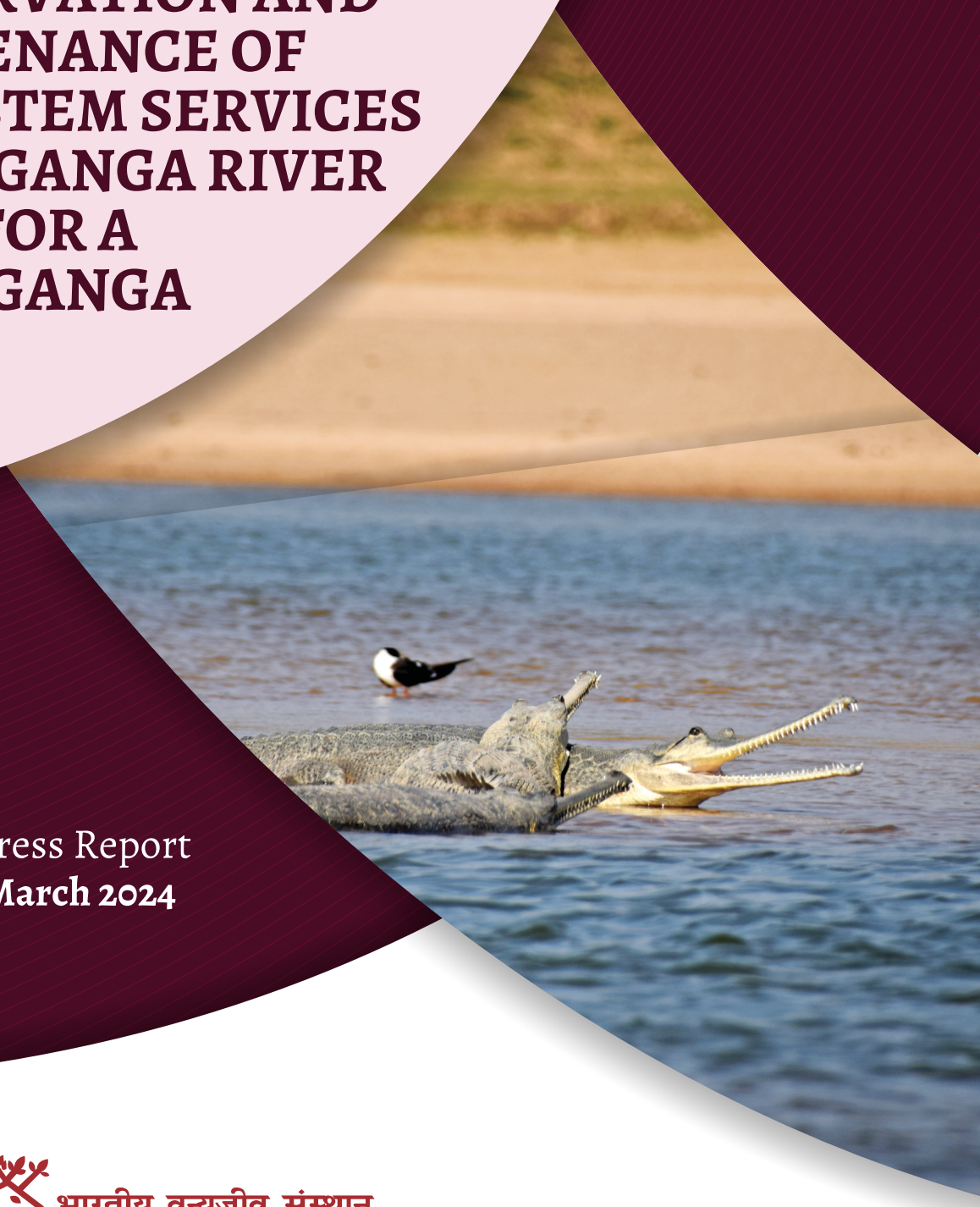
NMCG-WII GANGA BIODIVERSITY CONSERVATION INITIATIVE PHASE II

PLANNING AND MANAGEMENT FOR AQUATIC SPECIES CONSERVATION AND MAINTENANCE OF ECOSYSTEM SERVICES IN THE GANGA RIVER BASIN FOR A CLEAN GANGA



Annual Progress Report
April 2023 – March 2024

नमामि गंगे

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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Annual Progress Report
April 2023 – March 2024

Project Investigators
Ruchi Badola, Syed Ainul Hussain

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This document is an output of the project "Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga", sponsored by the National Mission for Clean Ganga, Ministry of Jal Shakti, Government of India, New Delhi.

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COMPONENT - 1

SCIENCE-BASED AQUATIC SPECIES CONSERVATION

8TH MONITORING COMMITTEE MEETING AND EXTENSION OF THE PROJECT

The 8th Meeting of the Monitoring Committee of NMCG-WII project, sponsored by the National Mission for Clean Ganga (NMCG) under the Namami Gange programme was held at the National Mission for Clean Ganga, New Delhi, on 29th January 2024, at 1030 hrs under the chairmanship of Shri G Asok Kumar, Director General, NMCG. The meeting was conducted via hybrid mode. The committee appreciated the work done under the project. During the meeting, Dr. Badola also presented a proposal for sustenance of the centre as "National Centre for River Research".





The Competent Authority extented the project uptill 31st March 2026 with no increase in project cost. A reappropriated budget was presented before the Committee Members, for the extended period with no extra financial implication to NMCG

ESTABLISHMENT OF THE GANGA AQUALIFE CONSERVATION MONITORING CENTRE

Centre for innovation, catalysing change for a blue planet

The Ganga Aqualife Conservation Monitoring Centre/National Centre for River Research (GACMC/NCRR) has been established in the campus of the Wildlife Institute of India, Dehradun. The Centre has three state-of-the-art labs: a ecotoxicology laboratory, the aquatic ecology laboratory, and the GIS laboratory for spatial analysis.

(a) **Ecotoxicology Laboratory:** Equipped to conduct qualitative and quantitative estimation and monitoring of emerging and traditional toxic organic contaminants, determination of elements and their species in various kinds of aquatic samples, and quantitative estimation of diverse physical-chemical parameters related to environmental surveillance and management, which include water-quality indicators such as pH, dissolved oxygen, temperature, turbidity, conductivity and nutrient concentrations.

(b) **Aquatic Ecology Laboratory:** Equipped with the infrastructure for monitoring aquatic biodiversity and molecular studies.

(c) **GIS Laboratory:** Capable of conducting cutting-edge research pertaining to the application of geospatial tools for the conservation of freshwater ecosystems.

These three laboratories focus on research with respect to freshwater ecosystems and their associated biodiversity. In addition to the state-of-the-art laboratories, the Centre has a classroom, auditorium, library, and researchers' room to facilitate learning and research.





INITIATING M.Sc. COURSE

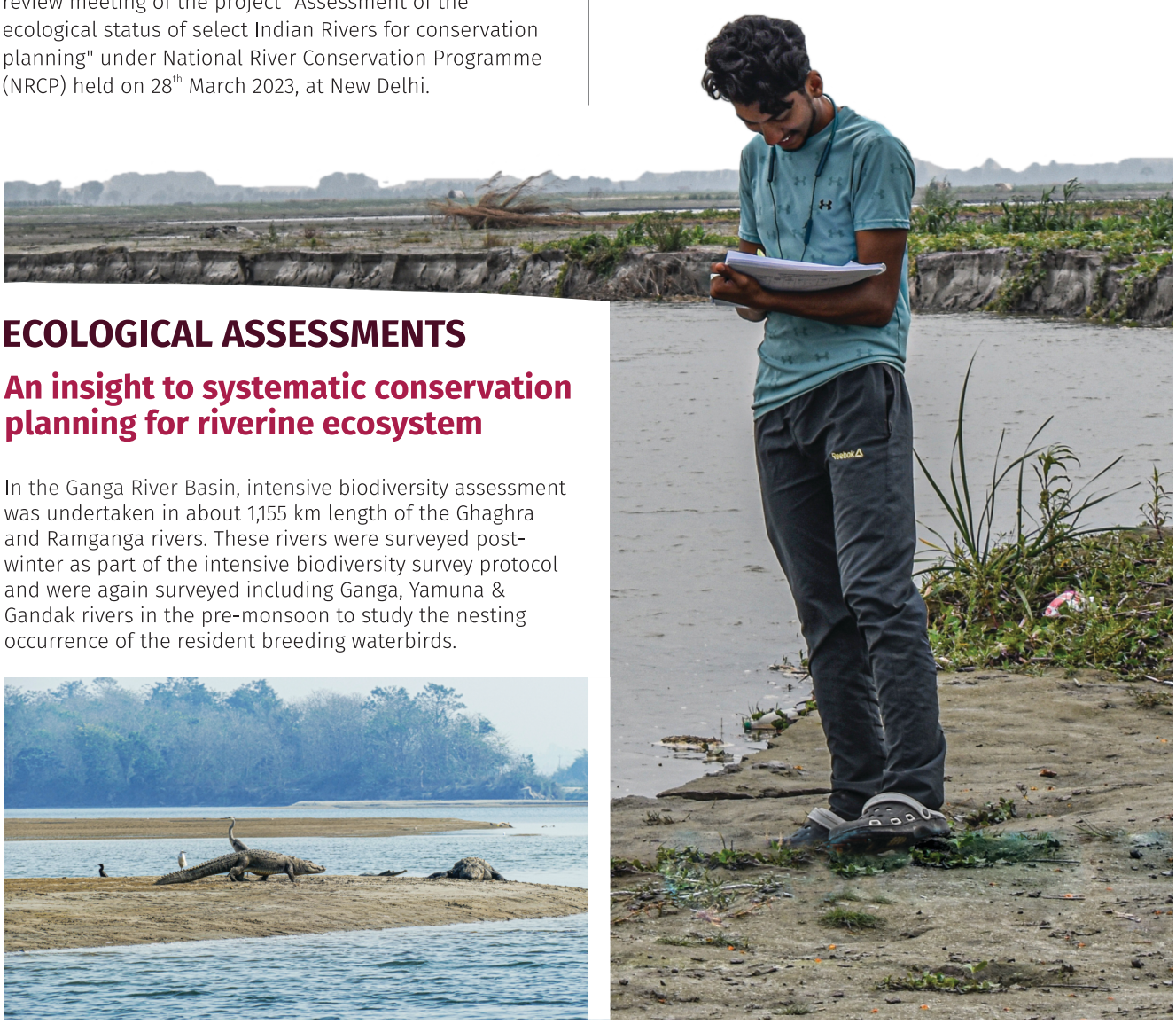
Shaping future of freshwater conservation

Freshwater ecosystems are among the most endangered biomes. The intricate links and connectivity between terrestrial and freshwater ecosystems further exacerbate the fragility of the freshwater ecosystem. The recovery plan urges the integration of biodiversity inventory and basic ecosystem science, stressor assessment, systematic restoration and protected area management with links to terrestrial realms as required. The emergency recovery plan for the freshwater ecosystems calls for urgent actions through a set of measures, for which a trained workforce of researchers and ecologists are needed. Therefore, a proposal for initiating Master's degree in Freshwater Ecology and Conservation was prepared, on the advice of Secretary, Department of Water Resources, River Development & Ganga Rejuvenation (DoWR, RD & GR), Ministry of Jal Shakti, Government of India, during the review meeting of the project "Assessment of the ecological status of select Indian Rivers for conservation planning" under National River Conservation Programme (NRCP) held on 28th March 2023, at New Delhi.

