AJAY RIVER

Ecological status and trends

नमामि गंगे

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

ASSESSMENT OF THE ECOLOGICAL STATUS OF AJAY RIVER FOR CONSERVATION PLANNING

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Wildlife Institute of India, Dehradun

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Preface

India being a megadiverse country, hosts a wide number of landscapes and ecosystems. A vital component of these are their riverine networks, which are in themselves a complete ecosystem. The nation's Ganga River is an internationally revered and recognised river that has been and continues to be a haven for a variety of animals and birds, making it an extremely important area with regard to biodiversity conservation. A number of tributaries make up the mighty Ganga River, of which the Ajay River is also a part. They also provide essential provisioning and regulating ecosystem services. The Wildlife Institute of India through the Biodiversity Conservation and Ganga Rejuvenation Project and National Mission for Clean Ganga funded by the Ministry of Water Resources, River Development and Ganga Rejuvenation has been working towards the conservation of Ajay River, along with all the other tributaries of Ganga River, so as to strengthen concerted efforts for restoration of its biodiversity value. For a complete scientific assessment of Ajay River, robust information on the diversity, abundance and distribution of aquatic vertebrate fauna of Ajay River, their major threats and the various drivers of these threats causing decline in their populations and habitat is collated in the present report.

As a part of the National Mission for Clean Ganga (NMCG), in the first phase, detailed biodiversity profiling of the Ganga River was carried out and subsequently the importance of its tributaries like the Ajay River in supporting biodiversity was realized. With this in mind, in phase II the project "Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga" was envisaged to prepare a holistic restoration plan for the Ajay River through the support and involvement of stakeholders of all the Ajay states. The Wildlife Institute of India through the Biodiversity Conservation and Ganga Rejuvenation Project and this report attempts to compile biodiversity of Ajay River through literature review and Rapid Biodiversity Assessment. This report aims to develop a thorough knowledge base for the priority species of Ajay River, aid in biological restoration, and assist policy planners and managers to judiciously use water from the Ajay River, in view of the needs of the aquatic species therein.

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EXECUTIVE SUMMARY

River floodplain systems are one of the most biodiversity rich ecosystems worldwide, but are vulnerable to human activities, especially the frequently concurrent processes such as agricultural encroachment, water pollution, over-fishing, alteration of natural flow regime, species invasion, climate change and urbanisation. These dynamic systems are often poorly protected, and certainly require more adaptive and harmonised approach for conservation and restoration planning at basin scale. Therefore, identification of river habitats with high biodiversity values and prioritizing those critical habitats for ecological restoration and management intervention is a logical step towards restoration. Such approach aims at enhancing resilience to eco-geographical alterations and anthropogenic influences, as well as act as sources for future restored sites.

The Ajay River is one of the major right bank tributaries of the Bhagirathi River that passes through three riparian states. The mean annual discharge of the Ajay River at Natunhat (45 km upstream of the Ajay and Hooghly River confluence) is 65.46 $m^3 s^{-1}$ and it reaches the peak of about 247.95 $m^3 s^{-1}$ in the month of August. It passes through two distinct biogeographic zones viz., Lower Gangetic Plain- 7B and the Deccan Peninsula (Chhota Nagpur Plateau- 6B). However, the natural flow of the river has been altered due to the construction of barrages, extensive sand mining and extraction of water for agriculture and industrial purposes. Besides, during the dry season when the availability of water is reduced significantly in the river, it becomes unfit for navigation.

Considering the above, a vehicle cum boat based biodiversity survey approach was adopted from December, 2020 to January, 2021 in the Ajay River to assess ecological status and to identify areas for effective conservation planning and future monitoring. A stretch of 285 km of the Ajay River covering between Chakai village in Jamui district, Bihar and confluence at Katwa in Bardhaman district, West Bengal was evaluated following Systematic Conservation Planning approach. The objectives of this study were (1) to gather baseline data on species occurrence and distribution along wide array of riverine habitats of the Ajay River and (2) Evaluate human induced habitat alteration factors to spatially prioritize river segments for conservation planning and restoration. Thus, for ecological restoration of the Ajay River, stretches with high biodiversity values were identified using information obtained from the rapid biodiversity assessment. Habitat-defining variables such as channel depth and anthropogenic influences were also determined along the entire length of the Ajay River.

The Ajay River basin is mainly under cultivation (68%)followed by small urban settlements (16%) with an average human density of 863 individuals/km^2. The present study did not encounter indicator species, such as Gangetic dolphin, otter, gharial and mugger in the Ajay River. A total of 489 individuals representing 25 waterbird species belonging to 8 orders and 9 families were recorded. Of the total recorded species two waterbird species were of global conservation significance as each one of them are listed Vulnerable and Near Threatened category in the IUCN Red List of Threatened Species. The entire study area is generally shallow in depth (< 1 m in depth) with limited water flow during post monsoon season. Channel width ranged from 40 to 260 m (average = 140.31 ± 69) and channel depth was between 0.3 to 3.3 m (average = 0.93 ± 0.76). The banks of surveyed river segments are either loamy or rocky and characterised by forest shrub and grasses. Almost 60% and 50% of the substrate was loamy on left & right banks of the surveyed stretch of the river respectively. 80% of both the banks of the river segments were found to be partially covered by vegetation. The study stretch between Chakdaha and Katwa in the Lower zone of the Ajay River was found to be suitable for waterbirds as the average channel depth of the stretch is comparatively higher than that of the average channel depth of the Ajay River (< 1 m in depth). Besides the confluence of Ajay River and Hooghly River at Katwa in the Lower zone of the Ajay River basin allows mixing of nutrients of both the rivers and thereby enrich species diversity of the stretch between Chakdaha and Katwa. Representative bird species of this stretch include River Lapwing (*Vanellus duvacelli*), Ruddy Shelduck (*Tadorna ferruginea*), Pied Kingfisher (*Ceryle rudis*) and Marsh Sandpiper (*Tringa stagnatilis*).

A detailed study is required to know more about geomorphological characteristics of the river like channel morphology, flow regime, water qualities and anthropogenic factors which influence the survival of the aquatic

species in the Ajay River. This information could help to mitigate anthropogenic factors and would restore the river ecosystem.

1. INTRODUCTION

Ajay River is one of the major right bank tributaries of the Bhagirathi River that passes through the state of Jharkhand, Bihar and West Bengal.

1.1 Course of the Ajay River

Ajay River originates from a small hill called Chakai about 300 m asl, south west of Munger in Bihar. It then flows through the states of Jharkhand and West Bengal before joining the Bhagirathi River. The Ajay River first forms the border between Bardhaman district and Jharkhand and then between Bardhaman and Birbhum districts, and finally enters Katwa subdivision of Bardhaman district at Nareng village in Ketugram police station (Dhar, 2010). The River then joins the Bhagirathi River at Katwa Town. Total length of the Ajay River is ~300 km (Bandyopadhyay et al., 2016) (Figure 10.1). Further based on terrain characteristics, river geomorphology and biogeographical provinces the Ajay River can be broadly grouped into three segments (Figure 10.1) viz., the upper segment (Chakai-Chittaranjan), the middle segment (Chittaranjan-Ilambazar) and the lower segment (Ilambazar-Bhagirathi confluence) (Table 10.1).

Figure 1.1 Zonation of the Ajay River

1.2 Geology & Geomorphology

The Ajay River can be categorised into the upper, middle and lower zones (Figure 10.1). The upper zone lies in Bihar and Jharkhand, while the middle and lower zones fall within the western part of West Bengal. The upper and middle zones of Ajay River belong to Gondwana sediment; it is one of the aged rock sequences in India. The upper zone of the river is characterised with Archaean gneissic complex and composed of huge stratified formation of sandstones, shale and limestones (Ghosh and Guchhait, 2015). Middle zone of Ajay River is positioned in the Gondwana super groups like Raniganj formation, Talcher formation and Durgapur bed. Raniganj formation is illustrated by the supremacy of kaolinite (70%) followed by illite (15%) and smectite (15%). Similarly, Talcher formation is dominated with chlorite (60%) followed by illite (30%) and kaolinite (10%) (Saha and Naskar, 2002). The lower zone of the Ajay River is entirely covered with broad coated younger and older alluvial soil, over the rocks of tertiary age. The younger alluvial is composed of clay, silt, sand, gravel, pebble, calcareous and concretion whereas older alluvial is composed of laterite, sand, silt, ferruginous concretion, lithomargic clay and gravel.

