

CHAMBAL RIVER

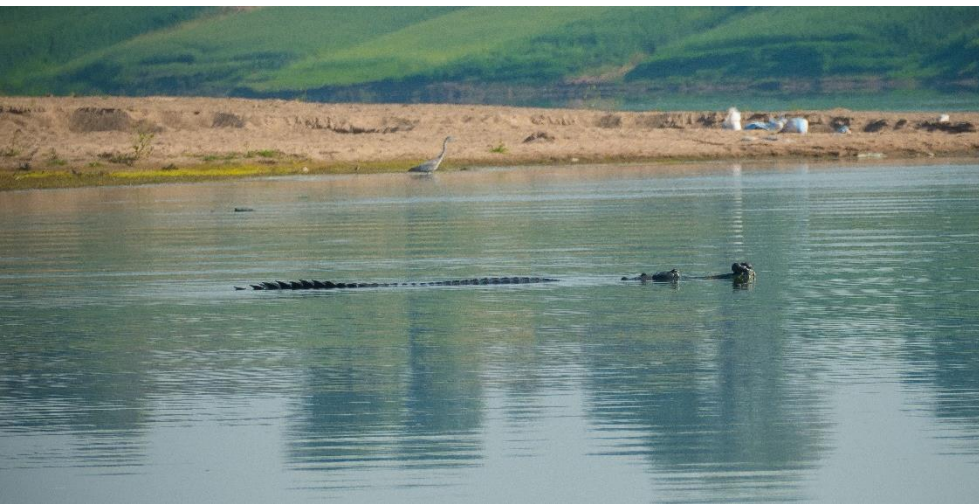
Ecological status and trends



नमामि
गंगे



भारतीय वन्यजीव संस्थान
Wildlife Institute of India



ASSESSMENT OF THE
ECOLOGICAL STATUS OF
CHAMBAL RIVER FOR
CONSERVATION
PLANNING

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Wildlife Institute of India, Dehra Dun**

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CHAMBAL RIVER

Ecological status and trends

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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 Chambal 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 Chambal 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 Chambal River, robust information on the diversity, abundance and distribution of aquatic vertebrate fauna of Chambal 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 Chambal 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 Chambal River through the support and involvement of stakeholders of all the Chambal states. The Wildlife Institute of India through the Biodiversity Conservation and Ganga Rejuvenation Project and this report attempts to compile biodiversity of Chambal River through literature review and Rapid Biodiversity Assessment. This report aims to develop a thorough knowledge base for the priority species of Chambal River, aid in biological restoration, and assist policy planners and managers to judiciously use water from the Chambal River, in view of the needs of the aquatic species therein.

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EXECUTIVE SUMMARY

River ecosystems comprise ecological, social, and economic processes (ecosystem functions) that interconnect ecosystem structures (including humans). For example, they provide water for drinking and irrigation, fish as food supply or recreational fishing, and areas for flood protection as a direct benefit. Its indirect importance, sometimes referred to as vital ecosystem services, comprises its essential function as biogeochemical transformers of energy and matter, physical transformers of the land, and the provision for a wide range of environmentally sustainable habitats across the river continuum.

The ecosystem boundaries are permeable to energy and materials flux; therefore, even large systems are influenced by the increasing intensification of land use and the associated channelisation, damming, and other radical changes (e.g., pollution, overfishing, Nutrient enrichment, etc.) and result in a shift of the functions and related services available in river landscapes. Unfortunately, besides their great ecological importance, these dynamic systems do not get the required attention for their conservation and restoration.

Identifying river habitats with high biodiversity values and prioritization vis-à-vis animal abundance can be considered a rational intervention towards better conservation and restoration. The river Chambal is one of the last strongholds of highly threatened aquatic fauna, largely due to its still relatively less disturbed nature. However, this is changing in recent times, regular scientific monitoring of its fauna can provide a vital early warning system and suggest mitigation measures.

The river Chambal is about 960 km long and is the largest tributary of the river Yamuna and in fact plays a vital role in reviving the Yamuna. The river originates and flows largely through central India. It flows through the States of Madhya Pradesh, Rajasthan and Uttar Pradesh.

The Chambal River is home to a remarkable assemblage highly threatened riverine fauna, including gharial and mugger, smooth-coated otters, ten freshwater turtles, skimmers, Gangetic dolphins, Sarus cranes, black-bellied terns, and black-necked storks, among others. However, riparian agriculture practices, illegal sand mining on the riverbank, and intense fishing are considered significant threats to the river ecosystem. In addition, there are severe risks due to changes in the natural flow of the river and variation in water depth as a result of the upstream storage dams.

Taking these factors into consideration, a rapid biodiversity assessment survey was conducted during February and March 2020 along the Chambal River as part of the National Mission for Clean Ganga. The entire length of the Chambal River was divided into five zones, namely Upper Vindhyan zone, Lower Vindhyan zone, Upper middle zone, Lower middle zone, and lower zone for the biodiversity assessment. However, the survey was conducted only in the Upper middle zone (173 Km), Lower middle zone (142 Km), and Lower zone (233 Km). The Upper middle zone extends from Kota Barrage to Banas–Chambal confluence, the lower middle zone from Banas–Chambal confluence to Basaidang and the lower zone from Basaidang to Chambal–Yamuna confluence. The underlying objectives of the survey were- (a) Biodiversity assessment in terms of the number of individuals and size classes of conservation priority species, (b) Evaluation of habitat characteristics concerning bank features, shoreline features, water quality, and water depth and (c) Evaluation of anthropogenic activities that influence the river ecosystem.

The direct count method was adopted for the estimation mammals and crocodiles during the survey. During the current study period, 75 individuals of dolphins were documented in the 233 km stretch of the river. All the dolphin sightings were restricted in the lower zone of the river. No otter presence (direct and indirect evidence) was recorded during the survey. A total of 1879 individuals of gharial, encompassing all the size classes, were recorded, adult individuals constituted the largest percentage of the sightings. Although the gharials were observed throughout the Chambal sanctuary, the relative abundance (encounter rate/km) was highest in the lower zone (6.3/km) as compared to lower middle zone (1.54/km) and upper middle zone (2.58/km). The mugger population has shown an increasing population trend in the NCS, where the current survey work in 2020 documented 617 individuals of all size classes. The encounter rate of the animal was found to be maximum in upper middle zone (2.08/km), followed by the lower zone (1.58/km) and lower middle zone (1.07/km). Overall, the abundance and distribution of the aquatic species was found to be higher in lower zone as compared to middle and upper middle zones. These

differences can mainly be attributed to key habitat features such as presence of large sandbanks, adequate water depth and riverine islands in the lower stretch of the river. River Habitat Index (RHI) suggests better habitat quality in the lower zone, which also recorded the highest relative abundance for Ganges River dolphin, mugger, and gharial. In the present study, enumeration of birds, amphibians, and birds has not been included.

The present survey reveals the importance of the Upper Vindhyan middle zone, Lower Vindhyan middle zone, and Lower zone as per the abundance and diversity of the animals. Therefore, these zones need proper conservation strategies to manage the wildlife. The study also calls for extending the monitoring and population estimation effort in the remaining Upper Vindhyan zone, Lower Vindhyan, for a comprehensive understanding of the wildlife status in these zones.



1. INTRODUCTION

The Chambal landscape is well-known for its historical and cultural significance, as well as its great natural beauty and biodiversity values. The Chambal is mentioned as the Charmanwati in Mahabharat in a reference to cattle skins being dried on its banks. Another source states about the origin of the Chambal River from the blood of cattle sacrificed by the king Rantideva (Jain et al., 2007). In recent past, the Chambal River and its associated ravines have been known for notorious gangs of bandits which were a serious law & order concern.



1.1 Course of the Chambal River

The Chambal is the largest tributary of the Yamuna, which in turn joins the Ganga at Prayagraj, Uttar Pradesh. It is 965 km long and in its course flows through the three largest states of India namely Madhya Pradesh (M.P), Rajasthan and Uttar Pradesh (U.P). The river originates in the northern slopes of the Vindhyan escarpment and joins the Yamuna River near Bareilly in Uttar Pradesh. After originating in the Vindhyas of Madhya Pradesh, the river flows in a northerly course for about 257 km. The rivers Shipra and Choti Kali Sindh join the Chambal in Madhya Pradesh. The river enters Rajasthan through a gorge near historic fort of Chaurasi garh. Subsequently, the river turns northeast, flows past Kota and joins one of its major tributaries, the Kali Sindh near Norera village (Laban). Another major tributary, the Parbati joins about 48 km downstream. Banas river, the largest tributary of the Chambal River joins near village Rameshwar in Khandar Block at Sawai Madhopur district. Further downstream, it flows in a straight course for 212 km, turning southeast at Panihat and continues to join the Yamuna, near Muradaganj, after a total run of 965 km. The first 274 km of Chambal lies entirely in Madhya Pradesh, the next 153 km, entirely in Rajasthan. Beyond Pali up to Panihat, 241 km of the river divides Rajasthan and Madhya Pradesh. In its last lap of 105 km, a little before it merges with Yamuna, it constitutes the border between Madhya Pradesh and Uttar Pradesh, the last 40 km of the river is entirely in Uttar Pradesh. The Chambal, is thus under a complex administrative regime (Figure 1.1). The Chambal River can be divided into Vindhyan zone, the middle zone and the lower zone based on the river geomorphological characters (Figure 1.2). The tributaries of the Chambal include Shipra, Choti Kalisindh, Sivanna, Retam, Ansar, Kali Sindh, Banas, Parbati, Seep, Kuwari, Kuno, Alnia, Mej, Chakan, Parwati, Chamla, Gambhir, Lakhunder, Khan, Bangeri, Kedel and Teelar (Jain et al. 2007; Gopal & Srivastava 2008).