Subsequently, a detailed syllabus for M.Sc. in Freshwater Ecology and Conservation was prepared and placed for approval by the 45th meeting of the Training, Research & Academic Council (TRAC) of Wildlife Institute of India (WII) held on 15th May 2023 at WII, Dehradun. The members of the TRAC approved initiating an M.Sc. course on Freshwater Ecology and Conservation. The course will be conducted through the Academy of Scientific & Innovative Research (AcSIR), at WII.

The proposal was sent to NMCG and it was presented during the 50th Meeting of the Executive Committee of NMCG, held on 31st July 2023. The proposal was approved and AA&ES was released on 31st August 2023. The MSc course was given in-principal approval for the 5 courses to be run over the course of 10 years.

The advertisement process for the course has been initiated and the social media posts were created for the same. The online application portal for MSc course in Freshwater Ecology & Conservation opened on 1st March 2024. The course will commence from 1st August 2024.



ECOLOGICAL ASSESSMENTS

An insight to systematic conservation planning for riverine ecosystem

In the Ganga River Basin, intensive biodiversity assessment was undertaken in about 1,155 km length of the Ghaghra and Ramganga rivers. These rivers were surveyed post-winter as part of the intensive biodiversity survey protocol and were again surveyed including Ganga, Yamuna & Gandak rivers in the pre-monsoon to study the nesting occurrence of the resident breeding waterbirds.

Intensive Biodiversity Survey

Ghaghra River

A survey was undertaken in the Ghaghra River, between Girijapuri barrage and Revelganj at Ganga confluence, covering a distance of 615 km, during April 2023. A total of 422 visual sightings of the Gangetic river dolphin, 462 sightings of gharials, four sightings of muggers, and 3,489 sightings of freshwater turtles, including 33 individuals of *Nilssonia gangetica* were recorded during the survey. Additionally, 88 water and water-associated bird species were documented. Furthermore, congregations of Indian skimmers at two sporadic sites with 24 and 48 individuals, respectively, were observed.

Ramganga River

A total of 540 km stretch of the Ramganga River, from Dhikala (Corbett Tiger Reserve) to Ganga confluence near Kusumkhor of District Kannauj, Uttar Pradesh, was surveyed during May-June 2023. About 40 km of the surveyed stretch was within Corbett Tiger Reserve (Kalagarh Reservoir). During the survey, 5,779 sightings of water and water-associated birds, including 341 island nesting birds, were recorded. Interestingly, only a single nesting site was observed throughout the surveyed stretch. Additionally, seven species of turtle were also recorded during the survey.

During the survey of Ramganga River within Corbett Tiger Reserve, four individuals of smooth-coated otters (two adults and two juveniles), 41 individuals of gharial, 30 individuals of mugger, and 26 species of water and water-associated birds were recorded.

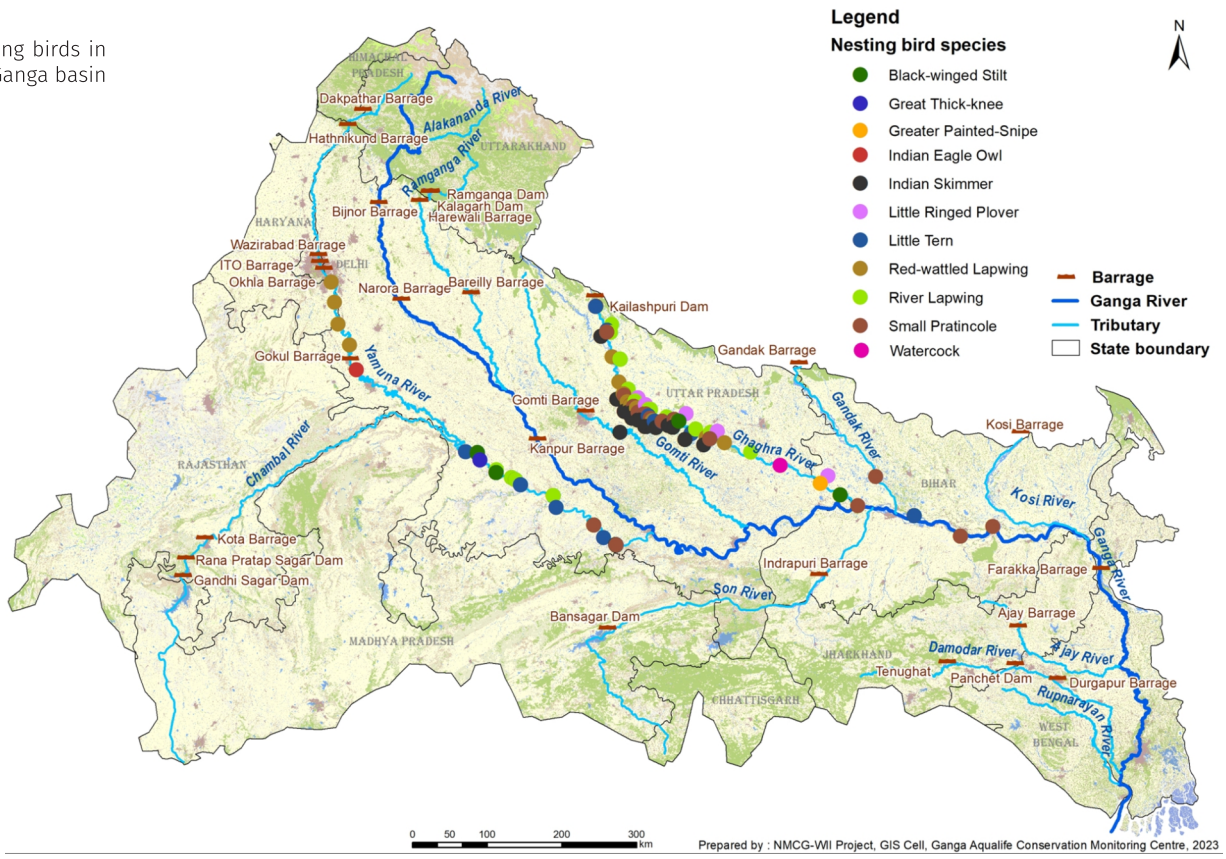




Nesting Survey

During the nesting survey of the river islands in the Ganga, Yamuna, Ghaghra and Gandak rivers, a total of 11 species of birds were found to be nesting, including Indian skimmer (*Rynchops albicollis*), river tern (*Sterna aurantia*), river lapwing (*Vanellus duvaucelii*), little ringed plover (*Charadrius dubius*), little tern (*Sternula albifrons*), red-wattled lapwing (*Vanellus indicus*), Indian thick-knee (*Burhinus indicus*), pheasant-tailed jacana (*Hydrophasianus chirurgus*), small pratincole (*Glareola lactea*), blue-tailed bee-eater (*Merops philippinus*), and black winged stilt (*Himantopus himantopus*). In the Ghaghra River, a total of ten species were recorded, including Indian skimmer, river tern, river lapwing, little ringed plover, little tern, red-wattled lapwing, Indian thick-knee, pheasant-tailed jacana, small pratincole and blue-tailed bee-eater. Three species, namely little tern, small pratincole, and black winged stilt were recorded from the Ganga River. Only red wattled lapwing and small pratincole were recorded from the Yamuna and Gandak rivers, respectively. Direct sighting of eggs or nests of any water birds could not be made from the Gandak River, as most of the river islands were submerged due to irregular water discharge from the Valmikinagar barrage.

Nesting birds in the Ganga basin





Amphibian Survey

Amphibian status was assessed using the Visual Encounter Method as per Crump et al. (1994) and Khatiwada et al. (2019). The survey covered a 500m buffer around the area, searching for amphibians along the riverbank, nearby ponds, and agricultural land during night (2000 hrs to 2200 hrs). Powerful flashlights and headlamps were used for the night survey, and weather data were collected with a Kestrel 5200 Professional Environmental meter. Various habitats, including riverbanks, ponds, agricultural land, were explored to locate different amphibian groups such as tree frogs, burrowing frogs, and stream-dwelling frogs. During each hour of sampling across varied habitats, information on species and their abundance was documented. Additionally, micro-habitat parameters, including ambient temperature, humidity, substrate characteristics (such as clayey, loamy, muddy, rocky, dry leaves, and other temporary water bodies), and ground cover, were recorded. Ground cover was assessed through the point intercept method, and photographs were taken for each identified species

During the amphibian survey of the Ganga, Yamuna, Ghaghra and Gandak rivers, a total of seven species representing four families, namely Bufonidae, Dicroglossidae, Microhylidae and Rhacophoridae were recorded. The skittering frog (*Euphlyctis cyanophlyctis*), and Indian bull frog (*Hoplobatrachus tigerinus*) were recorded from all four surveyed rivers, whereas common Asian toad (*Duttaphrynus melanostictus*) was recorded from the Ganga and Ghaghra rivers. The ornamented pigmy frog (*Microhyla ornate*) was recorded from the Yamuna and Ghaghra rivers. While the dudhwa tree frog (*Chirixalus dudhwaensis*) and Indian tree frog (*Polypedates maculatus*) was recorded only from the Ghaghra River, and the Terai cricket frog (*Minervarya teraiensis*), was recorded only from the Yamuna River.

Ajay River

The survey was conducted at nine sampling sites from the Punasi Dam to Katwa along the Ajay River between August and September 2023. A total of 13 man-hours and 13 Visual Encounter Surveys (VES) were dedicated to assessing amphibian status in the Ajay River and adjacent areas. A total of 18 species from five families (Bufonidae, Dicroglossidae, Microhylidae, Ranidae, and Rhacophoridae) were documented. Dicroglossidae emerged as the dominant family, comprising seven species, followed by four species in Bufonidae, and three species each in Microhylidae and Rhacophoridae. The Ranidae family was represented by a single recorded species in the survey. Noteworthy species identified in this river include the Bengal True Toad (*Duttaphrynus bengalensis*) and the Assam Pigmy Tree Frog (*Chirixalus simus*).

Damodar River

The study was carried out from Keliyasota to Binogramand five sampling sites were surveyed, during September 2023. A total of 14 species belonging to 11 genera and four families were recorded. Dicroglossidae was the dominant family with seven species, followed by Microhylidae were represented by three species. Bufonidae, and Rhacophoridae were represented by two species each. Four unique species were recorded from Damodar, viz., *Duttaphrynus bengalensis, Kaloula pulchra, Uperodon globulosus* and *Chirixalus simus*.

Rupnarayan River

The study was conducted at five sampling sites between Bandar to Mellak, during September 2023. A total 10 species belonging to nine genera and five families were recorded. Dicroglossidae was the dominant family with six species, followed by one species each from the Bufonidae, Microhylidae, Ranidae and Rhacophoridae families. Two unique species were recorded from Rupnarayan River, viz *Hylarana tytleri* and *Polypedates bengalensis*.



Indian bull frog



Indian tree frog

Fish Survey

Ajay River

Three sampling sites were surveyed in the upper, middle and lower stretches of the Ajay River. A total of 32 species spanning 17 families and seven orders were documented, with the dominant family being Cyprinidae, comprising six species. Among the 32 species, only one was identified as exotic and near threatened, namely the Silver Carp (*Hypophthalmichthys molitrix*).