The Ajay River basin is characterised in three geomorphic units viz. lateritic upland, older and younger alluvial terrace. The lateritic upland is mainly found near the Illambazar area and is commonly known as Illambazar formation. It is composed of ferruginous lateritic soil with sand, gravel and pebble. The elevation of Illambazar formation ranges from 54 m asl to 80 m asl (Ghosh & Guchhait, 2015). The lateritic terrain in the Bengal region extends from western part of Bhagirathi-Hooghly River to eastern part of Chotanagpur Plateau, and characterised into hilly upland, intermediate degraded plain and older deltaic plain. The river basin enters into the moderately dissected alluvial tract and covering the highest grounds above the occasional and usual flood level in the alluvial landscape of the Ajay basin. The river also forms alluvial terrace as a result of change in the regimen of the stream from alluviation to down cutting.

1.3 Soil Types

The soil in the hilly region and hill rocks of the very steep slopes of the Ajay River are yellowish brown to reddish brown, very shallow to moderate deep, light texture (skeletal). In the foot hills the soils are yellowish brown to yellowish red and dark brown having red mottle at places, moderately deep to very deep, coarse to fine loamy textured. In the lower convex and depression of very gently to gently sloping areas the soils are of fine loamy and fine, pale brown to grey and dark grey, with red mottles, deep to very deep; and in the river terrace and levee of very gently to gently sloping areas developed over recent alluvium; the soils are fine to coarse loamy (Dhar, 2010).

1.4 Climate

The catchment of the Ajay, including the Bihar and Jharkhand portion is influenced by the monsoonal regime of Southeast Asia. The area is characterised by distinct wet (June–October) and relatively dry (November– May) seasons, and the average annual rainfall varies from 1280 to 1380 mm. The wet summer monsoon season accounts more than 80% of the annual rainfall. The basin lies in the path of tropical depression or cyclonic storms, which forms in the Bay of Bengal in the monsoon period and moves generally in the north-west direction. Hence, the hydrological regime of the Ajay River is influenced by the extreme fluctuations of the monsoonal rainfall. About 75–80% of the rainfall occurs in the monsoon months of June–September in the upper catchment area of the Ajay River (Bandyopadhyay et al., 2016).

1.5 Drainage and Hydrology

The important tributaries of Ajay River are Dudhwa, Partho, Jyanti, Hinglow, Tumoni, Kunur, Kopai and Kana rivers. Kunur is the main south bank tributary of the Ajay River. It originates from the undulating land near Kanksa police station, Bardhaman and drains into the Ajay River at Kogram. Furthermore, the Brahmani River also flows through this basin in the south-east of Mangalkot police station. The Kopai river drains the northern bank of the Ajay River and merges with Bakreswar River. The natural flow of the river has been altered due to the construction of barrages, extensive sand mining and extraction of water for agriculture and industrial purposes (Roy, 2018). Besides, during the dry season when the availability of water is reduced significantly in the river, it becomes unfit for navigation. The mean annual discharge of the Ajay River at Natunhat (45 km upstream of the Ajay and Hooghly River confluence) is 65.46 m3 s-1 and it reaches the peak of about 247.95 m3 s-1 in the month of August (Mukhopadhyay,2010)

1.6 Biogeography, Flora & Fauna

The Ajay River basin bears features of two biogeographic zones, viz., Lower Gangetic Plain- 7B and the Deccan Peninsula (Chhota Nagpur Plateau- 6B) (Rodgers & Panwar, 1988). There is no available information on the occurrence of the key aquatic species from the upper and middle reaches of the Ajay River. Forest cover of upper zone is comparatively higher than of the middle and lower zones of the Ajay River basin. The Ajay River basin is mainly under forest (considerable amount in degraded state), cultivated land, waste land and built-up (Figures 10.2 & 10.3). Based on the study by Bandyopadhyay et al., (2014) around 68% area of the river basin was cultivated and around 16% area was under small urban settlements but most of the basin area was rural. Increase of human population has triggered the change of land use pattern which has resulted in the expansion of cultivated land and built up area throughout the basin (Bandyopadhyay et al., 2016).

Table 1.1 Biogeography, Floral and Faunal Assemblages of Ajay River

River	Zone	Biogeographic Zone & Province	Length (km)	Characteristics	No. of dams	Human population density (persons/km^2)	Forest cover (km^2)	Species Richness					No. of Protected Areas
								Mammal	Bird	Turtle	Gharial	Mugger	
Ajay River	Upper (Chakai-Chittaranjan)	Chhota nagpur Plateau 6B	131	Chhota Nagpur Plateau	1 (Punasi Dam)	547.45	952.3	-	-	-	-	-	-
	Middle (Chittaranjan-Ilambazar)	Area interspersed with Chhota Nagpur Plateau (6B) and Lowe Gangetic Plain (7B)	82	Narrow channel with pebbles and sand	-	969.83	524.11	-	-	-	-	-	-
	Lower (Ilambazar-confluence)	Lower Gangetic Plain (7B)	86	Alluvial plain of lower Ganga basin	-	969.83	524.11	-	8	-	-	-	Two (Ballabhpur WLS & Ramnabagan WLS)

