnant population of this little known species. In 2006, after surveying the nearby areas of Miao, I moved to Deban and then from there to Vijoynagar through Gandhigram along the river Noa-Dehing so as not to miss any significant sighting(s) of heron. Daily, I walked for 7-8 hours looking for herons on either side of the river. It took me six nights and seven days to reach Vijoynagar and the same number of days to return to Deban. Magellen-300 GPS was used to record the coordinates of various places and later on those points were plotted on the map.

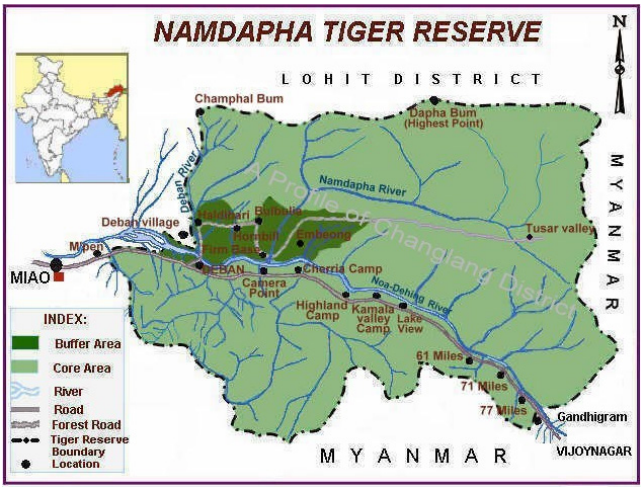

Figure 1. Map of the study Namdapha Tiger Reserve, Arunachal Pradesh.

Results and Discussion

In two years (2005 and 2006), 52 days were spent within Namdapha Tiger Reserve covering more than 250 km on foot looking for waterbirds, especially the White-bellied Heron. More than 90% of the time was spent walking along the Noa-Dehing and the remaining time was spent in visiting other waterbodies such as Ranijheel and Motijheel-two important natural ponds situated within the thick forest patches. White-bellied Herons were sighted twice in 2005 in the river Namdapha near

Embyong-where the confluence of Noa-Dehing and Namdapha takes place and thrice in 2006 in Namdapha and Noa-Dehing rivers. Assuming that these five herons are part of the 250 mature individuals of the species exist today in the wild (Kushlan and Hafner, 2000), Namdapha Tiger Reserve is considered to support about 2% of the world's total population of this species.

Rivers of Namdapha are perennial and have different depths at different places with high water current in some of the places especially where boulders are more. Crystal clear fresh water supports varieties of fish fauna which in turn attracts various bird species especially Little Cormorant *Phalacrocorax niger*, Great Cormorant *Phalacrocorax carbo* (only in winter) and Darter *Anhinga melanogaster*. Many flocks of Little Cormorant each comprises of more than 50-120 individuals were seen in Noa-Dehing River right from Miao up to Gandhigram in November/December 2006. They seem to be the big competitors of White-bellied Heron since they both depend on the fishes. However, the hunting strategy of both species differ significantly; while former prefers deep waters of the rivers whereas the later prefers mostly the edges or the places where the water level is comparatively less and strewn with boulders. Unlike in other places (especially in Assam) where the White-bellied Herons were reportedly seen in water close to reed-beds, herons of Namdapha in turn prefer fast-flowing rivers with abundant fish where human interference is negligible.

Though I could not see any significantly important migratory species (other than the Great Cormorant), presence of White-bellied Heron in Namdapha (Maheswaran, 2007; 2008) in September to December reveals that it is not a migratory species. Official photographer of the Park had taken a video footage of a lonely White-bellied Heron foraging in the fringes of river Noa-Dehing close to Deban Guest House (approx. 27° 29.06'N, 96° 24.27'E) sometime in August 2005. In January 1993, a single heron was spotted on the banks of Noa-Dehing river in between Deban and M'Pen (Choudhury, 1996b), further west of Embyong. Of the five sightings, one was in a place where the depth of water was not so high. Another sighting was in a place where the water current was relatively less with free-flowing water of roughly two feet. Presence of White-bellied Heron in such habitat is in total contrast to what Hancock and Kushlan (1984) have mentioned about it as a bird of the '*terai*' and '*duars*'. White-bellied herons were also sighted in Assam *terai* (Choudhury, 1992; Baruah *et al.*, 2004). The reasons why the herons preferred such areas in Namdapha could be due to less human disturbance and abundant fish in the rivers of the Reserve. However, within Namdapha, the Firmbase area has tall grassland patches intermingled with small streams branching out from the mighty river- Namdapha. Though, many of such streams loose much of their water during winter, possibility of herons using such streams when they have more water is not ruled out.