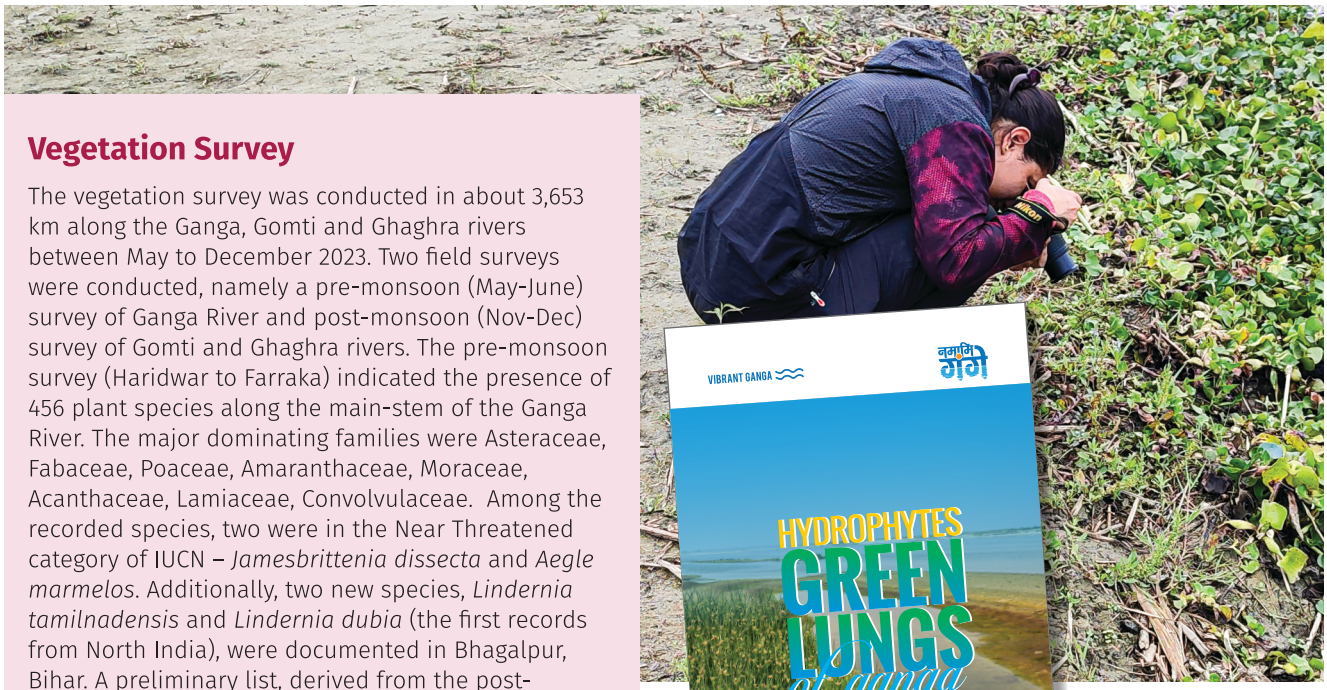
Damodar River

This survey was performed in the middle and lower stretches of the Damodar River. Fishes were sampled at four sampling sites. A total of 43 species belonging to 21 families and 11 orders were recorded. The most abundant family was Cyprinidae (nine species). Out of 43 species only one Vulnerable (*Oreochromis mossambicus*) and four Near threatened species (*Hypophthalmichthys molitrix, Chitala chitala, Parambassis lala, Ailia coila*) were reported.

Rupnarayan River

Three sampling sites were surveyed in the Rupnarayan River. Total 42 species belonging to 20 families and 11 orders were recorded. The dominant family was Danionidae (7 species). Out of 42 species only one Vulnerable (*Wallago attu*) and five Near threatened species (*Chitala chitala, Parambassis lala, Ompok bimaculatus, Ompok pabda, Harpadon nehereus*) were reported.

The fish survey in the Ramganga, Sharda, Mahananda, Bagmati and Gomti rivers has been ongoing since December 2023.



Vegetation Survey

The vegetation survey was conducted in about 3,653 km along the Ganga, Gomti and Ghaghra rivers between May to December 2023. Two field surveys were conducted, namely a pre-monsoon (May-June) survey of Ganga River and post-monsoon (Nov-Dec) survey of Gomti and Ghaghra rivers. The pre-monsoon survey (Haridwar to Farraka) indicated the presence of 456 plant species along the main-stem of the Ganga River. The major dominating families were Asteraceae, Fabaceae, Poaceae, Amaranthaceae, Moraceae, Acanthaceae, Lamiaceae, Convolvulaceae. Among the recorded species, two were in the Near Threatened category of IUCN – *Jamesbrittenia dissecta* and *Aegle marmelos*. Additionally, two new species, *Lindernia tamilnadensis* and *Lindernia dubia* (the first records from North India), were documented in Bhagalpur, Bihar. A preliminary list, derived from the post-monsoon survey along Gomti and Ghaghra rivers, suggested the presence of 317 and 308 plant species, (identification and listing yet to be finalized).

The first volume on hydrophytes of River Ganga, titled "Green Lungs of Ganga," was finalized, and the editing process for the second volume is currently underway.

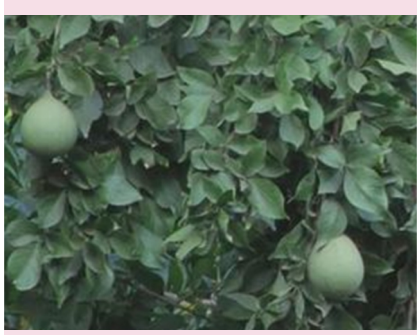
The vegetation survey of the Ajay, Rupnarayan and Damodar rivers is currently ongoing.

Green Lungs of Ganga Vol. I

Near Threatened species



Jamesbrittenia dissecta



Aegle marmelos

New Records

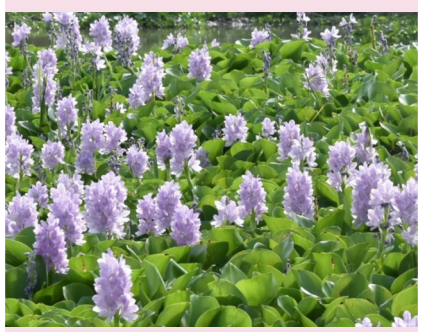


Lindernia dubia



Lindernia tamilnadensis

Dominant weeds (Aquatic)



Pontederia crassipes



Pistia stratoites

Wetland survey

A total of 20 wetlands with Ramsar sites were mapped in the Ganga River basin. Apart from these, other important wetlands were also identified in the basin that fulfills the Ramsar criteria. Following this, wetland habitat and waterbird surveys were conducted November 2023 to March 2024 in Bakhira Wildlife Sanctuary in Uttar Pradesh, Jhilmil Jheel Conservation Reserve, Banganga wetland and Asan Conservation Reserve in Uttarakhand. The waterbird survey in select wetlands will be continued in the next season.



Insights from the survey

For the first time, the Caspian tern (*Hydroprogne caspia*), grey plover (*Pluvialis squatarola*), black-faced bunting (*Emberizas podocephala*), black stork (*Ciconia nigra*) were recorded from the Ghaghra River.

Sighting of the grey plover from the Ghaghra and Mahanada rivers is the first recording of the species from the Ganga River Basin.



Grey plover recorded from Ghaghra River



Caspian tern



Black-faced bunting recorded from Katerniaghat, Ghaghra River

Invertebrate

Review of exiting knowledge base

A comprehensive inventory of major macroinvertebrate taxa, with a primary focus on Odonates, associated with the Damodar River was meticulously compiled. This checklist is founded upon a rigorous analysis of published secondary literature, ensuring the inclusion of the most relevant and scientifically validated information. In parallel, a detailed checklist encompassing major macroinvertebrate taxa, such as Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), has been curated for the Ramganga River, Asan River, Upper Ganga and Lower Ganga. This compilation is grounded in a thorough examination of pertinent secondary literature, enhancing the accuracy and completeness of the taxonomic inventory.

Field Survey

Invertebrate sampling was carried out in the Ramganga River, during July and October 2023. Macroinvertebrates were acquired utilizing the kick-net and hand-picking methods, ensuring a comprehensive representation of the aquatic ecosystem during different temporal phases. The collected macroinvertebrate samples and Odonates were identified through established taxonomic keys. The identification process revealed a total of six macroinvertebrate orders. Notably, the order Trichoptera emerged as the most prevalent among the identified aquatic macroinvertebrates.



Collecting specimens from Ramganga River



Family: Hydropsychidae



Orthetrum luzonicum



Family: Psephenidae

Study of Small Rivers – Song and Chandrabhaga

Song River

Song river, a small tributary of Ganga River, flows for 80 km before joining the Ganga River near Nepali Farm in Dehradun district. Its basin covers an area of 1040.49 sq. km. The 8 km of the river passes through the Motichur ranges and approx. 7 km passes through the Kansrao range of the Rajaji National Park. During a reconnaissance survey (February 2024), a total of 35 bird species belonging to 20 families were recorded from the river. Along the river 170 taxa of angiosperms with 137 genera, 54 families and 23 orders. Poaceae was the most dominant family with 26 species. Key threats observed in the river were sewage drain, human disturbance (unregulated tourism), religious waste, sand mining, water extraction, livestock presence and plastic waste.

Chandrabhaga River

Chandrabhaga, a small tributary of the Ganga River, flows for 23.68 km before joining the Ganga River near Rishikesh. Its basin covers an area of 190.04 sq. km. Rajaji National Park is situated along the river's edge. During a reconnaissance survey (February 2024), a total of 35 bird species belonging to 20 families were recorded from the river. Along the river, 158 taxa of angiosperms with 128 genera, 50 families and 23 orders. Poaceae was the most dominant family with 23 species. Key threats observed in the river were sewage drain, plastic waste, human settlement, sand mining and water extraction.