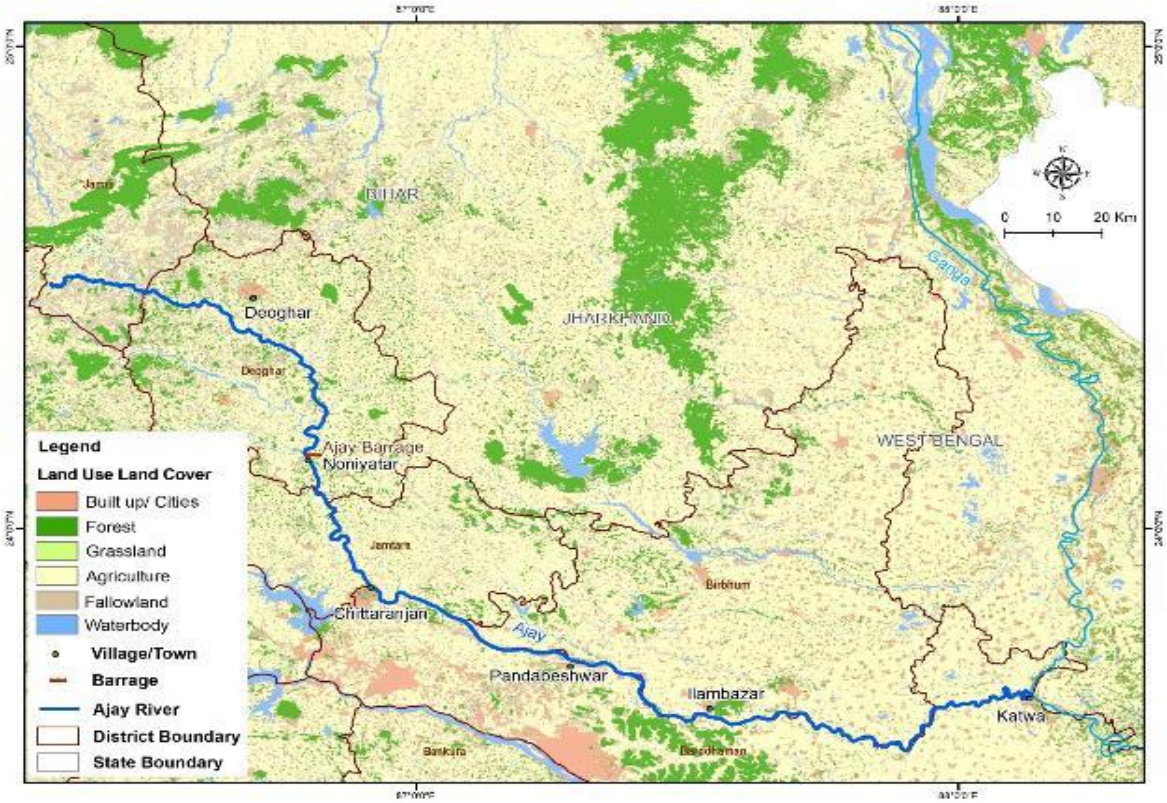

Figure 1.2 Land use and Land cover map of the Ajay River basin

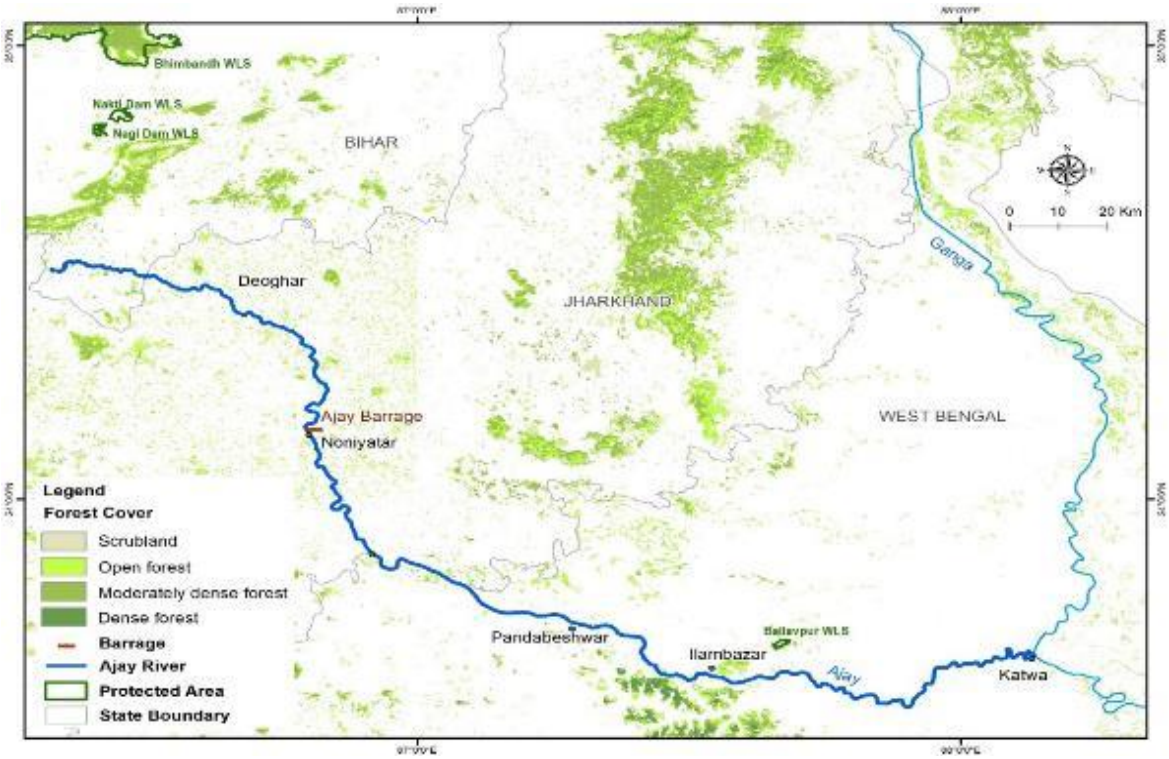

Figure 1.3 Forest cover of the Ajay River basin

1.7 Demography

The Ajay River basin supports an average human density of 863 individuals/km^2 (Figure 10.4). The upper zone of the river has an average density of 547 individuals/ km^2, which is lower than the density in the middle and lower stretches (969 individuals/km^2) of the river basin (Table 10.2).

Table 1.2 Human density along Ajay River (Source: GOI, 2011; FSI, 2019)

River	Zone	Districts	Geographical Area (Km²)	Persons	Density (Persons/km²)
Ajay	Upper	Jamui	3098	1760405	568
		Deoghar	2477	1492073	602
		Jamtara	1811	791042	437
	Middle	Bardhaman	7024	7717563	1099
		Birbhum	4545	3502404	771
	Lower	Bardhaman	7024	7717563	1099
		Birbhum	4545	3502404	771
Total			**30524**	**26483454**	**867.63**

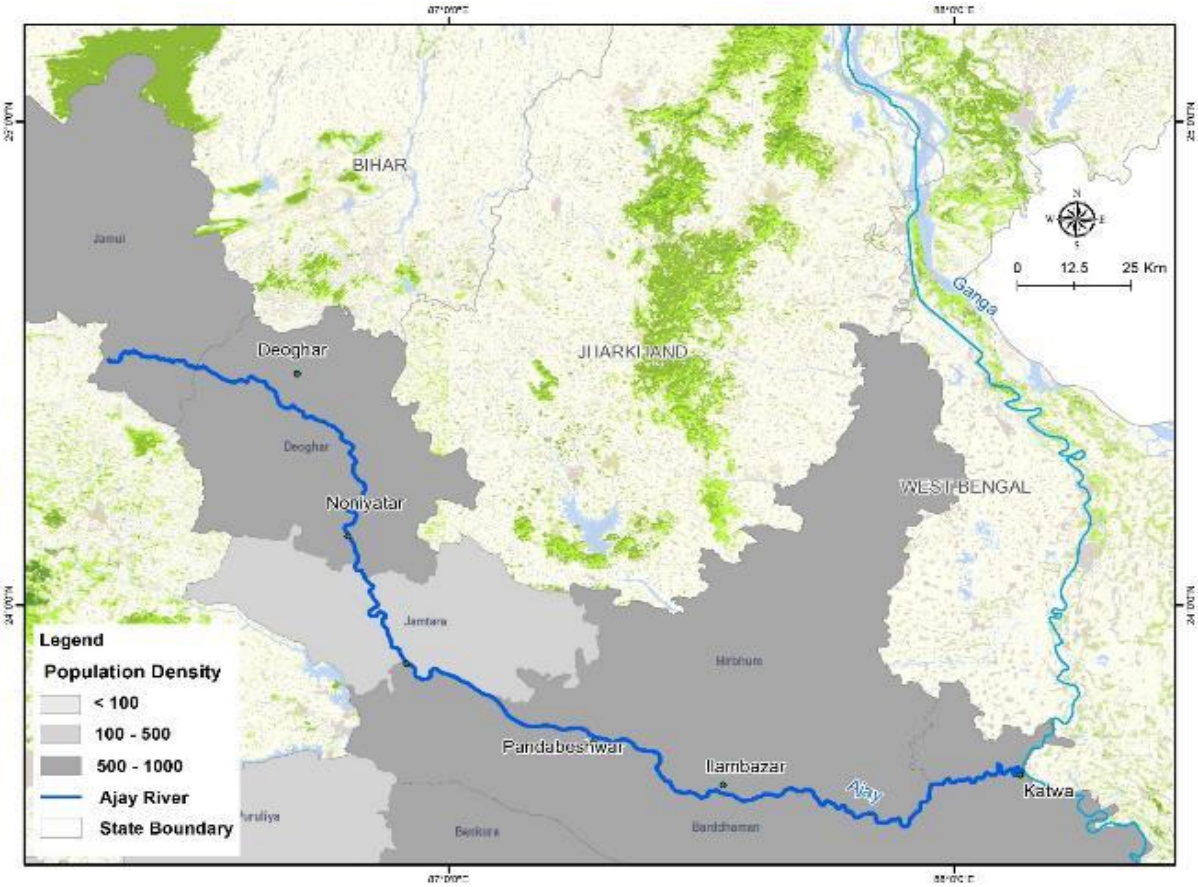

Figure 1.4 demographic map of Ajay River basin

2. STATUS OF AQUATIC WILDLIFE IN THE AJAY RIVER

2.1 Methodological Framework

A survey framework was developed with an aim to assess ecological status and to identify areas for effective conservation planning and future monitoring A reconnaissance survey was conducted in the month of February 2020 (from 10th - 14th February) to evaluate the hydromorphology, species distribution and occurrence patterns. Habitat profile and, survey protocol and species-specific assessment methods were developed. Since part of the river has insufficient depth for navigation, a vehicle cum boat based biodiversity survey approach was adopted from December, 2020 to January, 2021 covering a stretch of 285 km between Chakai village (N 24° 30’ 23.23”, E 86 ° 19 ’ 46.06 ”) in Jamui district, Bihar and confluence at Katwa (N 23° 39’ 29.08”, E 88° 07’ 47.02”) in Bardhaman district, West Bengal. Of this total 285 km, vehicle based survey was carried out from the source at Chakai (Jamui district) to Natunhat (Bardhaman district) in a stretch of 260 km covering ten river segments of 5 km each. The remaining 25 km was surveyed via boat between Chakdaha and Katwa in Bardhaman district. The objectives of this study were (1) to gather baseline data on species occurrence and distribution along wide array of riverine habitats of the Ajay River and (2) Evaluate human induced habitat alteration factors to spatially prioritize river segments for conservation planning and restoration. Species-specific assessment protocols followed are detailed below:

Gangetic dolphin

A vessel based visual count method (Perrin & Brownell, 1989; Smith & Reeves, 2000; Sinha, 1997; Smith et al., 2006; Behera et al., 2013) was adopted to enumerate the sighting occurrence of Gangetic dolphins (Platanista gangetica), sighting of dolphins was recorded between 8:00 hrs to 12:00 hrs in the morning and 16:00 hrs to 18:00 hrs in the afternoon using a country boat moving at a speed of 8–10 km per hour. Three independent observers were stationed on the motor boat in three different directions (right, left and front) to obtain concurrent records of dolphin sightings.

Gharial, Mugger and Turtle

Direct observation method was employed to assess the relative abundance and occurrence of gharial, mugger and turtle (Singh, 1985; Hussain, 2009). Two observers stationed in the survey boat recorded total numbers of individual of gharial and mugger and turtle and associated habitat parameters. The surveys were made during the peak basking time, assuming that all individuals come out from water for basking.

Avifauna

Abundance of waterbirds was obtained using Total Count Method (Sutherland et al., 2004; Sutherland, 2006). Field recordings of waterbirds were done with naked eye and using 50×10, Nikon binoculars follow by comparison with field guide (Grimmett et al., 2016; Gopi and Hussain, 2014).

Habitat Parameters

During the pilot survey, indices for habitat quality were noted down, at each 5 km interval. The parameters such as water current (slow, medium, fast), channel depth and channel width (m), Bank characteristics (right & left), shoreline vegetation (right & left), GPS coordinates, areas of confluences, meandering, downstream of sandbars, physicochemical parameters as well as anthropogenic factors were also recorded. Channel depth (m) and Channel width (m) were recorded with a help of GARMIN Striker Plus fish finder and a YUKON laser range finder, respectively. YSI ProDSS multi parameter water quality meter was used for measuring physicochemical parameters such as dissolved oxygen, pH, conductivity, salinity, TDS, water temperature. These parameters were monitored through in-situ measurement techniques following standard procedures of APHA (1998). Bank characteristics were broadly classified into five categories viz., 1. Pebbles and boulders; 2. Sandy; 3. Loamy; 4. Clayey and 5. Rocky embankment based on geomorphic features and substrate types of the river. Shoreline vegetation was grouped into three major classes i.e., fully covered (> 90% bank surface covered with riparian vegetation); partially covered (< 50% green cover) and exposed (< 10% green cover). As a measure of indices of the quality of riverbank a series of riverbank scenarios were assessed, based on bank slopes ranging from vertical (90° from horizontal) to an angle of < 30° from horizontal. Slopes of the bank were then classified into three categories viz. low slope (< 30°), medium slope (30-60°) and high slope (> 60°) (Doble et al., 2012).

2.2 Avifauna

A total of 489 individuals representing 25 waterbird species belonging to 8 orders and 9 families were recorded (Figure 1.5). Of the total recorded species two waterbird species were of high global conservation significance as each one of them are listed Vulnerable and Near Threatened category in the IUCN Red List of Threatened Species (Annexure 1). Of the nine families of waterbirds recorded, five species each belonged to Antidae and Ardeidae family, followed by three species each in Alcendinidae, Charadriidae and Motacillidae family. Phalacrocoracidae and Scolopacidae accounted for two species each, followed by one species each in Podicipedidae and Rallidae family (Figure 1.6).

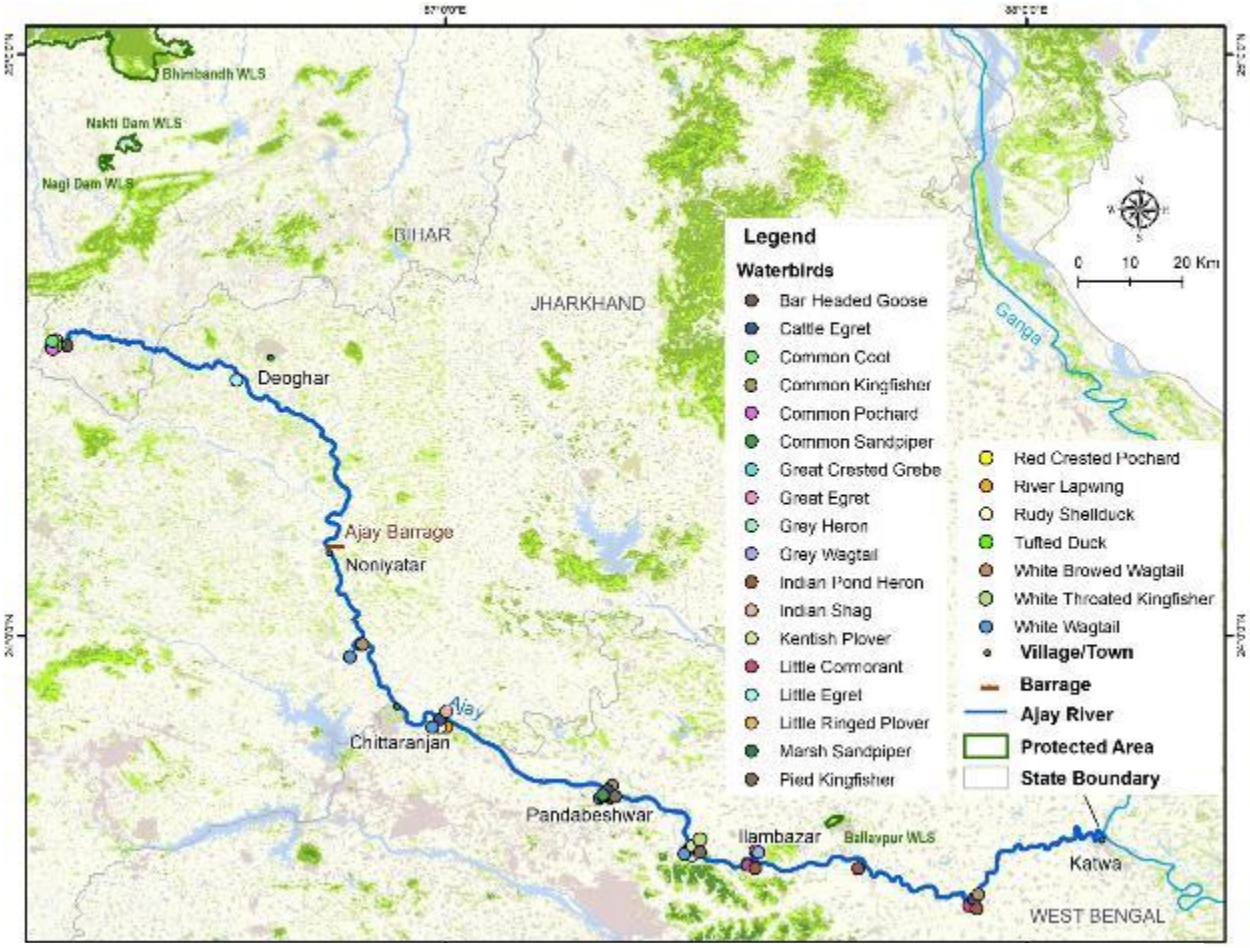

Figure 1.5 Occurrence of waterbird species recorded during post monsoon survey of the Ajay River