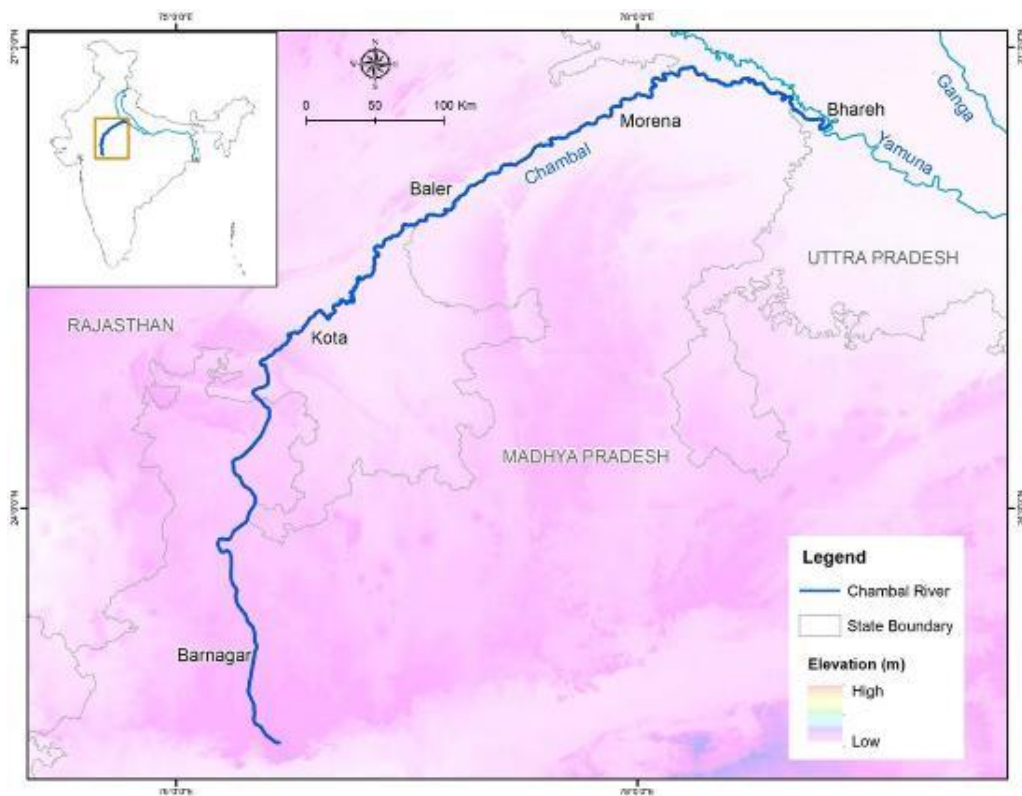


Figure 1.1
Course of the Chambal River

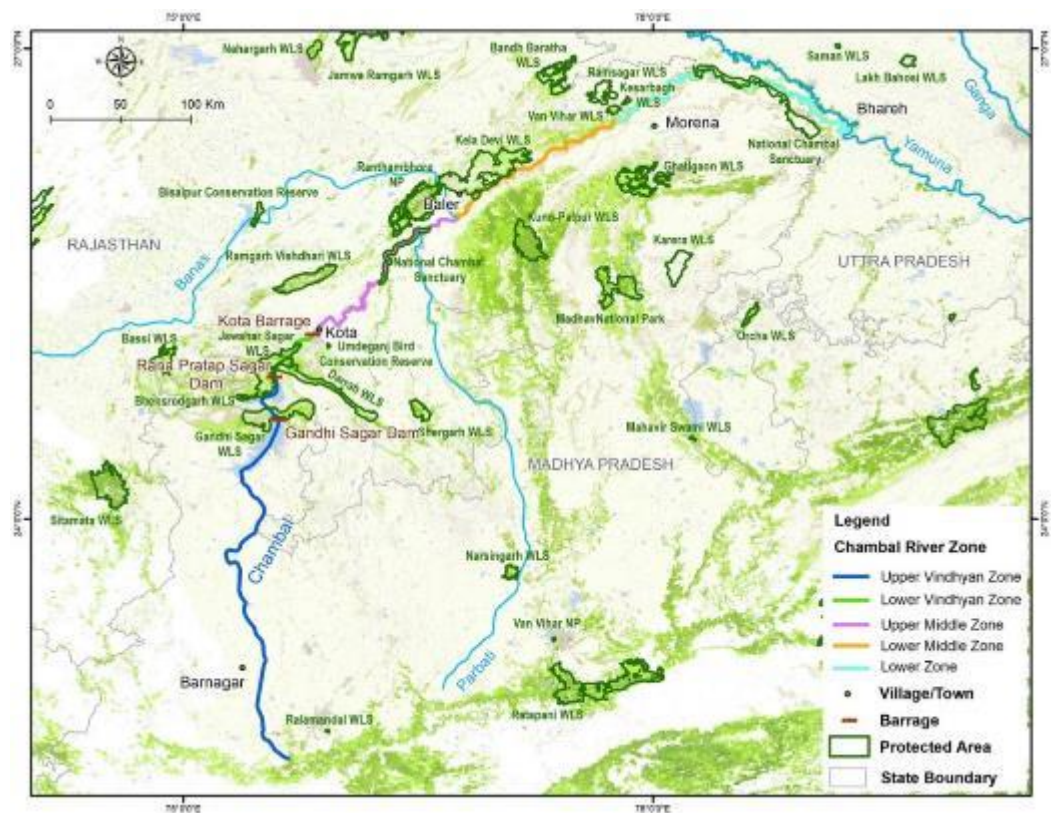


Figure 1.2
Zonation of the Chambal River

1.2 Geography and Geomorphology

The Chambal basin (22°27'N–73°20'E & 27°20'N–79°15'E) is a rain-fed basin and drains a total area of 143,219 km². The basin is characterised by an undulating floodplain, gullies, forests, ravines, and a mosaic of land-use types (Hussain & Badola 2001; Gopal & Srivastava, 2008). It is bound on the south, east and west by the Vindhyan mountain range and on the north-west by the Aravallis. The Chambal River valley consists of massive sandstone, slate and limestone deposits, of perhaps pre-Cambrian age, resting on the surface of older rocks. It is a part of the Vindhyan system, composed of large sandstone, slate and limestone. According to Heron (1953), the eastern peneplain, occurring between the Vindhyan plateau and the Aravalli hill range, contains a thin veneer of quaternary sediments, reworked soil and river channel fills. At least two erosional surfaces can be recognised within the Pedepain which are of the Tertiary age. The Vindhyan upland, the adjoining Chambal valley and the Indo-Gangetic alluvial tract (older alluvium) are of Pleistocene to sub-recent age. The ravines or badlands topography is a characteristic feature of the Chambal valley, where Kankar has extensively developed in the older alluvium.

1.3 Soil Types

The predominant soil type in the area is black soil which is distributed throughout the upper reaches of Madhya Pradesh; mixed red and black soil occurs in Mandsaur and Chittaurgarh districts; laterite soil is found in pockets particularly in Romper Plateau. Alluvial soils dominate the entire basin particularly the lower basin, which is often 60 meters thick (Sharma, 1980; Hussain & Badola, 2001).

1.4 Climate

The climate of the valley is a vital physical factor, which decides the nature, and the extent of the weathering and erosion processes and has profound influence on the agricultural conditions. In general, the valley is a part of the sub-humid regions of India with extremes of temperature and rainfall.

The mean annual rainfall over the Chambal Basin is reported to be 797 mm, of which about 93% falls during the three Monsoon months (July-September). Only 5% of the rainfall occurs during the cold season in the valley. Although the annual rainfall is not heavy, it can fall in intensive bouts.

One of the chief characteristics of climate of the Chambal, as other semi-arid climatic regions is the extremes of the temperature. The winter is quite cold at many places, while summers can be very hot. The period from October to February constitutes the cold season. January is the coldest month of the year. At Kota, the daily mean maximum and minimum temperatures are 25.02°C and 10.61°C respectively, the mean being 17.81°C. From February to April, the daily mean maximum and minimum temperatures rise at the rate of about 2.5°C to 3.0°C during the successive months. The highest temperature is recorded in May when hot season is at its peak, with daily mean maximum and minimum temperatures at 41.5°C and 29.08°C respectively, the mean being 35.29°C (as recorded at Kota). The weather cools down with the onset of monsoon and brings relief after prolonged heat of the summer season. July-August is the most humid period averaging 70% to 80% humidity. Relative humidity drops to about 20% during the months of March, April and May.

1.5 The Chambal Basin

Basin of the Chambal River extends to the states of Rajasthan, Madhya Pradesh and Uttar Pradesh. Twenty-five districts in these three states are part of the basin, which covers an area of 1,20,000 km². The Gandhi Sagar dam divides the basin into upper and lower parts. The upper basin, spread over an area of 35,750 km² has 320 km length of the river in the states of Madhya Pradesh and Rajasthan, the remaining 645 km of the river flows through the lower basin with an area of 84,250 km², spread over the three states. A large part of the basin falls under the semi-arid Gujarat-Rajputana (4B) biogeographic province, and a smaller part of the basin falls under the Upper Gangetic plains (7A) biogeographic province.

1.5.1 Flora of Chambal River Basin

The Chambal region lies within the semi-arid zone of north-western India at the border of Madhya Pradesh, Rajasthan and Uttar Pradesh states. The vegetation consists of ravine thorn forest, a sub-type of the Northern Tropical Forests (Champion & Seth, 1968). This sub type typically occurs in areas receiving rainfall between 600-700 mm. Alkaline Babul savannah (5E/8b), a type of Northern Tropical Dry Deciduous Forest, also occurs in this region. Evergreen riparian vegetation is completely absent, with only sparse ground cover along the severely eroded river banks and adjacent ravine lands. The forests of the basin are a combination of semiarid tract, thorny bushes or small trees, miscellaneous forest, mixed forest and grasslands (Pathak, 2013) (Figure 1.3). In addition to these, almost pure plantations of *Acacia nilotica*, *Prosopis juliflora* may be seen. Over 1000 flowering plants have been reported from the area (Verma, 1993). The forest cover of the basin is mainly moderate to open (Figure 1.4).

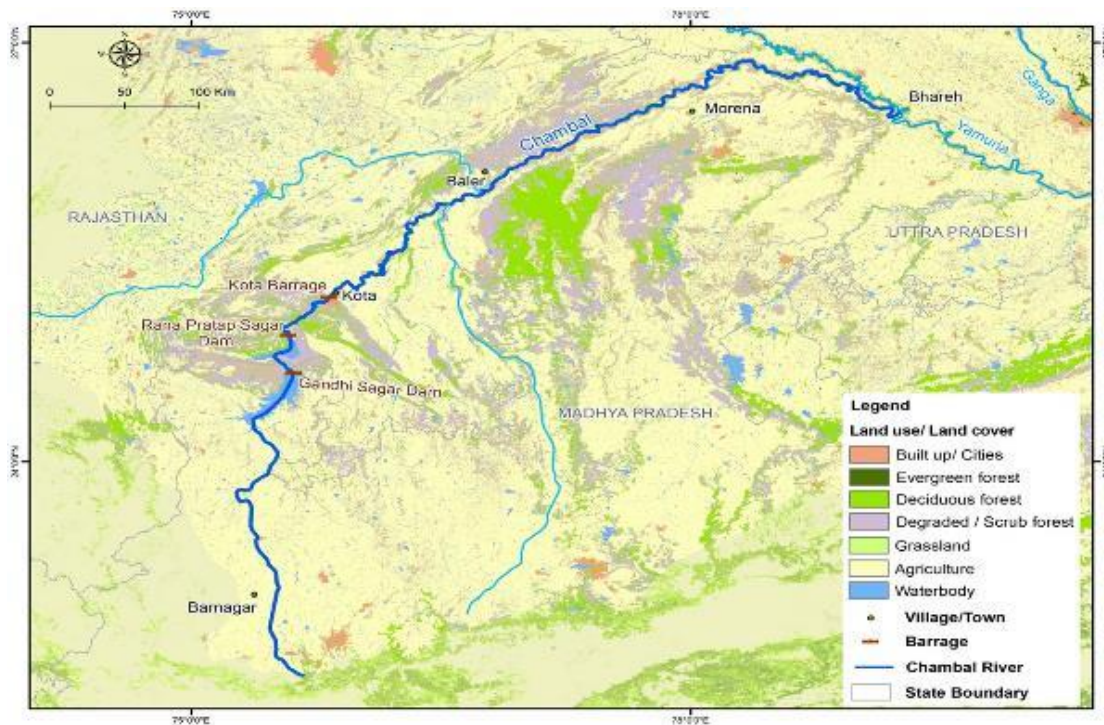


Figure 1.3

Land use and Land cover of the Chambal River





Figure 1.4
Forest cover of the Chambal River



1.5.2 Fauna of Chambal River Basin

The basin is home to scrubland terrestrial animals such as the Leopard (*Panthera pardus*), Grey Wolf (*Canis lupus*), Caracal (*Caracal caracal*), Jungle Cat (*Felis chaus*), Sloth Bear (*Melursus ursinus*) and ungulates such as Chinkara (*Gazella bennettii*) and Nilgai (*Boselaphus tragocamelus*). The gharial (*Gavialis gangeticus*), red-crowned roofed turtle (*Batagur kachuga*) and the Gangetic River dolphin (*Platanista gangetica*) are flagship aquatic species of the Chambal basin. The river harbours the largest breeding population of gharial, one of the highest densities of Gangetic dolphin, and provides nesting ground to the Indian skimmer and small Indian pratincole. Smooth coated otters and eight species of turtles are also reported from the Chambal basin. The river supports a large breeding population of the Indian Vulture (*Gyps indicus*), White rumped vulture (*Gyps bengalensis*) and Egyptian vulture (*Neophron percnopterus*).



A study conducted in 2012 (Nair & Krishna 2013) recorded 147 fish species comprising 32 families, 56 reptile species comprising 19 families, 308 bird species comprising 64 families and 60 mammal species comprising 27 families from this region. This includes six critically endangered, 12 endangered and 18 vulnerable species, as categorised by the IUCN Red List of Threatened Species (IUCN 2011).

About 5.49% of Chambal basin is under protected area (PA) network, wherein twenty-eight PAs have been notified under the Indian Wild Life (Protection) Act, 1972 (Figure 1.4). The Gandhi Sagar Wildlife Sanctuary, Jawahar Sagar Wildlife Sanctuary, Bhensrodgarh Wildlife Sanctuary, Darrah Wildlife Sanctuary, and the most notable National Chambal Sanctuary (NCS) provide protection to the aquatic habitat as well as to the threatened aquatic species. The NCS consists of a ~600 km long arc of the Chambal River, from Jawahar Sagar Dam to the Chambal–Yamuna confluence in Uttar Pradesh. Declared in 1978, it is the first riverine PA of the country. It contains the most important breeding populations of the gharial and red-crowned roofed turtle. It is also among the most important strongholds of the Deccan mahseer (*Tor khudree*), mahseer (*Tor putitora*), narrow-headed softshell turtle (*Chitra indica*), three-striped roofed turtle (*Batagur dhongoka*), Indian skimmer (*Rynchops albigollis*), Black-bellied tern (*Sterna acuticauda*), Sarus crane (*Grus antigone*) and the Gangetic River dolphin. The NCS functions as a vital source and nursery for fish fry and fingerlings, contributing significantly to downstream fisheries in the Gangetic River system

(Sivakumar & Choudhury 2008). It is an Important Bird Area particularly for the Oriental white-backed vulture (*Gyps bengalensis*), long-billed vulture (*Gyps indicus*), Pallas's fish-eagle (*Haliaeetus leucoryphus*) and greater spotted eagle (*Aquila clanga*) among others (Islam & Rahmani, 2004). Apart from being a strong candidate for World Heritage and Ramsar Convention listings, the NCS is also subject to international treaties like the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), which lists both flagship species of the NCS – the gharial and the Gangetic dolphin.

1.6 Demography

In Rajasthan, Chambal basin extends to eleven districts viz. Chittorgarh, Bhilwara, Bundi, Sawai Madhopur, Tonk, Jhalawar, Karauli, Kota, Baran, Pratapgarh and Dholpur (Anon, 2014), while in Madhya Pradesh the basin extends to twelve districts and in two districts of Uttar Pradesh (Figure 1.5). Mean human density of the basin rose from 256 persons/km² in 2000 to 323.12 persons/km² in 2011. The human density is lower than the national average of 382 persons/km². The Agra (U.P.) is most populous district with 44,18,797 persons and is also the most densely populated with 1084 persons/km². While, Karauli (Rajasthan) is the least populated with 82,960 persons and Baran (Rajasthan) has the lowest density with 175 persons/km² (Table 1.1) (Census of India, 2011).