GANGETIC DOLPHIN POPULATION

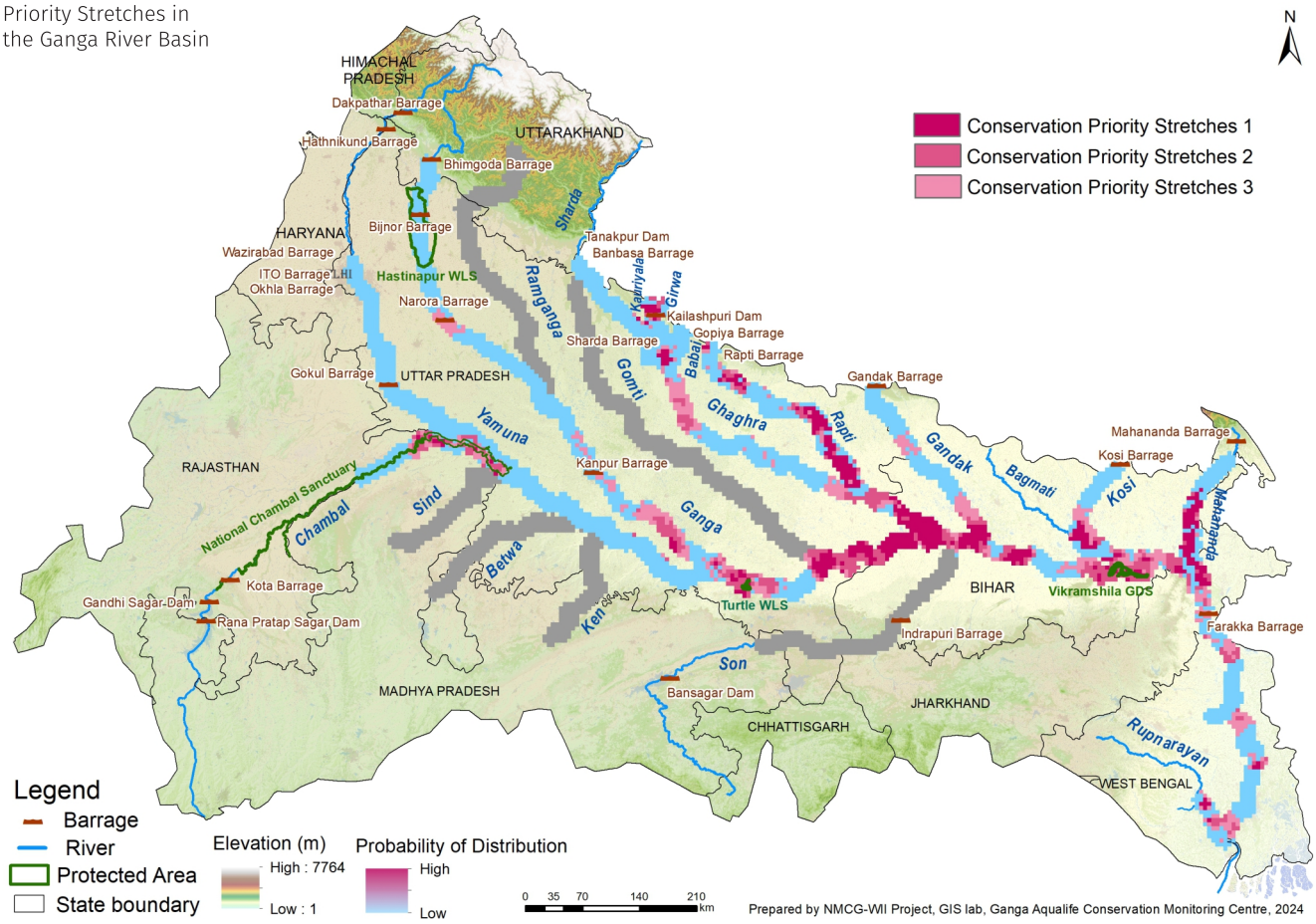
Insights from river surveys

Extensive surveys were conducted along a total of 5725 km of rivers within the Ganga basin, encompassing the mainstem of the Ganga River, its major tributaries such as the Yamuna, Ghaghra, Gandak, Son, Kosi, Rupnarayan, and Chambal and smaller tributaries including the Girwa, Kauriyala, Babai, Sharda, Rapti, Bagmati, Mahananda, Ken, Betwa, and Sind rivers. About 3936 ± 763 (mean ± SE) Gangetic dolphins inhabit the 14 rivers in the Ganga basin, including the Ganga River. Details on this study can be found at https://www.sciencedirect. com/science/article/ pii/ S2351989424001045.

To conserve this population of the Gangetic dolphin and their habitat, about 46.3% of the river stretches in the Ganga basin need to be conserved as Priority Stretches.



Priority Stretches in the Ganga River Basin



TECHNOLOGY IN ECOLOGY

Homogenising modern techniques into conservation initiatives

Genetic Analysis

A comprehensive genetic data set was generated and analysed for *Wallago attu*, spanning 19 locations across the Ganga, Ramgamga, Sharda, Saryu, Rapti, Gandak, and Kosi rivers. These findings suggest the presence of genetic connectivity among *Wallago attu* populations in the Ganga River Basin, with no evidence of a bottleneck effect.



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ORIGINAL ARTICLE

Genetic diversity, spatial connectivity, and population structure of Asian silurid catfish *Wallago attu* (Bloch and Schneider, 1801) in the Ganga River System: insights from mitochondrial DNA analysis

Ajit Kumar[1] · Naveen Negi[1] · Neha Yadav[1] · Ruchi Badola[1] · Syed Ainul Hussain[1] · Sandeep Kumar Gupta[1]

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Abstract

Background The Ganga River System (GRS) is a biodiversity hotspot, its ecological richness is shaped by a complex geological history. In this study, we examined the genetic diversity, spatial connectivity, and population structure of the Asian Silurid catfish, *Wallago attu*, across seven tributaries of the GRS.

Methods and results We employed three mitochondrial DNA (mtDNA) regions: cytochrome c oxidase subunit *I* (*COXI*), cytochrome *b* (Cyt *b*), and control region (CR). Our comprehensive dataset encompassed 2420 bp of mtDNA, derived from 176 *W. attu* individuals across 19 sampling sites within the seven rivers of GRS. Our findings revealed high gene diversity (Hd 0.99) within *W. attu* populations. Analysis of Molecular Variance (AMOVA) highlighted that maximum genetic variations were attributed within the populations, and the observed genetic differentiation among the seven populations of *W. attu* ranged from low to moderate. Network analysis uncovered the presence of three distinct genetic clades, showing no specific association with seven studied rivers. Bayesian skyline plots provided insights into the demographic history of *W. attu*, suggesting a recent population expansion estimated to have occurred approximately 0.04 million years ago (mya) during the Pleistocene epoch.

Conclusions These results significantly enhance our understanding of the genetic diversity and spatial connectivity of *W. attu*, serving as a vital foundation for developing informed conservation strategies and the sustainable management of this economically valuable resource within the Ganga River System.

Keywords *Wallago attu* · Mitochondrial DNA · Genetic diversity · Population genetic structure · Ganga river system

Introduction

The Ganga River System (GRS) is the world's most populous river basin, which extends over an area of 1,086,000 km² and also known as important aquatic biodiversity hotspots. This extensive basin is intricately interwoven with a vast network of tributaries, threatened by anthropogenic pollution and degradation, significantly impacting aquatic biodiversity and their habitats [1]. It also faces the challenge of accommodating the highest human density. Consequently, these ecological disruptions hinder the conservation efforts to preserve the river's delicate ecosystem [2]. To comprehensively assess the implications of the contemporary environmental threats and losses for biodiversity management, harnessing the link between genetics and associated habitat in populations of focal species within the tributaries is crucial. This approach allows for a more insightful evaluation of the impact on the microecosystem and aids in developing targeted conservation strategies. Consequently, the preservation and sustainable management of the freshwater ecosystem, rich biodiversity, and natural habitats within the GRS have emerged as significant concerns in India. This is particularly pertinent under the ambit of the National Mission for Clean Ganga Project, which is undertaking comprehensive measures aimed at reinstating the ecological health of the GRS.

The Asian Silurid catfish, *Wallago attu* is widely distributed in the Indian subcontinent and several Southeast Asian

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African catfishes from Yamuna river



Genetic characterization of African sharptooth catfishes, Clarias gariepinus in the selected stretches of Yamuna river was conducted.

Sampling locations of *Wallago attu*



Eco-toxicological Assessment

A comprehensive spatio-temporal assessment of water quality parameters and chemical toxicants, such as pharmaceuticals, personal care products, endocrine-disrupting compounds, heavy metals, pesticides, and plasticizers, was conducted within the Ganga river basin (GRB). Additionally, the associated ecological risks to aquatic biodiversity from these anthropogenic stressors were evaluated. Under this study, ecotoxicological data from 12 rivers and 143 sampling sites along the Ganga River basin have been synthesized, identifying pollution hotspots within rivers Ganga, Yamuna, Gomti, Ghaghra, Gandak, Kosi, Son, Chambal, Ramganga, Rupnarayan, Ajay, and Damodar. A preliminary report has been submitted to provide a basis for regulatory authorities to design effective monitoring strategies and formulate appropriate contamination mitigation efforts aimed at sustaining the healthy ecological diversity of the GRB.

In May and June 2023, an eco-toxicological survey targeted the Chambal River to develop a non-invasive method for monitoring emerging contaminants in endangered species like the gharial, mugger, waterbirds, and turtles. The survey collected surface water, sediment, scat, and bird feathers to monitor contaminants. Biotic samples from various trophic levels were gathered to study bioaccumulation and species-specific distribution of contaminants, as well as biomagnification in the freshwater food web. Preliminary data on light pollution in habitats of threatened turtles and gharials, including the gharial's response to different light regimes, were also sought.

Two field surveys occurred from July to December 2023 to understand trophodynamics of emerging contaminants in critical habitats and estimate risks to apex predators like the Gangetic Dolphin and the Gharial. The first survey in July covered sites within the National Chambal Sanctuary and downstream, collecting water, sediment, plankton, scat, and fish samples. Another survey from October to November 2023 examined biomagnification of Contaminants of Emerging Concerns (CECs) in Ganga river zones including Varanasi, Bihar, and Jharkhand. Abiotic and biotic samples were collected for analysis to assess potential risks to threatened species through their diet and environment.