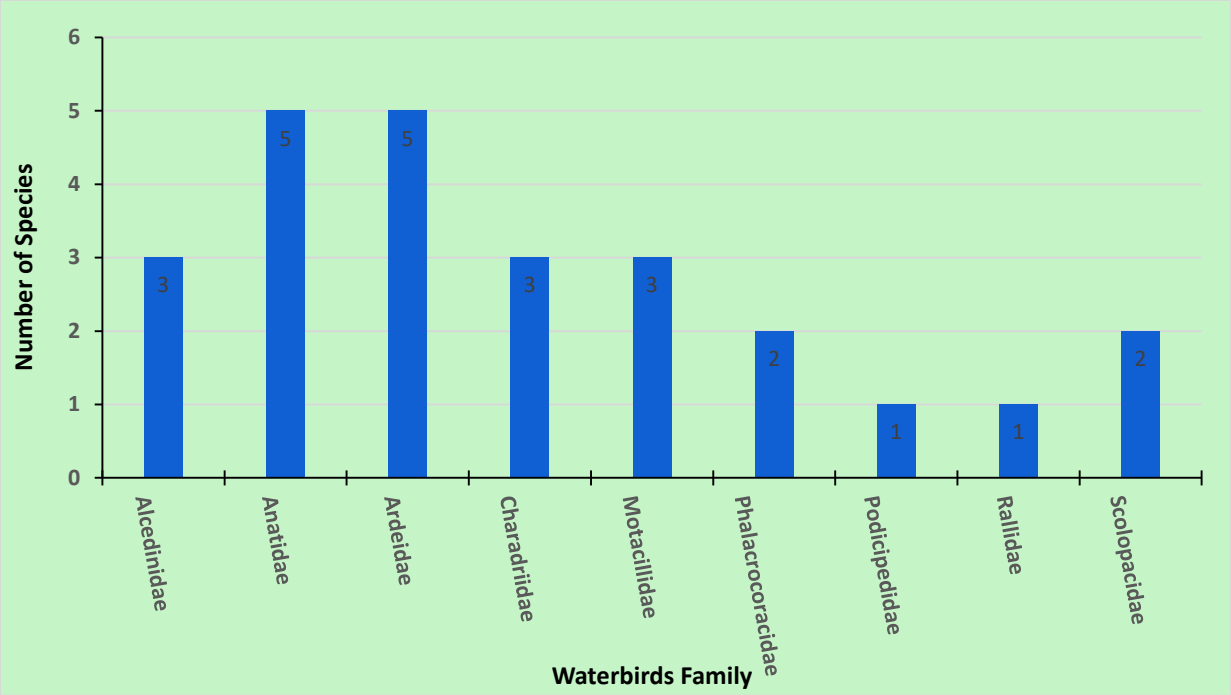

Figure 1.6 Familywise composition of waterbirds communities observed during the post monsoon survey of the Ajay River.

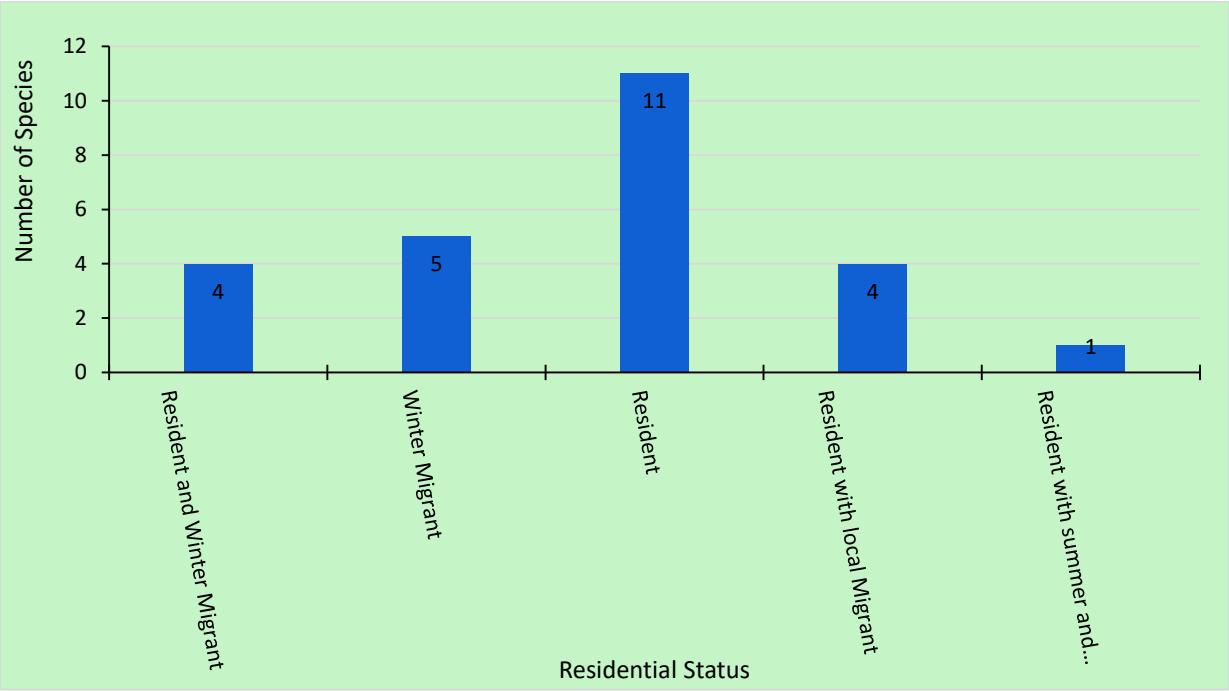

Figure 1.7 Residential status of waterbirds along the Ajay River observed during post monsoon survey of the Ajay River

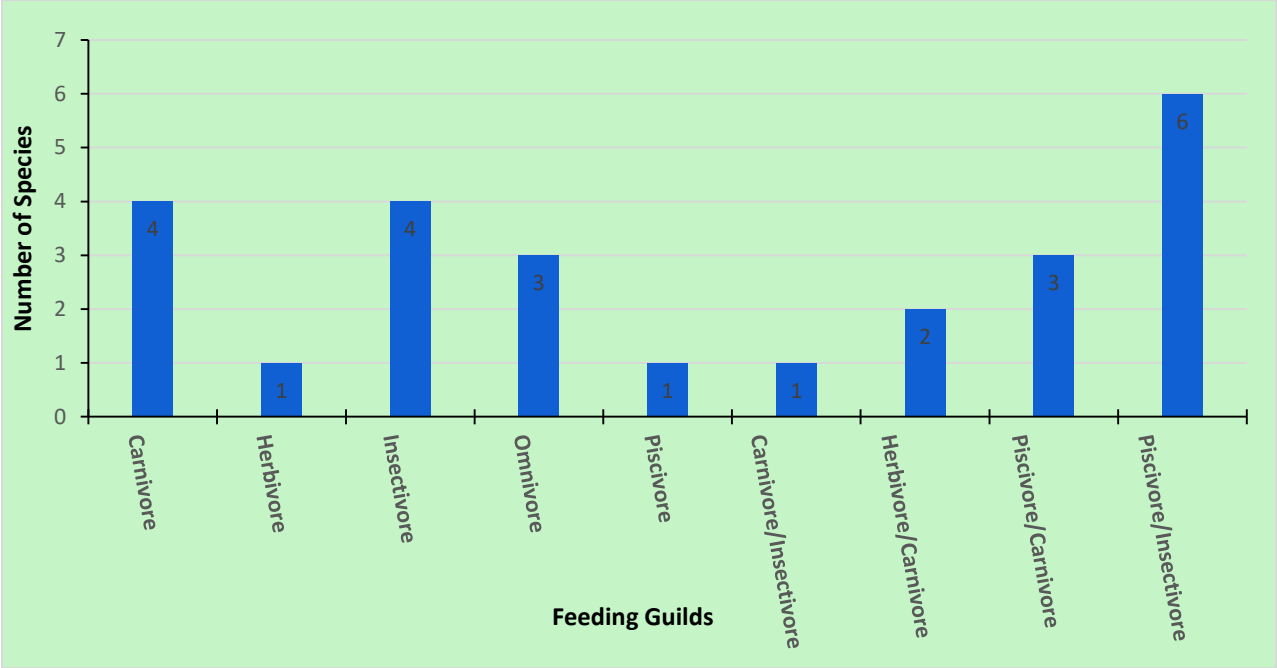

Figure 1.8 Feeding guilds composition of water birds observed during the post monsoon survey of the Ajay River

Out of the 25 species, 11 species were resident, 5 species were winter migrant,4 species each in resident and winter migrant and resident with local migrant category, followed by one species were resident with summer and winter movements (Kumar et. al. 2003) (Figure 1.7). These twenty-five species were categorized into nine feeding guilds: piscivorous/insectivorous (six species), carnivorous (four species), and insectivorous (four species) followed by three species each in omnivorous and piscivorous/carnivorous group. Herbivorous/carnivorous group accounted two species and each of the group herbivorous, piscivorous and carnivorous/insectivorous consists one species each (Figure 1.8).