Figure 1.5
Population density of the Chambal River

Table 1.1: Population and population density in the districts of the Chambal River basin

State	Districts	Population	Density (person/km ²)
Rajasthan	Chittorgarh	1,544,338	197
	Bhilwara	2,408,523	230
	Bundi	1,110,906	192
	Sawai Madhopur	1,335,551	297
	Tonk	1,421,326	198
	Jhalawar	1,411,129	227
	Kota	1,951,014	374
	Baran	1,222,755	175
	Pratapgarh	867,848	195
	Dholpur	1,206,516	398
	Karauli	82,960	264
Madhya Pradesh	Guna	1,241,519	194
	Indore	3,276,697	841
	Dhar	2,185,793	268
	Dewas	1,563,715	223
	Mandsour	1,340,411	242
	Bhind	1,703,005	382
	Sehore	1,311,332	199
	Shajapur	1,512,681	244
	Ujjain	1,986,864	326
	Ratlam	1,455,069	299
	Rajgarh	1,545,814	251
	Morena	1,965,970	394
	Etawah	1,581,810	384

Water Quality

Chambal is one of the least polluted rivers of the country. However, increasing human population, agricultural practices, flow reduction and industrialization along the river has increased the wastewater inflow into the river. Major cities such as Kota contribute substantial amount of untreated domestic and industrial sewage. Thermal power plant of Sri Ram Chemical Factory is also a possible source of pollution of the NCS. Increased use of chemical intensive agriculture has also added to the load of pollutants from the rural areas (Hussain et al., 2013).

2. STATUS OF AQUALIFE IN THE CHAMBAL RIVER



2.1 Methodological Framework

To prepare the status report for the Chambal River, a combined approach of comprehensive literature review and field surveys was used. Rapid biodiversity assessment was carried out during February and March 2020 along the Chambal River. The biodiversity assessment was conducted during daylight hours (1000-1600 hrs) using an inflatable boat with a 25 HP outboard motor. For the biodiversity estimation, whole length of Chambal River was divided into 5 stretches namely Upper Vindhyan zone, Lower Vindhyan zone, Upper middle zone, Lower middle zone and Lower zone. The rapid biodiversity assessment was conducted only in Upper middle zone (173 Km), Lower middle zone (142 Km) and Lower zone (233 Km). Upper Middle zone extends from Kota Barrage to Banas Chambal confluence, the lower middle zone from Banas Chambal confluence to Basaidang and Lower Zone from Basaidang to Chambal Yamuna confluence.



Gharials, muggers and gangetic dolphins were counted on the basis of direct observation. For every sighting, the number of individuals, size class and the habitat characteristics were recorded. Further, habitat characteristics such as bank features, shoreline features, and water quality and water depth were recorded at every 5 km intervals. The presence of anthropogenic activities such as illegal fishing and illegal sand mining sites were recorded as and when encountered. Direct counting method was adopted for the estimation of Birds and Mammals during the survey work.

2.2 Mammals

Gangetic Dolphin (*Platanista gangetica*)

The Gangetic dolphin, the national aquatic animal, is one of the two aquatic mammal species found in the Chambal River. It is present in the lower 250 km stretch of the Chambal River. The species population has been regularly monitored in the NCS since 1985. Population status of dolphins in a 425 km stretch of the Chambal River was determined by surveys conducted every year between 2007 and 2010. The survey reported 82.75 ± 09.1 individuals per year, with an encounter rate of 0.19 per km (Singh et al., 2017). From November 2011 to March 2014 seven

surveys were conducted in upstream and downstream to study the status, habitat and distribution pattern of Gangetic dolphin in NCS covering a length of 180 km from Rea to Panchhnada. A total of 44 dolphin sightings were observed during these surveys (Singh et al., 2014). In 2016, 78 dolphins were sighted, in 2017, 75 and in 2018, 74 individuals were recorded. During the current survey, a total of 75 individuals were recorded in the 233 km stretch of the lower zone. All the dolphin sightings occurred in the lower half of the river, downstream of Rajghat-Dhaulpur bridge (Figure 2.1).

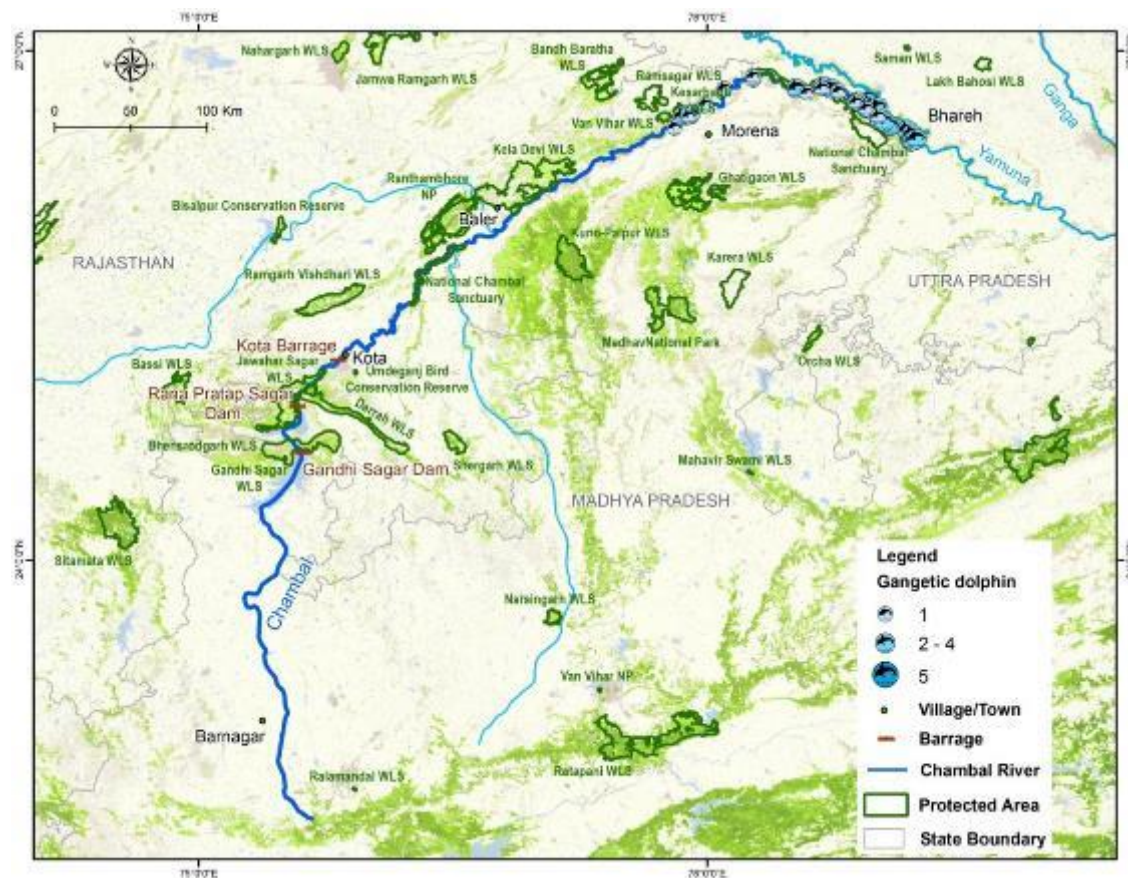


Figure 2.1
Gangetic dolphin distribution
in the Chambal River

Smooth-coated otter (*Lutrogale perspicillata*)

The smooth-coated otter is the second mammal species known to occur in the Chambal River, and most of the documentation of this species is from the NCS. The first study of otters in NCS was initiated in 1988, during which otter presence was found in 62 sampling sites over the 425 km distance between Pali and Panchhnada. Whilst the survey conducted later in 1992, otter presence was recorded in only 41 sites (Hussain, 1992). The study concluded that smooth-coated otter occupied the NCS in low densities and there has been a decline in population based on the annual surveys between 1988 and 1992 (Hussain & Choudhury, 1997). During the current survey, otter presence was not recorded either through direct sightings or indirect evidence.

2.3 Avifauna

Nair et al (2013) reported presence of 308 bird species comprising 64 families in the Chambal River basin. Among the different species of birds found in the sanctuary, bar-headed goose, brahmini duck, cormorants spp, several heron and egret species, black and white ibises, brown headed gulls, painted stork, common crane, sarus crane, spoon bills and pelicans, are some of the notable species. The NCS is also notable for the largest population of the threatened Indian skimmer.



2.4 Reptiles

Gharial (*Gavialis gangeticus*)

During 1978 the Chambal River was declared as a Crocodile Sanctuary under the Crocodile Project with an aim to provide fully protected habitat for conservation and propagation of gharial, crocodile and other wild animals. During a survey conducted between 2010 – 2014, the average number of Gharial recorded was 916.25 ± 91.6 per year with an encounter rate of 2.15 per km (Singh & Rao 2017). Current survey in NCS, recorded 1879 individuals of all size classes, adults were highest in number, followed by sub-adult and juveniles. Hatchlings were lowest in number (Table 2.1). Gharials were found throughout the surveyed stretches of the Chambal, but were most abundant in the Lower zone (1568 Individuals, encounter rate of 6.3/km) followed by Lower Middle Zone (249 Individuals, 2.58/km) and Upper Middle zone (62 Individuals, 1.54/km) (Figure 2.2).

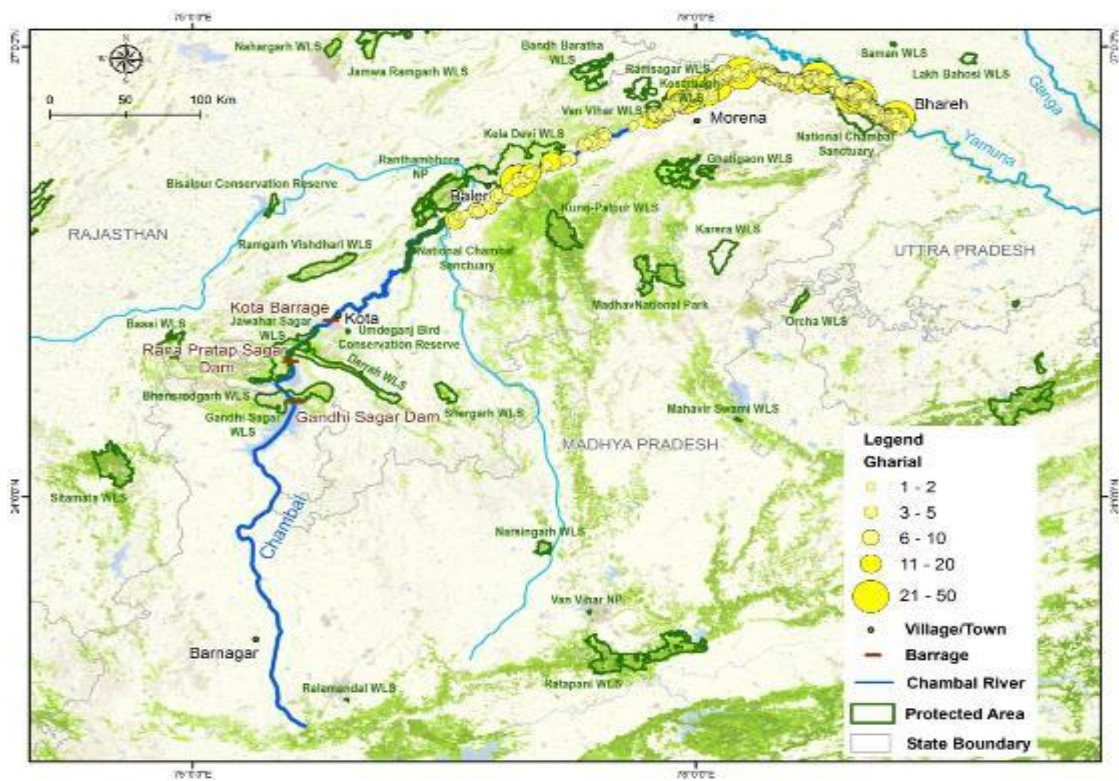


Figure 2.2
Gharial distribution in the Chambal River



Table 2.1: Abundance of gharials in different size classes

Size Class	Number of Individuals
Hatchling (<60 cm)	6
Yearling (60 – 90 cm)	74
Juvenile (120 –180 cm)	240
Sub-adult (180 –270 cm)	415
Adult (>270 cm)	1144
Total	1879

The NCS has most of the global gharial population and is the last stronghold of the species. While the gharial population in the NCS shows an increasing trend it is still extremely threatened mainly due to habitat destruction caused by illegal sand mining, dams, water extraction projects and mortality in fishing nets.



Mugger (*Crocodylus palustris*)

During a survey conducted between 2010 – 2014, the average number of mugger recorded was 235 ± 27.7 per year with an encounter rate of 0.56 per km (Singh & Rao, 2017). The current survey in 2020 recorded 617 individuals of all size classes, indicating an increasing population trend (Table 2.2).