Ecotoxicology Survey-July 2023

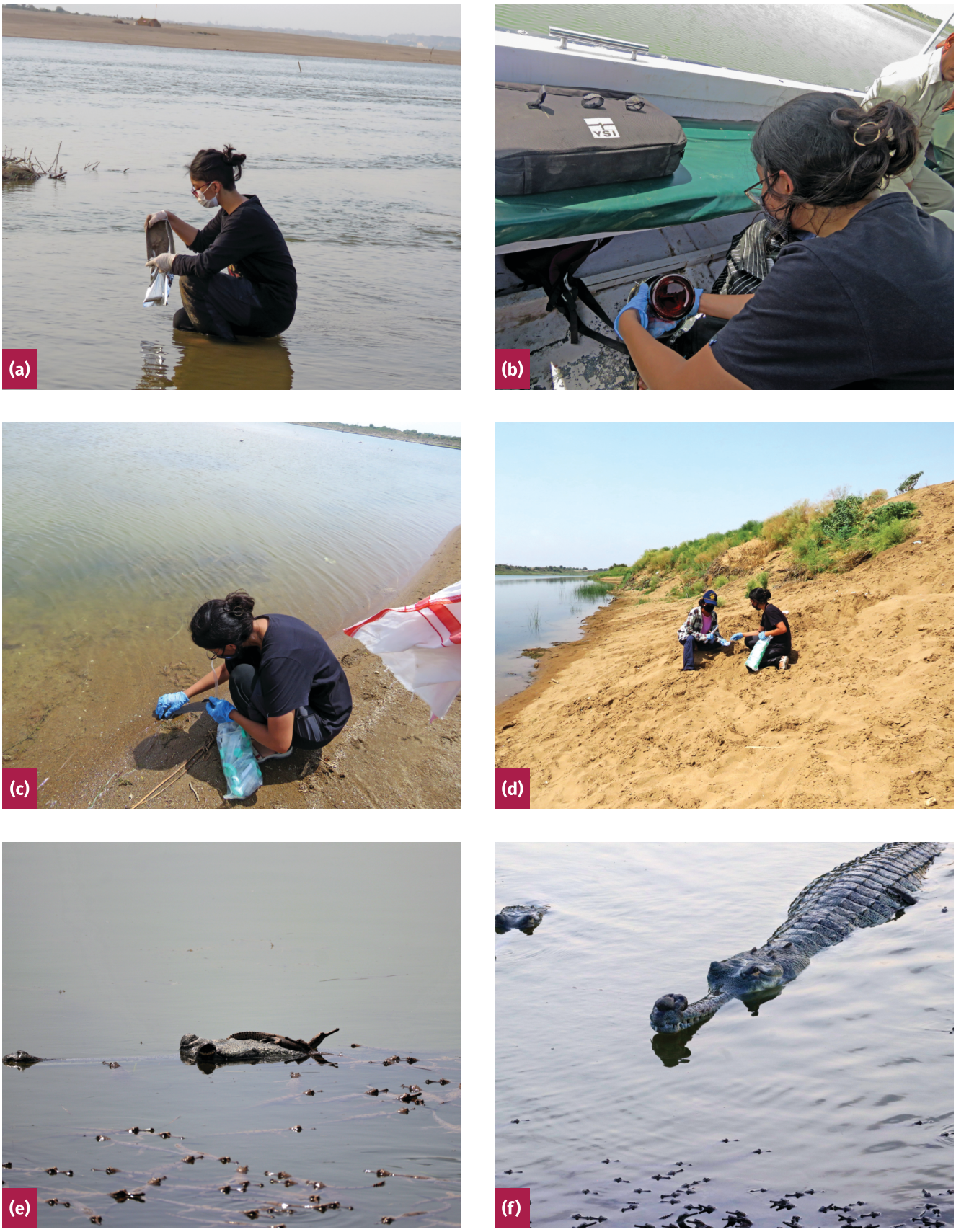


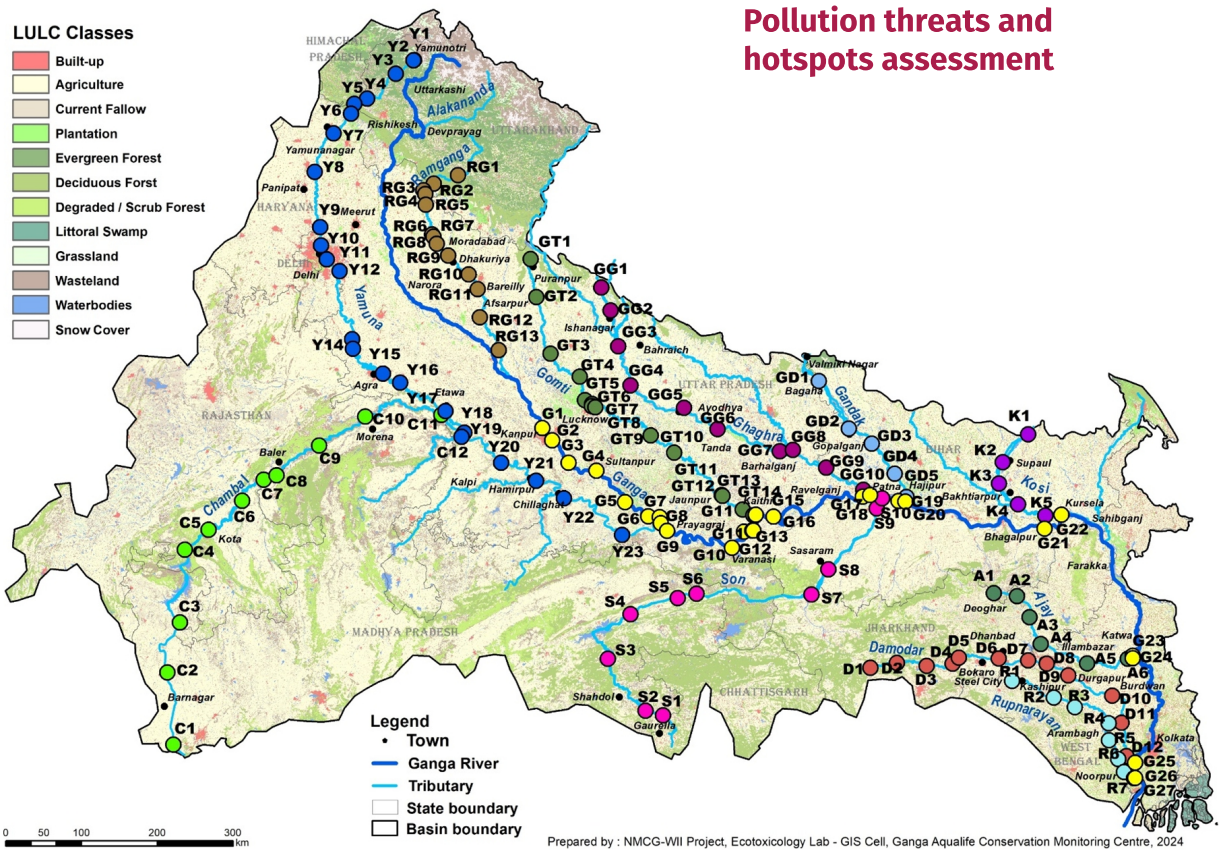
Figure 1: (a-d) Abiotic sample collection, Pali, Chambal (e-f) Gharial at Pali and Nadigaon, Chambal

Ecotoxicology Survey: October-November 2023

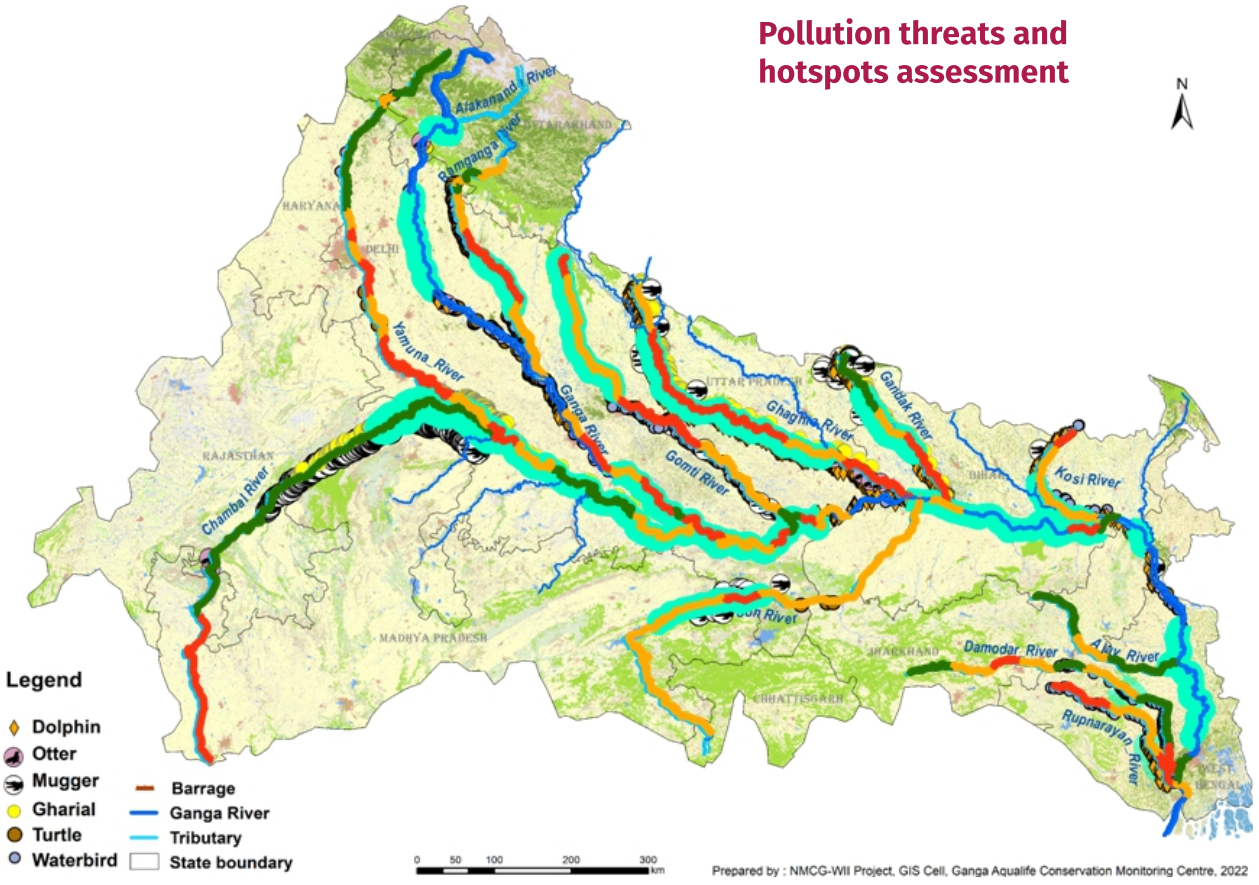


Figure 2: **(a)** Macroinvertebrates collection at Kaithi, Uttar Pradesh **(b)** Planktons and zooplanktons collection at Kahalgaon, Bihar **(c-d)** Water quality parameters assessment, at Kahalgaon, Bihar **(e-f)** Collection of surface water and sediment at Sahibganj, Jharkhand

Pollution threats and hotspots assessment



Pollution threats and hotspots assessment



RESCUE, REHABILITATION, RELEASE, AND RESEARCH

Daily management of the Barhi Turtle Center and Sarnath Rescue and Rehabilitation Centre

Notching for individual identification of three striped roofed turtles (*Batagur dhongoka*) and Red-crowned roofed turtles (*Batagur kachuga*) was carried out in November. Hatchlings of three striped-roofed turtles (*Batagur dhongoka*) and Red-crowned roofed turtles (*Batagur kachuga*) are being reared at the Barhi turtle rescue centre. They were provided with an enriched habitat and balanced diet for ensuring their good health. Feeding with variable diets, including commercial turtle pellets, vegetables, occasional live or dead fish, and dried super worms, was provided. Regular cleaning of the enclosure and pond was carried along-with temperature regulation through creation of sun and shade areas and use of artificial heating sources for temperature regulation.

About 976 individuals of freshwater turtles were rescued and brought to the Kachua Punarwaas Kendra in Sarnath and Carnivore Turtle Rescue Centre, Barhi, Bhind, Madhya Pradesh. At the Turtle Rescue and Rehabilitation Centre in Sarnath, daily operations are focused on providing optimum care for ensuring the well-being of the turtles in our care. Every day, the turtles receive proper feeding, and the personnel on-site ensure the implementation of appropriate enclosure enrichment practices to support their overall health. The team conducts daily monitoring of incubated turtle eggs, taking necessary measures to control the hatchery temperature. As a precautionary measure against winter conditions, polythene sheets and heating lights are installed in the turtle ponds for maintaining an optimum temperature for the turtles during colder months. The centre also actively engages in the procurement of necessary items vital for the effective functioning of the rescue facility. A critical aspect of the centre's activities involves morphometric assessments, focusing on *Batagur kachuga, Batagur dhongoka* (for the years 2020 and 2023), and *Nilssonia hurum* (for the 2023 batch).

Winter management of the centres was carried out by installing plastic sheets for insulation along with heating lamps in each enclosure. Running water in the pond was maintained to ensure a temperature range of 28-30°C. In winter, external low temperatures can lower metabolism and activity rates, leading to a 1% body weight loss per month during hibernation. Consequently, feed quantity for all individuals was reduced. Some turtles exhibited swelling on the eyes and nasal discharge at the onset of winter. Both the Barhi and Sarnath centres implemented wintering management, installing plastic sheets and UV lights, along with 200-watt bulbs, to regulate temperatures. Regular temperature recordings were conducted at both centres.