More than 80% of the areas within Namdapha are still unexplored, thereby raising the speculation that one could possibly see few more herons in the interior areas where accessibility is difficult. In general, though the wetlands with shallow water are ideal habitats for herons, White-bellied Herons in particular prefer to feed on fishes of rivers. The reasons behind why White-bellied heron select secluded freshwater riverbeds are not clear and still to be explored. However, I speculate that, the

Table 4. Sightings of the White-bellied Heron in Namdapha Tiger Reserve in 2005 and 2006

Date	River	Place	Locality	No. of birds
18/09/2005	Namdapha	Firmbase	27° 31.58' N	01
			96° 31.13' E	
19/09/2005	Namdapha-	Embyong	27° 29.32' N	01
	Noa-Dehing		96° 29.42' E	
19/11/2006	Noa-Dehing	27 Mile	27° 29 21' N	01
			96° 26 64' E	
20/11/2006	Noa-Dehing	40 Mile	27° 29 54' N	01
			96° 32.29' E	
30/11/2006	Namdapha-	Embyong	27° 29.25' N	01
	Noa-Dehing		96° 29.32' E	

less-disturbance in terms anthropogenic activities seems to be a prime criterion behind the heron's selection of such habitat. Unfortunately, illegal fishing is also evident within Namdapha mainly by various tribes. I had come across many abandoned fishing camps setup by tribes. Most of these camps seem very close to the rivers and I even sighted a White-bellied heron a few meters away from one of such camps in Firmbase. In Deban, Chakma tribes collect fish and fingerlings using fishing nets and mosquito nets, respectively. Fishing is also very rampant with in the Park (from Miao to Vijoynagar) mainly by Lisu tribes who reside inside the Reserve. Floods in Namdapha are usual every year and they can drastically alter available feeding habitats by rendering large areas of usually suitable feeding habitats inhospitable for the herons. More surveys are needed in Arunachal Pradesh and also in the neighbouring Assam to find out the present status of this endangered species.

Pakke Tiger Reserve

The study was conducted in Pakke Wildlife Sanctuary (862 km^2, 27°19'07"N, 92°51"37"E) in the foothill forests of western Arunachal Pradesh, in the Eastern Himalaya in a global biodiversity hotspot. The park is surrounded by contiguous forests on most sides and bounded by rivers in the east, west, and north. The terrain is undulating and hilly, with altitude ranging from 150 m to about 2000 m above sea level. The area has a tropical and subtropical climate, with cold weather from November to February. It receives rainfall from the southwest monsoon (May-September) and the northeast monsoon (December-April). October and November are relatively dry. May and June are the hottest months. The monsoon lasts till September, but occasional rains occur throughout the year. The southwest monsoon is responsible for more than three-quarters of the annual rainfall. Thunderstorms occasionally occur in March-April. The average annual rainfall is 2500 mm. The mean

Table 5. List of waterbirds recorded in Namdapha Tiger Reserve and Pakke Tiger Reserve, Arunachal Pradesh in 2005, 2006, and 2009

Common Name	**Scientific Name**
Family: Phalacrocoracidae	
Great Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)
Little Cormorant	*Phalacrocorax niger* (Vieillot, 1817)
Family: Ciconiidae	
Black Stork	*Ciconia nigra* (Linnaeus, 1758)
Family: Ardeidae	
Little Egret	*Egretta garzetta* (Linnaeus, 1766)
Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)
Black Bittern	*Dupetor flavicollis* (Latham, 1790)
Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus, 1758)
Indian Pond Heron	*Ardeola grayii*
Little Heron	*Butorides striatus*
White-bellied Heron	*Ardea insignis* Hume 1878
Common Merganser	*Mergus merganser* Linnaeus, 1758
Rudy Shelduck	*Tadorna ferruginea* (Pallas, 1764)
Northern Pintail	*Anas acuta*
Family: Anhingidae	
Darter	*Anhinga melanogaster* Pennant, 1769
Family: Burhinidae	
Eurasian Thick-knee	*Burhinus oedicnemus* (Linnaeus, 1758)
White-breasted Waterhen	*Amaurornis phoenicurus*