Table 2.2 Size class wise classification of muggers sighted during the survey in the National Chambal Sanctuary

Size Class	Number of Individuals
Hatchling	0
Yearling	0
Juvenile	6
Sub-Adult	52
Adult	559
Total	617

Like the gharial, adults constituted the largest proportion of the population of muggers, followed by sub-adult and juvenile. Hatchlings and yearlings were not sighted (Table 1.3). Abundance and distribution of mugger population was found to be the highest in Lower Zone (394 Individuals), followed by Lower Middle Zone (173 Individuals) and Upper Middle Zone (50 Individuals). However, the encounter rate was highest in the Upper Middle Zone (2.08 per km), followed by Lower Zone (1.58 per km) and Lower Middle Zone (1.07 per km) (Figure 2.3).

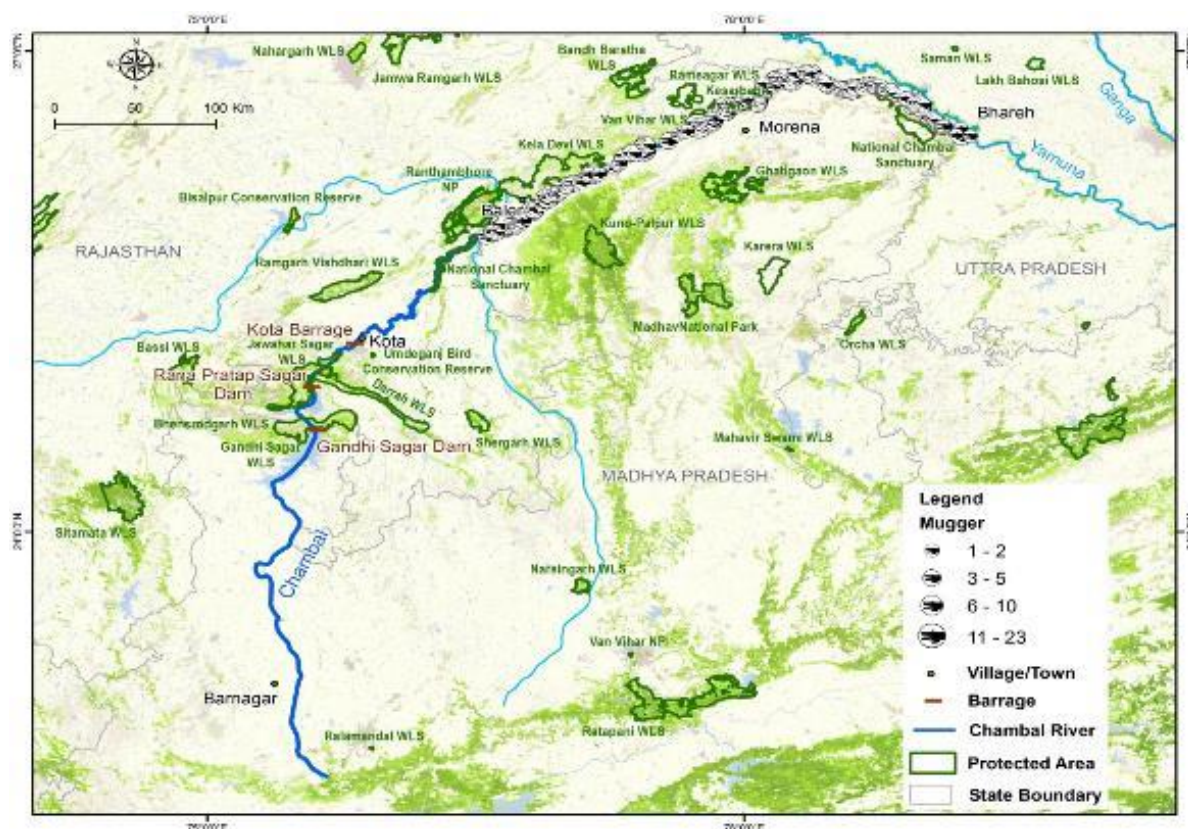


Figure 2.3
Mugger distribution in the Chambal River

Relative abundance of gharial, mugger and Gangetic dolphin were highest in the lower zone. The lower zone (extending between Rajghat and Panchnada), has several habitats feature favorable to these species. The major substrate type was Ravines on the left bank (40.8 %) and sand on the right bank (42%) of the Chambal River. Sparse and open substrate cover types were dominant along the river. Average depth was 4.32 m in the lower zone. These habitat features combine to provide the preferred habitat for the key aquatic species.

Freshwater Turtles

The Chambal River is home to nine species of freshwater turtles and one species of tortoise, making it one of the most diverse regions in terms of testudine diversity. Knowledge of these species from the Chambal River is, however, restricted only to occurrence records and a few nesting records over the years. The freshwater turtles recorded from the NCS are: red-crowned roof turtle (*Batagur kachuga*), three-striped roofed turtle (*Batagur dhongoka*), Indian tent turtle (*Pangshura tentoria*), Indian roof turtle (*Pangshura tecta*), Brahminy river turtle (*Hardella thurjii*), Indian star tortoise (*Geochelone elegans*), Indian narrow-headed softshell turtle (*Chitra indica*), Indian softshell turtle (*Nilssonia gangetica*), peacock softshell turtle (*Nilssonia hurum*) and Indian flapshell turtle (*Lissemys punctata*). The Indian tent turtle is one of the most frequently sighted turtles in the NCS. During the current survey, 127 turtle individuals were recorded along 315 km length of the Chambal River, which constitute the upper and lower middle zones.



The declining population trend of species such as the *B. kachuga* and *B. dhongoka* has prompted the Madhya Pradesh Forest Department and the Uttar Pradesh Forest Department to undertake in-situ conservation practices. Temporary in-situ hatcheries are built in a few locations where nests of the above mentioned species are kept under protection. This is with the aim of increasing hatching success and reversing the population trend.

2.5 Amphibians

In the NCS, where riverine reptiles and migratory birds are often the focus of various studies, amphibians have been poorly studied. A report by the Madhya Pradesh Forest Department dated 2013 is the only known study documenting presence of various amphibian species in the NCS. Based on the above mentioned study, a total of 10 species of amphibians have been documented from the NCS; viz., common toad (*Duttaphrynus melanostictus*), marbled toad (*Duttaphrynus stomaticus*), ornate frog (*Microhyla ornata*), Indian burrowing frog (*Sphaerotheca breviceps*), balloon frog (*Uperodon globulosus*), Jerdon's bullfrog (*Hoplobatrachus crassus*), marbled balloon frog (*Uperodon systoma*), Indian bullfrog (*Hoplobatrachus tigerinus*), skittering frog (*Euphlyctis cyanophlyctis*), cricket frog (*Fejervarya limnocharis*). Beyond this study, not much is known about the status of amphibians in the NCS or the Chambal River.

2.6 Fishes

The fish fauna of the Chambal River is rich and diverse. Various species of carps, catfish, and mullets reside in the river waters. Fifty-four species of fishes were reported from the Rajasthan part of the Chambal River. A survey in 2019 reported a total of fifty-four fish species belonging to 9 orders, 18 families and 39 genera from Madhya Pradesh part of the Chambal River (Bose et al., 2019). Group-wise distribution of fishes showed that catfishes were the most dominant (23.21%). The most dominant species as per total relative abundance of the river was *Glossogobius giuris* (6.84%). The abundance of fishes was found to be highest in winter. A total of 147 species of fish belonging to 32 families have been recorded so far from the NCS on the Chambal River (Nair et al., 2013). Out of these, 4 species

belong to the endangered category, viz., Deccan mahseer (*Tor khudree*), golden mahseer (*Tor putitora*), the freshwater whip ray (*Himantura chaophraya*) and *Puntius aurilius*. Invasive species are represented by *Hypophthalmichthys molitrix*, *Carassius carassius*, *Cyprinus carpio*, *Clarias gariepinus*, *Oreochromis niloticus* and *Oreochromis mossambicus*. Dubey and Mehra (1959) is one of the earliest available accounts of fish diversity of the Chambal region. Over the years, there have been sporadic studies documenting fish diversity. A rapid survey carried out by WII in 2017 recorded the presence of the Nile tilapia (*O. niloticus*). Bose et al (2019) found catfishes to be the dominant group with 13 species (23% of the recorded species), *Glossogobius giuris* (6.84%) was numerically the most abundant species. Detailed studies on ecological status of various species, especially species of conservation importance such as the Mahseer species are lacking. Beyond occasional sightings, very little is known about the fish fauna of the Chambal River.

2.7 Stretches with High Biodiversity Value

Of the three stretches of the surveyed river, the lower stretch had highest encounter rate for dolphin, gharial and mugger, making it the high biodiversity stretch of the Chambal River. The total length of this stretch is 233 km stretching from Basai Dang, Dhaulpur district in Rajasthan to Pachhnada, Etawah district in Uttar Pradesh. The water depth in this stretch ranges from 0.1 to 43 m with a mean value of 4.9 m. The stretch has good presence of large sandbanks and riverine islands. Human dependency in terms of riverbed farming was recorded throughout the stretch. The stretch has a healthy breeding population of gharial. During the survey 1568 gharial individuals were recorded from this stretch, including several breeding groups. A total of 75 individuals of Gangetic dolphin and 394 individuals of mugger were also recorded in the stretch.

Overall, the distribution pattern of dolphins, mugger and gharial revealed that Lower Zone, Lower Middle Zone and Upper Middle Zone of the River have significant importance for the conservation and management of these species. These zones need proper conservation strategies to manage the wildlife. The Upper and Lower Vindhyan Zones need to be surveyed to assess the distribution and abundance of aquatic wildlife.

3. THREATS TO THE BIODIVERSITY OF CHAMBAL RIVER

Major anthropogenic activities such as bankside (riparian) agriculture, sand mining and fishing, with the latter two being illegal within the protected area, have been identified as major threats to biological integrity to this River system.

3.1 Altered Hydrology

The hydrology of the Chambal River has been affected by three large upstream storage dams viz., Gandhi Sagar, Rana Pratap Sagar and Jawahar Sagar and the Kota Barrage, which were built between 1960 and 1972. These impoundments have altered the natural flow of the Chambal River to the extent that the river ceases to flow below the Kota barrage during the lean season (Hussain et al., 2011). The river revives after the Kali Sindh and the Parvati join further downstream. However, the new Parbati-Kali Sindh-Chambal Link proposes to divert the 'surplus' waters of the Parbati, Newaj and Kalisindh rivers to the Gandhi Sagar/Rana Pratap Sagar Dam on the Chambal. This will now deny the Chambal whatever water, sand and silt it receives from these tributaries. Sand banks, bars and spits are important resting and breeding sites in the National Chambal Sanctuary for crocodilians, freshwater turtles and ground nesting birds, and the loss of these sites is a major cause for their population declines. Upriver dams also exacerbate the problem by preventing down river replacement of sand, while increasing erosion by periodic and unseasonable elevation of water levels (Moll, 1997). Upstream and downstream effects of dams are well-known, stemming from inundation, flow manipulation and fragmentation. Inundation destroys terrestrial ecosystems and eliminates turbulent reaches, disfavours lotic biota. It can cause anoxia, greenhouse gas emission, sedimentation, and an upsurge of nutrient release in new reservoirs.

3.2 Riparian Agriculture

Riparian agriculture and associated activities like water abstraction via water pumps, persistent human presence as a result of pump operation and crop protection, risks of water pollution from agro-chemical use and oil leaks contribute substantially to habitat loss, degradation and pollution. Increased use of submersible pumps leads to further risk of electrocution through live wires and hazardous installations. The settlement of rights of villages falling within the sanctuary boundary and the final notification of the sanctuary has not been carried out as yet. This has proved to be a major hurdle in preventing the spread of agriculture along the banks of the river.



During the survey, bankside agriculture was documented throughout the stretch, and in most instances, it was being carried out over an entire sand bank, right till the shoreline. Such agriculture takes up the vital basking and nesting sites of the aquatic reptiles.

3.3 Sand Mining

Sand mining poses a severe threat to the basking and nesting sites of gharials and other species. Continued presence of human activity at the mining sites prevents animals from utilising the sites for their needs. Animals are thus denied access to necessary basking and nesting habitats. Sand mining was more prominent in the lower half of the NCS, particularly ~20km upstream and downstream of Rajghat (Morena).



3.4 Illegal Fishing

Fishing is more prevalent in the upper half of the NCS. Main fishing gears used is gill nets. Use of hook lines has also been observed on a smaller scale, while there are records of dynamite fishing also. Fishing using gill nets is a severe threat to most of the aquatic fauna in the Chambal River. Piscivores like the gharial, gangetic dolphin, Indian skimmer and other species of diving waterbirds are all susceptible to entanglement in the fishing nets. Over the years, several cases of gharials and muggers dying due to entanglement in fishing nets have been recorded. In 2008 and 2009, dead gharials were reported which were completely entangled in fishing nets. A mugger, similarly entangled in a fishing net was found dead in 2012, followed by two hard shell turtles entangled in fishing nets (Madhya Pradesh Forest Department records). In 2017, an adult gharial male was found dead with fishing net around its snout at Rijetha ghat.