2.3 Habitat quality parameters

Most of the course of the river is generally shallow in depth (< 1 m in depth) with limited water flow during post monsoon season. Channel width ranged from 40 to 260 m (average = 140.31 ± 69) and channel depth ranged between 0.3 to 3.3 m (average = 0.93 ± 0.76). The banks of surveyed river segments were either loamy or rocky and had a cover of forest shrub and grasses. Almost 60% and 50% of the substrate was loamy on Left & Right banks of the surveyed stretch of the river respectively, followed by Rocky (33.33% at right bank, 20% at left bank) and Sandy (20% at left bank and 16.67% at the right bank). About 80% of both the banks of the river segments surveyed was found to be partially covered by vegetation and 20% of both the banks were fully covered by vegetation. River bank slope of left side of the river was recorded as, high slope (10%), medium slope (80%) and low slope (10%) but on the right side, high slope was 20% and medium slope was 80%.

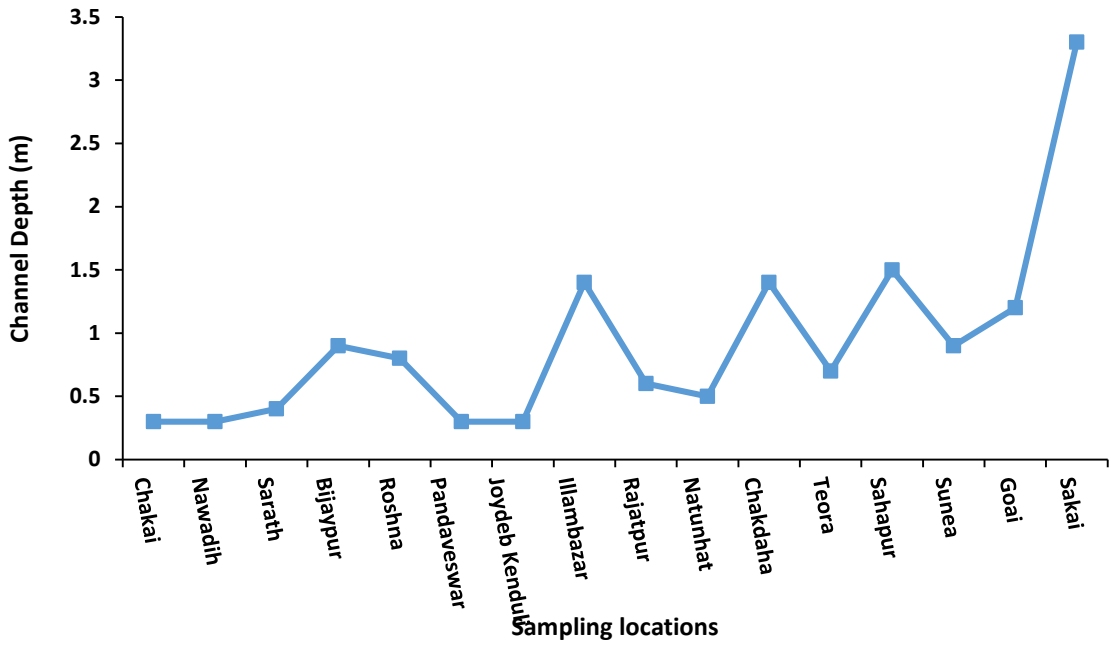

Figure 1.9 Channel depth profile of the Ajay River sampled during post monsoon season, 2020

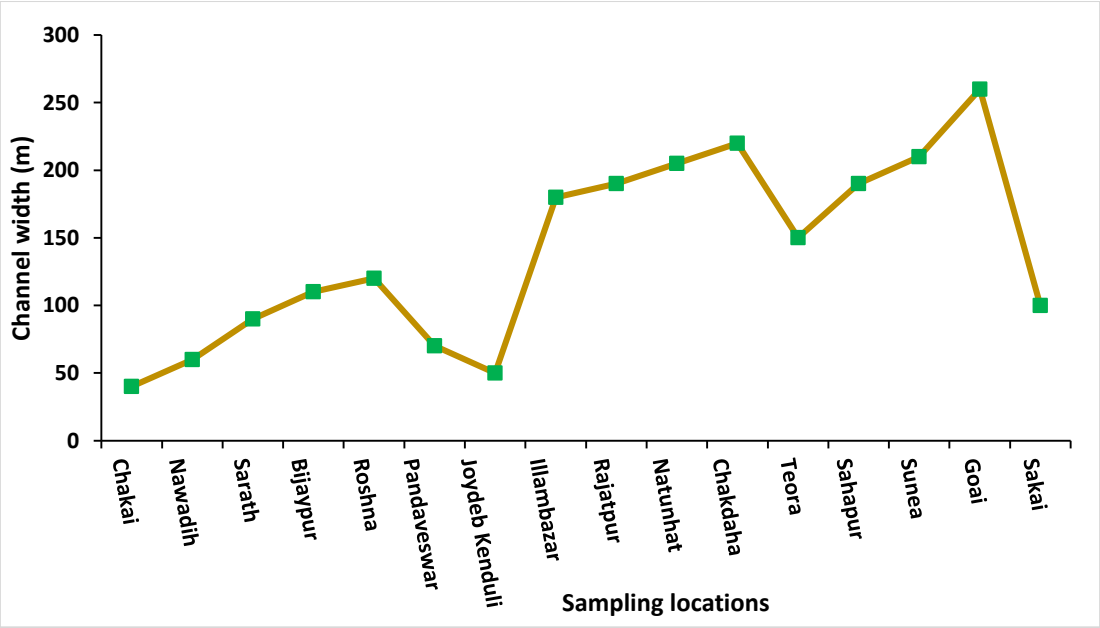

Figure 1.10 Channel width profile of the Ajay River sampled during post monsoon season, 2020

2.4 River Stretches with High Biodiversity Value

Identification of river habitats with high biodiversity values and prioritizing those critical habitats for ecological restoration and management intervention is based on the 'refuge approach' to restoration (WII-GACMC, 2018). Protecting high biodiversity stretches provide resilience to eco geographical alterations and anthropogenic influences as well as act as sources for future restored sites (Beechie et al., 2008). It also provides a measure against the likelihood of local extirpation of species. Thus, for ecological restoration of the Ajay River, stretches with high biodiversity values were identified using information obtained from the rapid biodiversity assessment. Habitat-

defining variables such as channel depth and anthropogenic influences were also assessed along the entire length of the Ajay River. The 25 km stretch between Chakdaha and Katwa in the Lower zone of the Ajay River was found to be suitable for waterbirds as the average channel depth and water availability of this stretch is comparatively higher than the average channel depth of the Ajay River (< 1 m in depth). Besides, the confluence of Ajay River and Hooghly River at Katwa in the Lower zone of the Ajay River basin allows mixing of nutrients of both the rivers and thereby enriches the species diversity of the river stretch between Chakdaha and Katwa. Representative bird species of this stretch include River Lapwing (Vanellus duvacelli), Ruddy Shelduck (Tadorna ferruginea), Pied Kingfisher (Ceryle rudis) and Marsh Sandpiper (Tringa stagnatilis). In addition, this stretch could also provide refuge to species of conservation significance such as Gangetic dolphin (Platanista gangetica) and other higher vertebrate fauna during high discharge seasons as many of the species tend to venture into smaller tributaries during monsoon.