Health care management of turtle hatchlings at the centers

Health monitoring through morphometric assessments and physical examination was carried out on a regular basis. A part of the health management efforts was the necropsy examination of two dead hatchlings of three striped roofed turtles (*Batagur dhongoka*). The carcass was observed with no external signs of injury or disease. Even then, the lungs, liver and heart were observed to be congested. Mucus was found in the intestine, and hypertrophy of the gall bladder was indicative of starvation. Incomplete ingested yolk was found attached with stomach. Undigested food in the stomach was seen and enteritis along with secondary bacterial infection in the gastrointestinal tract which may be due to an unabsorbed yolk sac and metabolic disturbance. Secondary bacterial infection was seen in both the carcasses and animals died due to septicemia.

Biological samples, including nails, tissue, oral swabs, carapace swabs, and cloacal swabs, were collected at the Turtle Rescue and Rehabilitation Centre in Sarnath, Varanasi. The collection of samples for further analysis was ensured during post-mortem examinations. Nail samples from *Nilssonia hurum* hatchlings were specifically gathered for the phylogeny. Blood samples from *Lissemys punctata*, contributing to comprehensive research efforts aimed at improving care and conservation practices at the centre. Additionally, post-mortem and blood collection procedures for rescued animals were carried out, and samples for histopathology, bacterial and viral analysis were taken, further enhancing the centre's commitment to scientific research and the well-being of the rescued turtles.



Rescue and Rehabilitation of turtles

Ten Indian flap shell turtles (*Lissemys punctata*) were rescued from near the Bhind, Railway Station. All rescued individuals were injured (abrasion), and dehydrated. Primary treatment e.g. ASD (Anti Septic Dressing) with Betadine solution (10%) and Neosporin powder was done. Subsequently the turtles were placed in the rescue pond with water at ambient temperature to enable the turtles to regain appropriate hydration levels. To encourage natural behaviours and reduce stress in the turtles housed at the centre environmental enrichment was carried out (Sieved sand, wooden and bamboo platform) for providing opportunities for swimming, basking, and exploration. Monitoring of turtle's behaviour, feeding habits, and overall health was carried. Detailed records of treatments, observations, and any changes in condition are being maintained.



During the rescue operations, the Railway Police Force (RPF) and Forest Dept. successfully rescued 27 *Lissemys punctata* on 15th October 2023, and 23 turtles, including eight *Nilssonia gangetica* and 15 *Lissemys punctata*, on 3rd October 2023, from Mughalsarai railway station. These rescued turtles were expertly cared for at our Turtle Rescue and Rehabilitation Centre, receiving necessary attention such as first aid treatment, feeding, and rehydration. Additionally, a rescue mission was undertaken on 22nd October 2023, in Firozpur, Chandauli, to rescue a Marsh crocodile from a fishery pond, although the attempt was unsuccessful. Remarkably, the crocodile independently escaped the pond a few days later, returning to its natural habitat in the river. The cumulative efforts resulted in the successful rescue of a total of 50 turtles from various locations between July and December 2023.

Capacity-building workshops

Conducted a workshop on 4th October 2023, at Chaudhary Charan Singh University, jointly organized with the Uttar Pradesh Forest Department. The event aimed to focus on the rescue and rehabilitation, specifically on aquatic macro-fauna and snakes. About 35 Forest Department officials, 90 MSc Zoology students from Chaudhary Charan Singh University, University Faculty, participated in the workshop. The workshop covered various aspects of freshwater aquatic ecology and conservation.



The Aquatic Conclave Programme was held at Sanjay Gandhi Biological Park, Patna, on 3rd and 4th September 2023. The event saw active participation from 30 PhD Research Scholars from Patna University, 25 Researchers from NIT, 25 Zoo Ambassadors (comprising students from MSc, BSc, and other classes), and 10 Veterinarians from Patna Zoo. Throughout the conclave, participants shared valuable insights, best practices, and innovative research findings, fostering a collaborative environment focused on advancing aquatic conservation efforts.

An educational exposure visit was organized for the MSc students in Wildlife Science (AcSIR-73-WL-303) of the Wildlife Institute of India, Dehradun. The visit included a trip to the Agra Wildlife SOS Bear Centre and Ganga Avlokan, Haridwar, aimed at providing valuable insights into wildlife health management, survey techniques, and the rescue and rehabilitation of aquatic macrofauna.

Engaged with 40 students from Rajghat Besant School during their field trip to our rescue centre on 9th October 2023, providing a detailed session on the conservation of aquatic species with a special focus on Gangetic turtles.

Engaged with 24 children from Vivekananda Public School during their field trip to our rescue centre on 25th October 2023, providing a detailed session on the conservation of aquatic species with a special focus on Gangetic turtles.

Around 65 students of BSc III years Zoology, Banaras Hindu University, visited Rescue and Rehabilitation Centre, Sarnath, on 25th October 2023, with the purpose of introducing the students to the conservation of aquatic fauna of Ganga Basin. Students were sensitised about basic principles of rescue and rehabilitation, animal identification, handling, morphometry, principles of wild animal health and post-mortem examination, sample collection and storage, etc.

Interacted with six MSc Zoology students of BHU, guiding them through hands-on practice on handling, morphometry, and management of Gangetic turtles. They visited our centre on 3rd and 9th December 2023.

Engaged with 50 trainee teacher students from District Institute of Education Technology, Varanasi, providing a detailed session on the conservation of aquatic species with a special focus on Gangetic turtles. They visited our centre on 16th December 2023.

Rescue and Rehabilitation of Aquatic Species





Hatchling management and husbandry practices





Healthcare of Rescued Turtles





Necroscopy and Virological Sampling



Renovation And Establishment Of New Center - Rudrapur



COMPONENT - 2

CAPACITY BUILDING OF THE FOREST DEPARTMENT AND OTHER STAKEHOLDERS

SPEARHEAD TRAININGS

Prompt execution of conservation efforts

Three national and one state level spearhead training workshop were conducted between April 2023 to March 2024. Total 309 participants comprising of police personnel, forest official, engineers, NSS volunteers and Ganga Praharis were trained on River conservation and the role of enforcement agencies in biodiversity





Discussion with the participants of the irrigation Department, at Tehri Dam



Participants learnt about the illegally traded artciles



National Level Training Workshop on 'Freshwater Biodiversity Conservation' for Professors and University teachers held from 5th to 7th March 2024

PROMOTING CONSERVATION BY TRAINING AND EDUCATION

Three training programmes were conducted for college students and professors, in which 124 college students and 68 professors were trained on different aspects of biodiversity conservation.

CATCH THE RAIN CAMPAIGN

Activities under the 'Catch the Rain' campaign were initiated in June 2022 and continued till June 2023. Activities such as awareness programmes, cleanliness and plantation drives, pledge, board installation, sandbagging, *chal & khal* renovations, slogan writing competitions, de-silting of tanks and removal of obstruction in channels were organised. A total of 10,356 people from different stakeholder groups, such as NCC cadets, NSS volunteers, local youth, college students, school children, teachers participated in the activities.





TRAINING OTHER STAKEHOLDERS

Three onsite training workshops were conducted one for NSS volunteers at Jaipur, Roorkee and Maldevta. A total of 298 NSS Volunteers and Programme Officers were trained on Ganga Biodiversity Conservation.









BAL GANGA PRAHARI

Bal Ganga Prahari Corners (Ganga Aqualife Knowledge Centre)

Twelve Ganga Aqualife Knowledge Centres were established in government schools across various states of the Ganga basin.





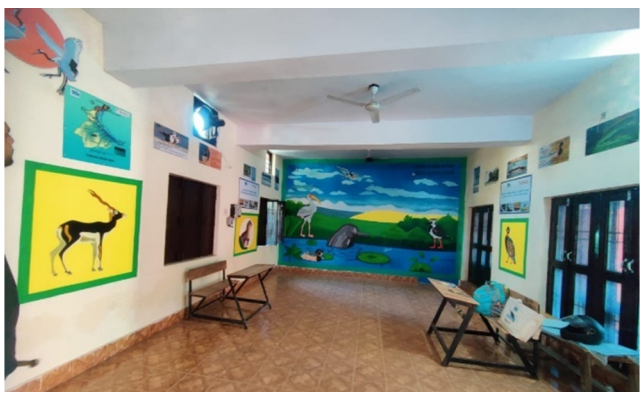
Government High School, Behral, Himachal Pradesh



Govt.Abhinav Inter College, Kannauj, Uttar Pradesh



Govt. Girls Inter College, Prayagraj, Uttar Pradesh



Govt. Sr. Sec. School, Pratapnagar, Haryana



Rajasthan Inter School, Sahibganj, Jharkhand



Govt. High School, Behral, Himachal Pradesh

Bal Ganga Prahari Spearhead teams

Spearhead teams were also established comprising of 10 students in each teams.





Bal Ganga Prahari Sensitization Programmes

95 Sensitization programmes were carried out in which 15,012 students and 300 teachers were sensitized about the importance of Ganga biodiversity and its conservation.











National River Dolphin Day



Independence Day



Plantation Drive (Van Mahotsav)



National Wildlife Week

RADIO TALKS

WII-NMCG resource persons delivered 14 Radio talks on various aspects of conservation and career options for youths through 90.0 FM Radio Rishikesh.

Date/Day	Topic
08/08/2023	Bal Ganga Prahari Programme
12/08/2023 International Youth Day	Environment, Development and Youth
15/08/2023 Independence Day	Role of Youth in Nation Development and Gender Equality
16//08/2023	Career options for youth in Forestry and Biotechnology fields
19/08/2023 World Photography Day	Wildlife and Photography
23/08/2023	Career options for youth in Wildlife Sciences
24/08/2023	Waste Management
25/08/2023	Remote Sensing, GIS and its Applications
25/08/2023	Career options in Remote Sensing and GIS
30/08/2023	Career options in the Field of Commerce and Science
02/09/2023	Importance of street plays for conservation related awareness
09/09/2023 Himalaya Day	Role of Women in Conservation of Himalayas
13/09/2023	Career options in the Field of Environmental Science and Management
04/10/2023 Swachhata Pakhwada	Plastic Waste Management and Composting



COMPONENT - 3

COMMUNITY BASED AQUATIC SPECIES CONSERVATION AND OUTREACH PROGRAMMES

LIFE LESS ORDINARY GANGA PRAHRIS: GUARDIANS OF THE RIVER

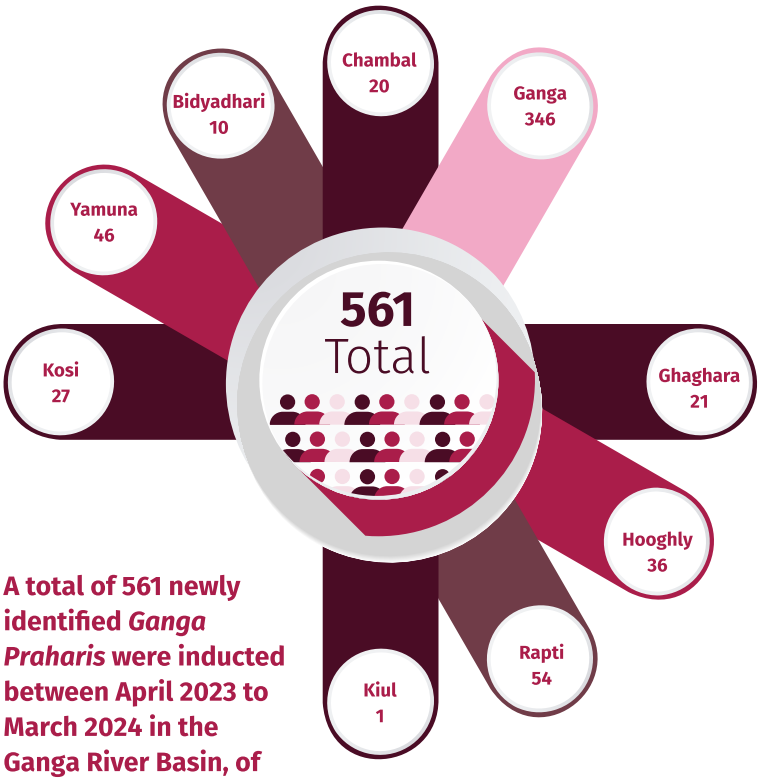
Role of Riverine Community in Conservation

The *Ganga Prahari* cadre has increased to 4,808 individuals in the Ganga River Basin, of which 3,067 are female and 1,741 are male. Capacity development workshops were conducted for the *Ganga Praharis* from 19 significant tributaries, sub-tributaries, and newly identified *Ganga Praharis* from the Ganga mainstem. Subsequently, they were integrated with the previously trained cadre. These dedicated Ganga Praharis are strategically distributed across 105 districts of 11 states in the Ganga River basin. Notably, 561 Ganga Praharis (493 females and 68 males) were inducted to the cadre between April 2023 and March 2024, emanating from various regions within the Ganga River and its tributaries, including Hooghly, Yamuna, Chambal and sub-tributaries (Bidhyadhari and Kiul).