4. CONSERVATION IMPLICATIONS

The legal protection and consistent conservation efforts have been responsible for the population recovery of the gharial, especially in the Chambal River. The NCS, thus, has been a focus of studies, especially on gharials. Project reports, annual survey reports of the MPFD, research publications and management plans are vital repositories of knowledge of the NCS. These knowledge banks, help in making informed decisions but have also highlighted knowledge gaps. These gaps need to be addressed with urgency to plan a way forward for safeguarding the ecological integrity of the Chambal River. Compared to the amount of research carried out on the Chambal River, there is a relative dearth of information regarding the freshwater turtles of the NCS. There are only 4 publications on the ecology of freshwater turtles in the NCS, out of which 3 studies were carried out over 30 years ago, while the fourth publication is based on two *Batagur* species studied over a 3-year period before 2010 (Sirsi et. al., 2017). Beyond species occurrence records (Nair & Krishna, 2013), there is little information available on the basic ecology of freshwater turtles in the NCS. As such, this indicates a major knowledge gap in the fundamental understanding of the ecology freshwater turtle. The study assessing ecological flow needs of the sanctuary pointed to diminishing flows in the sanctuary and warned against new projects on the river (Hussain et al., 2011). It is necessary to address the issue at the earliest by engaging dam authorities and proposing changing the dam operations by focusing on the ecological requirements of aquatic species. Alternate water harvesting techniques such as rainwater harvesting should be explored based on water requirements of the dependent human population so as to reduce the demand for river water. A continuous flow monitoring mechanism should be in place to determine the present state so as to make necessary changes to achieve objectives.

Way forward

Historical knowledge which is constantly updated by revisions and by addition of new information will be the key to a sound conservation strategy for safeguarding the future of the key aquatic species of the Chambal River as well as of the Ganga basin. New areas of focus should involve knowledge gaps in understanding the current status of different species. The socio-economic status of the human population dependent on the NCS should be factored in. The importance of restoring the Chambal River needs to be highlighted to involve the local residents and garner their support.

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ANNEXURE I

Annexure I List of plant species from Chambal River basin

Family	Scientific name	Common name
Anacardiaceae	<i>Lannea coromandelica</i>	Indian Ash Tree
Apocynaceae	<i>Pergularia daemia</i>	Pergularia
Apocynaceae	<i>Calotropis procera</i>	Apple of Sodom
Apocynaceae	<i>Leptadenia pyrotechnica</i>	Khimp
Apocynaceae	<i>Ceropegia bulbosa</i>	Khadula
Asteraceae	<i>Xanthium indicum</i>	Common cocklebur
Burseraceae	<i>Boswellia serrata</i>	Indian Frankincense
Capparaceae	<i>Capparis decidua</i>	Kerda
Capparaceae	<i>Capparis sepiaria</i>	Wild Caper Bush
Capparaceae	<i>Maerua oblongifolia</i>	Desert Caper
Celastraceae	<i>Maytenus emarginata</i>	Kankera
Cleomaceae	<i>Cleome viscosa</i>	Asian spider flower
Cruciferae	<i>Farsetia hamiltonii</i>	Faridbuti
Ebenaceae	<i>Diospyros melanoxylon</i>	Coromandel Ebony
Fabaceae	<i>Butea monosperma</i>	Flame of the Forest
Fabaceae	<i>Hardwickia binata</i>	Bridelia squamosa and Anjan
Fabaceae	<i>Pueraria tuberosa</i>	Kudzu
Fabaceae	<i>Acacia senegal</i>	Gum Acacia
Fabaceae	<i>Acacia nilotica</i>	Babul/Kikar
Fabaceae	<i>Acacia leucophloea</i>	Reonja
Fabaceae	<i>Prosopis juliflora</i>	Vilayati babul
Fabaceae	<i>Crotalaria medicaginea</i>	Trefoil Rattlepod
Fabaceae	<i>Crotalaria burhia</i>	Saniya
Fabaceae	<i>Tephrosia purpurea</i>	Wild Indigo
Lamiaceae	<i>Tectona grandis</i>	Teak
Lamiaceae	<i>Clerodendrum phlomidis</i>	Arni
Malvaceae	<i>Sterculia urens</i>	Gum Karaya
Menispermaceae	<i>Tinospora cordifolia</i>	Guduchi
Molluginaceae	<i>Glinus lotoides</i>	Lotus sweetjuice
Nyctaginaceae	<i>Boerhavia diffusa</i>	Red Spiderling
Papaveraceae	<i>Argemone mexicana</i>	Mexican poppy
Pedaliaceae	<i>Pedaliium murex</i>	Large Caltrops
Pedaliaceae	<i>Sesamum mulayanum</i>	Sesame
Phyllanthaceae	<i>Emblica officinalis</i>	Indian Gooseberry/Amla
Rubiaceae	<i>Mitragyna parviflora</i>	Kaim
Salvadoraceae	<i>Salvadora persica</i>	Meswak

Salvadoraceae	<i>Salvadora oleoides</i>	Vann
Zygophyllaceae	<i>Balanites aegyptiaca</i>	Egyptian balsam
Zygophyllaceae	<i>Tribulus terrestris</i>	Tackweed

ANNEXURE II

List of species from the Chambal River basin in the IUCN red list of threatened species (IUCN 2011)

	Critically Endangered	Endangered	Vulnerable
Fishes		<i>Himantura chaophraya</i>	<i>Botia rostrata</i>
		<i>Puntius arulius</i>	
		<i>Tor khudree</i>	
		<i>Tor putitora</i>	
		<i>Clarias magur</i>	
Reptile	<i>Gavialis gangeticus</i>	<i>Chitra indica</i>	<i>Crocodylus palustris</i>
	<i>Batagur kachuga</i>		<i>Hardella thurjii</i>
	<i>Batagur dhongoka</i>		<i>Nilssonina gangetica</i>
			<i>Nilssonina hurum</i>
Birds	<i>Gyps bengalensis</i>	<i>Neophron percnopterus</i>	<i>Leptoptilos javanicus</i>
	<i>Gyps indicus</i>		<i>Pelecanus crispus</i>
	<i>Gyps tenuirostris</i>		<i>Haliaeetus leucoryphus</i>
	<i>Sarcogyps calvus</i>		<i>Aquila clanga</i>
			<i>Aquila heliaca</i>
			<i>Grus antigone</i>
			<i>Rynchops albicollis</i>
			<i>Amandava formosa</i>
Mammals		<i>Prionailurus viverrinus</i>	<i>Melursus ursinus</i>
		<i>Panthera tigris</i>	<i>Lutrogale perspicillata</i>
		<i>Cuon alpinus</i>	<i>Gazella gazella</i>
		<i>Platanista gangetica</i>	<i>Tetracerus quadricornis</i>
			<i>Rusa unicolor</i>

ANNEXURE III

Checklist of fishes of the Chambal River basin

S. No.	Species	IUCN status (2009–2011)	References
Dasyatidae			
1	<i>Himantura marginata</i> ¹ (Blyth, 1860)	DD	A
2	<i>Himantura chaophraya</i> ² Monkolprasit & Roberts, 1990 [<i>H. polylepis</i> ^{2*} (Bleeker, 1852)]	EN	F
3	<i>Pastinachus sephen</i> (Forsskal, 1775)	DD	C, F
Notopteridae			
4	<i>Chitala chitala</i> (Hamilton, 1822)	NT	A,B,C,D,E,G
5	<i>Notopterus notopterus</i> (Pallas, 1769)	LC	A,C,D,E,G,H
Anguillidae			
6	<i>Anguilla bengalensis</i> (Gray, 1831)	LC	C
Clupeidae			
7	<i>Gonialosa manmina</i> (Hamilton, 1822)	LC	J
8	<i>Gudusia chapra</i> (Hamilton, 1822)	LC	A,C,D,E,G,I
9	<i>Tenualosa ilisha</i> (Hamilton, 1822)	-	A,C,D
Cyprinidae			
10	<i>Amblypharyngodon microlepis</i> (Bleeker, 1853)	LC	G
11	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	LC	A,C,E,G
12	<i>Aspidoparia jaya</i> (Hamilton, 1822)	LC	J
13	<i>Aspidoparia morar</i> (Hamilton, 1822)	LC	A,E,G
14	<i>Bangana dero</i> (Hamilton, 1822)	LC	A
15	<i>Barilius barila</i> (Hamilton, 1822)	LC	A,G,H
16	<i>Barilius bendelisis</i> (Hamilton, 1807)	LC	A,C,G,H,I
17	<i>Barilius modestus</i> Day, 1872	-	G
18	<i>Barilius shacra</i> (Hamilton, 1822)	LC	B
19	<i>Barilius vagra</i> (Hamilton, 1822)	LC	G
20	<i>Bengala elanga</i> (Hamilton, 1822)[<i>Megarasbora elanga</i> ³]	LC	G
21	<i>Opsarius barna</i> (Hamilton, 1822)	LC	C,G
22	<i>Carassius carassius</i> ^{INT} (Linnaeus, 1758)	-	C,E,G
23	<i>Catla catla</i> (Hamilton, 1822) [<i>Gibelion catla</i> ⁴]	LC	A,B,C,E,G,H,I
24	<i>Chagunius chagunio</i> (Hamilton, 1822)	LC	A,E,G

25	<i>Chela cachius</i> (Hamilton, 1822)	LC	A,E,G
26	<i>Cirrhinus mrigala</i> (Hamilton, 1822)	LC	A,C,G,H,I
27	<i>Cirrhinus reba</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
28	<i>Crossocheilus latius</i> (Hamilton, 1822)	LC	A,D,G
29	<i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	-	C,E,G
30	<i>Cyprinus carpio</i> ^{INT} Linnaeus, 1758	-	C,D,E,G
31	<i>Danio rerio</i> (Hamilton, 1822)	LC	A,E,G
32	<i>Devario aequipinnatus</i> (McClelland, 1839)	LC	G
33	<i>Devario devario</i> (Hamilton, 1822)	LC	A,C,E,G,H
34	<i>Esomus danricus</i> (Hamilton, 1822)	LC	A,C,E,G
35	<i>Garra gotyla</i> (Gray, 1830)	LC	C,E,G,H
36	<i>Garra lamta</i> (Hamilton, 1822)	LC	A,G
37	<i>Garra mullya</i> (Sykes, 1839)	LC	E,G
38	<i>Hypophthalmichthys molitrix</i> ^{INT} (Valenciennes, 1844)	-	C,E,G
39	<i>Hypophthalmichthys nobilis</i> (Richardson, 1845)	-	E,G
40	<i>Labeo angra</i> (Hamilton, 1822)	LC	E,G
41	<i>Labeo bata</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
42	<i>Labeo boga</i> (Hamilton, 1822)	LC	A,C,E,G
43	<i>Labeo boggut</i> (Sykes, 1839)	LC	A,C,E,G,H
44	<i>Labeo calbasu</i> (Hamilton, 1822)	LC	A,C,E,G,H
45	<i>Labeo dyocheilus</i> (McClelland, 1839)	LC	A,C,D,E,G
46	<i>Labeo fimbriatus</i> (Bloch, 1795)	LC	C,E,G
47	<i>Labeo gonius</i> (Hamilton, 1822)	LC	A,C,D,E,H
48	<i>Labeo pangusia</i> (Hamilton, 1822)	NT	E
49	<i>Labeo rajasthanicus</i> Datta & Majumdar, 1970	-	E
50	<i>Labeo rohita</i> (Hamilton, 1822)	LC	A,C,E,G,H,I
51	<i>Laubuca laubuca</i> (Hamilton, 1822)	LC	A,C,H
52	<i>Osteobrama cotio</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
53	<i>Puntius amphibius</i> (Valenciennes, 1842)	DD	E,G
54	<i>Puntius arulius</i> ⁵ (Jerdon, 1849)	EN	G
55	<i>Puntius chola</i> (Hamilton, 1822)	LC	E,G
56	<i>Pethia conchonius</i> (Hamilton, 1822)	LC	A,C
57	<i>Puntius guganio</i> (Hamilton, 1822)	LC	I
58	<i>Pethia phutunio</i> (Hamilton, 1822)	LC	A
59	<i>Systemus sarana</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
60	<i>Puntius sophore</i> (Hamilton, 1822)	LC	A,C,D,E,G,I
61	<i>Pethia ticto</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
62	<i>Puntius vittatus</i> Day, 1865	LC	G