Family: Charadriidae	
River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)
Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)
Northern Lapwing	*Vanellus vanellus* (Linnaeus, 1758)
Long-billed Plover	*Charadrius placidus* J.E. Gray, 1863
Great Stone-Plover	*Esacus recurvirostris* (Cuvier, 1829)
Kentish Plover	*Charadrius alexandrinus* Linnaeus, 1758
Little Ringed Plover	*Charadrius dubius* Scopoli, 1786
Family: Scolopacidae	
Common Sandpiper	*Actitis hypoleucos* Linnaeus, 1758
Family: Haematopodidae	
Ibisbill	*Ibidorhyncha struthersii* Vigors, 1832
Family: Threskiornithidae	
Black-headed Ibis	*Threskiornis melanocephalus*
Family: Glareolidae	
Small Pratincole	*Glareola lacteal* Temminck, 1820
Family: Alcedinidae	
Small Blue Kingfisher	*Alcedo atthis* (Linnaeus, 1758)
Crested Kingfisher	*Megaceryle lugubris* (Temminck, 1834)
Ruddy Kingfisher	*Halcyon coromanda* (Latham, 1790)
Blue-eared Kingfisher	*Alcedo meninting* Horsefield, 1821
Lesser Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)
White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)
Family: Motacillidae	
Large Pied Wagtail	*Motacilla maderaspatensis* Gmelin, 1789
Family: Accipitridae	
Greater Grey-headed Fishing Eagle	*Ichthyophaga ichthyaetus* (Horsfield, 1821)
Family: Pandionidae	
Osprey	*Pandion haliaetus* (Linnaeus, 1758)
Family: Rallidae	
Elwe's (Black-tailed) Crake?	*Porzana bicolor* (Walden, 1872)
Family: Muscicapidae	
Brown Dipper	*Cinclus pallasii* Temminck, 1820
Plumbeous Redstart	*Rhyacornis fuliginosus* (Vigors, 1831)
White-capped Water Redstart	*Chaimarrornis leucocephalus*
Little Forktail	*Enicurus scouleri* Vigors, 1832
Slaty-backed Forktail	*Enicurus schistaceus* (Hodgson, 1836)
Black-backed Forktail	*Enicurus immaculatus* (Hodgson, 1836)
White-crowned Forktail	*Enicurus leschenaulti* (Vieillot, 1818)
Bar-headed Geese	*Anser indicus* (Latham, 1790)
Family: Laridae	
Black-headed Gull	*Larus ridibundus* Linnaeus, 1766
River Tern	*Sterna aurantia* J.E. Gray, 1831

(±SD) maximum temperature was 29.3°C±4.2 and the mean minimum temperature was 18.3°±4.7, based on data from 1983 to 1995 recorded by the Tipi Orchid Research Centre. The vegetation of the reserve is classified as Assam Valley tropical semi-evergreen forest 2B/C1. Avian species like White-winged Duck *Cairina scutulata*, Rufous-necked Hornbill *Aceros nipalensis* and Marsh Babbler *Pellorneum palustre* have been reported from this area (Choudhury 1995; Datta 1998; Datta 1999). Avifauna of PTR has been documented by some previous workers. Datta *et al*., (1998) reported 256 species from the area. Birand and Pawar (2004) also recorded about 120 species from Pakke Tiger Reserve and Nameri National Park of Assam, which is contiguous with the southern boundary of Pakke Tiger Reserve.

References

Ali, S. and Ripley, S.D. 1983. Compact Handbook of the Birds of India and Pakistan. Oxford University Press, New Delhi. pp 737.

Athreya, R. 2006. A new species of Liocichla (Aves: Timaliidae) from Eaglenest Wildlife Sanctuary, Arunachal Pradesh, India. *Indian Birds*, **2**(4): 82–94. Publication date: 8 September 2006.

Barua, M. and Sharma, P. 1999. Birds of Kaziranga National Park, India. *Forktail,* **15**: 47-60.

Barua, M., Chettri, G. and Bordoloi, P. 2004. Sighting of White-bellied Heron *Ardea insignis* Hume in Pobitor Wildlife Sanctuary. *Journal of Bombay Natural History Society*, **101**(2): 311.

Choudhury, A.U. 2000. The Black-necked crane *Grus nigricollis* in Arunachal Pradesh. *Twilight*, **2**(2-3): 31-32.