Awareness Programmes



A total of 561 newly identified *Ganga Praharis* were inducted between April 2023 to March 2024 in the Ganga River Basin, of which 445 are female.

COMMUNITY ENGAGEMENT IN GANGA RIVER AND BIODIVERSITY CONSERVATION

Communities as custodians

A cumulative total of 1,796 activities, encompassing awareness programs, cleanliness drives, plantation initiatives, sensitisation workshops, mobilization, orientation workshops, consultative meetings, livelihood training sessions, cultural activities, participatory mapping, LiFE activities and ecological surveys were diligently carried out across 52 districts of 8 states including Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Himachal Pradesh, Haryana, Madhya Pradesh across the Ganga River basin by the Wildlife Institute of India (WII). Approximately 58,898 participants, predominantly comprised of different stakeholder categories, including local community representatives, Ganga Praharis, Forest department officials, district administration officials, NGOs and other line agencies, participated in these events.



Social Mapping



Cleanliness Drive

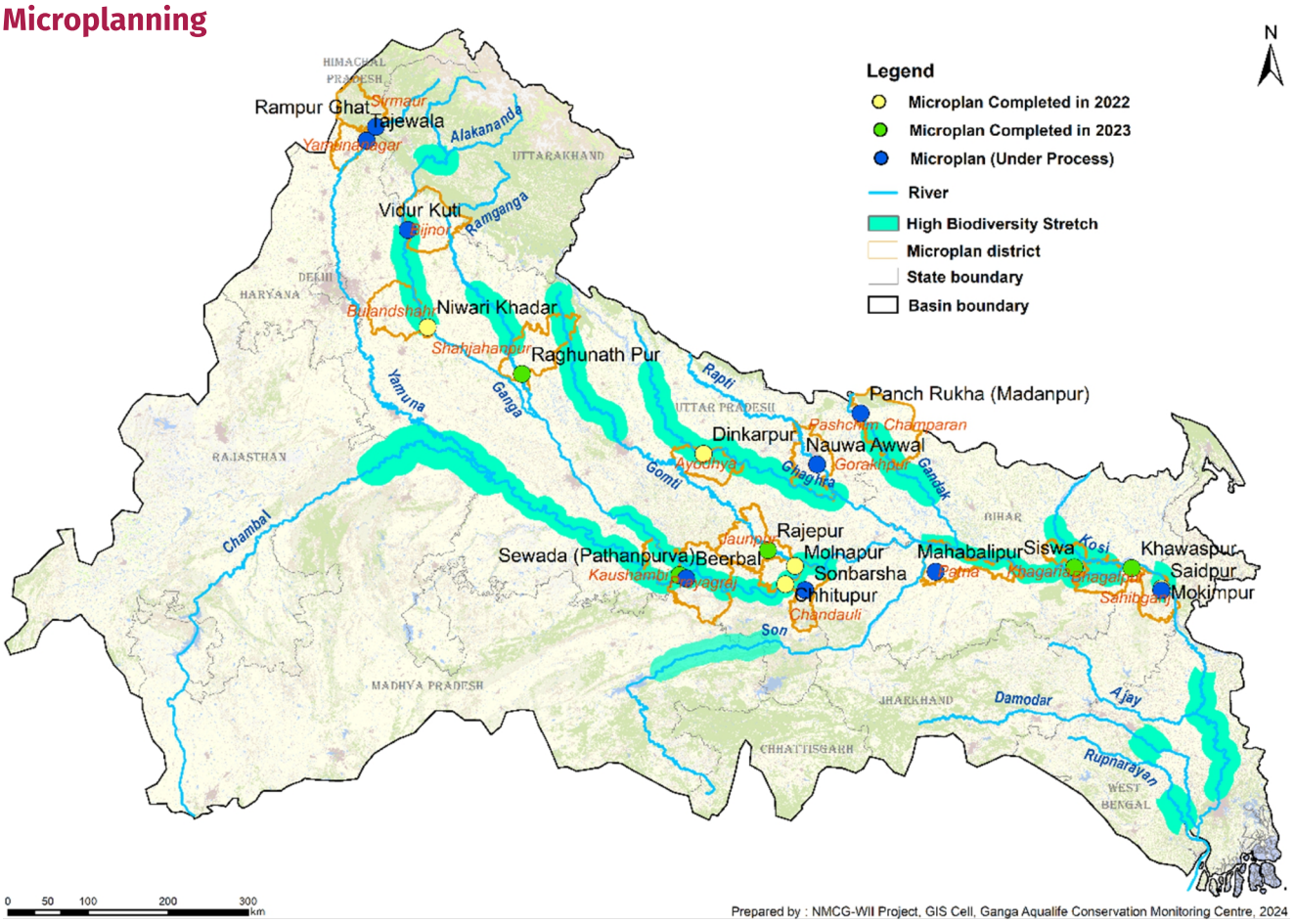


Millet farming

Activities conducted April 2023 and March 2024

Activities	Nos. of activities	Sum of Participants
Awareness Programmes (Exhibition, Cultural activities, Awareness activities)	329	18,780
Cleanliness Drives	46	1,241
Competitions	4	430
Consultative Meetings	656	7,183
Ecological Monitoring	2	14
Field visit	12	171
Focus Group Discussion	27	398
LiFE Activities	118	7,619
Livelihood Activities	238	5,928
Livelihood Training	59	2,467
Orientation and Mobilization workshop	14	240
Participatory Mapping	12	626
Plantation Drives	24	856
Sensitisation and Training Workshops	70	2,016
Socio-economic Survey	33	182
Special Occasions and Days Celebration	141	9,844
Others	11	903
Total	1,796	58,898

Microplanning



Sixty-seven distinct training Programmes were initiated in 17 districts of five states (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, Himachal Pradesh) in the Ganga River basin, each functioning as a specialized platform for skill development. Across these training sessions conducted at diverse locations, a cumulative total of 1,982 Ganga Praharis underwent comprehensive training in various fields, including Bag making, Basket weaving, Herbal Soap making, Dhoop and Incense stick making, Health and wellness, Organic Farming and sewing and stitching. Furthermore, Ganga Prahari's active participation in Jalaj initiatives was pivotal in establishing additional opportunities geared towards cultivating self-sufficiency and independence, aligning with the Arth Ganga initiative.

Skill Development Trainings

Training	No. of training	No. of people trained
Bag making	2	33
Basket weaving	3	45
Food Processing	2	50
Health and Wellness	2	20
Herbal soap making	4	111
Incense stick, candle and organic colour-making	17	566
Jewellery making	1	34
Millet Value addition	2	59
Nukkad Natak	1	43
Organic farming	1	21
Sewing & Stitching	32	1,000
Total	**67**	**1,982**



Food processing training



Certificate distribution of Herbal soap-making training

From April 2023 to March 2024 Ganga Praharis, who underwent training, conducted a total of 553 activities, with 395 categorized as input activities and 158 as output activities. These activities encompassed initiatives such as awareness and cleanliness drives, tree plantation, livelihood development, assistance in ecological monitoring and ecological surveys, and microplan data collection, rescue, and rehabilitation.

Activities initiated by Ganga Praharis

Type of Activities	Input		Output	
	No. of Activities	Participants	No. of Activities	Participants
Anti-poaching operation	1	10		
District Ganga Committee Meeting	1	26		
Participation in activities organised by other organisations	3	77	16	1,621
Millet Farming	4	11		
Socio-Economic Survey	5	71		
Livelihood development activities	7	485	2	10
Consultation with stakeholders	11	109	3	50
Plantation Programme	14	262	11	146
Cleanliness drive	41	1,210	11	209
Rescue & Rehabilitation	34	271	32	176
Ecological Monitoring	37	550	7	34
Awareness and sensitisation	228	10,147	76	5,096
Days Celebration	9	230	1	13
Total	**395**	**13,459**	**158**	**7,342**



Rescue activity by Ganga Praharis



Awareness Programme organized by Ganga Praharis



Cleanliness Drive

Participatory mapping of ecosystem services by local communities was carried out in 27 districts across the five Ganga states, viz. Uttarakhand (districts Uttarkashi, Tehri Garhwal, Chamoli, Rudraprayag and Pauri Garhwal; no. of villages covered = 13), Uttar Pradesh (districts Bulandshahr, Sambhal, Kannauj, Farrukhabad, Shahjahanpur, Gorakhpur, Mau, Sant Kabir Nagar, Ayodhya, Gonda and Pilibhit; no. of villages covered = 27), Bihar (districts Bhagalpur, Khagaria, Supaul, East Champaran, West Champaran, Begusarai, Jamui, Samastipur and Vaishali; no. of villages covered = 18), Jharkhand (District Sahibganj; no. of villages covered = 4) and West Bengal (District Murshidabad; no. of villages covered = 2), along the rivers Bhagirathi, Alaknanda, Ganga, Kali, Ramganga, Rapti, Ghaghra, Gomti, Gandak, Kosi, Nagi, and Budhi Gandak. The purpose of the study is to assess the perceived dependency of local communities on the ecosystem services provided by rivers (such as the biotic and abiotic resources, cultural and religious services, dependence of agriculture, livestock and other village-level economic constituents upon the riverine resources) and the change in the supply of these ecosystem services over the years, and the consequent change in livelihood. Participants were also asked about any disservices provided by the river.



Participatory mapping

CELEBRATION OF SPECIAL DAYS AND EVENTS

A total of 10,087 participants including local communities, teachers and students participated in the special day celebrations at 124 different locations of the Ganga River Basin states.