63	Raiamas bola (Hamilton, 1822)	LC	B,C,E,H
64	Rasbora daniconius (Hamilton, 1822)	LC	A,C,D,E,H,I
65	Rasbora rasbora (Hamilton, 1822)	LC	I
66	Salmophasia bacaila (Hamilton, 1822)	LC	A,B,C,D,G,H
67	<i>Salmophasia balookee</i> (Sykes, 1839)	LC	A,B,C,G,H,I
68	Salmophasia phulo (Hamilton, 1822)	LC	G
69	Salmophasia punjabensis (Day, 1872)	-	G
70	Securicula gora (Hamilton, 1822)	LC	A,E,G
71	Tor khudree (Sykes, 1839)	EN	E,G,K
72	<i>Tor tor</i> (Hamilton, 1822)	NT	A,C,D,E,G,H
73	Tor putitora (Hamilton, 1822)	EN	C,G
Psilorhynchidae			
74	Psilorhynchus balitora (Hamilton, 1822)	LC	G
Cobitidae			
75	<i>Botia birdi</i> Chaudhuri, 1909	-	E,G
76	<i>Botia lohachata</i> Chaudhuri, 1912	-	E,G
77	<i>Botia rostrata</i> Günther, 1868	VU	G
78	<i>Lepidocephalichthys guntea</i> (Hamilton, 1822)	LC	A,S,E,G
Nemacheilidae			
79	<i>Acanthocobitis botia</i> (Hamilton, 1822)	LC	A,C,E,H,I
80	<i>Nemacheilus carletoni</i> Fowler, 1924	-	G
81	<i>Nemacheilus corica</i> (Hamilton, 1822)	LC	G
82	<i>Nemacheilus denisoni</i> Day, 1867	LC	G
83	<i>Paraschistura montana</i> (McClelland, 1838)	-	G
84	<i>Schistura baluchiorum</i> ⁶ (Zugmayer, 1912)	-	G
85	<i>Schistura beavani</i> (Günther 1868)	LC	A
86	<i>Schistura horai</i> (Menon, 1952)	-	G
87	<i>Schistura rupecula</i> McClelland, 1838	LC	G
Bagridae			
88	<i>Mystus bleekeri</i> (Day, 1877)	LC	A,C,E,G
89	<i>Mystus cavasius</i> (Hamilton, 1822)	LC	A,C,E,G
90	<i>Mystus tengara</i> (Hamilton, 1822)		I
91	<i>Mystus vittatus</i> (Bloch, 1794)	LC	A,C,E,G
92	<i>Rita rita</i> (Hamilton, 1822)	LC	A,B,C,D,E,G,H,I
93	<i>Sperata aor</i> (Hamilton, 1822)	LC	A,C,D,E,G,H

94	<i>Sperata seenghala</i> (Sykes, 1839)	LC	A,C,D,E,G,H
<i>Siluridae</i>			
95	<i>Ompok bimaculatus</i> (Bloch, 1794)	NT	A,C,D,E,G,H,I
96	<i>Wallago attu</i> (Bloch & Schneider, 1801)	NT	A,B,C,D,E,G,H,I
<i>Schilbeidae</i>			
97	<i>Ailia coila</i> (Hamilton, 1822)	NT	E,G
98	<i>Ailiichthys punctata</i> Day, 1872	DD	B
99	<i>Clupisoma garua</i> (Hamilton, 1822)	LC	B,C,E,G
100	<i>Eutropiichthys murius</i> (Hamilton, 1822)	LC	I
101	<i>Eutropiichthys vacha</i> (Hamilton, 1822)	LC	A,C,D,E,G,H,I
102	<i>Neotropius atherinoides</i> (Bloch, 1794)	LC	I
103	<i>Silonia silondia</i> (Hamilton, 1822)	LC	A,C,D,E,G,H,I
<i>Pangasiidae</i>			
104	<i>Pangasius pangasius</i> (Hamilton, 1822)	LC	A,B,C,D
<i>Amblycipitidae</i>			
105	<i>Amblyceps mangois</i> (Hamilton, 1822)	LC	G
<i>Sisoridae</i>			
106	<i>Gogangra viridescens</i> (Hamilton, 1822)	LC	A
107	<i>Bagarius bagarius</i> (Hamilton, 1822)	NT	A,C,D,E,G,H,I
108	<i>Bagarius yarrelli</i> (Sykes, 1839)	NT	G
109	<i>Gagata cenia</i> (Hamilton, 1822)	LC	G
110	<i>Gagata sexualis</i> Tilak, 1970	LC	I
111	<i>Glyptothorax botius</i> (Hamilton, 1822)	LC	A
112	<i>Glyptothorax pectinopterus</i> (McClelland, 1842)	LC	G
113	<i>Glyptothorax telchitta</i> (Hamilton, 1822)	LC	G
114	<i>Nangra nangra</i> (Hamilton, 1822)	LC	G
115	<i>Sisor rhabdophorus</i> Hamilton, 1822	LC	G
<i>Erethistidae</i>			
116	<i>Pseudolaguvia ribeiroi</i> (Hora, 1921)	LC	I
<i>Clariidae</i>			
117	<i>Clarias magur</i> ⁷ (Linnaeus, 1758)	EN	C,D,E,G
118	<i>Clarias gariepinus</i> ^{INT} (Burchell, 1822)	-	E,G
<i>Heteropneustidae</i>			
119	<i>Heteropneustes fossilis</i> (Bloch, 1794)	LC	A,C,D,E,G,I
<i>Aplocheilidae</i>			

120	<i>Aplocheilus blockii</i> Arnold, 1911	LC	G
121	<i>Aplocheilus lineatus</i> (Valenciennes, 1846)	LC	G
Belonidae			
122	<i>Xenentodon cancila</i> (Hamilton, 1822)	LC	A,B,C,D,E,G,H,I
<i>Adrianichthyidae</i>			
123	<i>Oryzias melastigma</i> (McClelland, 1839)	LC	G
Synbranchidae			
124	<i>Monopterus albus</i> (Hamilton, 1822)	LC	C,E,G
Mastacembelidae			
125	<i>Macrognathus aral</i> (Bloch & Schneider, 1801)	LC	G
126	<i>Macrognathus pancalus</i> Hamilton, 1822	LC	A,C,D,G
127	<i>Mastacembelus armatus</i> (Lacepède, 1800)	LC	A,C,D,G,H,I
Ambassidae			
128	<i>Chanda nama</i> Hamilton, 1822	LC	A,C,D,E,G,H,I
129	<i>Pseudambassis baculis</i> (Hamilton, 1822)	LC	G
130	<i>Pseudambassis ranga</i> (Hamilton, 1822)	LC	A,C,D,G,H
Badidae			
131	<i>Badis badis</i> (Hamilton, 1822)	LC	A
Sciaenidae			
132	<i>Otolithoides pama</i> ⁸ (Hamilton, 1822)	-	A
Nandidae			
133	<i>Nandus nandus</i> (Hamilton, 1822)	LC	A,B,C,E,G,H
Mugilidae			
134	<i>Mugil cephalus</i> ⁹ Linnaeus, 1758	LC	G
135	<i>Rhinomugil corsula</i> (Hamilton, 1822)	LC	A,C,D,E,H,I
136	<i>Sicamugil cascasia</i> (Hamilton, 1822)	LC	G
Cichlidae			
137	<i>Oreochromis mossambicus</i> ^{INT} (Peters, 1852)	-	G,I
Gobiidae			
138	<i>Glossogobius giuris</i> (Hamilton, 1822)	-	A,C,E,G,H,I
Anabantidae			
139	<i>Anabas testudineus</i> (Bloch, 1792)	DD	E,G
Osphronemidae			
140	<i>Trichogaster fasciata</i> Bloch & Schneider, 1801	LC	C,E,G

141	<i>Trichogaster labiosa</i> Day, 1877	-	G
142	<i>Trichogaster lalius</i> (Hamilton, 1822)	LC	G
Channidae			
143	<i>Channa gachua</i> (Hamilton, 1822)	LC	A,C
144	<i>Channa marulius</i> (Hamilton, 1822)	LC	A,C,D,E,G,H
145	<i>Channa orientalis</i> ¹⁰ Bloch & Schneider, 1801	-	E,G
146	<i>Channa punctata</i> (Bloch, 1793)	LC	A,C,D,E,G,H,I
147	<i>Channa striata</i> (Bloch, 1793)	LC	A,C,D,E,G,H

¹ *Himantura marginata* is primarily a marine fish, occasionally entering brackish waters. We do not have information of the specimen or identification. This record needs to be verified.

² *Himantura chaophraya* is not known from India. We do not have information of the specimen or identification. This record needs to be verified.

^{2*} *H. chaophraya* is considered as a synonym of *H. polylepis* by the IUCN Red List (Vidthayanon et al. 2011).

³ *Bengala elanga* is considered as *Megaraspboria elanga* by the IUCN Red List (Vishwanath 2010b).

⁴ *Catla catla* is considered as *Gibelion catla* by the IUCN Red List (Tenzin 2010).

⁵ *Dawkinsia arulius* (reported earlier as *Puntius arulius*) is known only from South India (Knight et al. 2011). This species may be *Dravidia melanampyx* or *D. fasciatus* but its taxonomy is unresolved (Abraham 2011).

Also see Pethiyagoda et al. (2012) for species hitherto referred to the genus *Puntius*.

⁶ *Schistura baluchiorum* is mainly distributed in the Indus drainage. *S. baluchiorum* is listed here because of its doubtful synonymy with *Noemacheilus rajasthanicus*. However, if *N. rajasthanicus* is a valid species this record should refer to it.

⁷ *Clarias magur* has been described as *C. batrachus* in previous reports. *C. batrachus* is now reported only from the Sunda Islands [see Ng & Kottelat (2008), and Vishwanath (2010a) for details].

⁸ *Otolithoides pama* is primarily an estuarine / marine fish. We do not have information of the specimen or identification. This record needs to be verified.

⁹ *Mugil cephalus* is primarily a marine species, and is introduced in freshwater systems. We do not have information of the specimen or identification. This record needs to be verified.

¹⁰ *Channa orientalis* is endemic to Sri Lanka, and earlier reports of this species from India probably refers to a species of the *C. gachua* complex. For details, see http://fl.biology.usgs.gov/Snakehead_circ_1251/html/channa_orientalis.html

^{INT} Refers to introduced species, and hence IUCN status is not provided.

IUCN status: LC - Least Concern; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered.

References: A - Dubey & Mehra (1959); B - Molur & Walker (1998a); C - Saksena (2007); D - Sale (1982); E - Sharma & Choudhury (2007); F - Sivakumar (2002); G - Srivastava (2007); H - Vyas & Singh (2004); I - This study (2009–2010); J - N. Kelkar pers. comm.; K - Sivakumar & Choudhury (2008).

ANNEXURE IV

Checklist of reptiles of the Chambal River basin

S. No.	Species	Common Name	IUCN status 2009 - 2012	References
Crocodylidae				
1	<i>Crocodylus palustris</i> (Lesson, 1831)	Mugger or Marsh Crocodile	VU	A,G,H,M
Gavialidae				
2	<i>Gavialis gangeticus</i> (Gmelin, 1789)	Gharial	CR	A,G,H,M
Geoemydidae				
3	<i>Batagur dhongoka</i> (Gray, 1832)	Three-striped Roofed Turtle	CR (2019)	A,G,M
4	<i>Batagur kachuga</i> (Gray, 1831)	Red-crowned Roofed Turtle	CR	A,G,M
5	<i>Hardella thurjii</i> (Gray, 1831)	Brahminy/Crowned River Turtle	VU	A,G,M
6	<i>Pangshura tecta</i> (Gray, 1830)	Indian Roofed Turtle	LC	K,M
7	<i>Pangshura tentoria</i> (Gray, 1834)	Indian Tent Turtle	LC	A,G,M
Testudinidae				
8	<i>Geochelone elegans</i> (Schoepff, 1795)	Indian Star Tortoise	LC	H,L
Trionychidae				
9	<i>Lissemys punctata</i> (Bonnaterre, 1789)	Indian Flapshell Turtle	LC	A,G,H,M
10	<i>Chitra indica</i> (Gray, 1830)	Narrow-headed Softshell Turtle	EN	A,G,M
11	<i>Nilssonina gangetica</i> (Cuvier, 1825)	Indian Softshell Turtle	VU	A,G,H,M
12	<i>Nilssonina hurum</i> (Gray, 1830)	Peacock Softshell Turtle	VU	C
Gekkonidae				
13	<i>Hemidactylus brookii</i> (Gray, 1845)	Brook's House Gecko	-	A
14	<i>Hemidactylus flaviviridis</i> Rüppell, 1840	Yellow-bellied House Gecko	-	A,H,M
15	<i>Hemidactylus frenatus</i> Duméril & Bibron, 1836	Common House Gecko	LC	A
16	<i>Hemidactylus maculatus</i> Duméril & Bibron, 1836	Northern Spotted Gecko	-	M
17	<i>Hemidactylus leschenaultii</i> Duméril & Bibron, 1836	Bark Gecko	-	A,M
18	<i>Hemidactylus triedrus</i> (Daudin, 1802)	Termite Hill Gecko	-	A
Agamidae				
19	<i>Calotes versicolor</i> (Daudin, 1802)	Oriental Garden Lizard	-	A,H,M
20	<i>Sitana ponticeriana</i> Cuvier, 1829	Fan-throated Lizard		A
Chamaeleonidae				
21	<i>Chamaeleo zeylanicus</i> Laurenti, 1768	Indian Chameleon	-	A
Varanidae				
22	<i>Varanus bengalensis</i> (Daudin, 1802)	Common Indian Monitor	LC	A,F,H,L,M
23	<i>Varanus griseus</i> Mertens, 1954	Indian Desert Monitor	LC	H
Lacertidae				
24	<i>Ophisops jerdonii</i> Blyth, 1853	Jerdon's Snake-eye	LC	A, D