3. THREATS TO THE BIODIVERSITY OF THE AJAY RIVER

3.1 Upper zone

- The upper zone of the Ajay river is subjected to extensive exploitation of natural products through open-cast mining of coal and mineral as well as growing industrialisation and urbanisation, which has impacted the ecological processes in this zone (Roy, 2020). Deforestation activities have escalated since the last few decades (Dhar, 2010).

- The rural population is mainly dependent on the forest products. People extensively use the woods from the forest for the domestic needs, e.g, for repairing and construction of house, manufacturing equipment and as a source of fuel. The illegal cutting of valuable woody trees species and illegal grazing in the forest is the major cause for the forest degradation (Figure 1.13).

- During the post-monsoon season, the water quality of the stretch was found to be in the range of 8.96 to 9.8 for pH (Figure 1.11) and 1.15mg/l to 1.35mg/l for Dissolved oxygen (Figure 1.12). However, for propagation of wildlife and fisheries the standards set by CPCB have determined the range of pH from 6.5 to 8.5 and for Dissolved Oxygen the value is set at 4mg/l or more (CPCB, 2012).

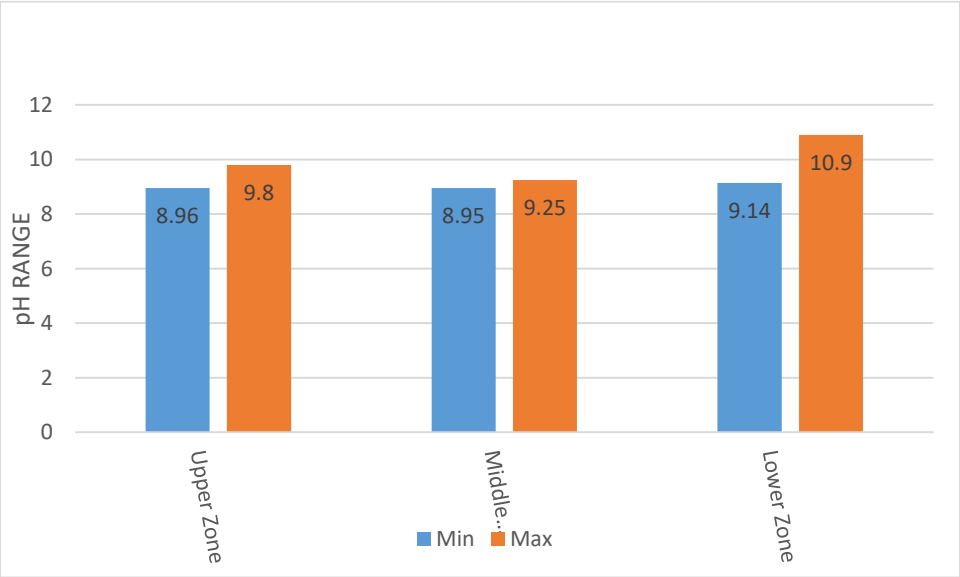

Figure 1.11 pH Levels in the upper, middle & lower stretches of the Ajay River

3.2 Middle zone

- Alteration in hydrological regimes due to construction of embankments as a measure of protection from severe floods and change in land use pattern have adversely influenced natural processes of the Ajay River (Mukhopadhyay, 2010).

- Relatively longer dry season (November- May) and emerging sand splay due to high human interference could have altered the physical structure and riparian vegetation of the Ajay River (Mukhopadhyay, 2010; Bandyopadhyay et al., 2016).

- During the post-monsoon season, the water quality of this stretch was found to be in the range of 8.95 to 9.25 for pH (Figure 10.11) and 1.87mg/l to 3.39mg/l for Dissolved Oxygen (Figure 10.12). It gradually increased from the upper stretch to the lower stretch, dissolved oxygen range in lower zone was favourable to sustain many fishes and other aquatic fauna.

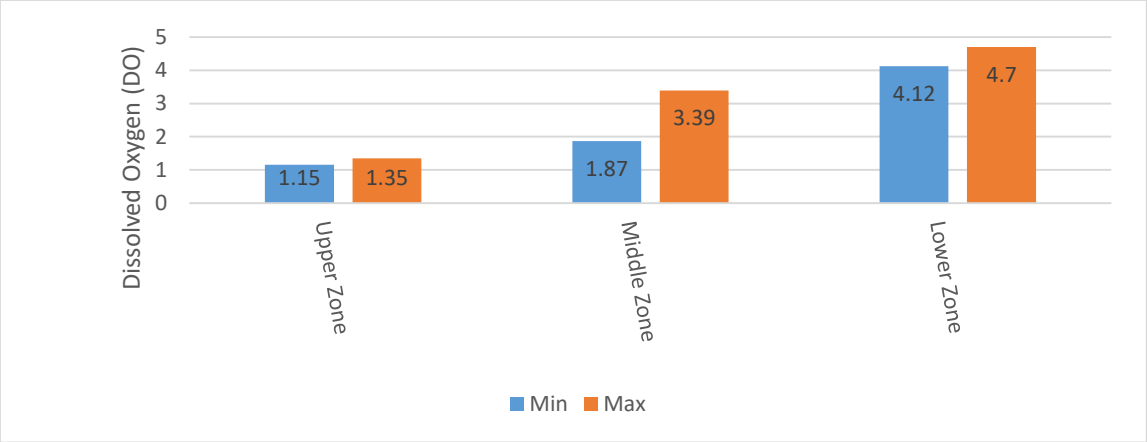

Figure 1.12 Dissolved Oxygen (DO) levels found in the upper, middle and lower stretches of the Ajay River.

3.3 Lower zone

- Alteration of channel morphology, construction of embankments, increasing transport networks and expansion of urban areas has led to loss of connectivity between upstream and downstream channels and possibly resulted in ecological impairment of the Ajay River (Roy, 2020).The floodplain and native riparian vegetation in this zone of the river has also been widely replaced by extensive riverbed agriculture and supports highest human density (935 persons/km2) among the three zones of the Ajay River.

- From the present study it is evident that in the Lower zone of the Ajay River, sand mining activities, riverbank agriculture and water extraction for irrigation are widespread and likely to have a significant negative impact (Figure 10.13). Besides, commercial fishing, ferry services, brick kilns and livestock grazing near riverbank also threaten the integrity of the river (Table 1.3).

- The Ajay River has optimum range of dissolved oxygen(DO) and pH (CPCB, 2012) for riverine wildlife but due to high anthropogenic activity sighting of major vertebrate fauna are rare (Table 1.3). During the post-monsoon season, pH was found to be in the range between 9.14 to 10.9 (Figure 1.12) and 4.12mg/l to 4.70mg/l for Dissolved Oxygen (Figure 1.13).

Table 1.3: Occurrence of anthropogenic influences along the upper, middle & lower zones of Ajay River

Disturbances	Upper Zone	Middle Zone	Lower Zone
Sand mining	-	+	+
Fishing activity	-	+	+
Livestock	+	+	+
Riverbed Agriculture	-	+	+
Human Presence	+	+	+
Ferry Intensity	-	-	-
Water Extraction	-	+	+
Brick Kiln	-	+	+
Feral Dogs	-	+	+