Special days/occasions	No. of activities	No. of locations	Total Participants
Bird Festival	1	1	232
Desh ki MaatiDesh Ka Jal	1	1	23
Dolphin Day	7	5	394
Earth Day	1	1	24
Environment Day	10	7	352
Gandhi Jayanti	1	1	153
Ganga Utsav celebration	5	2	403
Hindi Diwas	1	1	21
Independence Day	18	14	1,827
International Women's Day	1	1	47
International Yoga Day	8	6	412
International Youth Day	1	1	125

Special days/occasions	No. of activities	No. of locations	Total Participants
Meri Maati Mera Desh	1	1	149
National Reptile Awareness Day	2	1	582
Nature Conservation Day	1	1	21
Owl Awareness Day	2	1	110
Republic Day Celebration	8	8	321
Social Science Day	1	1	45
Swacchta Hi Seva	47	40	1,931
Teachers Day	2	1	225
Turtle Day	3	3	199
Wildlife Week Celebration	15	13	1,919
World Wetland Day Celebration	3	7	135
World Wildlife Celebration	7	3	108
World Ozone Day Celebration	1	1	48
World Water Monitoring Day	2	1	61
Yamuna Pooja	1	1	220
Total	151	124	10,087

SAFEGUARDING THE GANGA

The Ganga Prahari Conclave, 2024

The Ganga Prahari Conclave, spanning three days, was convened at Parmarth Niketan Ashram in Rishikesh, Uttarakhand from the 19th to the 21st of March 2024. The event gathered Ganga Praharis from across 11 Ganga basin states, with the primary objective of facilitating the exchange of knowledge, experiences, and visionary insights pertaining to Ganga Basin Conservation.

The Ganga Praharis and experts spearheaded discussions during the conclave. A total of 315 Ganga Praharis, including 161 female participants, actively engaged in the conclave, demonstrating a widespread commitment to safeguarding the Ganga River.



INTERPRETATION CENTRES

Advocating freshwater conservation

Established 39 small-scale interpretative corners, *Jalmala Samvaad* in 17 districts of Uttarakhand, Uttar Pradesh and Bihar, along the Ramganga, Yamuna, Gomti and Gandak rivers.







Educational Tour

Various schools of Sarnath and Varanasi undertook educational tours to the "*Ganga Darpnan*" Interpretation Centre at Sarnath. A total of 300 participants including students and teachers were sensitised and made aware of the biodiversity of the Ganga River and threats to its aquatic ecosystem.

Nature: the idol of leadership

Dr. Ruchi Badola, Dean, Wildlife Institute of India gave a TedX talk at the Welham Boys School, Dehradun on 10th March 2024. She gave examples from NMCG-WII Ganga Project's work on Ganga Praharis for the conservation and ecological restoration of Ganga River by bringing positive behavioral changes and nurturing leadership among common people, particularly children. She illustrated how the Ganga River is a symbol of leadership and an inspiration for many.



TRAINING AND WORKSHOPS

Student Awareness Workshop

A total of 3,695 students and 167 teachers from 67 schools from the 15 districts of Uttarakhand, Uttar Pradesh and Bihar were sensitised and made aware of the biodiversity of the Ganga River and threats to its aquatic ecosystem.

Training the Trainers

Conducted a teacher training session with the teachers of the District Institution of Education and Training, Sarnath, Prayagraj, Kanpur and Dehradun of Uttar Pradesh and Uttarakhand. A total of 219 trainees participated enthusiastically in the training session with the team. Teacher trainees were equipped with the correct knowledge, attitudes, behaviours, and approaches to conserve biodiversity.

Capacity Building Workshops

Capacity building workshop for 165 participants such as tourist guides, e-rickshaw drivers, Local Vendors and Media person, were conducted at *Ganga Darpan* Interpretation Centre, Sarnath and Wildlife Institute of India, Dehradun. The workshop enhanced their skills as biodiversity guides and also enlightened them about the Mission LiFE campaign. Inspired, they passionately pledged to embrace an eco-friendly lifestyle, fostering a sustainable future.

Village Walk

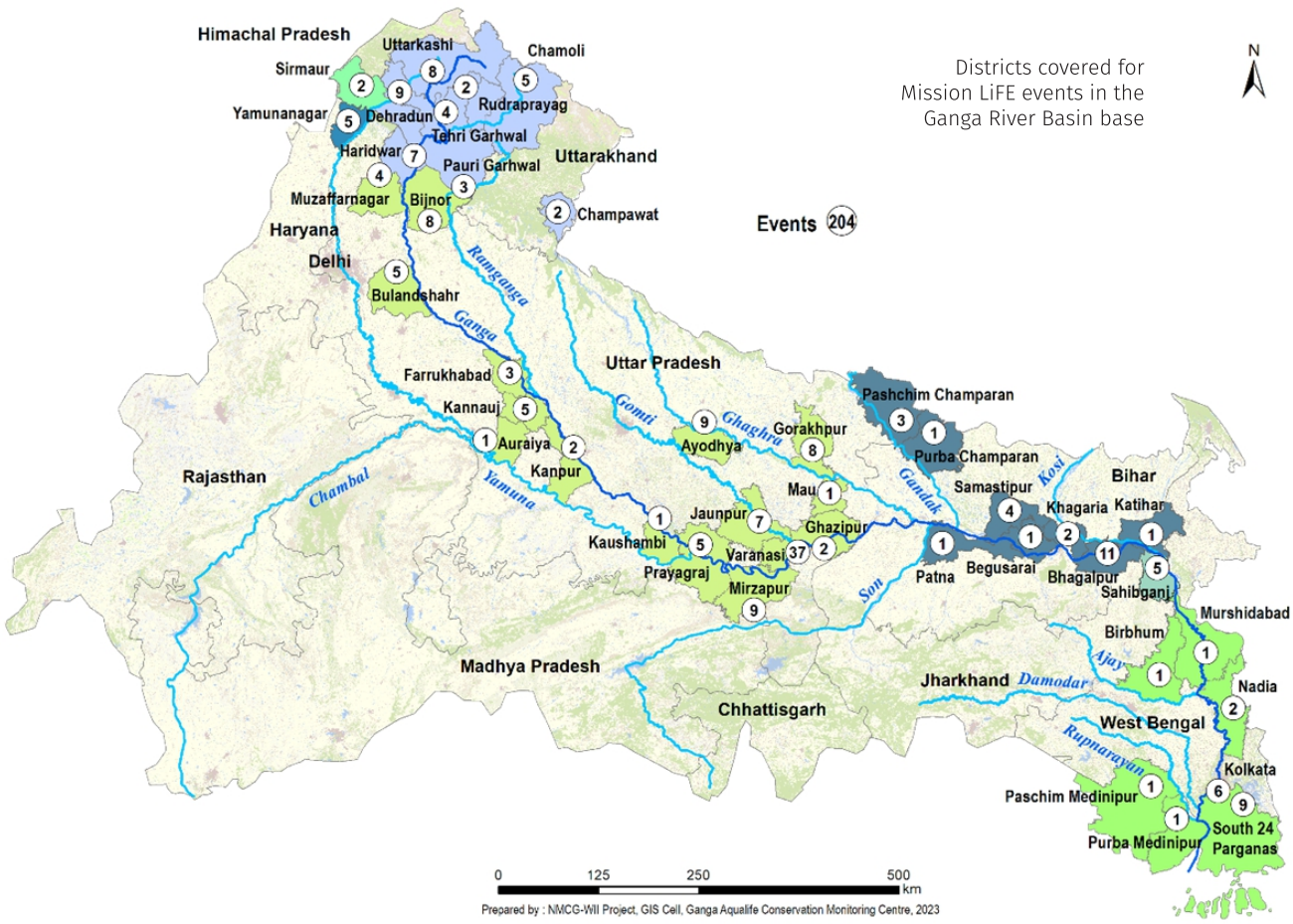
Established a village walk with biodiversity and informative signages at Sirror Village, Uttarkashi, Uttarakhand. Also conducted a workshop with 50 participants, including students and the local community, regarding the importance of the river and its biodiversity.



MISSION LIFESTYLE FOR ENVIRONMENT (LiFE) CAMPAIGN

A series of 204 LiFE events were conducted in 42 districts of the seven Ganga River Basin states, namely Himachal Pradesh, Uttarakhand, Uttar Pradesh, Haryana, Bihar, Jharkhand, and West Bengal, from April to June 2023, in which more than 23,000 people participated Infographic 3.1. During these events, a total of 265 activities were conducted under 15 categories, including awareness activity and oath (n=117), awareness activity (n=32), cleanliness drive (n=24), educational competition (n=19), awareness activities and educational competition (n=17), yoga (n=14), plantation (n=13), training workshop (n=10), earthen drinking water pot installation (n=5), river walk (n=5), cultural activity (n=3), eco-art (n=3), bird watching (n=1), exposure visit (n=1), and nukkad natak (n=1). Of these activities, 51.7% of were conducted in Uttar Pradesh (n=137),followed by 19.2% in Uttarakhand (n=51), 13.6% in Bihar (n=36), 9.4% in West Bengal (n=25), 2.6% in Haryana (n=7), 2.6% in Jharkhand (n=7), and 0.8% in Himachal Pradesh (n=2). These activities created awareness among the general public about the Mission LiFE Campaign, the importance of adopting sustainable practices, the significance of cleanliness and conserving rivers and wetlands, and the impact of pollution on the river and wetland ecosystems.





CELEBRATION OF SPECIAL DAYS

Important days like Earth day, World Environment day, Turtle day, Independence day, National Bird day and Wildlife week were celebrated in Varanasi, Kaushambi, Prayagraj and Kanpur districts of Uttar Pradesh. About 2,120 participants of local communities, student and teachers were sensitized and made aware about the importance of aquatic biodiversity and their conservation.

















GANGA DARPAN - DIGITAL MILESTONE

Between April 2023 and March 2024, Ganga Darpan Blog released 54 posts, with 1,866 visitors and 3,335 views.



PUBLICATIONS




PLANNING AND MANAGEMENT FOR AQUATIC SPECIES CONSERVATION AND MAINTENANCE OF ECOSYSTEM SERVICES IN THE GANGA RIVER BASIN FOR A CLEAN GANGA
Project Progress Report
BIHAR
JANUARY - DECEMBER 2023
PLANNING AND MANAGEMENT FOR AQUATIC SPECIES CONSERVATION AND MAINTENANCE OF ECOSYSTEM SERVICES IN THE GANGA RIVER BASIN FOR A CLEAN GANGA
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DRAFT PROPOSAL FOR
ADOPTION OF
NATIONAL CENTRE
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ORIGINAL ARTICLE
Genetic diversity, spatial connectivity, and population structure of Asian silurid catfish Wallago attu (Bloch and Schneider, 1801) in the Ganga River System: insights from mitochondrial DNA analysis
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Abstract
Introduction
VIBRANT GANGA
wings of ganga
RIVER AND WETLAND BIRDS OF GANGA RIVER
PART IV


प्लम्बिंग मैन्युअल
फल प्रसंस्करण मैन्युअल
VIBRANT GANGA
Bagmati River
NAMAMI GANGE
इलैक्ट्रीशियन
प्रशिक्षण मैन्युअल


VIBRANT GANGA
Rapti River
NAMAMI GANGE
VIBRANT GANGA
Sharda River
NAMAMI GANGE
VIBRANT GANGA
Mahananda River
NAMAMI GANGE
VIBRANT GANGA
Tributaries of the Ghaghara River
Giriwa, Kausiala and Babai
NAMAMI GANGE


नदी किनारे
चिड़ियों का डेरा
कहानी उदु
उद्बिलाव की
गंगा का सफर
गौमुख से गंगा सागर तक
नमामि गंगे
PROPOSAL FOR
MASTER OF SCIENCE COURSE IN FRESHWATER ECOLOGY & CONSERVATION

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