25	<i>Ophisops microlepis</i> Blanford, 1870	Small-scaled Lacerta	LC	B
26	<i>Ophisops minor nictans</i> Arnold, 1989	Indian Dwarf Lacerta	-	A,D
Scincidae				
27	<i>Eutropis carinata</i> (Schneider, 1801)	Keeled Grass Skink	-	A,M
28	<i>Eutropis innotata</i> (Blanford, 1870)	Blanford's Grass Skink	-	D
29	<i>Eutropis macularia</i> (Blyth, 1853)	Bronze Skink	-	A
30	<i>Lygosoma punctata</i> (Gmelin, 1799)	Spotted Supple Skink	-	A,M
Typhlopidae				
31	<i>Ramphotyphlops braminus</i> (Daudin, 1803)	Brahminy Blind snake	-	A
Pythonidae				
32	<i>Python molurus</i> (Linnaeus, 1758)	Indian Rock Python	NT	K,M
Boidae				
33	<i>Eryx johnii</i> (Russell, 1801)	Red Sand Boa	-	A,M
34	<i>Gongylophis conicus</i> (Schneider, 1801)	Common Sand Boa	-	M
Colubridae				
35	<i>Coelognathus helena</i> (Daudin, 1803)	Common Trinket Snake	-	N
36	<i>Ptyas mucosa</i> (Linnaeus, 1758)	Indian Rat Snake	-	A,H,M
37	<i>Platyceph ventromaculatus</i> (Gray, 1834)	Glossy-bellied Racer	-	I
38	<i>Argyrogena fasciolata</i> (Shaw, 1802)	Banded Racer	-	N
39	<i>Spalerosophis atriceps</i> Fischer, 1885	Black-headed Royal Snake	-	N
40	<i>Oligodon taeniolatus</i> (Jerdon, 1853)	Russell's Kukri Snake	LC	A
41	<i>Oligodon arnensis</i> (Shaw, 1802)	Common Kukri Snake	-	A,N
42	<i>Dendrelaphis tristis</i> (Daudin, 1803)	Common Bronzeback Tree Snake	-	N
43	<i>Lycodon striatus</i> (Shaw, 1802)	Barred Wolf Snake	-	N
44	<i>Lycodon aulicus</i> (Linnaeus, 1758)	Common Wolf Snake	-	A,N
45	<i>Sibynophis subpunctatus</i> (Dumeril Bibron & Dumeril, 1854)	Dumeril's Black-headed Snake	-	J
46	<i>Xenochrophis piscator</i> (Schneider, 1799)	Chequered Keelback	-	A,M,N
47	<i>Amphiesma stolata</i> (Linnaeus, 1758)	Buff Striped Keelback	-	A,N
48	<i>Macropisthodon plumbicolor</i> (Cantor, 1839)	Green Keelback	-	N
49	<i>Boiga trigonata</i> (Schneider, 1802)	Common Cat Snake	LC	N
50	<i>Ahaetulla nasuta</i> (Bonnaterre, 1790)	Common Vine Snake		A,N
Elapidae				
51	<i>Bungarus caeruleus</i> (Schneider, 1801)	Common Krait	-	A,H,N
52	<i>Naja naja</i> (Linnaeus, 1758)	Spectacled Cobra	-	A,N
Homalopsidae				
53	<i>Enhydryis sieboldii</i> (Schlegel, 1837)	Siebold's Smooth-water Snake	LC	E
Psammophiidae				
54	<i>Psammophis leithii</i> Gunther, 1869	Leith's Sand Snake	-	N
Viperidae				

55	<i>Daboia russelii</i> (Shaw & Nodder, 1797)	Russell's Viper	-	F,M
56	<i>Echis carinatus</i> (Schneider, 1801)	Saw-scaled Viper	-	A,N

IUCN status: LC - Least Concern; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered.

References: A - This study (fieldwork in 2009 - 2010); B - Böhm & Richman (2010); C - Das et al. (2010); D - Molur & Walker (1998b); E - Murphy & Lobo (2010); F - Nair (2009); G - Rao (1988); H - Sale (1982); I - Schätti & Schmitz (2006); J - Sharma (2003); K - Vyas (2004); L - Vyas & Singh (2004); M - Vyas et al. (in prep.); N - This study (intermittent fieldwork between 2006 and 2008).

ANNEXURE V

Checklist of waterbirds of the Chambal River basin

Species	Common Name	IUCN Status 2011	References
Anatidae			
<i>Dendrocygna javanica</i> (Horsfield, 1821)	Lesser Whistling-duck	LC	A,B,G,I,K,M
<i>Anser anser</i> (Linnaeus, 1758)	Greylag Goose	LC	A,H,I,L,M
<i>Anser indicus</i> (Latham, 1790)	Bar-headed Goose	LC	A,B,H,I,K,L,M
<i>Sarkidiornis melanotos</i> (Pennant, 1769)	Comb Duck	LC	A,B,G,H,I,K,M
<i>Tadorna ferruginea</i> (Pallas, 1764)	Ruddy Shelduck	LC	A,B,G,H,K,L,M
<i>Tadorna tadorna</i> (Linnaeus, 1758)	Common Shelduck	LC	K
<i>Nettapus coromandelianus</i> (Gmelin, 1789)	Cotton Pygmy-goose	LC	A
<i>Anas strepera</i> Linnaeus, 1758	Gadwall	LC	K,L,M
<i>Anas penelope</i> Linnaeus, 1758	Eurasian Wigeon	LC	L,M
<i>Anas platyrhynchos</i> Linnaeus, 1758	Mallard	LC	A,H
<i>Anas poecilorhyncha</i> Forster, 1781	Western Spot-billed Duck	LC	A,B,G,H,K,L,M
<i>Anas clypeata</i> Linnaeus, 1758	Northern Shoveler	LC	A,B,I,L,M
<i>Anas acuta</i> Linnaeus, 1758	Northern Pintail	LC	A,I,K,L,M
<i>Anas querquedula</i> Linnaeus, 1758	Garganey	LC	A,B,G,L,M
<i>Anas crecca</i> Linnaeus, 1758	Common Teal	LC	A,H,I,K,L,M
<i>Mergus merganser</i> Linnaeus, 1758	Common Merganser	LC	M
<i>Netta rufina</i> (Pallas, 1773)	Red-crested Pochard	LC	A,B,H,I,K,M
<i>Aythya ferina</i> (Linnaeus, 1758)	Common Pochard	LC	L,M
<i>Aythya nyroca</i> (Gldenstdt, 1770)	Ferruginous Duck	NT	A,H,K
<i>Aythya fuligula</i> (Linnaeus, 1758)	Tufted Duck	LC	A,H,L
Podicipedidae			
<i>Tachybaptus ruficollis</i> (Pallas, 1764)	Little Grebe	LC	A,B,G,H,K,L,M
<i>Podiceps cristatus</i> (Linnaeus, 1758)	Great Crested Grebe	LC	A,B,K
Phoenicopteridae			
<i>Phoenicopiterus roseus</i> Pallas, 1811	Greater Flamingo	LC	A,M
Ciconiidae			
<i>Mycteria leucocephala</i> (Pennant, 1769)	Painted Stork	NT	A,B,G,H,K,L,M
<i>Anastomus oscitans</i> (Boddaert, 1783)	Asian Openbill	LC	A,B,G,H,I,K,M
<i>Ciconia nigra</i> (Linnaeus, 1758)	Black stork	LC	K,L,M
<i>Ciconia episcopus</i> (Boddaert, 1783)	Woolly-necked Stork	LC	A,B,G,H,K,L,M
<i>Ephippiorhynchus asiaticus</i> (Latham, 1790)	Black-necked Stork	NT	A,B,H,I
<i>Leptoptilos javanicus</i> (Horsfield, 1821)	Lesser Adjutant	VU	E
Threskiornithidae			
<i>Threskiornis melanocephalus</i> (Latham, 1790)	Black-headed Ibis	NT	A,B,G,I,K,M

<i>Pseudibis papillosa</i> (Temminck, 1824)	Red-naped Ibis	LC	A,B,G,I,K,L,M
<i>Plegadis falcinellus</i> (Linnaeus, 1766)	Glossy Ibis	LC	A,G,K,M
<i>Platalea leucorodia</i> Linnaeus, 1758	Eurasian Spoonbill	LC	A,B,G,I,K,L,M
Ardeidae			
<i>Botaurus stellaris</i> (Linnaeus, 1758)	Great Bittern	LC	A
<i>Ixobrychus sinensis</i> (Gmelin, 1789)	Yellow Bittern	LC	B
<i>Ixobrychus cinnamomeus</i> (Gmelin, 1789)	Cinnamon Bittern	LC	M
<i>Ixobrychus flavicollis</i> (Latham, 1790)	Black Bittern	LC	A
<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Black-crowned Night-heron	LC	A,B,G,K,M
<i>Butorides striata</i> (Linnaeus, 1758)	Little Heron	LC	A,B,K,L,M
<i>Ardeola grayii</i> (Sykes, 1832)	Indian Pond-heron	LC	A,B,G,H,K,L,M
<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	LC	A,B,G,H,K,L,M
<i>Ardea cinerea</i> Linnaeus, 1758	Grey Heron	LC	A,B,G,H,K,L,M
<i>Ardea purpurea</i> Linnaeus, 1766	Purple Heron	LC	A,B,G,K,M
<i>Casmerodius albus</i> (Linnaeus, 1758)	Great Egret	LC	B,G,K,L,M
<i>Mesophoyx intermedia</i> (Wagler, 1829)	Intermediate Egret	LC	A,G,K,L,M
<i>Egretta garzetta</i> (Linnaeus, 1766)	Little Egret	LC	A,B,G,H,K,L,M
Pelecanidae			
<i>Pelecanus onocrotalus</i> Linnaeus, 1758	Great White Pelican	LC	K
<i>Pelecanus crispus</i> Bruch, 1832	Dalmatian Pelican	VU	A,B,E
<i>Pelecanus philippensis</i> Gmelin, 1789	Spot-billed Pelican	NT	A,E,H,I
Phalacrocoracidae			
<i>Phalacrocorax niger</i> (Vieillot, 1817)	Little Cormorant	LC	A,B,G,H,K,L,M
<i>Phalacrocorax fuscicollis</i> Stephens, 1826	Indian Cormorant	LC	A,B,G,L,M
<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	Great Cormorant	LC	A,B,G,I,K,L,M
Anhingidae			
<i>Anhinga melanogaster</i> Pennant, 1769	Oriental Darter	NT	A,B,G,H,K,L,M
Falconidae			
<i>Falco peregrinus</i> Tunstall, 1771	Peregrine Falcon	LC	A,B,M
Accipitridae			
<i>Pandion haliaetus</i> (Linnaeus, 1758)	Osprey	LC	A,B,G,H,K,L,M
<i>Haliastur indus</i> (Boddaert, 1783)	Brahminy Kite	LC	B
<i>Haliaeetus leucoryphus</i> (Pallas, 1771)	Pallas's Fish-eagle	VU	C,D,F
<i>Haliaeetus albicilla</i> (Linnaeus, 1758)	White-tailed Eagle	LC	B
<i>Circus aeruginosus</i> (Linnaeus, 1758)	Western Marsh-harrier	LC	A,B,G,H,K,L,M
<i>Aquila clanga</i> Pallas, 1811	Greater Spotted Eagle	VU	A,C,D,E,F,M
<i>Aquila nipalensis</i> Hodgson, 1833	Steppe Eagle	LC	B
Rallidae			
<i>Amaurornis akool</i> (Sykes, 1832)	Brown Crake	LC	A,K,M
<i>Amaurornis phoenicurus</i> (Pennant, 1769)	White-breasted Waterhen	LC	A,B,L,M

<i>Porzana pusilla</i> (Pallas, 1776)	Baillon's Crake	LC	A
<i>Porphyrio porphyrio</i> (Linnaeus, 1758)	Purple Swamphen	LC	A,B,G,M
<i>Gallinula chloropus</i> (Linnaeus, 1758)	Common Moorhen	LC	M
<i>Fulica atra</i> Linnaeus, 1758	Common Coot	LC	A,B,G,K,L,M
Gruidae			
<i>Grus antigone</i> (Linnaeus, 1758)	Sarus Crane	VU	A,B,C,D,E,F,G,H,I,L,M
<i>Grus virgo</i> (Linnaeus, 1758)	Demoiselle Crane	LC	M
<i>Grus grus</i> (Linnaeus, 1758)	Common Crane	LC	I,L
Burhinidae			
<i>Esacus recurvirostris</i> (Cuvier, 1829)	Great Thick-knee	LC	A,B,I,K,L,M
<i>Burhinus oedicnemus</i> (Linnaeus, 1758)	Eurasian Thick-knee	LC	A,B,H,M
Recurvirostridae			
<i>Himantopus himantopus</i> (Linnaeus, 1758)	Black-winged Stilt	LC	A,B,G,H,K,L,M
<i>Recurvirostra avosetta</i> Linnaeus, 1758	Pied Avocet	LC	(Rakesh Vyas, pers. comm.)
Charadriidae			
<i>Vanellus malarbaricus</i> (Boddaert, 1783)	Yellow-wattled Lapwing	LC	A,B,G
<i>Vanellus duvaucelii</i> (Lesson, 1826)	River Lapwing	LC	A,B,G,K,M
<i>Vanellus indicus</i> (Boddaert, 1783)	Red-wattled Lapwing	LC	A,B,G,H,K,L,M
<i>Vanellus leucurus</i> (Lichtenstein, 1823)	White-tailed Lapwing	LC	A,G,L
<i>Charadrius dubius</i> Scopoli, 1786	Little Ringed Plover	LC	A,B,G,H,K,L,M
<i>Charadrius alexandrinus</i> Linnaeus, 1758	Kentish Plover	LC	A,K,L,M
Rostratulidae			
<i>Rostratula benghalensis</i> (Linnaeus, 1758)	Greater Painted-snipe	LC	A,M
Jacanidae			
<i>Hydrophasianus chirurgus</i> (Scopoli, 1786)	Pheasant-tailed Jacana	LC	A,K,M
<i>Metopidius indicus</i> (Latham, 1790)	Bronze-winged Jacana	LC	M
Scolopacidae			
<i>Gallinago gallinago</i> (Linnaeus, 1758)	Common Snipe	LC	L,M
<i>Limosa limosa</i> (Linnaeus, 1758)	Black-tailed Godwit	NT	A,G,K,L,M
<i>Numenius arquata</i> (Linnaeus, 1758)	Eurasian Curlew	NT	K,L,M
<i>Tringa erythropus</i> (Pallas, 1764)	Spotted Redshank	LC	L
<i>Tringa totanus</i> (Linnaeus, 1758)	Common Redshank	LC	A,G,H,K,L,M
<i>Tringa stagnatilis</i> (Bechstein, 1803)	Marsh Sandpiper	LC	L
<i>Tringa nebularia</i> (Gunnerus, 1767)	Common Greenshank	LC	A,G,K,L,M
<i>Tringa ochropus</i> Linnaeus, 1758	Green Sandpiper	LC	A,K,L,M
<i>Tringa glareola</i> Linnaeus, 1758	Wood Sandpiper	LC	A,B,G,K,L,M
<i>Actitis hypoleucos</i> Linnaeus, 1758	Common Sandpiper	LC	A,B,G,H,K,L,M
<i>Calidris minuta</i> (Leisler, 1812)	Little Stint	LC	A,G,H,K,L,M
<i>Calidris temminckii</i> (Leisler, 1812)	Temminck's Stint	LC	L,M