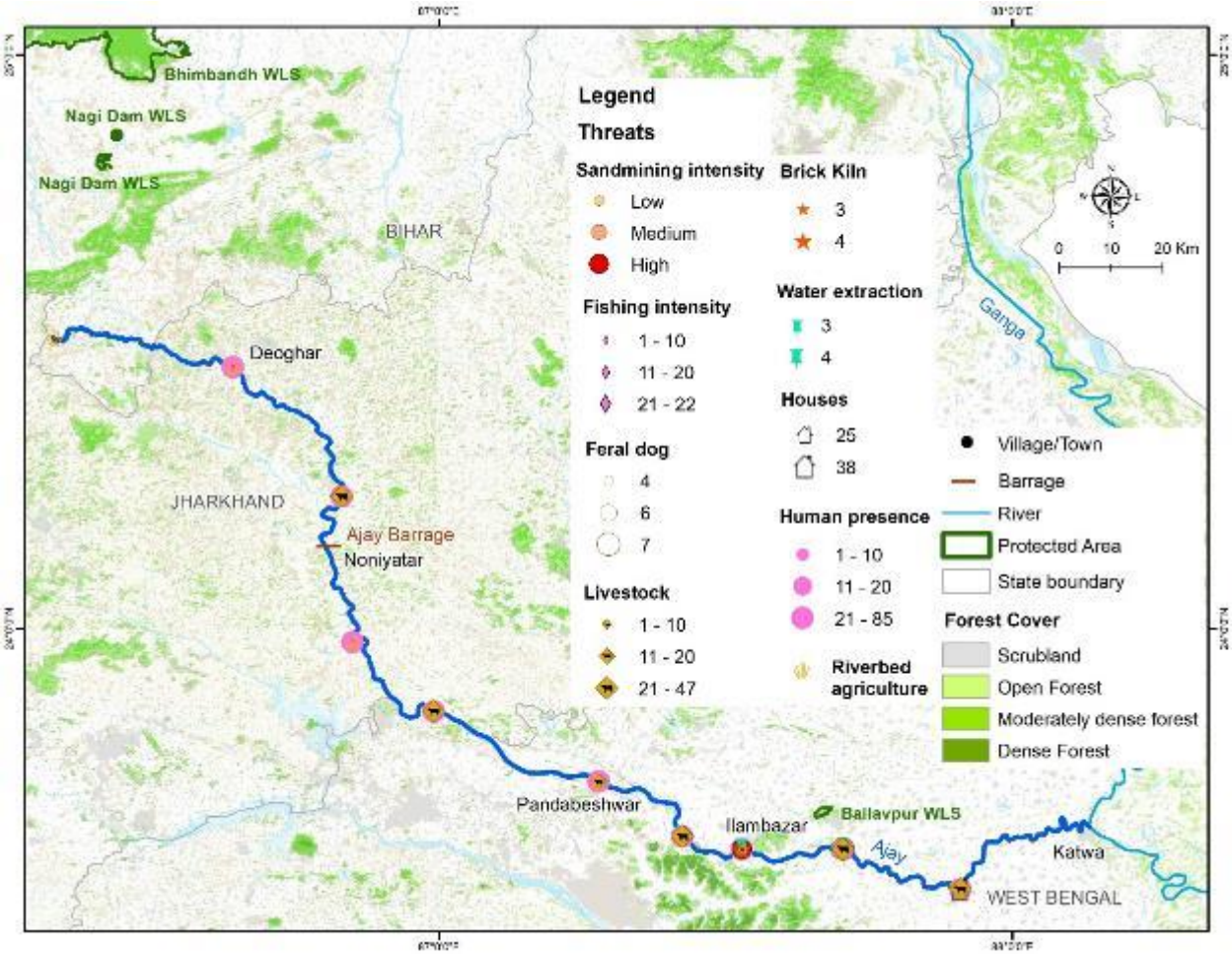

Figure 1.13 Map of threats recorded during post monsoon survey of the Ajay River

4. CONSERVATION IMPLICATIONS

- The present study did not encounter indicator species, such as Gangetic dolphin, otter, gharial and mugger in the Ajay River. However, the 25 km stretch between Chakdaha and Katwa in the Lower zone of the Ajay River was found to be suitable for water birds of high global conservation significance. Besides, the confluence of Ajay River and Hooghly River at Katwa in the Lower zone of the Ajay River basin allows mixing of nutrients of both the rivers and thereby enrich species diversity of the river stretch between Chakdaha and Katwa. Representative bird species of this stretch include River Lapwing (Vanellus duvacelli), Ruddy Shelduck (Tadorna ferruginea), Pied Kingfisher (Ceryle rudis) and Marsh Sandpiper (Tringa stagnatilis). In addition, this stretch could also provide refuge to species of conservation significance such as Gangetic dolphin and other higher vertebrate fauna during high discharge seasons as many of the species tend to venture into smaller tributaries during monsoon Nonetheless, the stretch could offer suitable nesting grounds for many of the resident breeding water birds if due protection is provided to regulate increasing anthropogenic influences.

- A detailed study is required to know more about geomorphological characteristics of the river like channel morphology, flow regime, water qualities and anthropogenic factors which influence the survival of the aquatic species in the Ajay River. This information could help to mitigate anthropogenic factors concerned and will further restore the river ecosystem.

- Seasonal flood is very common phenomenon in the Middle and Lower zones of the Ajay River. Intense sand mining activities further amplify the flood situation in this River basin. Encouraging afforestation programmes to check bank erosion, controlled mining on river banks and limiting exploitation of riparian vegetation would help in mitigation of seasonal flood occurrence.

- Community interaction and linking local livelihoods with sustainable ecotourism can help in making local people meaningful stakeholders in implementation of biodiversity conservation action plan.

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ANNEXURE I

Feeding habits, conservation and residential status of waterbirds recorded in the Ajay River

Order	Family	Species Name	Scientific Name	IUCN Status	Residential status	Feeding Guilds	Reconnaissance survey 2020	Post monsoon 2020
Anseriformes	Anatidae	Bar-headed Goose	*Anser indicus*	LC	R/WM	H	-	+
		Common Pochard	*Aythya ferina*	VU	WM	H/C	-	+
		Red Crested Pochard	*Netta rufina*	LC	WM	H/C	-	+
		Ruddy Shelduck	*Tadorna ferruginea*	LC	WM	O	+	+
		Tufted Duck	*Aythya fuligula*	LC	WM	O	-	+
Charadriifomes	Charadriidae	Kentish Plover	*Charadrius alexzandrinus*	LC	R/LM	C	-	+
		Little Ringed Plover	*Charadrius dubius*	LC	R	C	-	+
		River Lapwing	*Vanellus duvaucelli*	NT	R	C	+	+
		Red wattled Lapwing	*Vanellus indicus*	LC	R	C	+	-
	Scolopacidae	Common Greenshank	*Tringa nebularia*	LC	WM	C	+	-
		Common Sandpiper	*Actitis hypoleucos*	LC	R/WM	I	-	+
		Marsh Sandpiper	*Tringa stagnatilis*	LC	WM	C	-	+
Ciconiiformes	Ciconiidae	Asian Openbill	*Anastomus oscitans*	LC	R	C	+	-
Coraciiformes	Alcedinidae	Common Kingfisher	*Alcedo atthis*	LC	R/SM/WM	P/I	+	+
		Pied Kingfisher	*Ceryle rudis*	LC	R	P/I	-	+
		White-throated Kingfisher	*Halcyon gularis*	LC	R	P/C	-	+
Gruiformes	Rallidae	Common Coot	*Fulica atra*	LC	R/WM	O	-	+
Passeriformes	Motacillidae	Grey Wagtail	*Motacilla cinerea*	LC	R	I	-	+
		White-browed Wagtail	*Motacilla maderaspatensis*	LC	R	I	-	+
		White Wagtail	*Motacilla alba*	LC	R	I	+	+
Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*	LC	R	C/I	-	+
		Great Egret	*Ardea alba*	LC	R/LM	P/I	-	+

		Grey Heron	*Ardea cinerea*	LC	R	P/I	-	+
		Indian Pond Heron	*Ardeola grayii*	LC	R/LM	P/I	-	+
		Little Egret	*Egretta garzetta*	LC	R/LM	P/I	-	+
Podicipediformes	Podicipedidae	Great Crested Grebe	*Podiceps cristatus*	LC	R/WM	P/C	-	+
Suliformes	Phalacrocoracidae	Indian Cormorant	*Phalacrocorax fuscicollis*	LC	R	P	+	+
		Little Cormorant	*Microcarbo niger*	LC	R	P/C	-	+

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Abbreviation: NT-Near threatened, VU-Vulnerable, LC-Least Concerned,
R- Resident, WM-Winter migratory, R/WM-Resident and winter migrant, R/LM-Resident with local migrant,
R/SM/WM-Resident with summer and winter movements,
C-Carnivore, H-herbivore, O-Omnivore, P-Piscivore, I-Insectivore, H/C-Herbivore/Carnivore, P/I-Piscivore/Insectivore, C/I- Carnivore/Insectivore, P/C-Piscivore/Carnivore

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