Choudhury, A.U. 2015. *Conservation of Status of threatened waterbirds in north-east India in* Gopi, G.V. and S.A. Hussain (Eds.) 2014. Waterbirds of India, ENVIS Bulletin: Wildlife and Protected Areas. Vol. 16; Wildlife Institute of India, Dehradun-248001, India.

Choudhury, A. 1990 Checklist of birds of Assam. Sofica Press and Publishers, Guwahati.

Choudhury, A.U. 1992. Sighting of the Great White-bellied Heron in Kamjing Reserve Forest, Assam. *Newsletter for Birdwatchers,* **32**(7&8): 17.

Choudhury, A.U. 1994. A report on bird survey in Dibru-Saikhowa Wildlife Sanctuary, Assam, India. *Report to the Oriental Bird Club*, U.K. 71 pp.

Choudhury, A.U. 1996a. Recent records of the White-bellied Heron from Assam and Arunachal Pradesh. Abstracts of the Sálim Ali Centenary Seminar on Conservation of Avifauna of wetlands and Grasslands, Bombay Natural History Society, Mumbai.

Choudhury, A.U. 1996b. Winter waterfowl count in Namdapha National Park. *Oriental Bird Club Bulletin,* **23**: 29-30.

Datta, A. 1998. Hornbill abundance in unlogged forest, selectively logged forest and a plantation in western Arunachal Pradesh. *Oryx,* **32**: 285-294.

Datta, A., Singh, P., Athreya, R.M., and Karthikeyan, S. 1998. Birds of Pakhui Wildlife Sanctuary in western Arunachal Pradesh. *Newsletter for Birdwatchers,* **38**: 91-96.

Ghosh, A. 1997. Fauna of Namdapha, Arunachal Pradesh-A Proposed Biosphere Reserve. *Records of the Zoological Survey of India*, **82**: 1-330.

Hancock, J.A., and Kushlan J.A. 1984. The Herons Handbook. Croom Helm, London, and Harper & Row, New York.

Harvey, W.G. 1990. Birds in Bangladesh. University Press Ltd, Dhaka.

Inskipp, C. and Inskipp T. 1993a. Birds recorded during a visit to Bhutan in Autumn 1991. *Forktail,* **8**: 97-112.

Inskipp, C. and T. Inskipp (1993b) Birds recorded during a visit to Bhutan in Spring 1993. *Forktail* 9: 121-142.

Jepson, P. 1987. Recent reports. *Oriental Bird Club Bulletin,* **6**: 36-40.

Kamei, R.G., San Mauro, G., Gower, D.J., Van, I., Bocxlaer, Sherratt, E., Thomas, A., Babu, S., Bossuyt, F., Wilkinson, M. and Biju, S.D. 2012. Discovery of a new family of amphibians from northeast India with ancient links to Africa. *Proc. R. Soc. B*. DOI: 10.1098/rspb.2012.0150.

King, B., Buck, H., Ferguson, R., Fisher, T., Goblet, C., Nickel, H and Suter, W. 2001. Birds recorded during two expeditions to North Myanmar (Burma). *Forktail,* **17**: 29-40.

Kushlan, J.A. and H. Hafner (2000) Heron Conservation. Academic Press, United Kingdom.

Maheswaran, G. 2007. Records of White-bellied Heron *Ardea insignis* in Namdapha Tiger Reserve, Arunachal Pradesh, India. *Birding ASIA,* **7**: 48-49.

Maheswaran, G. 2008. Waterbirds of Namdapha Tiger Reserve, Arunachal Pradesh with special reference to White-bellied Heron *Ardea insignis*. *Rec. zool. Surv. India*. **108**(Part-3): 109-118.

Mittermeier, R.A., Robles Gil, P., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. and da Fonseca, G.A.B. 2004. Hotspots Revisited. CEMEX, Mexico City

Scott, D.A. 1989. A directory of Asian wetlands, IUCN, Gland, Switzerland.

Smythies, B.E. 1953. Birds of Burma. 2nd ed. Oliver and Boyed, London.

Stanford, J.K. and Ticehurst C.B. 1983-1939. On the birds of northern Burma. *Ibis,* **2**(14): 65-102, 197-229, 391-428, 599-638; **3**(14): 1-45, 211-258.

Thompson, P.M., Harvey W.C., and Johnson D.L. 1993. Recent notable bird records from Bangladesh. *Forktail,* **9**: 13-15.

Walters, M. 1976. Some observations of the eggs of the Great White-bellied Heron *Ardea insignis*. *J. Bombay nat. Hist. Soc*. **73**: 213-214.