<i>Philomachus pugnax</i> (Linnaeus, 1758)	Ruff	LC	A,G,H,L,M
Glareolidae			
<i>Glareola pratincola</i> (Linnaeus, 1766)	Collared Pratincole	LC	A,M
<i>Glareola lactea</i> Temminck, 1820	Small Pratincole	LC	A,G,H,J,K,M
Laridae			
<i>Larus cachinnans</i> Pallas, 1811	Caspian Gull	LC	K,M
<i>Larus ichthyaetus</i> Pallas, 1773	Pallas's Gull	LC	A,K,L,M
<i>Larus brunnicephalus</i> Jerdon, 1840	Brown-headed Gull	LC	A,H,I,K,L,M
<i>Larus ridibundus</i> Linnaeus, 1766	Black-headed Gull	LC	K,L,M
<i>Sterna aurantia</i> Gray, 1831	River Tern	LC	A,B,G,H,K,L,M
<i>Sterna albifrons</i> Pallas, 1764	Little Tern	LC	A,G,J
<i>Sterna acuticauda</i> Gray, 1832	Black-bellied Tern	NT	A,G,K,L,M
<i>Chlidonias hybrida</i> (Pallas, 1811)	Whiskered Tern	LC	A,G,H,K,L,M
<i>Rynchops albigollis</i> Swainson, 1838	Indian Skimmer	VU	A,B,C,D,E,F,G,I,J,K,M
Tytonidae			
Strigidae			
<i>Ketupa zeylonensis</i> (Gmelin, 1788)	Brown Fish-owl	LC	A,K,M
Alcedinidae			
<i>Pelargopsis capensis</i> (Linnaeus, 1766)	Stork-billed Kingfisher	LC	B,M
<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	White-throated Kingfisher	LC	A,B,G,H,K,L,M
<i>Alcedo atthis</i> (Linnaeus, 1758)	Common Kingfisher	LC	A,B,G,K,L,M
<i>Ceryle rudis</i> (Linnaeus, 1758)	Pied Kingfisher	LC	A,B,G,H,K,L,M
Meropidae			
<i>Merops philippinus</i> Linnaeus, 1766	Blue-tailed Bee-eater	LC	B,G,L,M
Hirundinidae			
<i>Riparia paludicola</i> (Vieillot, 1817)	Plain Martin	LC	A,B
<i>Hirundo rustica</i> Linnaeus, 1758	Barn Swallow	LC	A,B,G,K,L,M
<i>Hirundo smithii</i> Leach, 1818	Wire-tailed Swallow	LC	A,K,L
<i>Hirundo daurica</i> Linnaeus, 1771	Red-rumped Swallow	LC	A,B,K,L,M
<i>Hirundo fluviicola</i> Blyth, 1855	Streak-throated Swallow	LC	A,G,K,M
Motacillidae			
<i>Motacilla alba</i> Linnaeus, 1758	White Wagtail	LC	A,H,L,M
<i>Motacilla madaraspatensis</i> Gmelin, 1789	White-browed Wagtail	LC	A,B,G,H,K,L,M
<i>Motacilla citreola</i> Pallas, 1776	Citrine Wagtail	LC	K
<i>Motacilla flava</i> Linnaeus, 1758	Yellow Wagtail	LC	A,B,G,K,M
<i>Motacilla cinerea</i> Tunstall, 1771	Grey Wagtail	LC	A,B,G,K,L,M
<i>Anthus spinoletta</i> (Linnaeus, 1758)	Water Pipit	LC	L

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ANNEXURE VI

Checklist of mammals of the Chambal River basin

S. No.	Species	Common Name	IUCN status 2011	References
Cercopithecidae				
1	<i>Macaca mulatta</i> (Zimmermann, 1780)	Rhesus Macaque	LC	A,B,K,O
2	<i>Semnopithecus entellus</i> (Dufresne, 1797)	Bengal Hanuman Langur	LC	A,B,J,K,O
Sciuridae				
3	<i>Funambulus pennantii</i> Wroughton, 1905	Five-striped Palm Squirrel	LC	A,B,O
Muridae				
4	<i>Tatera indica</i> (Hardwicke, 1807)	Indian Gerbil	LC	A,B,G,O
5	<i>Millardia meltada</i> * (Gray, 1837)	Soft-furred Field Rat	LC	B
6	<i>Mus musculus</i> Linnaeus, 1758	House Mouse	LC	A,B,G
7	<i>Rattus rattus</i> (Linnaeus, 1758)	House Rat	LC	B,K
8	<i>Bandicota bengalensis</i> * (Gray, 1835)	Lesser Bandicoot Rat	LC	B
Hystricidae				
9	<i>Hystrix indica</i> Kerr, 1792	Indian Crested Porcupine	LC	J,K,O
Leporidae				
10	<i>Lepus nigricollis</i> F. Cuvier, 1823	Indian Hare	LC	A,B,J,K,O
Erinaceidae				
11	<i>Hemiechinus collaris</i> (Gray, 1830)	Collared Hedgehog	LC	G
12	<i>Paraechinus micropus</i> Blyth, 1846	Indian Hedgehog	LC	O
Soricidae				
13	<i>Suncus murinus</i> Linnaeus, 1766	Asian House Shrew	LC	A,K
Pteropodidae				
14	<i>Rousettus leschenaulti</i> * (Desmarest, 1820)	Leschenault's Rousette	LC	B
15	<i>Pteropus giganteus</i> (Brünnich, 1782)	Indian Flying Fox	LC	A,B,O,H
16	<i>Cynopterus sphinx</i> (Vahl, 1797)	Short-nosed Fruit Bat	LC	A,B,
Rhinopomatidae				
17	<i>Rhinopoma microphyllum</i> (Brünnich, 1792)	Greater Mouse-tailed Bat	LC	H
18	<i>Rhinopoma hardwickii</i> Gray, 1831	Lesser Mouse-tailed Bat	LC	A*,H
Hipposideridae				
19	<i>Hipposideros fulvus</i> Gray, 1838	Fulvous Leaf-nosed Bat	LC	B,H
Megadermatidae				
20	<i>Megaderma lyra</i> É. Geoffroy, 1810	Greater False vampire Bat	LC	A,H
Rhinolophidae				
21	<i>Rhinolophus lepidus</i> Blyth, 1844	Blyth's Horseshoe Bat	LC	H
Emballonuridae				

22	<i>Taphozous longimanus</i> Hardwicke, 1825	Long-winged Tomb Bat	LC	H
23	<i>Taphozous melanopogon</i> * Temminck, 1841	Black-bearded Tomb Bat	LC	B
24	<i>Taphozous perforatus</i> É. Geoffroy, 1818	Egyptian Tomb Bat	LC	A,B
25	<i>Taphozous nudiventris</i> Cretzschmar, 1830	Naked-rumped Tomb Bat	LC	H
<i>Molossidae</i>				
26	<i>Tadarida aegyptiaca</i> (É. Geoffroy, 1818)	Egyptian Free-tailed Bat	LC	A,H
<i>Vespertilionidae</i>				
27	<i>Scotophilus heathii</i> (Horsfield, 1831)	Greater Yellow House Bat	LC	H
28	<i>Scotophilus kuhlii</i> * Leach, 1821	Lesser Yellow House Bat	LC	A
29	<i>Pipistrellus coromandra</i> (Gray, 1838)	Indian Pipistrelle	LC	B,O
30	<i>Pipistrellus tenuis</i> (Temminck, 1840)	Indian Pygmy Bat	LC	H
31	<i>Scotozous dormeri</i> Dobson, 1875	Dormer's Bat	LC	H
<i>Manidae</i>				
32	<i>Manis crassicaudata</i> É. Geoffroy, 1803	Indian Pangolin	NT	C
<i>Felidae</i>				
33	<i>Felis chaus</i> Schreber, 1777	Jungle Cat	LC	I,K,O
34	<i>Felis silvestris</i> Schreber, 1777	Wild Cat / Desert Cat	LC	E,J,O
35	<i>Prionailurus bengalensis</i> (Kerr, 1792)	Leopard Cat	LC	K,L
36	<i>Prionailurus viverrinus</i> Bennett, 1833	Fishing Cat	EN	O
37	<i>Caracal caracal</i> (Schreber, 1776)	Caracal	LC	F
38	<i>Panthera pardus</i> (Linnaeus, 1758)	Leopard	NT	K,O
39	<i>Panthera tigris</i> (Linnaeus, 1758)	Tiger	EN	K
<i>Viverridae</i>				
40	<i>Paradoxurus hermaphroditus</i> (Pallas, 1777)	Asian Palm Civet	LC	A,B,O
41	<i>Viverricula indica</i> (É. Geoffroy Saint-Hilaire, 1803)	Small Indian Civet	LC	A,B,O
<i>Herpestidae</i>				
42	<i>Herpestes edwardsii</i> (É. Geoffroy Saint-Hilaire, 1818)	Indian Grey Mongoose	LC	A,B,K,O
43	<i>Herpestes javanicus</i> (É. Geoffroy Saint-Hilaire, 1818)	Small Indian Mongoose	LC	A,B,O
44	<i>Herpestes smithii</i> Gray, 1837	Ruddy Mongoose	LC	B,D
<i>Hyaenidae</i>				
45	<i>Hyaena hyaena</i> (Linnaeus, 1758)	Striped Hyaena	NT	A,B,J,K,O
<i>Canidae</i>				
46	<i>Canis lupus pallipes</i> Linnaeus, 1758	Indian Wolf	LC	J,K,O
47	<i>Canis aureus</i> Linnaeus, 1758	Common Jackal	LC	A,B,I,J,K,O
48	<i>Cuon alpinus</i> (Pallas, 1811)	Dhole	EN	K
49	<i>Vulpes vulpes pusilla</i> (Linnaeus, 1758)	Desert Fox	LC	K
50	<i>Vulpes bengalensis</i> (Shaw, 1800)	Indian Fox	LC	J,K

<i>Ursidae</i>				
51	<i>Melursus ursinus</i> (Shaw, 1791)	Sloth Bear	VU	K,O
<i>Mustelidae</i>				
52	<i>Mellivora capensis</i> (Schreber, 1776)	Honey Badger	LC	K
53	<i>Lutrogale perspicillata</i> (I. Geoffroy Saint-Hilaire, 1826)	Smooth-coated Otter	VU	A,B,M,N,J,K,O
<i>Suidae</i>				
54	<i>Sus scrofa cristatus</i> Linnaeus, 1758	Indian Wild Boar	LC	A,J,K,O
<i>Bovidae</i>				
55	<i>Antelope cervicapra</i> (Linnaeus, 1758)	Blackbuck	NT	A,K,O
56	<i>Gazella gazella</i> (Pallas, 1766)	Chinkara	VU	K,O
57	<i>Boselaphus tragocamelus</i> (Pallas, 1766)	Nilgai	LC	A,J,K,O
58	<i>Tetracerus quadricornis</i> (de Blainville, 1816)	Four-horned Antelope	VU	K
<i>Cervidae</i>				
59	<i>Axis axis</i> (Erxleben, 1777)	Chital	LC	J,K
60	<i>Rusa unicolor</i> (Kerr, 1792)	Sambar	VU	A,J,K
<i>Platanistidae</i>				
61	<i>Platanista gangetica</i> (Roxburgh, 1801)	Gangetic River Dolphin	EN	A,B,M,N,I,J,K,O

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